Flooding & SuDS
Lunch & Learn
Midland Highways Authority

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28 Jan 2026

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Lunch & Learn Overview

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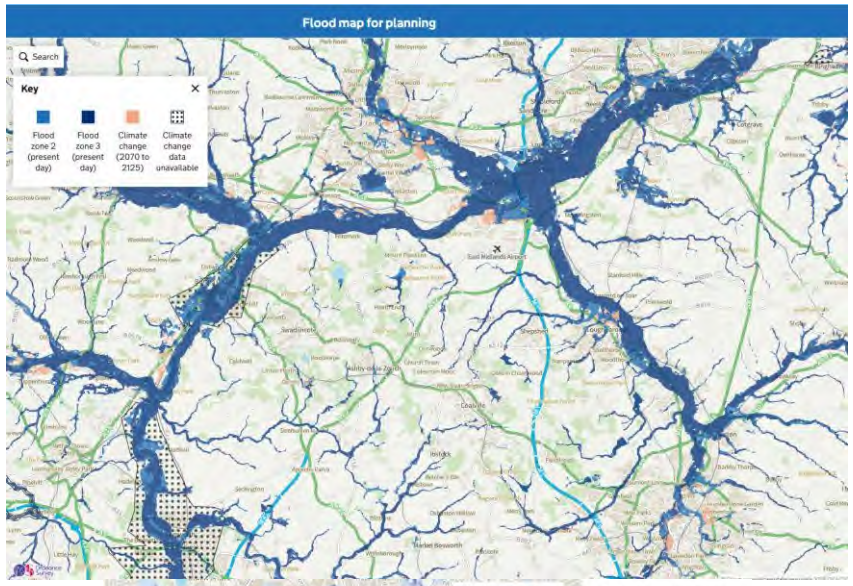
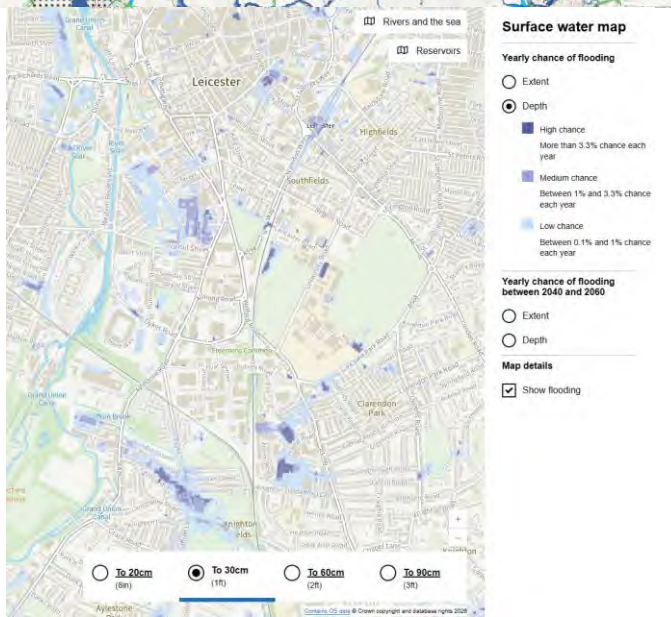
Flood risk management is a key activity involving a multitude of stakeholders, raging from the Environment Agency for main rivers, local authorities dealing with ordinary rivers and surface water flooding, combined with water companies and relevant bodies. Integrated Catchment Models are important tools to assess complex water systems involving open channels, sewer networks and overland flows, and are widely used to produce flood risk management plans and surface water management plans.

Sharing our experience from working at scale across the UK, AMEY will present our approach to modelling, planning, and designing flood schemes to ensure we provide water resilient cities, tackling climate change impacts, focusing on sustainable drainage, flood risk reduction, biodiversity improvements and smart monitoring.

During this Lunch and Learn, we will present the typical project stages of using ICM to produce flood and surface water management plans, leading to detailed SuDS designs, sharing key lessons learned at each stage, weaving in our case study experience, and sharing how we believe projects can be delivered with sustainable and nature-based solutions in mind.

Comment on UK NaFRA 2024 Flood Maps





Properties at risk of flooding from rivers

At risk 2.4 million
High risk 367,900, with 163,300 likely to flood to depths of greater than 30cm

Climate change (2069)

At risk 3.1 million – a 27% increase
High risk 637,600 with 288,800 likely to flood to depths of greater than 30cm – a 77% increase

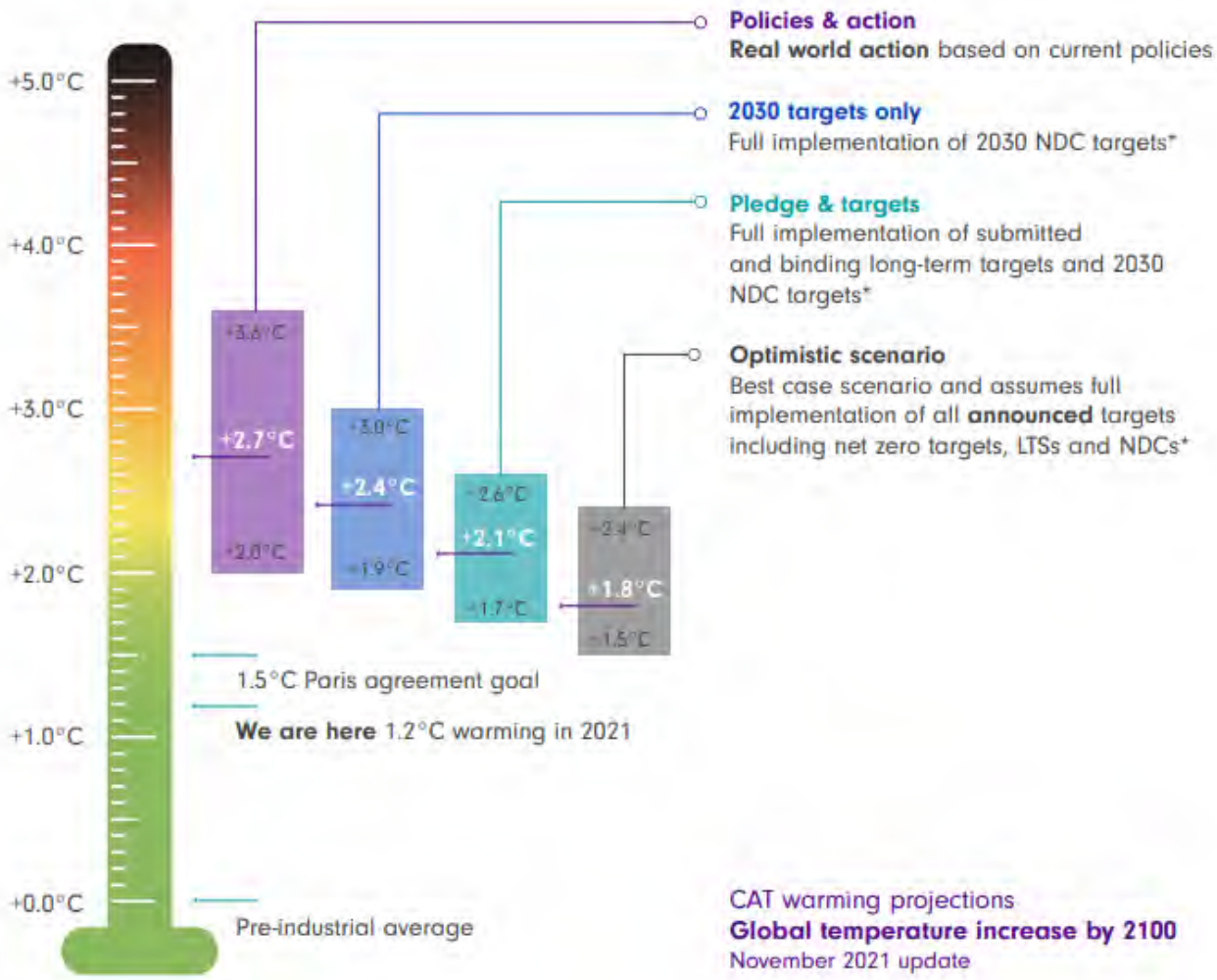
Properties at risk of flooding from surface water

At risk 4.6 million
High risk 1.1 million, with 184,200 likely to flood to depths of greater than 30cm
83% of properties less than 30cm

Climate change (2060)

At risk 6.1 million – a 30% increase
High risk 1.8 million, with 288,400 likely to flood to depths of 30cm – a 57% increase

Current climate change trajectory



UK NaFRA 2024

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Uses UKCP18 latest updated in 2024 and RCP 8.5

Emission standard assumes business as usual with 4C rise in temp by 2100 uses. Central allowance (50%ile)

NaFRA maps are conservative and so local assessments are required with more suitable CC uplifts

Peak River or Rainfall CC increase depends upon future time frame 2050's or 2070/80's

Normally we assume a Central allowance, then do sensitivity with Higher allowance (70%ile) and possible Upper allowance (95%ile)

Hydrology Updates

FEH22 rainfall model includes 10-year update
ReFH2.3 (2024) incorporates FEH22 rainfall
FEH statistical method (2025) – WINFAP 5.3

Perth FPS & SWMP – National Flood Maps

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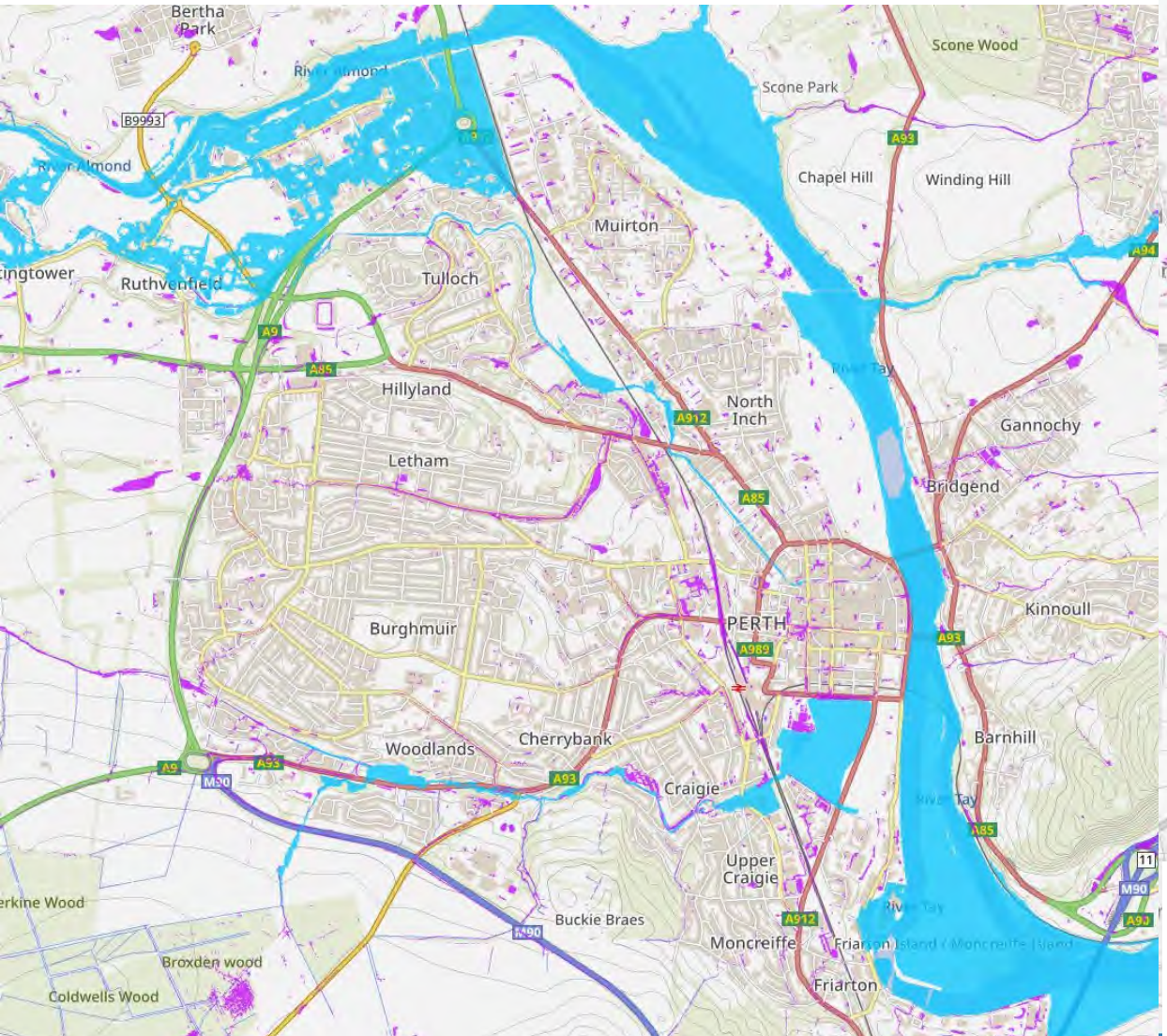
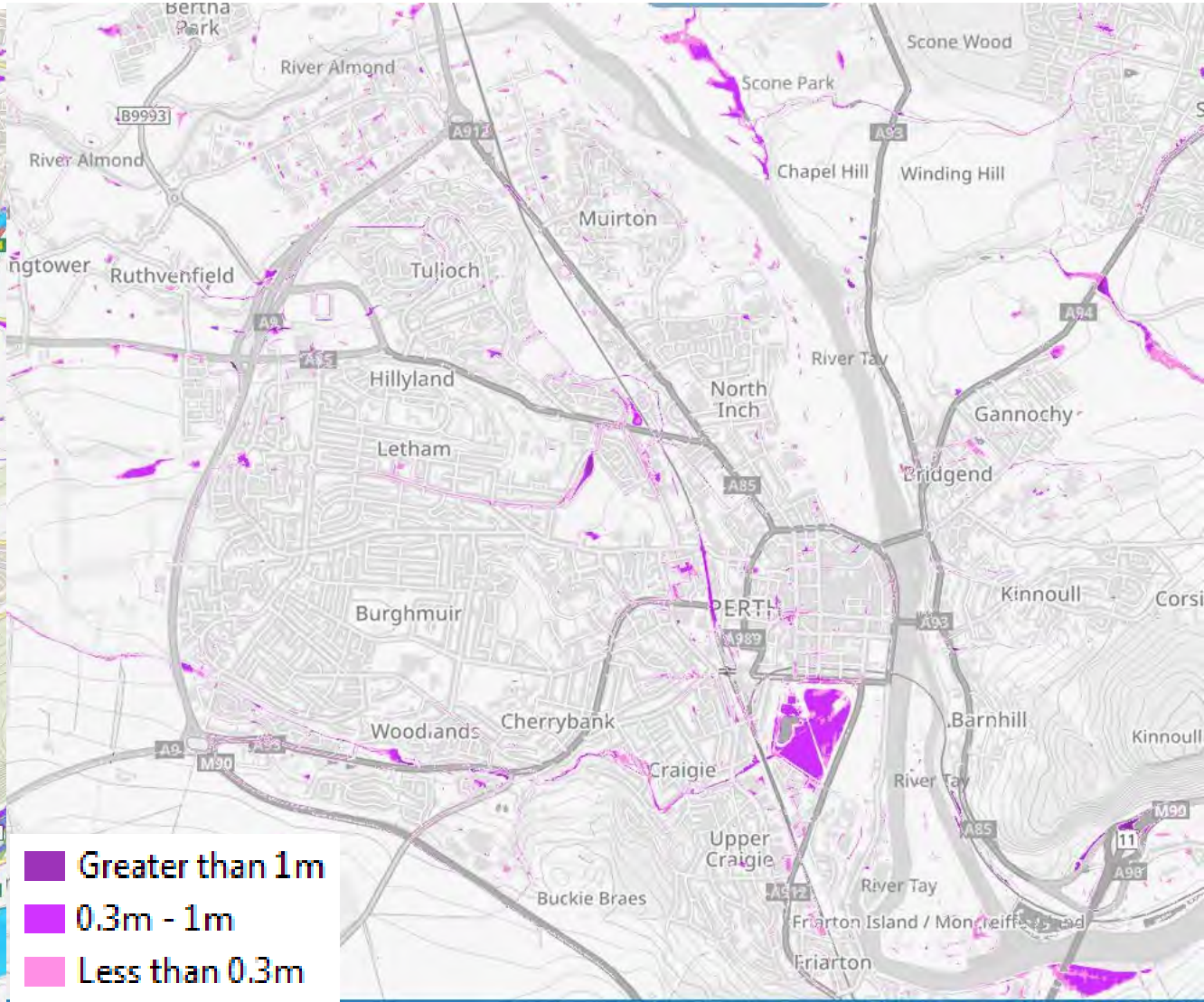
Existing Medium likelihood (Fluvial and Pluvial)



Medium likelihood Pluvial Depths



Catchment Overview. Perth Flood Scheme, Craigie Burn

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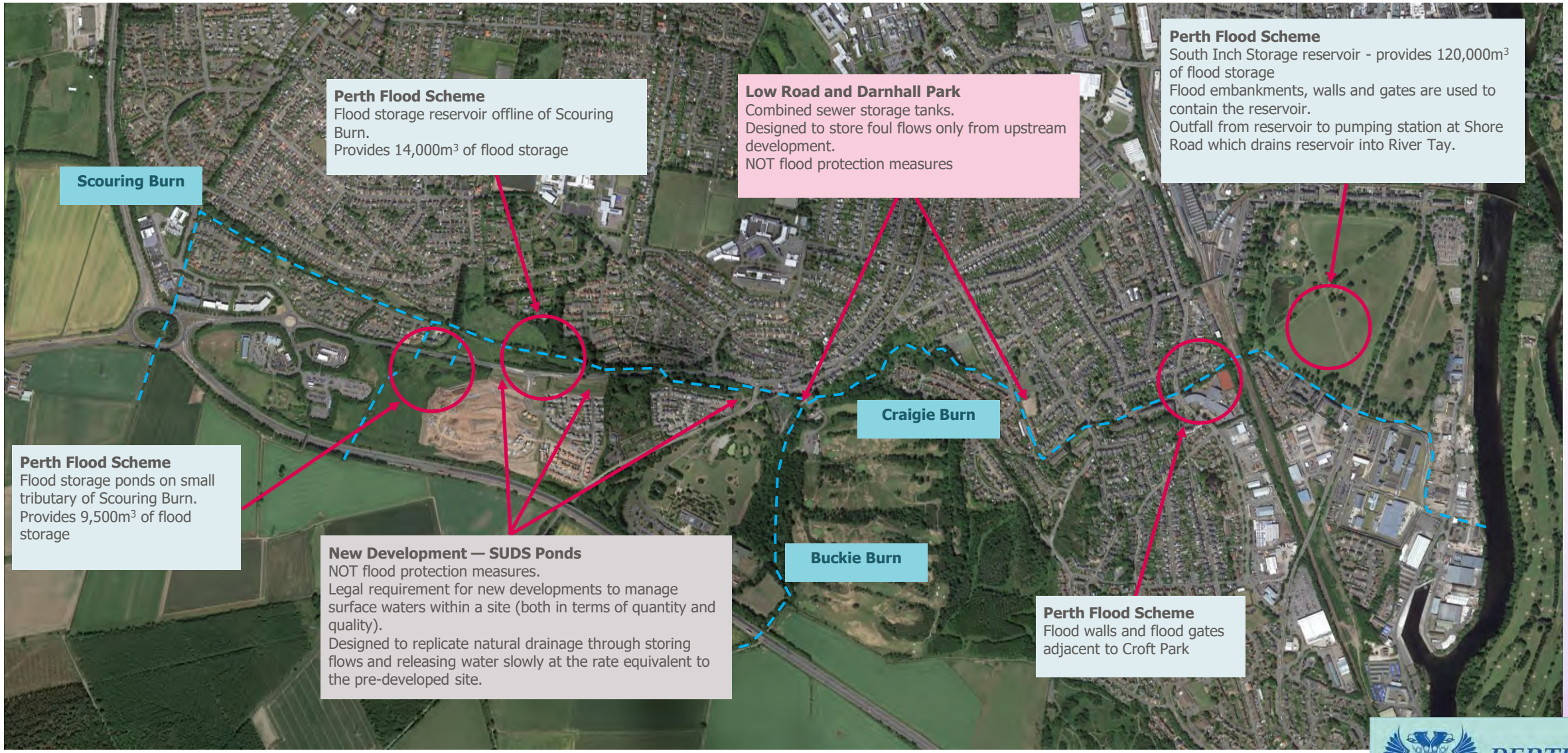
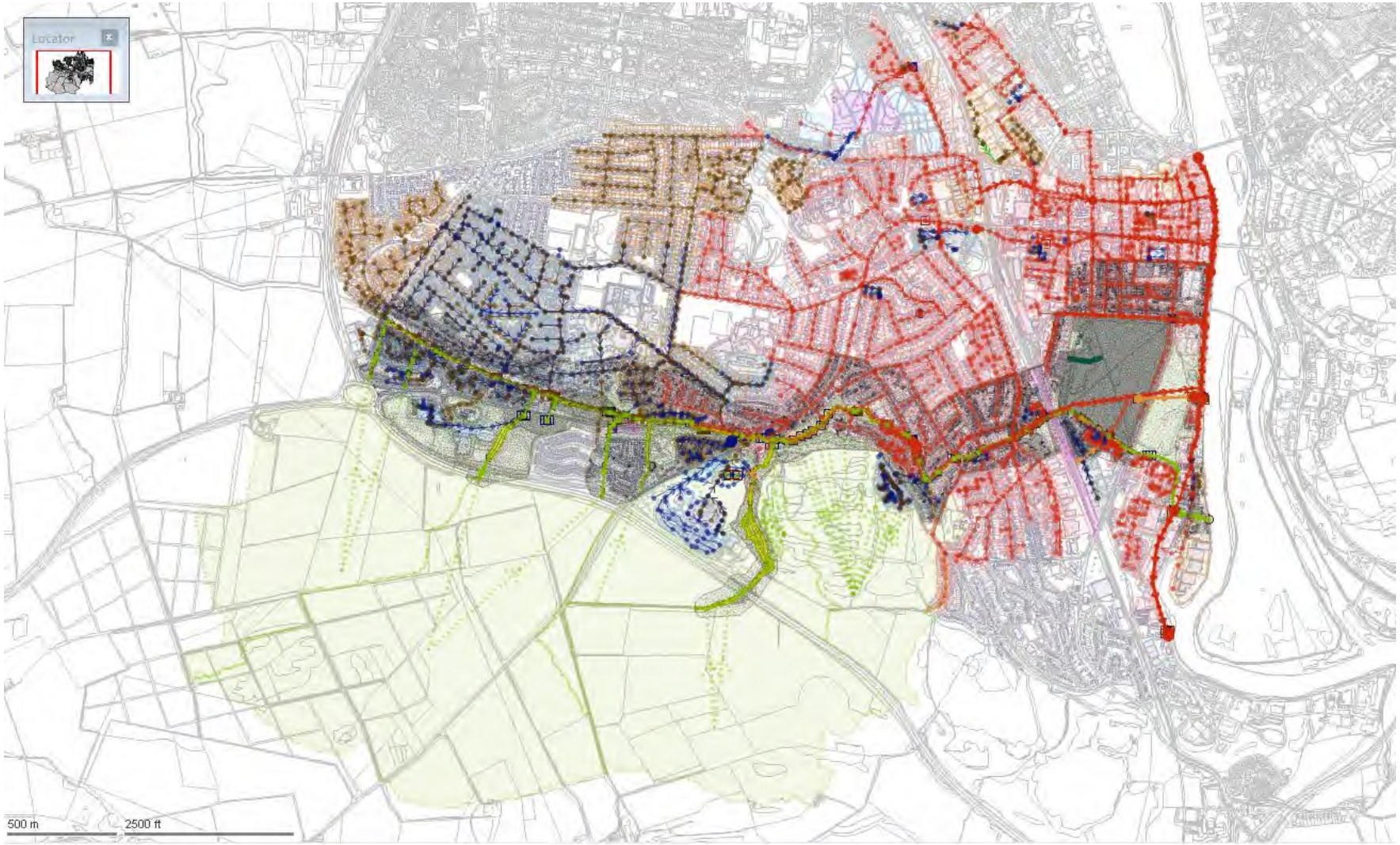


PERTH & KINROSS COUNCIL

Model Build & Extents



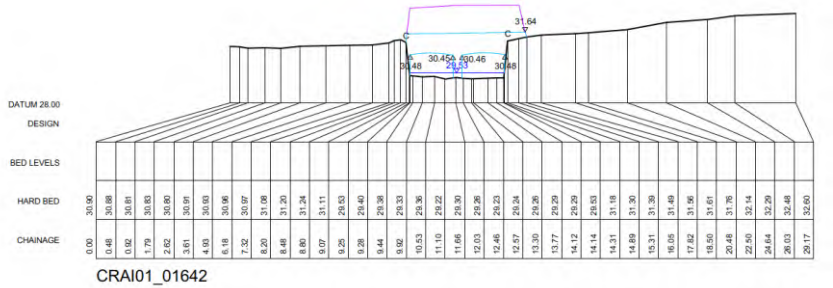
1D/2D Integrated Model for CB

2D mesh covers the areas potentially contributing into the watercourse flow due to combined network capacity being exceeded.

Cutdown version from sewer Model DOA000674

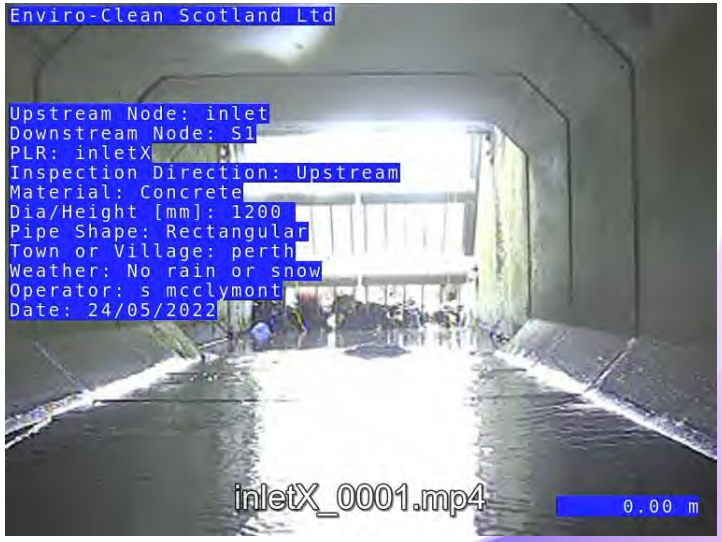
Model Build & Surveys

Additional Cross Sections to improve the representation of Craigie Burn



- Cross sections
- River structures
- CCTV in culverts
- Threshold level survey
- Trash levels after September 2022 flooding event
- Topo survey at Croft Park

CCTV Surveys



Model Build & Watercourse Structures

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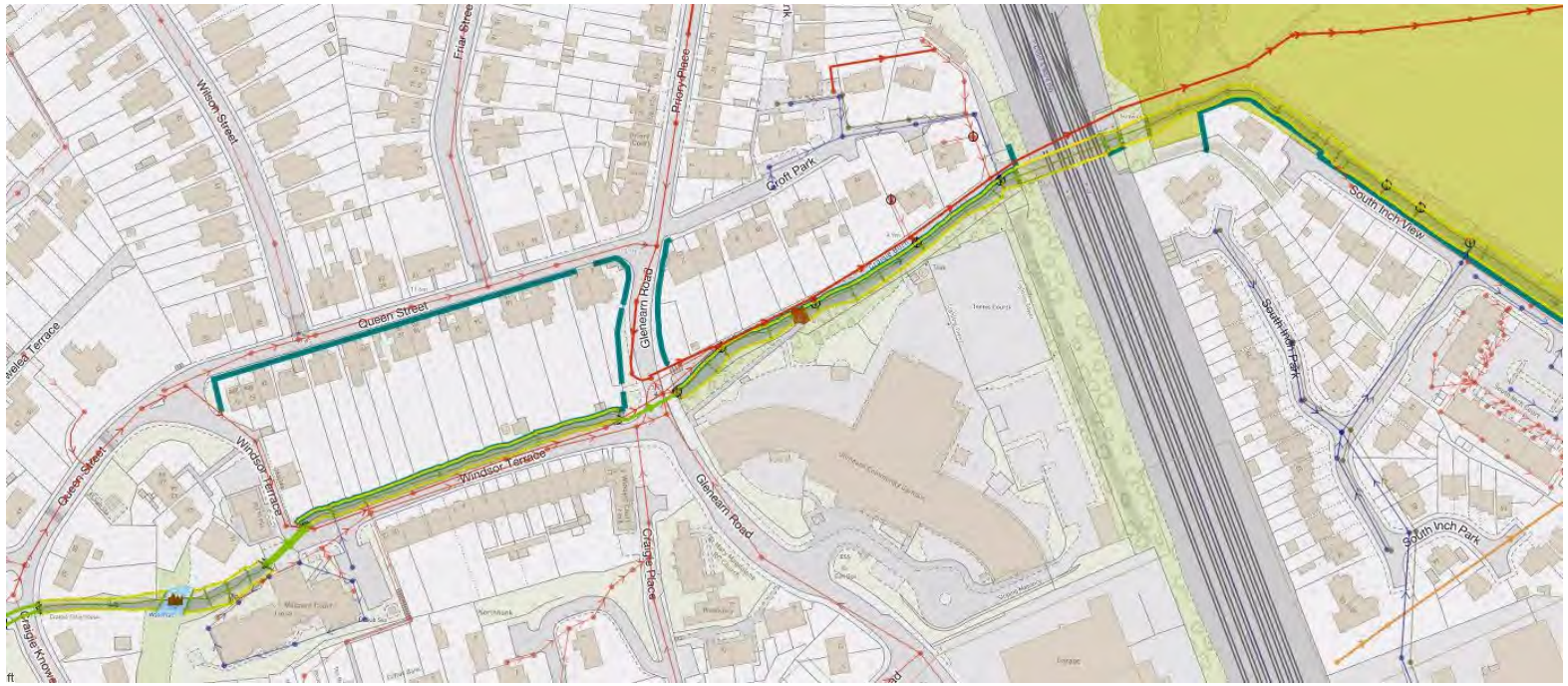

Updating or inclusion of a number of structures

- 12 Bridges
- 38 Culverts
- Flood Protection Structures

Other elements, such as SuDS ponds, reviewed and updated if required.

Calibration & Verification Events. ReFH2 Runoff Model

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Rainfall Data – Station: Perth Norwich Union (SEPA API) (2004 – 2022)

Telemetry Data – Provided by PKC (Level data only). Not calibrated/ gauged to any extent. Time series not completely available.

4 Summer Events

- 17 July 2015
- 5 June 2017
- 17 July 2012
- 9 August 2019

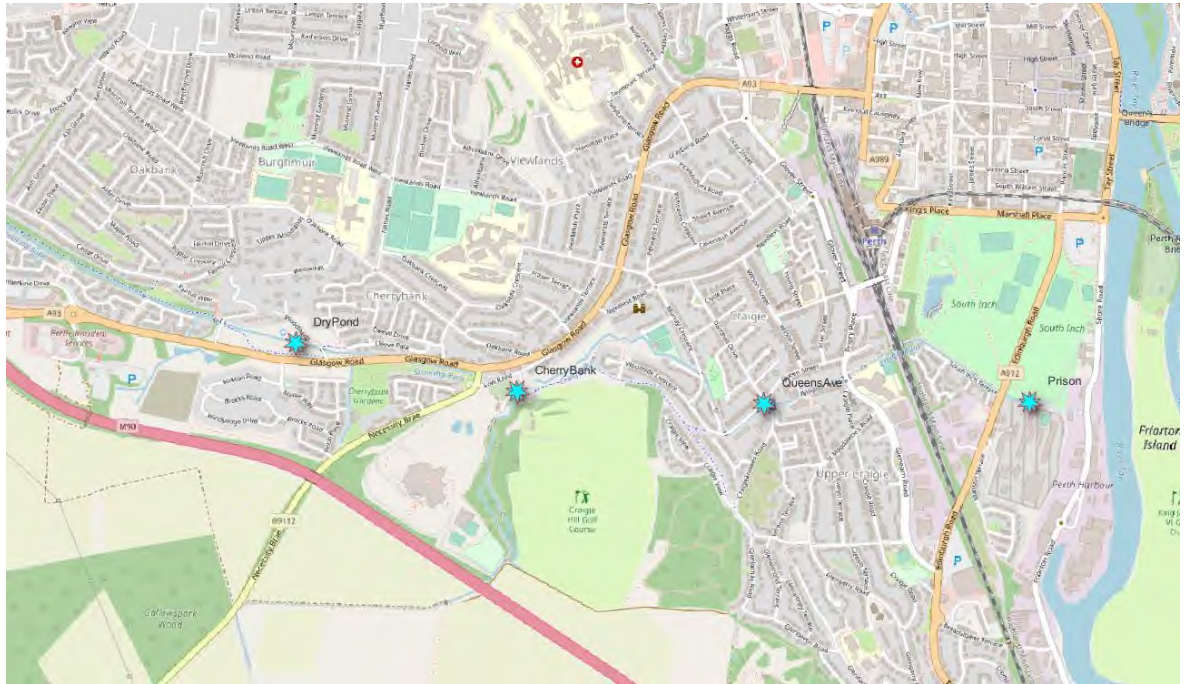
5 Winter Events

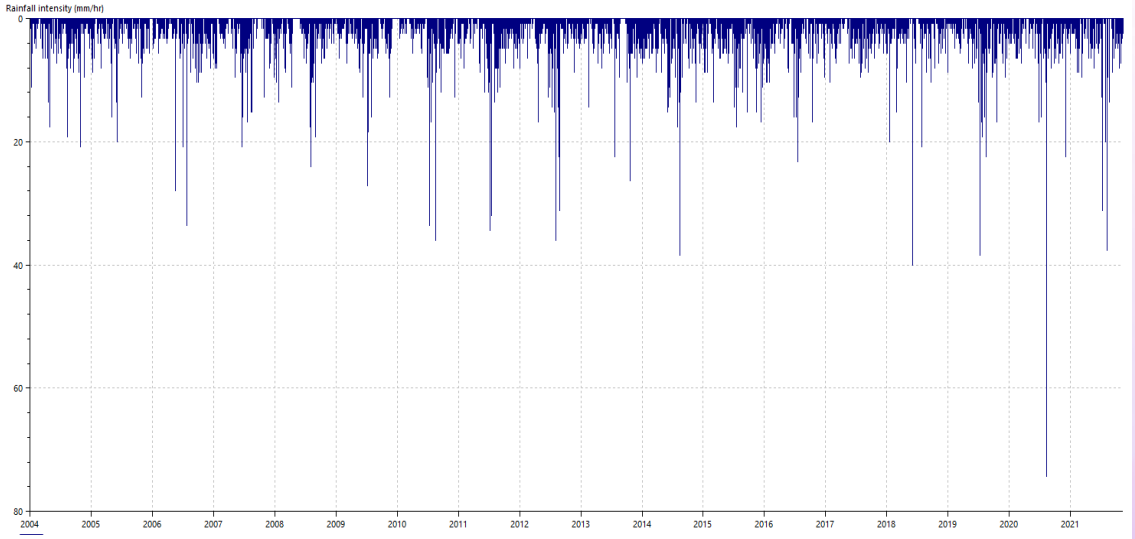
- 21 October 2013
- 14 January 2015
- 26 January 2016
- 29 December 2015
- 8 February 2020

3 Historical Events

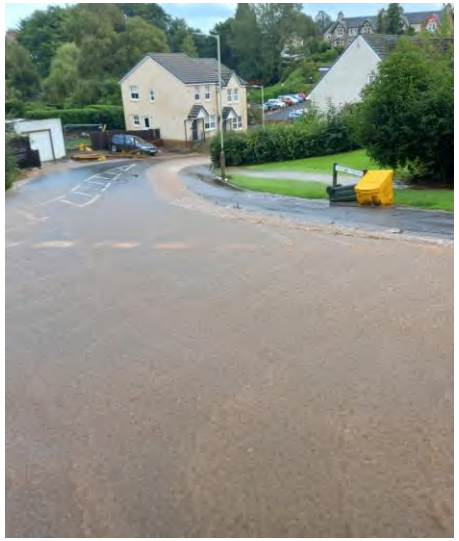
- 6 August 2002
- 11 August 2020
- 8 September 2022

Initial Parameters (C_{ini} and BF_0) have been calculated based on antecedent 1 year rainfall data





Calibration & Verification. Historical Flooding Events


Event	Date	Season	Start	End	Rainfall depth and duration	Estimated Return Period
V1	August 2002	Summer	06/08/2002 16:45	06/08/2002 20:45	32 mm (1 hour)	90
V2	August 2020	Summer	11/08/2020 20:00	13/08/2020 00:00	76.8 mm (7.5 hours)	372
V3	September 2022	Summer	08/09/2022 04:15	08/09/2022 11:00	70.4 mm (6.75 hours)	265

The simulated events were compared with existing data and the knowledge held by PKC to validate the results.

Calibration & Verification. Historical Flooding Events

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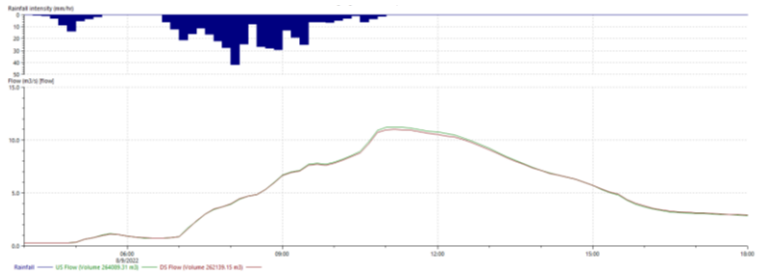
8th September 2022



1 in 265 years Return Period Event
11.1 m^3/s at Croft Park (Railway Bridge)

- Craigie Burn capacity is predicted to be exceeded at Balmoral Place. Floodwater is predicted to affect the green area and playground at Murray Crescent, the garages at Balmoral Place and the some of the residential properties.
- The model predicts out-of-bank flows to occur at Queen's Avenue, mainly due to the lack of hydraulic capacity of the culvert beneath the acces road to the block of flats on the right bank of Craigie Burn at Queen's Avenue. The floodwater originated at Queen's Avenue flows along Queen Street and splits between Windsor Terrace and Queen Street until Glenearn Road. Flood waters finally re-join the watercourse downstream from the waterfall.

- The hydraulic model predicts surface water flooding from the combined sewer network at Oakbank Road, Oakbank Place and Glasgow Road. Mainly floodwaters from the sewer system flow towards Glasgow Road and Low Road.
- Fluvial flooding is predicted at this area. The culvert inlet at Necessity Brae does not provide enough hydraulic capacity; consequently, water level upstream increases gradually until it exceeds the capacity of the green area and flows over B9112 Necesity Road and downslope of the grass verge into the car park of Cherrybank Inn. Scour was developed at the grass verge due to the constant flow and high velocities.

Design Events. Catchment Critical Duration

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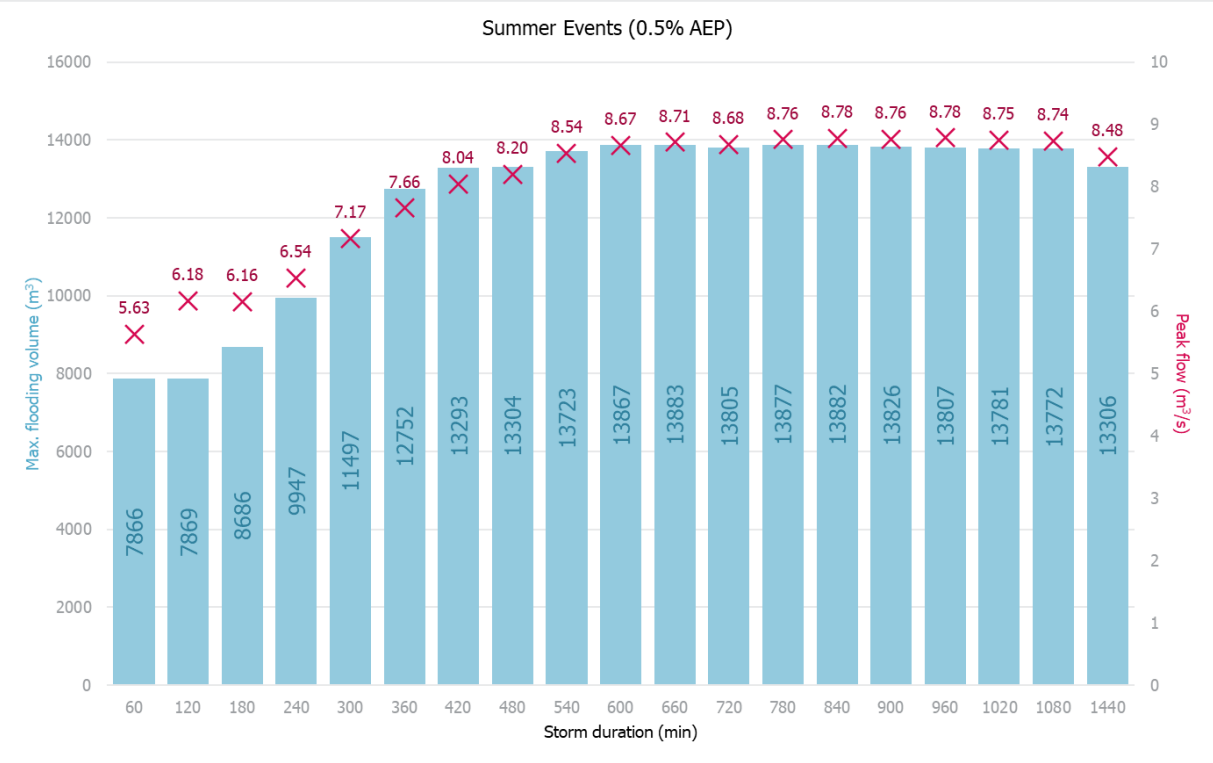
Critical duration: **Most flooding volume from watercourses**

Model runs indicate a critical storm duration of 11 hours for flooding volume.

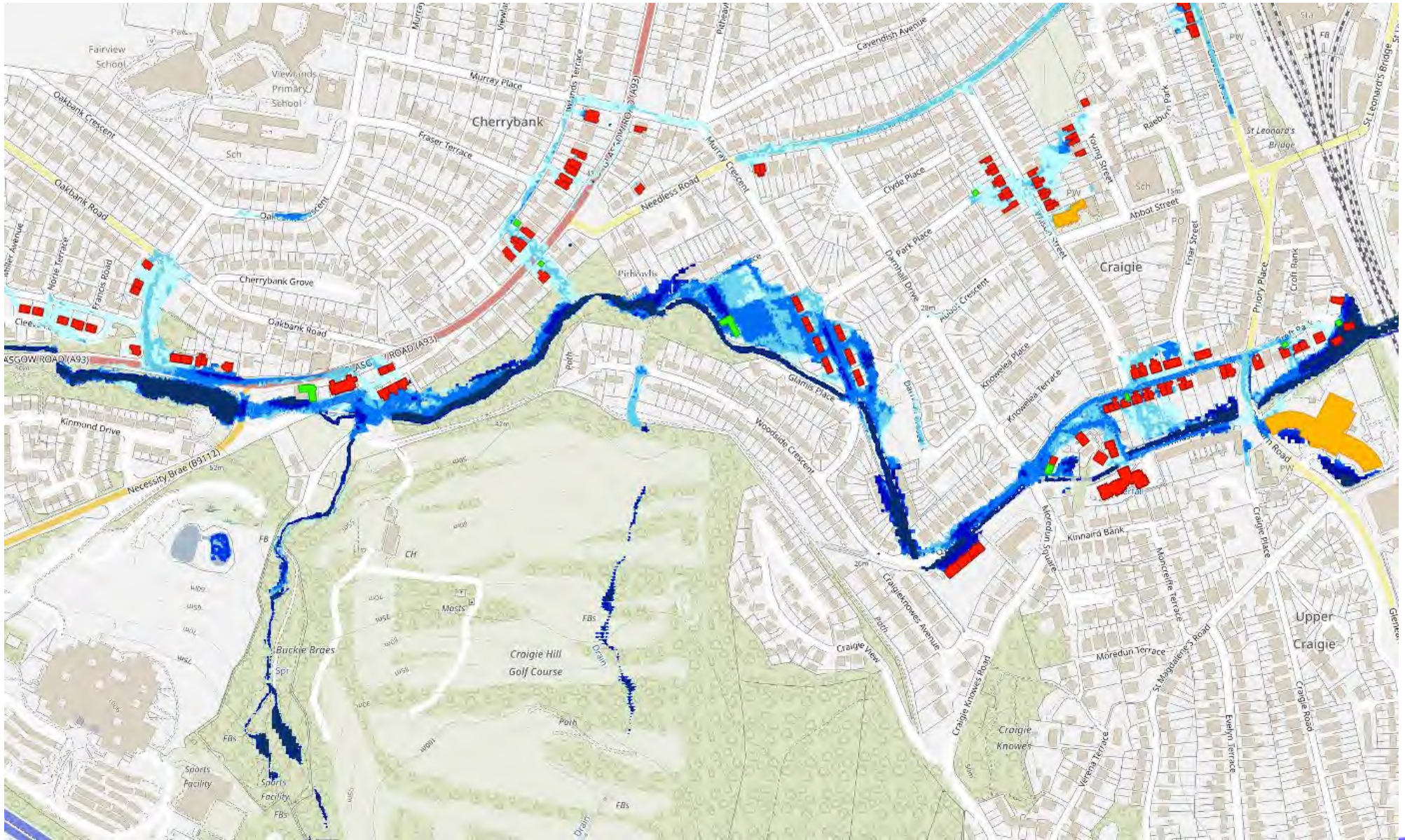


Hydraulic analysis and inundation mapping has been carried out using an integrated catchment model which includes watercourses, urban drainage network and their interactions, for the following return periods:

- 1 in 2 years (50% AEP)
- 1 in 5 years (50% AEP)
- 1 in 10 years (10% AEP)
- 1 in 30 years (3.33% AEP)
- 1 in 50 years (2% AEP)
- 1 in 75 years (1.33% AEP)
- 1 in 100 years (1% AEP)
- 1 in 200 years (0.5% AEP)
- 1 in 1000 years (0.1% AEP)

Flood Mapping. Flood Maps

0.5% AEP (1 in 200 years) (2 of 3)



Flood Mapping. Flood Maps

0.5% AEP (1 in 200 years) (3 of 3)

Optioneering. Multi-criteria Assessment

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Option development process:

1. **Baseline scenario** defines the flooding issues.
2. **Long-list** of measures is considered.
3. **Short-list** of measures is obtained after a scoring exercise to evaluate the long-list options.
4. **Detailed appraisal** of the short-listed options.
5. **Recommended option** is selected.

Options are considered against a range of criteria to determine their suitability, including technical, environmental, social and economic feasibility.

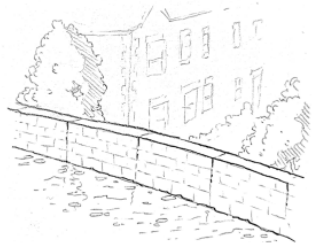
For an option to be considered viable, the costs must not exceed the benefits, i.e. the benefit/cost ratio (BCR) must be greater than 1.

What was considered?

A range of structural and non structural options were considered, including:

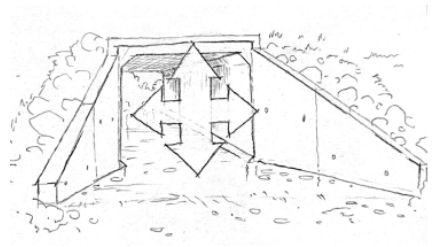
Direct Defences

This group of measures include construction of flood walls and embankments.



Conveyance Improvements

This includes channel modifications and culvert upgrades to increase flow capacity where capacity is limited or at pinch points



Upstream Storage

Measures to create new, or upsize existing storage areas were considered

Natural Flood Management (NFM)

NFM techniques work with natural processes to manage flood risk, and work on the principle of slowing the flow down in the upper catchment. Measures include, tree planting, field ditch/drain blocking, leaky barriers and channel re-profiling.

Non-structural measures

Property level flood resilience and flood warning schemes

These were considered separately from the structural measures.

The flashy nature of the Craigie Burn means that limited warning time is available to make a formal flood warning scheme feasible. The community is working with SFF to install a rivertrack system that will help to improve personal resilience to flooding.

Property level flood resilience measures are encouraged to be considered by property owners.

Optioneering. Long-List of Options

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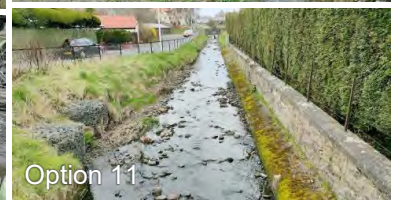
#	Option	Figure	Description
1	Upstream storage & NFM south of M90		Upstream online storage and attenuation provided using NFM in the areas to the south of the M90 motorway. Private ownership of the land.
2	Improved drainage on M90 and Broxden area		Upsize and improve the drainage network of the M90 motorway and Broxden Roundabout. Council and Transport Scotland ownership.
3	Improved storage Berwick Rae ponds (Perth FPS 'Wet' Ponds)		This area could be a suitable location for increased storage and attenuation reducing the peak flow downstream during extreme rainfall events. Council ownership.
4	Improved attenuation Perth FPS storage area ('dry' pond)		This area could be a suitable location for increased storage and attenuation reducing the peak flow downstream during extreme rainfall events. Council ownership.
5	Cherrybank Necessity Brae Culvert and storage area		This area could be a suitable location for online storage and attenuation, but culvert arrangement requires upgrade. Council ownership.
6	Buckie Brae Culvert Upgrade		Upgrading of culvert and deal with potential sediment issues.
7	Buckie Brae to South Inch Dredging		Assess dredging impact of Craigie Burn on flood risk from Buckie Braes to South Inch penstock.
8	Attenuation Low Rd to Woodside Crescent		This area could be a suitable location for online storage and attenuation. Council ownership.
9	Orchard Place overtopping		Embankment and walls raising potentially down to Murray Crescent to reduce the flood risk in this area. Council ownership.
10	Balmoral Place & Queens Avenue Culverts		There are several structures in this urbanised area that could be negatively impacting the hydraulic performance of the watercourse. Upgrades potentially required. Council ownership.
11	Balmoral Place & Queens Avenue Channel modifications		Sediment removal and channel modification. Council ownership.
12	Croft Park Overtopping and Sewers		Rearrangement and upgrading of the existing flood defences (flood gates and flood walls). The area is prone to sewer flooding. Council ownership.
13	South Inch Outlet		Rearrangement of outlet collection system at the South Inch reservoir. Council ownership.
14	South Inch storage		Rearrangement of storage volume. The current footpaths setup is likely to be affecting the filling process of the reservoir. Council ownership.
15	South Inch flood gates		Removal of flood gates to eliminate a potential failure factor. Council ownership.
16	South Inch spill mechanism		Improve the spill mechanism into South Inch storage area. Council ownership.

Optioneering. Short-List of Options

Modelled Scenarios
'Do-Nothing'
'Do-Minimum'
Option 1 - Upstream Storage and NFM South of M90
Option 3 – Improved Storage at A93 Glasgow Road ('Wet' Ponds)
Option 4 – Improved Attenuation at Perth FPS Storage Area ('Dry' Ponds)
Option 5 – Necessity Brae (Cherrybank) Culvert and Storage Area
Option 7 – From Buckie Brae to South Inch Channel Dredging
Option 8 – Attenuation Low Road to Woodside Crescent
Option 9 – Orchard Place Raised Embankments and Flood Walls
Option 10 – Queen's Avenue Culvert
Option 11 – Balmoral Place and Queen's Avenue Channel Modification + Option 10
Option 12 – Croft Park Overtopping and Sewers
Option 16 – South Inch Spill Mechanism



Optioneering. Benefit-Cost Ratio

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Scenario	Total PV Costs	Total PV Damages	Total PV Benefits	Average BCR
'Do-Nothing'	£0.00	£1,179,111.52	-	-
'Do-Minimium'	£406,130.90	£632,172.59	£546,938.93	1.35
Option 1 - Upstream Storage and NFM South of M90	£633,330.90	£544,977.99	£634,133.53	1.00*
Option 3 – Improved Storage at A93 Glasgow Road ('Wet' Ponds)	£878,234.90	£601,934.51	£577,177.01	0.66
Option 7 – From Buckie Brae to South Inch Channel Dredging	£617,329.30	£561,203.98	£617,907.54	1.00
Option 8 – Attenuation Low Road to Woodside Crescent	£961,068.50	£603,625.41	£575,486.11	0.60
Option 10 – Queen's Avenue Culvert	£675,623.70	£242,034.57	£937,076.95	1.39
Option 11 – Balmoral Place and Queen's Avenue Channel Modification	£720,209.30	£158,444.30	£1,020,667.22	1.42
Option 16 – South Inch Spill Mechanism	£1,063,058.90	£552,357.19	£626,754.33	0.59
Combined Option 11 + 16	£1,377,138.90	£153,615.31	£1,025,496.21	0.74
Option 16 – South Inch Spill Mechanism (no footpath/floodgate modification)	£713,618.10	£552,357.19	£626,754.33	0.88
Combined Option 11 + 16 (no footpath/floodgate modification)	£1,027,696.90	£153,615.31	£1,025,496.21	1.00

Economic assessment conducted for a **100-year period based on present value** (PV) to obtain the **Benefit-Cost Ratio** (BCR) based on the Flood or Coastal Erosion Risk Management (FCERM) guidance.

- Importance of the maintenance of the watercourses
- Costly options benefiting limited number of properties
- Option 11 highest BCR

Optioneering. Preferred Option

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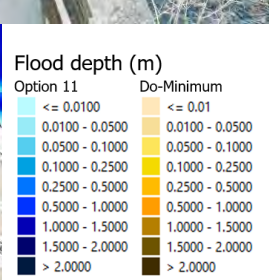
Upgrading the Culvert



Channel modifications

Flash Flooding Assessment

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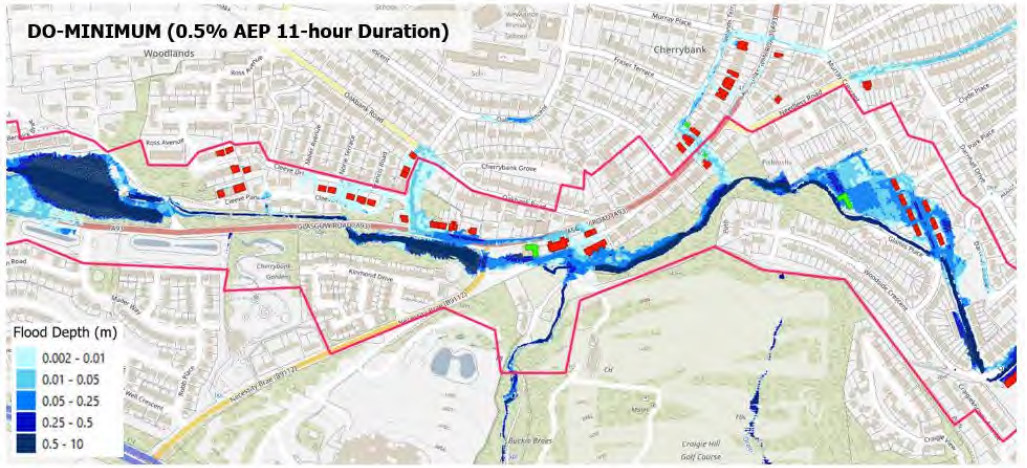
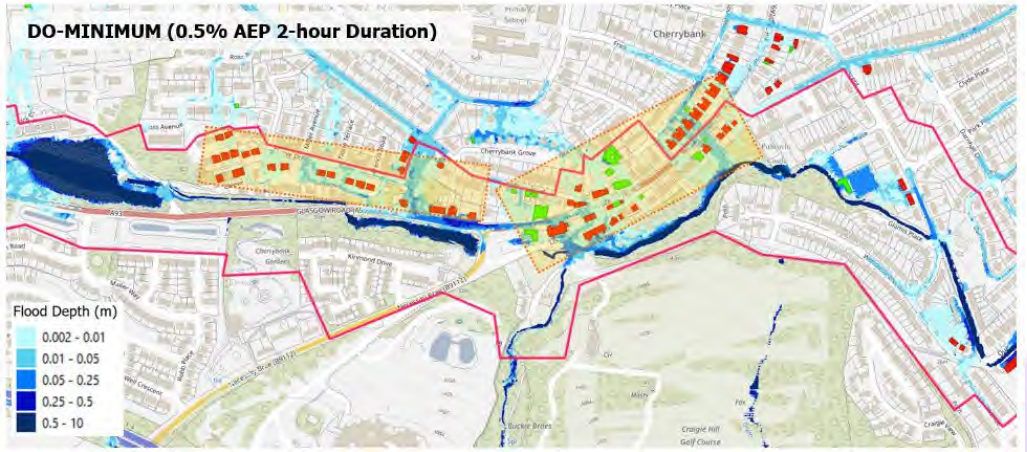
Storm	3.33% AEP	0.5% AEP
Short Duration (2-hour event)	Total: 3,254m^3 Fluvial: 1,469m^3 (45%) Pluvial: 1,785m^3 (55%)	Total: 7,869m^3 Fluvial: 2,328m^3 (30%) Pluvial: 5,541m^3 (70%)
Long Duration (11-hour event)	Total: 2,455m^3 Fluvial: 1,869m^3 (76%) Pluvial: 586m^3 (24%)	Total: 13,883 m^3 Fluvial: 11,999m^3 (86%) Pluvial: 1,884m^3 (14%)

Option	AAD (£)		Benefit (£) (2-Hour)	Comment
	11-Hour	2-Hour		
'Do-Nothing'	46,446.44	38,891.22	-	
'Do-Minimum'	25,584.07	32,482.49	6,408.73	Options below are compared against this scenario
Option 10 – Queen's Avenue Culvert	9,161.46	18,451.93	14,031.49	-
Option 11 – Balmoral Place and Queen's Avenue Channel Modification	6,399.74	16,802.26	15,680.23	-





Short duration storms: **Pluvial** flooding mainly

Long duration storms: **Fluvial** flooding mainly

Impact of Climate Change

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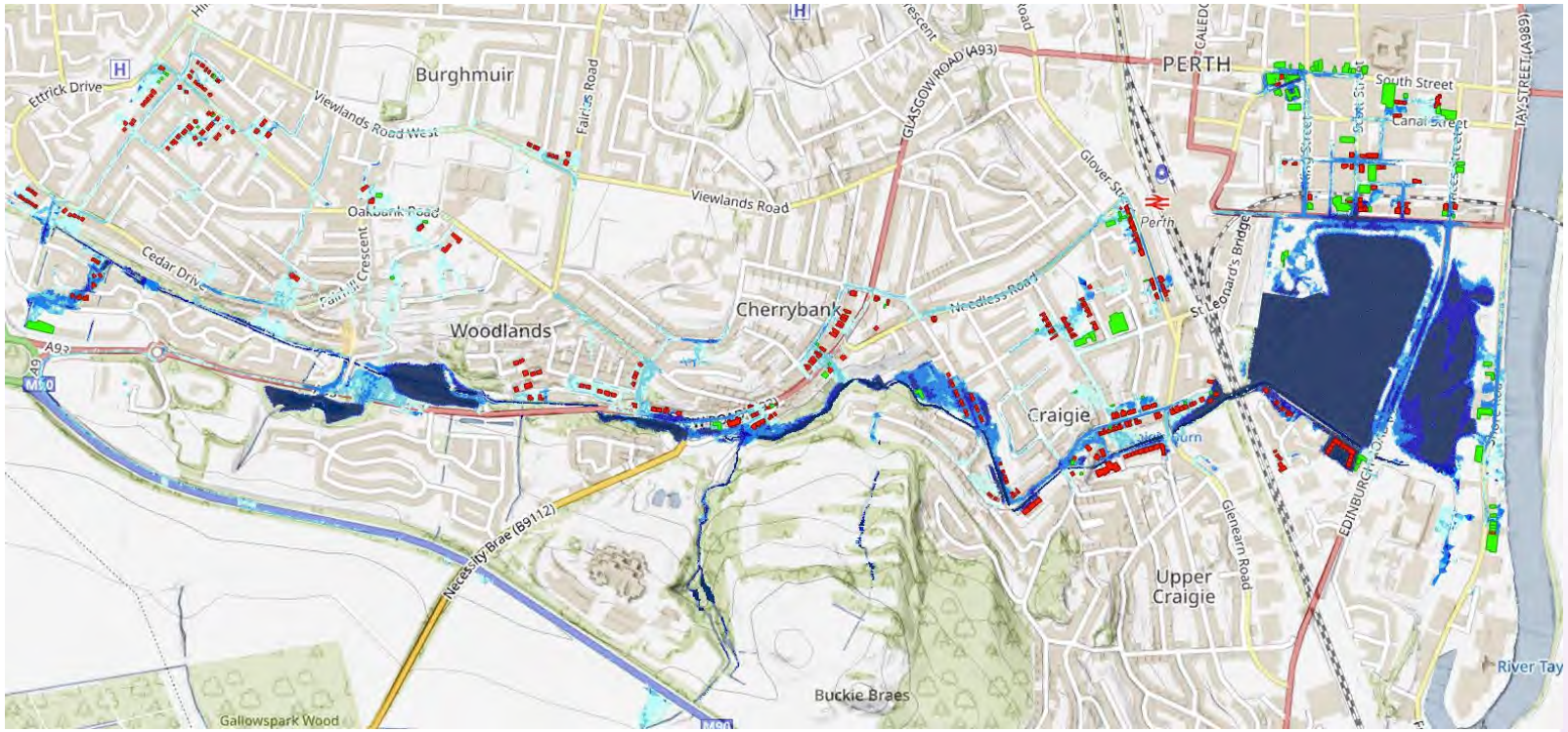
The impact of climate change evaluated for the:

- 'Do-nothing' scenario
- 'Do-minimum'
- Preferred option (Option 11)

In the assessment for the River Tay basin region:

- Peak rainfall intensity allowance of 39%
- Sea level rise allowance of 0.85 meters.



Option	AAD (£)	
	No CCU	CCU
'Do-Nothing'	46,446	123,576
'Do-Minimum'	25,584	87,591
Option 11 – Balmoral Place and Queen's Avenue Channel Modification	6,400	33,641

Perth SWMP Process

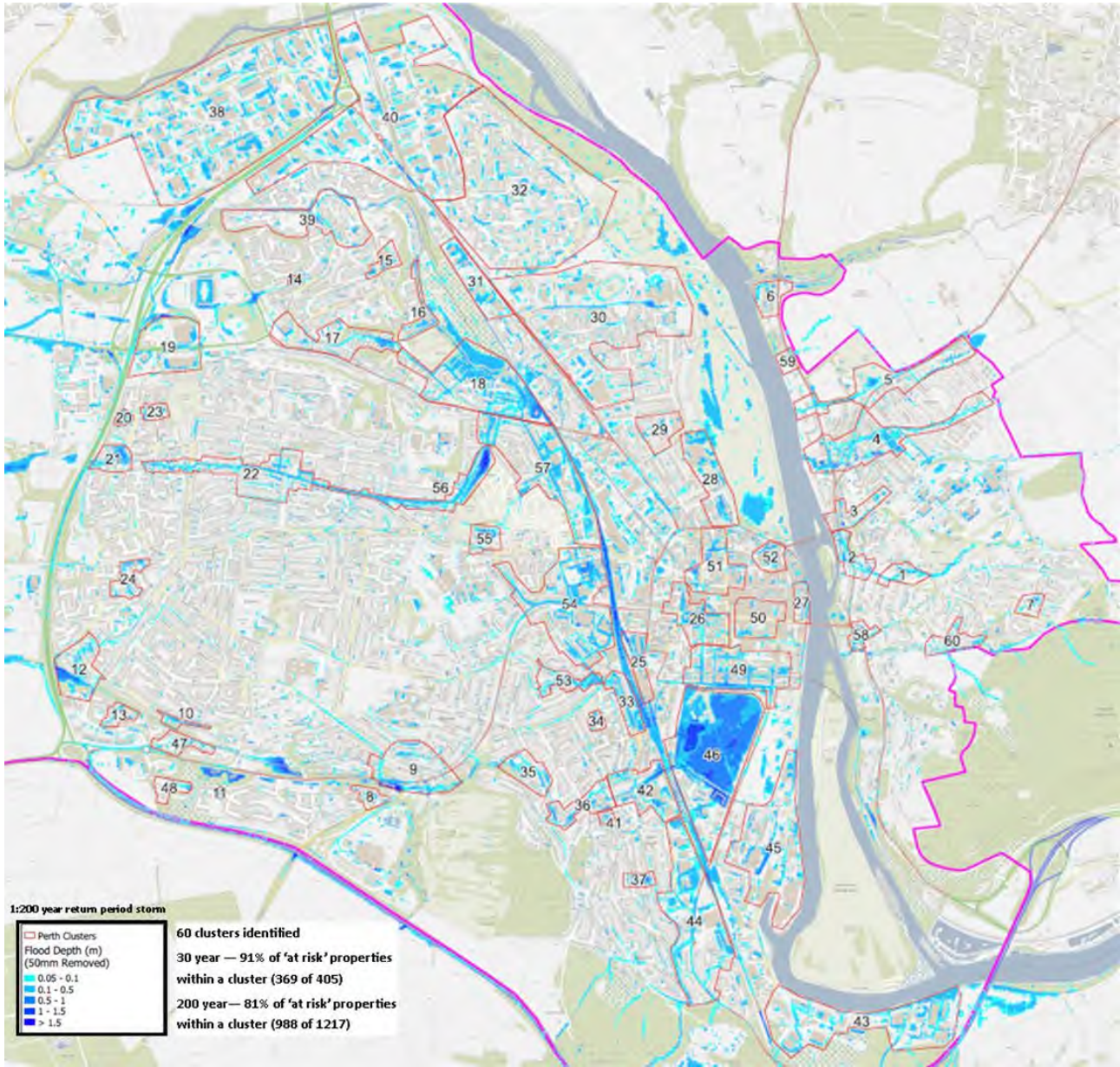
- Perth ICM network is 70% combined, 30% separated
- The 1D/2D model was converted to a 2Di model with 1000 gullies and manholes added (in green)
- The SWMP then identified the following:
  - ✓ A prioritised list of areas (clusters) in the city which are affected by flooding
  - ✓ A ranking matrix to determine which areas would benefit most from mitigation
  - ✓ A list of mitigation measures to reduce impact of flooding
  - ✓ Determination of most effective mitigation options
  - ✓ Estimated costs and CBR for preferred options

SWMP Clusters

- 60 Clusters were identified based on new 2Di flood risk models
- Clusters refined by ranking the:
  - ✓ Highest Average Annual Damages (all properties)
  - ✓ Highest Average Annual Damages (residential only)

These combined ranks created the final cluster score which allowed the clusters to be prioritised. Clusters scoring over 20 were progressed to the mitigation stage (29 no).

Cluster	Location	Initial Rank (Total AAD)	Second Rank (Residential AAD)	Final Cluster Score (AAD & Options)
4	Dupplin Road	3	1	28
9	Cherrybank Grove/ Oakbank Rd./ Glasgow Rd.	11	3	28
46	South Inch	12	2	28
3	Lochie Brae	15	5	28
36	Queens Avenue	28	11	24
42	Inch View Nursery Primary School	13	8	22
18	Fairfield Avenue	17	6	22
17	A85/ Wallace Cres.	22	7	22
22	Rannoch Road (Upper)	24	12	22
54	Dewars Centre	2	9	20
51	Perth Playhouse	9	15	20
57	Feus Rd.	14	10	20
32	Muirton	33	16	20
41	Kinnaird Bank	36	18	20



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Cluster Analysis

- The following measures were considered for identifying the most suitable clusters for optioneering: (in accordance with SWMP Guidance)
  - ✓ Flooding sources; including from watercourses, drainage system exceedance, overland flows
  - ✓ The return period where flooding occurs, e.g. 5yr return period (M5)
  - ✓ Number of properties affected; both residential and non-residential
  - ✓ Annualised damages to residential and non-residential (scored between 1 and 5)
  - ✓ Suitability for SuDS - Location to watercourses or open spaces, including distance to discharge/infiltration points
- Only clusters with a **Combined SuDS Score above 20** progressed to optioneering (14 no).

Location of predicted flooding	Cluster	Source of Flooding	Distance to Watercourse	Distance to Greenspace	Return period	No. Properties			Potential cause of flooding	Flooding from the main trunk	Access to a watercourse	Access to open space	SuDS suitability	Image	Annualised Damages £k			Annualised Damages Score	Combined SuDS Score
					Summer 60	Residential	Non-Residential	Total							Residential	Non-Residential	Total		
										1 to 5	1 to 5	1 to 5						1 to 5	0
Dupplin Road	4	From secondary pipe	9	23	R2	22	11	33		3	5	5	13		96	622	718	5	28
South Inch Terrace	46	From secondary pipe	5	5	R2	20	11	31		3	5	5	13		59	1	60	5	28

SWMP Option Development

- 25 long-list options were proposed and assessed on the following 15 criteria:
- Score allocated to each options based on impact and weighting of the category.
- Only options scoring **over 100** were recommended for a short-list

	Option ID	Figure	Clusters	Ownership	Type of Opportunity	Additional Areas	Description	Score	Impact on Watercourse	Impact on Sewer System	Water Quality	Biodiversity	Buildability	Land Ownership	Water efficiency	Cost CAPEX	Cost OPEX	Transport /traffic calming	Community Benefits	H&S	Climate change resilience	Enabling of economic development	Integrated Investment
	Perth SWMP								5	1	3	1	5	3	1	5	3	1	1	3	3	1	1
1	Disconnection and SUDS Storage Gannochy pond or Curly play area		4	Council Owned	Off-line		This area (6000m2) suitable location for increased storage and attenuation	145	H	M	M	H	H	H	M	M	M	L	M	H	H	L	L
2	Watercourse storage in fields adjacent to rohallion care clinic		4	Council Owned	Off-line		This area (6000m2) suitable location for increased storage and attenuation	145	H	M	M	H	H	H	M	M	M	L	M	H	H	L	L
3	Create surface water route to River Tay through derelict land		4	Private Land	on-line		Deculvert burn and facilitate flows to the burn	131	H	M	M	H	H	L	M	M	M	L	L	H	H	L	L
4	S Inch Terrace disconections & SUDS		46	Private Land	Off-line	Large roof areas from comercial	This area (24000m2) suitable location for storage and attenuation and discharge to Craigie Burn	109	H	M	M	M	M	L	M	L	L	M	M	H	H	M	L

Criteria/Score	Low	Medium	High	Weight
Impact on watercourse	Likely detriment to hydraulic conditions in the watercourse	Zero or manageable impact on watercourse	Improvement or reduction on watercourse flows	High
Impact on sewer system	Increase in flows to sewer system	Negligible change in flows to sewer system	Reduction in flows to sewer system	Low
Water quality	No improvement likely to water quality	Option provides water quality treatment	Improvement to water quality through reduced CSO spills	Medium
Biodiversity	Negligible impacts on biodiversity	Small scale or local biodiversity improvements	Significant or notable impacts on biodiversity	Low
Buildability	Complex build with utility or contamination issues	Build with utility or contamination issues	Straightforward build	High
Land ownership	Private land - occupied	Private land - vacant	Land owned by Council	Medium
Water efficiency	No water removal	Some removal of the water from system	Large amounts of water removed from the system	Low
Cost CAPEX	High	Medium	Low	High
Cost OPEX	Frequent maintenance required	Some maintenance required	Minimal maintenance required	Medium
Transport/traffic calming	No changes to transport	Minimal traffic calming improvements	Considerable traffic calming improvement	Low
Community benefit	No benefit	Minimal benefit	Considerable benefit	Low
Health and safety	Specific H&S issues	Manageable H&S issues	Minimal H&S issues	Medium
Climate change resilience	No resilience	Some resilience within design	Resilience to climate change and could also be retrofitted at a later date	Medium
Enabling of economic development	Making potential for economic development worse	Minimal potential	Considerable potential	Low
Integrated investment	No potential	Potential	Potential with more than one investor	Low

SWMP Option Development

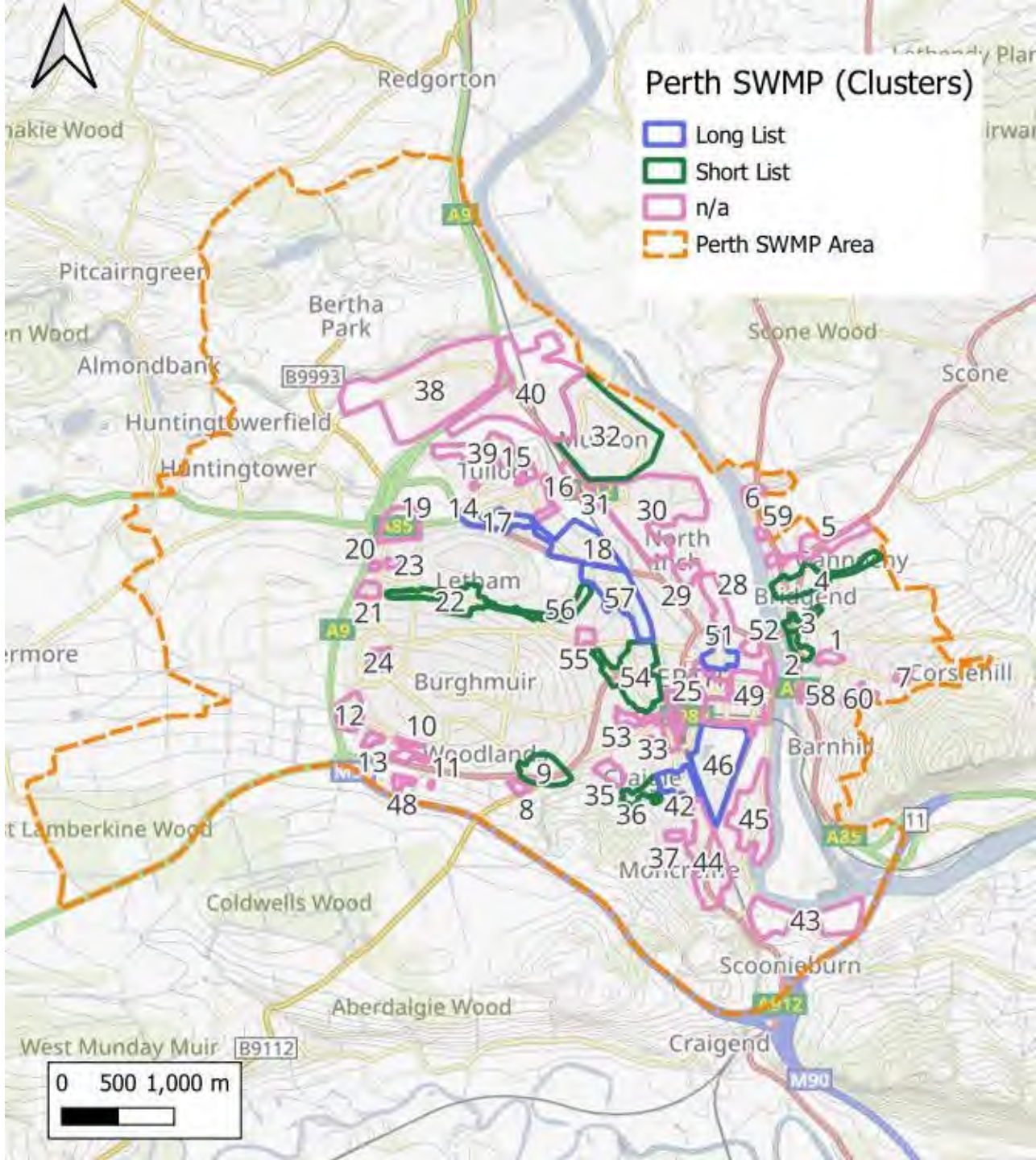
- 18 long-list options were proposed and assessed on the following 15 criteria:
- Score allocated to each options based on impact and weighting of the category.
- Only options scoring **over 100** were recommended for a short-list

Cluster number	Option ID and Description	Score
Target Opportunities (High Priority)		
4	1 - Disconnection and SUDS Storage at Gannochy pond or Curly play area	145
4	2 - Watercourse storage in fields adjacent to Rohallion care clinic	145
32	17 - Muirton improved storage	143
36 & 41	8 - Queens Avenue Culverts	141
22 & 56	12 - Rannoch Road drainage improvements	137
4	3 - Create surface water route to River Tay through derelict land	131
9	5 - Cherrybank Grove/ Oakbank Rd./ Glasgow Rd disconnect roads and roofs	127
54	14 - Dewars Centre and Perth Leisure centre disconnections	125
2 & 3	7 - A85 & Bowerswell Road attenuation in Millennium Park	123
54	13 - Whitefriars industrial roof top disconnections	123
Common Opportunities (Medium Priority)		
42	11 - Inch View Nursery Primary School disconnections	119
2 & 3	6 - Lochie Brae & A85 & Bowerswell Road road drainage	117
17 & 18	10 - A85/ Wallace Crescent disconnections	117
51	15 - Murray Street/City centre N Permeable	111
51	16 - Murray Street/City centre N SuDS North Inch	111
57	18 - Unity Terrace/Feus Road disconnection	111
Future Opportunities (Long Term Options)		
46	4 - South Inch Terrace disconnections & SuDS	109
18	9 - Fairfield Avenue disconnection and SuDS storage	107

SWMP Clusters – Short List

- Each Short List option (10 no) has:
  - ✓ a schematic of the proposal and model assessment
  - ✓ challenges and opportunities
  - ✓ indicative costs, benefits and CBR

	Option Overview and Location	Comment
Disconnection and SuDS	Cluster 4 – Gannochy Pond / Curly Play Area	Progress to modelling
Greenspace Attenuation	Cluster 4 – Fields adjacent to Rohallion Care Clinic	Progress to modelling
Improved Storage	Cluster 32 - Muirton	Progress to modelling
Culverts	Cluster 36 & 41 – Queens Avenue	Progressed in Cobble Burn FRS
Disconnection	Cluster 22 & 56 – Rannoch Road	Progress to modelling
Surface Water Route	Cluster 4 – Conachar Bank Retirement Living	Progress to modelling
Disconnection	Cluster 9 – Cherrybank Grove/ Oakbank Road/ Glasgow Road	Progress to modelling
Disconnection	Cluster 54 – Dewars Centre/ Perth Leisure/ Whitefriars Industrial Park	Progress to modelling
Greenspace Attenuation	Cluster 2 & 3 – Millennium Park	Progress to modelling
Disconnection	Cluster 54 –Whitefriars Industrial Park	Progress to modelling
Disconnection	Cluster 42 – Inch View Nursery Primary School	Discuss
Disconnection	Cluster 2 & 3 – A85/ Lochie Brae/ Bowerswell Road	Discuss
Disconnection	Cluster 17 & 18 – A85/ Wallace Crescent	Discuss
Permeable Paving	Cluster 51 – Murray Street/ City Centre North	Discuss
SuDS Storage	Cluster 51 – North Inch	Discuss
Disconnection	Cluster 57 – Unity Terrace/ Feus Road	Discuss
Disconnection and SuDS	Cluster 46 – South Inch Terrace	Discuss
Disconnection and SuDS	Cluster 18 – Fairfield Avenue	Discuss



Mitigation Considerations

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Raingardens

Interactive greenspace

Kerb drainage

Swales

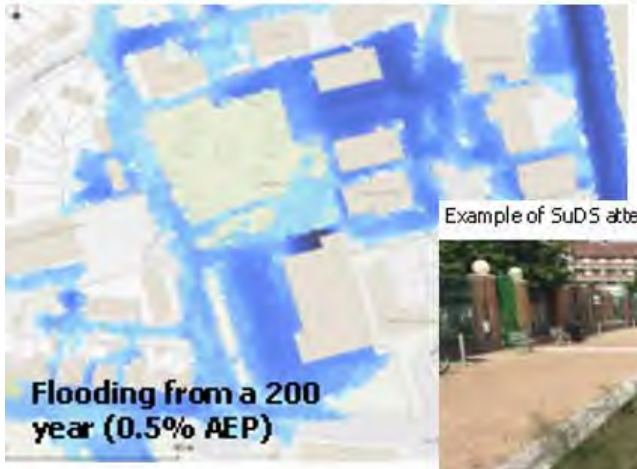
System Upgrade

Storage/Wetlands

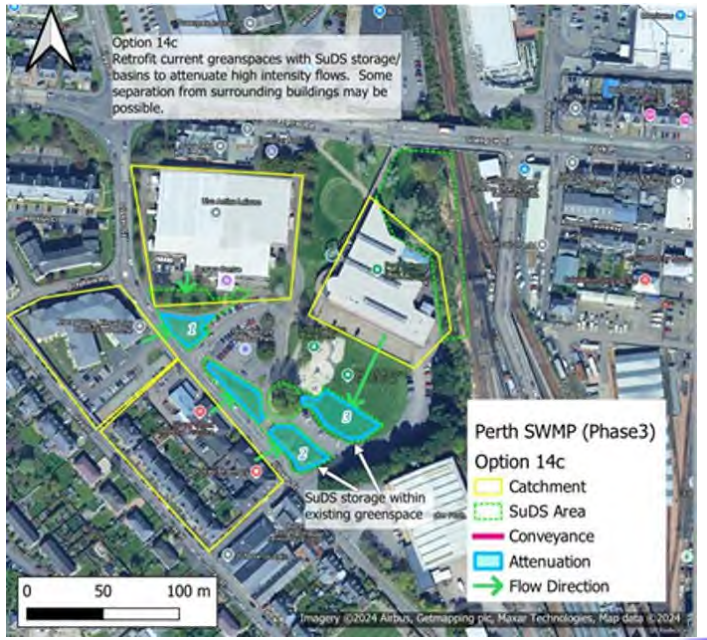
Perth SWMP– Short List BCR

Amey

Option ID	Cluster Number	Option Description	Capital cost	Total PV Benefits	Benefit : cost ratio
1a	4	SuDS Attenuation, additional road drainage on Dupplin Road and Annat Road with a raingarden opposite Gannochy Pond.	£145,622	- £ 12,327	0
2	4	Upper catchment attenuation and storage in fields opposite the	£189,201	- £ 11,212	0
3	4	Create surface water route to River Tay through derelict land using cascading swales and raingardens.	£134,231	£ 5,927	0
5a	9	Kerb drainage and storm sewer upgrade at Oakbank Crescent and Oakbank Place.	£171,180	£ 14,207	0.1
5b	9	SuDS swale and detention basin within Perth Academy grounds to intercept drainage before it reaches Oakbank Place.	£156,299	£ 21,291	0.1
7	2	SuDS attenuation in Millennium Park.	£467,409	£ 8,457	0
12a	22	Rannoch Road drainage upgrade and SuDS feature within Newhouse Road roundabout. Kerb drainage along Rannoch Road between Newhouse Road and Letham Road roundabouts.	£399,633	£ 6,718	0
12b	56	Kerb drainage along Rannoch Road between Letham Road and Unity Terrace roundabout, including periodic raingardens for interception	£293,487	- £ 11,392	0
13	54	Whitefriars industrial rooftop disconnections.	£412,647	£ 1,857,908	3.4
14	54	SuDS (infiltration and storage) Dewars C[illegible]re and Perth Leisure Pool	£220,600	£ 694,204	2.2



Example of SuDS attenuation (source: susdrain.org)



Projects contributing to surface water management in Perth

Amey

Sustainable Urban Drainage Systems

Chris Swain – Amey Drainage Infrastructure Practice Lead

Dr. Doug Lewis – Amey Flooding Practice Lead

January 2026

Amey

Life's better connected

Introduction

Amey

Overview of the Amey Drainage Design and Water team, location and capabilities

Section 19's

Brief run through of the Principles of SUDS

Detailed case studies – overcoming site constraints and scheme challenges

- **Grey to Green Phase 1, Sheffield – City Centre**
- **Clay Lane, Doncaster – Residential area**
- **Cardiff Bay railway station**

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Flood and Water Management Act 2010 Section 19

Requirement for Local Authorities to Investigate the cause of flooding events. This usually includes a desk top study and site inspection.

The level of detail in the study should be appropriate for the severity of the flood event.

Collaboration between relevant flood risk management authorities is required as part of the investigation.

Resulting actions to be allocated to the most appropriate flood risk authority to address them.

The reports can be very helpful for developing strategies for further studies, optioneering and improvement schemes.

Amey can assist with the preparation of S19 investigations, business cases and design

Flood Investigation Report – S19-442

The Grange & Old Hall Farmhouse, Main Street, Wilsthorpe, PE9 4PE

Figure 22: Culvert 3 (approximate inlet location circled in red)[6]

Figure 23: Culvert 3 outfall[6]

Infiltration: Allowing water to soak into the ground. Decreasing flow rates to watercourses.

Attenuation: Slowing down the flow of water. Storing or re-using surface water.

Source Control: Managing runoff as close to its source as possible.

Surface Water Management: Using surface features to manage water and reduce flood risk.

Flood Risk Management: Reducing the risk of flooding.

Water Quality Improvement: Reducing pollution from urban runoff. Collecting pollution close to source.

Biodiversity and Amenity: Creating green spaces and habitats.

Community Benefits: Enhancing public spaces and social cohesion.

Example SuDS Systems – Grey to Green Phase 1, Sheffield

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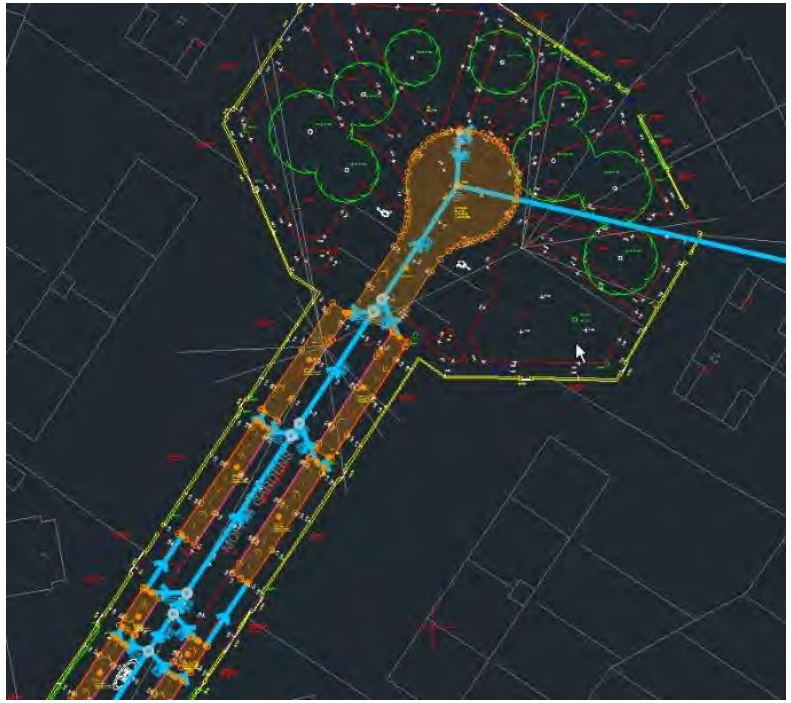
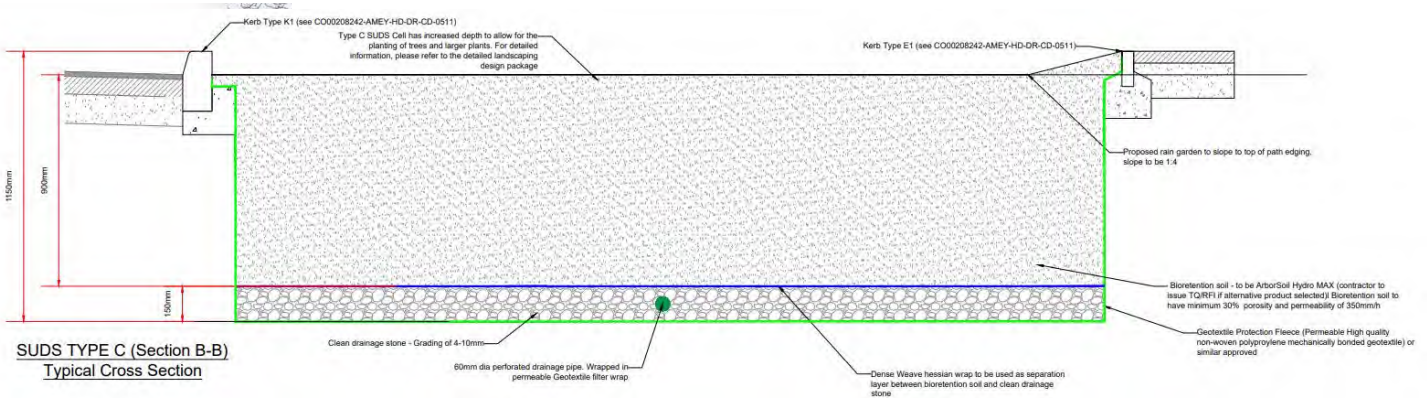
Before and after images

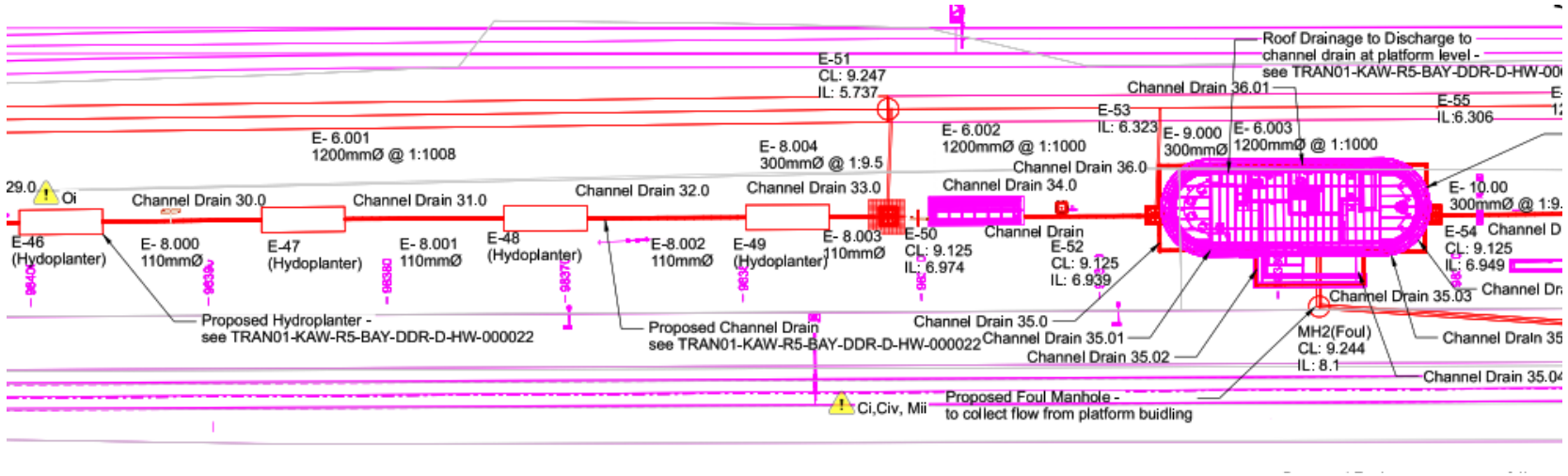
Example SuDS Systems – Clay Lane, Doncaster

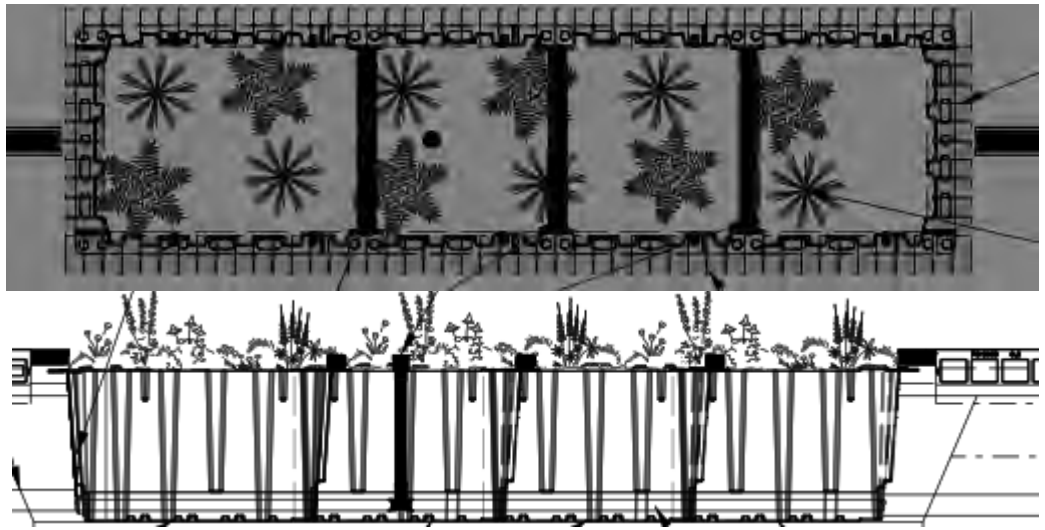


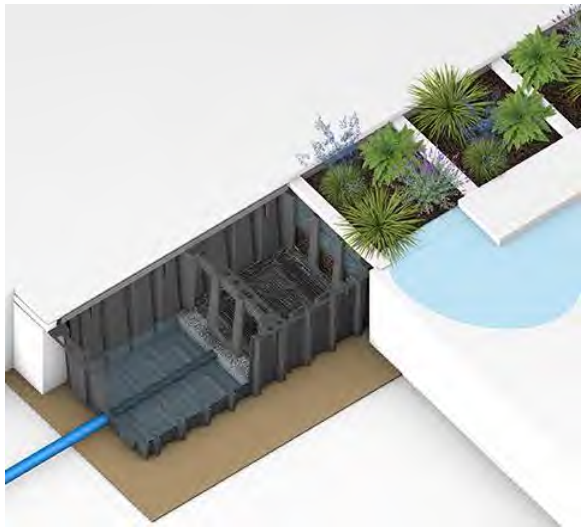


SUDS TYPE C (Section B-B)
Typical Cross Section

Example SuDS Systems – Rail Platform, Cardiff Bay







Key Design Considerations

Catchment Management: SuDs Scheme are ideal as part of a river catchment wide flood reduction strategy

Hydraulic Performance: Ensure the systems have the storage volumes and connectivity to achieve the required flood resilience

Maintenance: Designating for long term low maintenance is essential. These systems are generally more expensive to maintain than traditional drainage but offer more benefits.

Community Engagement: Involving local communities can reduce maintenance and vandalism costs.

Landscaping: Low maintenance and drought resistant planning is required. They should also provide year-round interest and amenity.

Thank You

Any Questions?

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