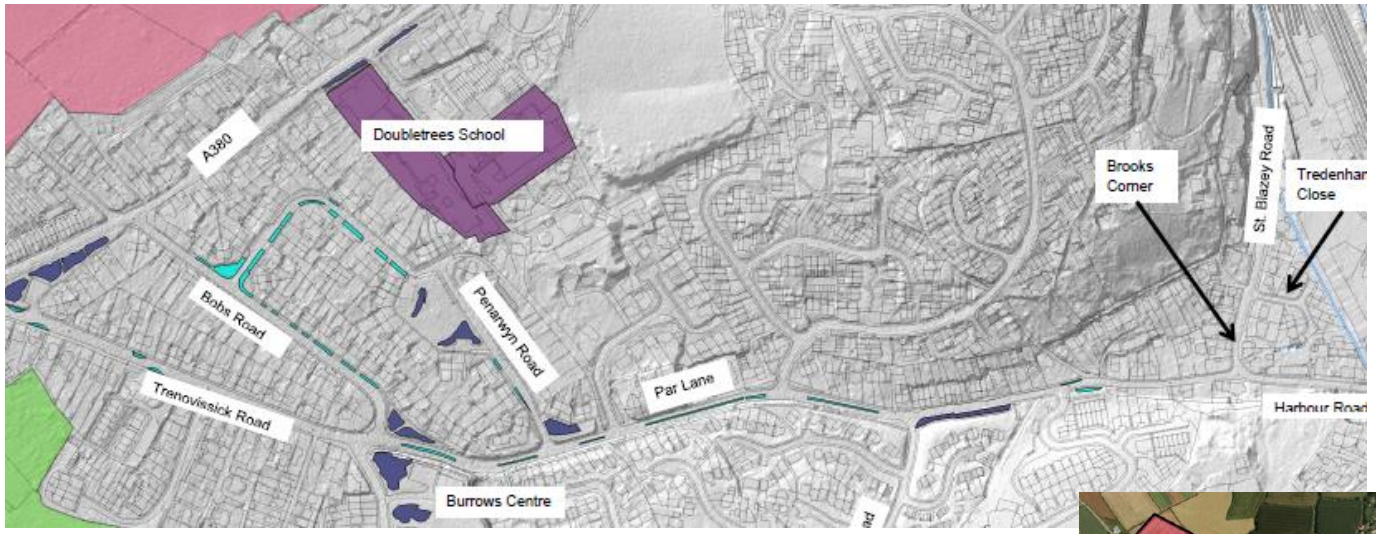
# Proofing the Concept of Sustainable Drainage Schemes Using an Integrated Urban Drainage Model




Anthony Raine

Principal Modeller Catchment Management


**Welcome to**
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# Contents

- Project / Catchment Description & History;
- Integration With Other Stakeholders;
- Flooding History & Mechanisms;
- Surveys & Modelling Undertaken;
- Joint Probability & Boundary Conditions;
- Damage Cost Assessment;
- Concept Proofing Using the Model;
- Latest Options;
- Conclusions / Lessons Learnt;
- Next Steps.

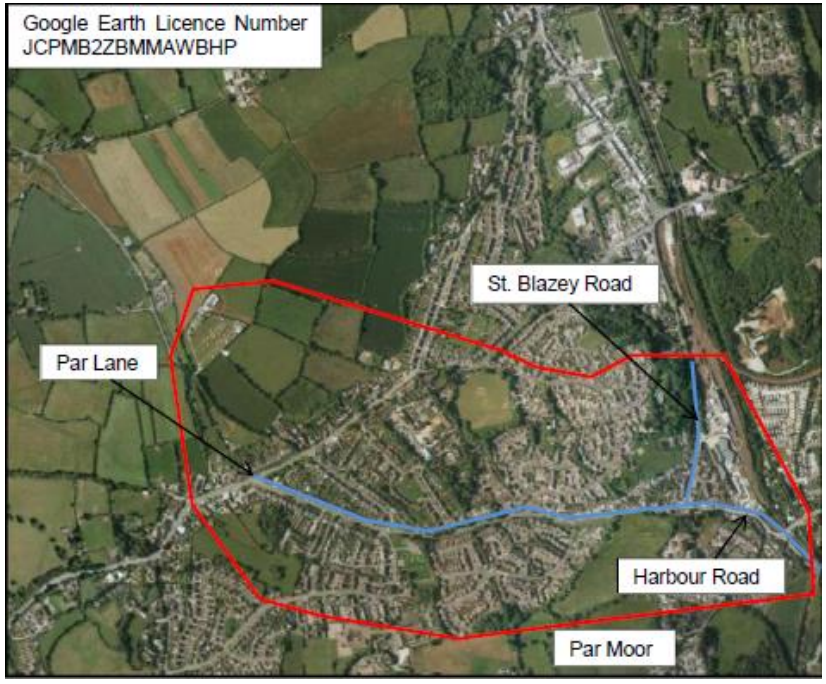
# St Austell Resilient Regeneration (StARR) Project

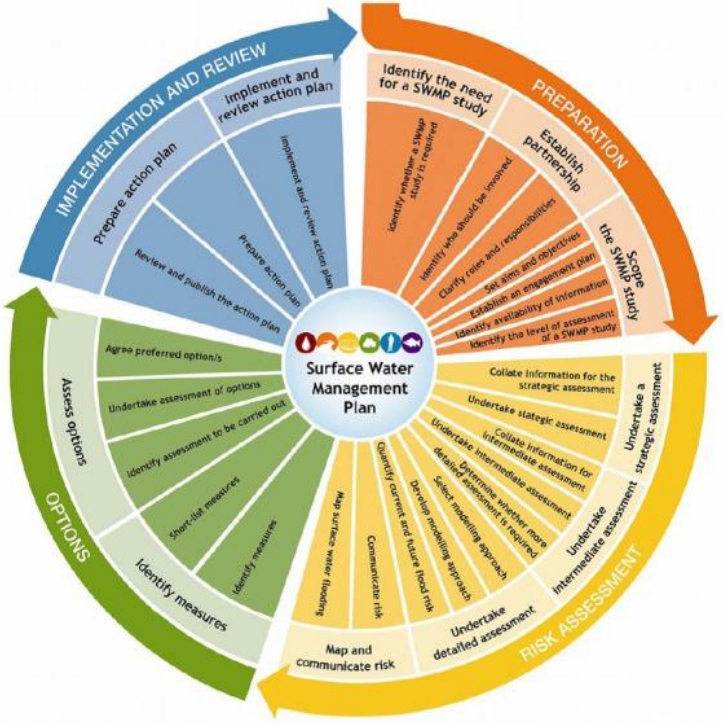
- Recognition that flooding cannot be entirely prevented, but via a partnership approach the risk can be reduced;
- Partners in StARR Project Include:-
    - Environment Agency;
    - Cornwall Council;
    - South West Water;
    - University of Exeter;
    - Cornwall Development Company;
    - West Country Rivers Trust.
- £20M bid to:-
    - reduce flood risk and pollution affecting >500 homes & 200 businesses;
    - reduce flood risk to strategic road and London rail network;
    - work with nature to reduce flood risk & create habitats;
    - encourage investment in area through greater resilience and increase the wellbeing of the affected communities.




European Union
European Regional Development Fund

# Par Lane SWMP Case Study





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# Par Lane Integrated Urban Drainage Management – The Key Players

SOUTH WEST WATER

Pell Frischmann

Environment Agency

The Local Community

AECOM

one and all onen hag oll
CORNWALL COUNCIL

Mott MacDonald

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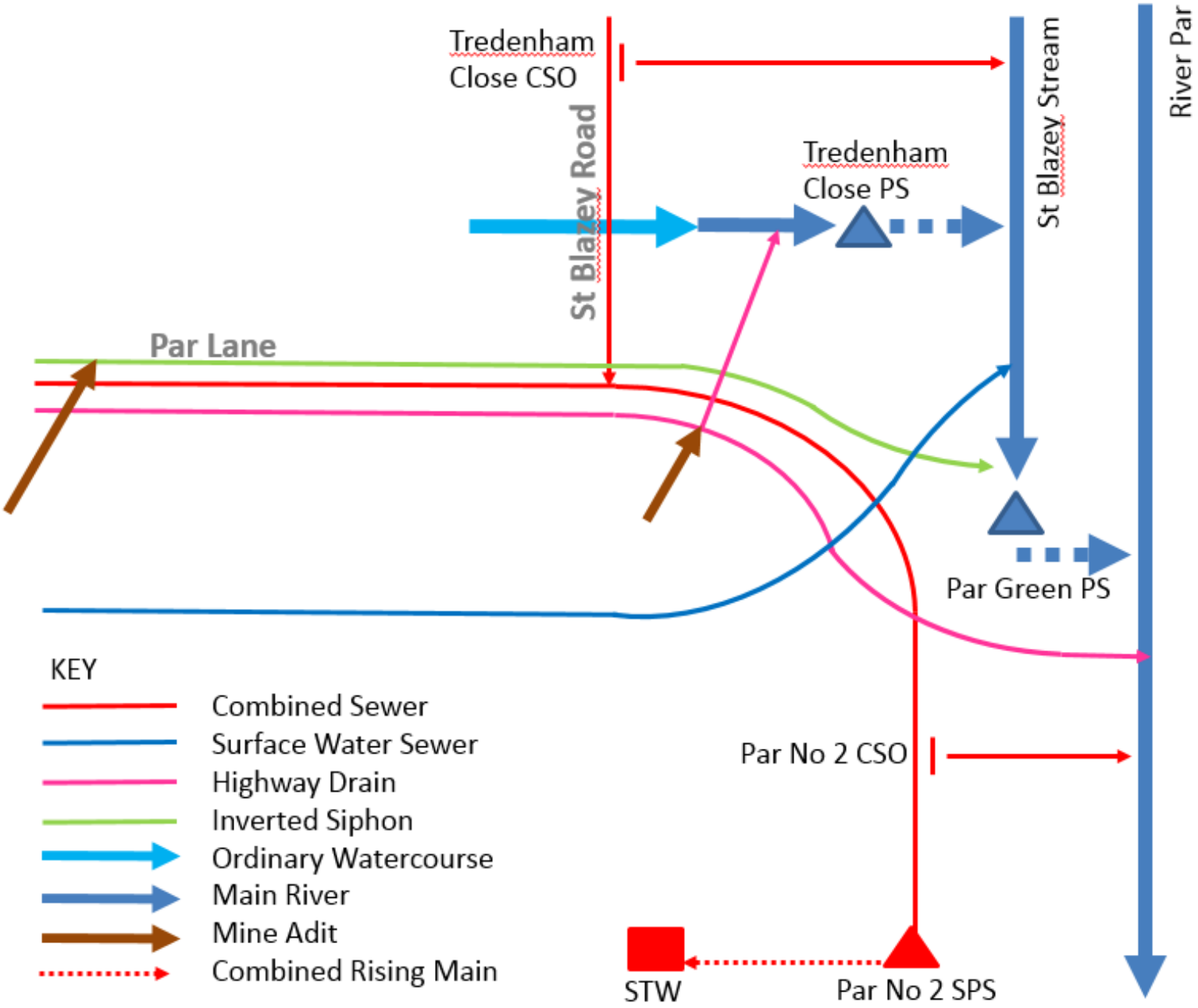
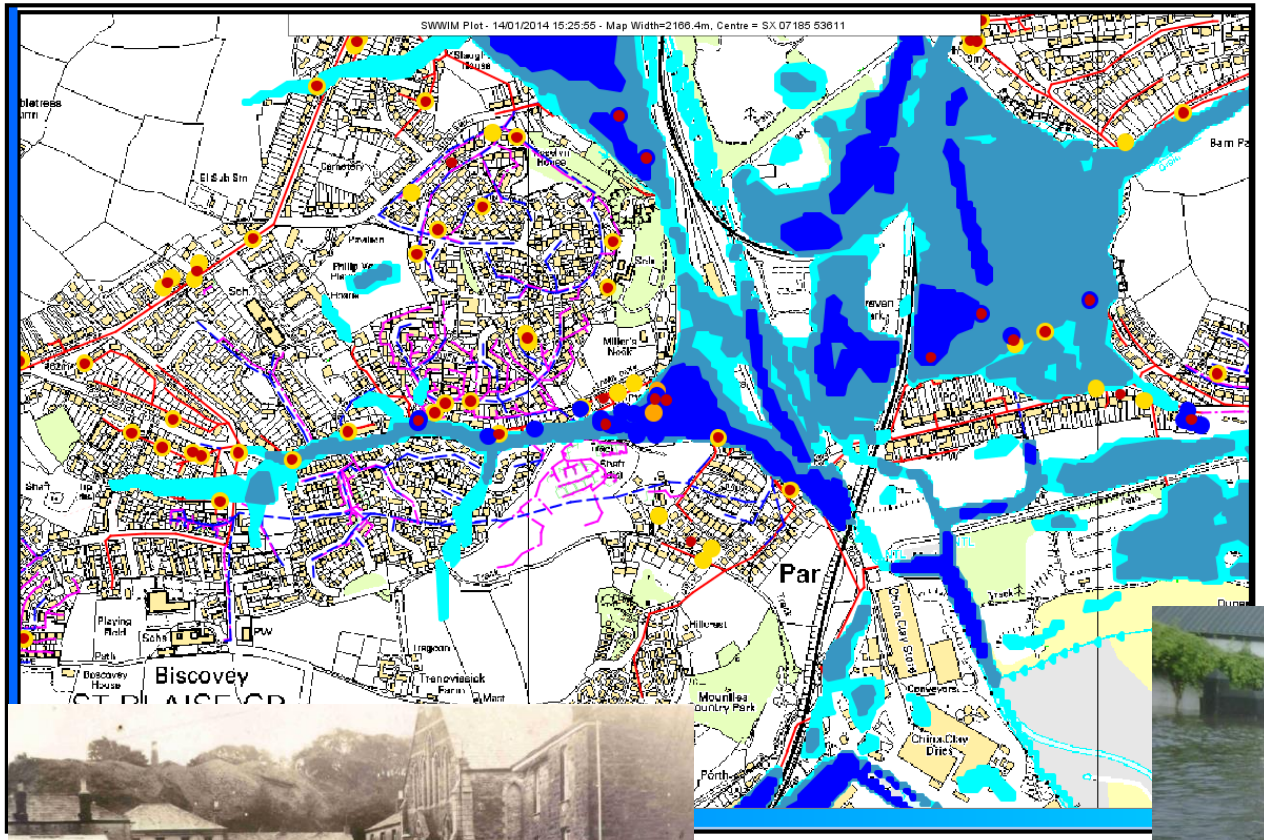
# Project History

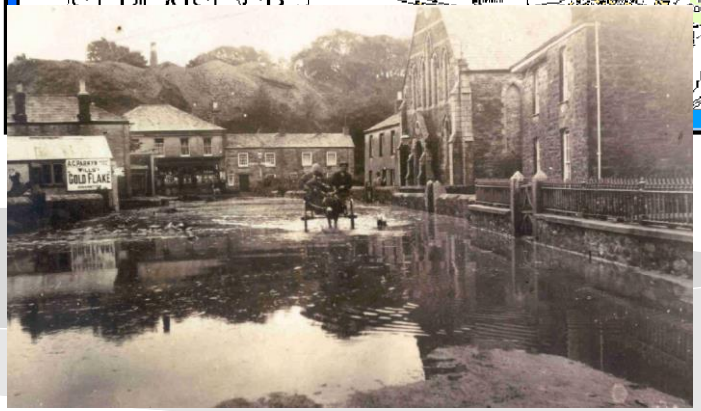
- 2004 – SWW/PF Par DAS/DAP;
- 2006 – SWW/PF DG5 Evaluation 5 Internals / 18 Externals;
- 2010 – EA/Capita Symonds ISIS -Tuflow Fluvial Model;
- 2012 – SWW Supplementary DG5 Evaluation Report Recommending Need For A SWMP;
- 2014 – SWW/EA/Cornwall Council/PF – SWMP Phase 1;
- 2015 - SWW/EA/Cornwall Council/PF – SWMP Phase 2 (Incl. Flooding Appraisal & Options Report);
- 2016 - SWW/EA/Cornwall Council/PF/Mott MacDonald – EU Regional Development Fund Application - SWMP Supporting Information Report.




**Simplified Schematic of Drainage within the Study Area**

# Flooding History



# Flooding Mechanisms

- Multiple sources and complex i.e. All drainage (Incl. Highway Drains, Public SW Sewers, Combined Sewers and Watercourses) systems become inundated and flood under varying conditions;
- Direct rainfall runoff, boundary conditions (tide & river levels), mine adit flows and infiltration all play a part too.

**Table 1 - Sources of Flooding at Brooks Corner**

| | Flood Event | | | |
|---|---|---|---|---|
| | 5 year | 10 year | 30 year | 100 year |
| Inverted Siphon (currently maintained by SWW) | 0% | 0% | 1% | 2% |
| Highway Drainage (CC) | 48% | 48% | 55% | 60% |
| Combined Sewers (SWW) | 7% | 10% | 2% | 2% |
| Surface Water Sewers (SWW) | 0% | 0% | 0% | 1% |
| Biscovey Stream (CC/EA) | 18% | 22% | 30% | 26% |
| Overland Flows (private landowners) | 27% | 19% | 11% | 6% |
| St. Blazey Stream (EA) | 0% | 0% | 0% | 3% |

# Surveys Undertaken

- Private Drainage Surveys;
- Impermeable Area & Connectivity Surveys;
- CCTV Surveys;
- Flow Surveys;
- Manhole & Ancillary Surveys;
- River Channel & Culvert Surveys;
- Site Walkovers;
- Flooding Questionnaires & Public Meetings.

# Modelling Undertaken

- 1D Type II DAP SWW Combined Sewer Model;
- Model Enhancement (Incl. SW/Highway Sewers & Watercourses);
- Model Updated With Additional Survey Information;
- 2D Model of Affected Area Incl. Infiltration Zones On Surrounding Hillsides To Yield Greenfield Runoff Using The Horton Method;
- Verification of IUDM Model;
- Existing Performance Assessment & Historical Verification;
- Creation Of Design Horizon Model (Incl. Allowances For Development Growth, Climate Change & Urban Creep);
- Joint Probability Analysis Of Return Period Rainfall;
- Sensitivity Testing (Incl. Proofing Concept Solutions);
- Detailed Option Modelling.

# Climate Change & Joint Probability (Rainfall & Sea Level)

## Climate Change

- "Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities", EA;

## Joint Probability

- "Methods in Flood Management: A Guide to Best Practice – R&D Technical Report FD2308/TR2", Defra / EA;
- "Joint Probability: Dependence Mapping and Best Practice: Technical report on dependence mapping, R&D Technical Report FD2308/TR1", Defra / EA, March 2005.

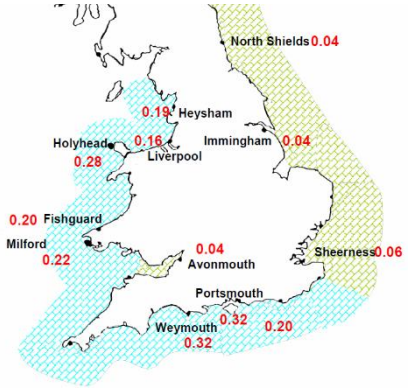
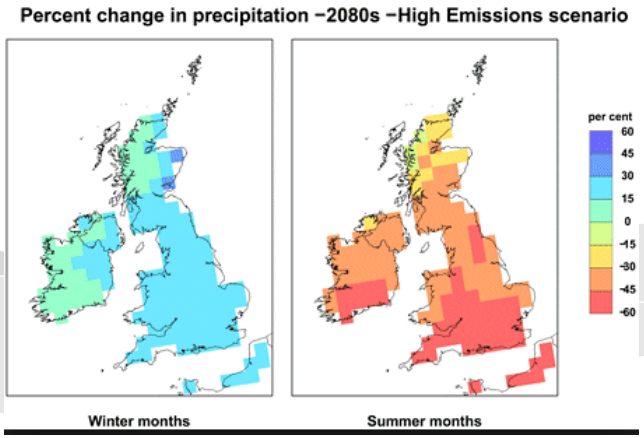
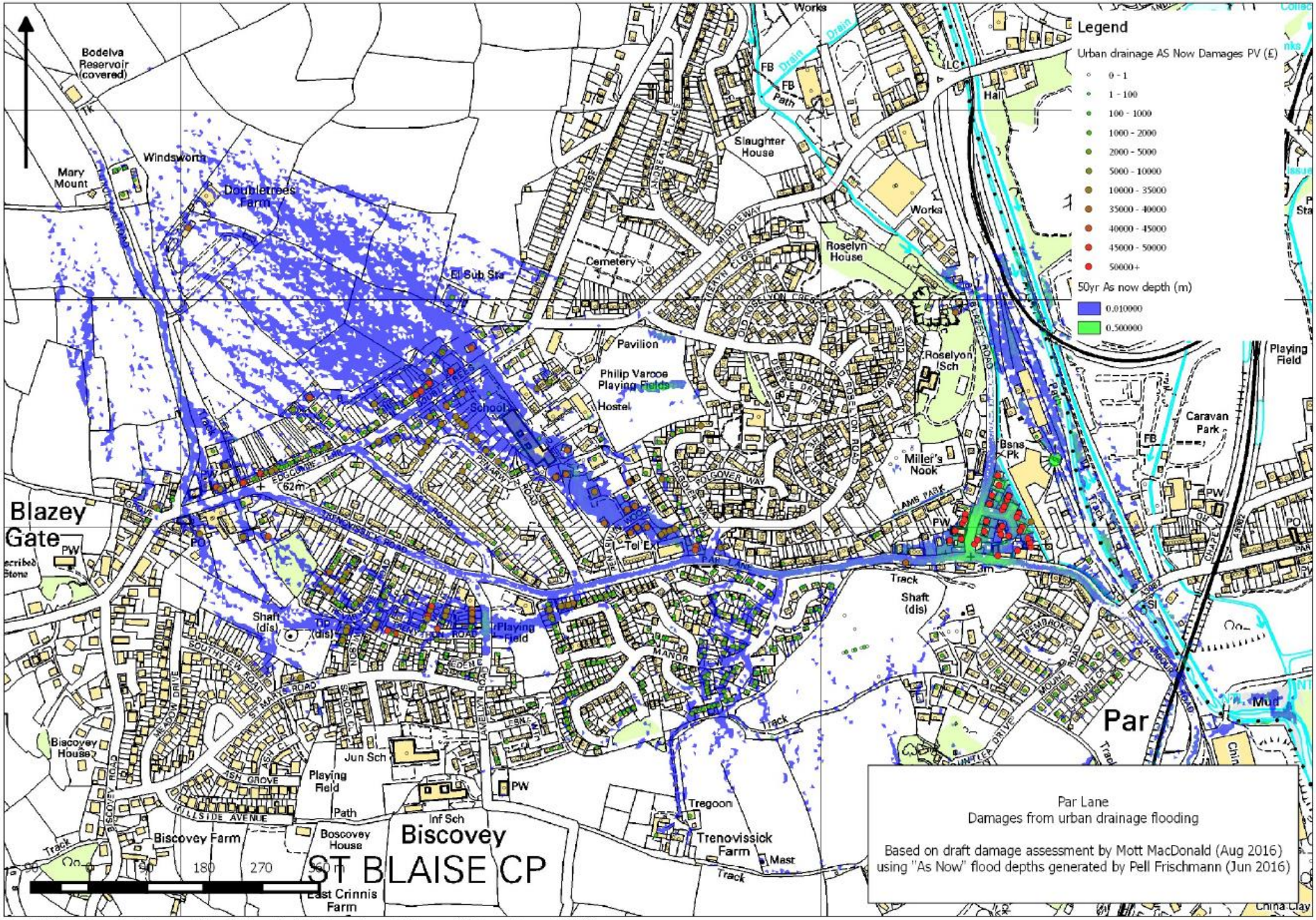



Figure 3 Summary dependence information for rainfall and sea level





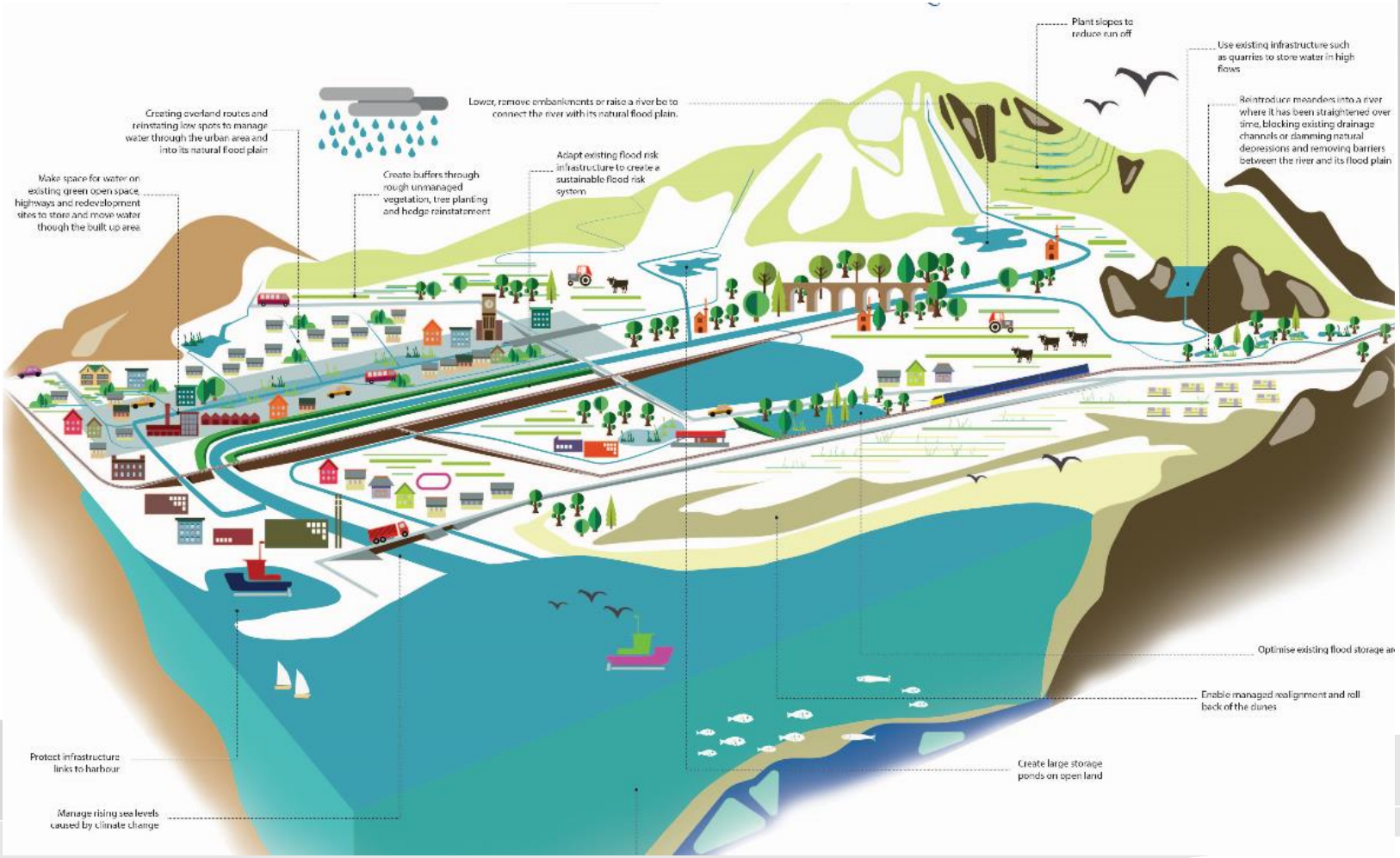
# Proofing Concept Solutions

- Why? – To Support Funding Application From EU Regional Development Fund;
- How? – Working With Other Stakeholders To Agree What Can Be Achieved & Testing Concepts Using IUDM Model;
- When? – 1 Month Tight Timescale Requiring Frequent Meetings Between Parties & Use Of Shared Desktop / Teleconferencing.

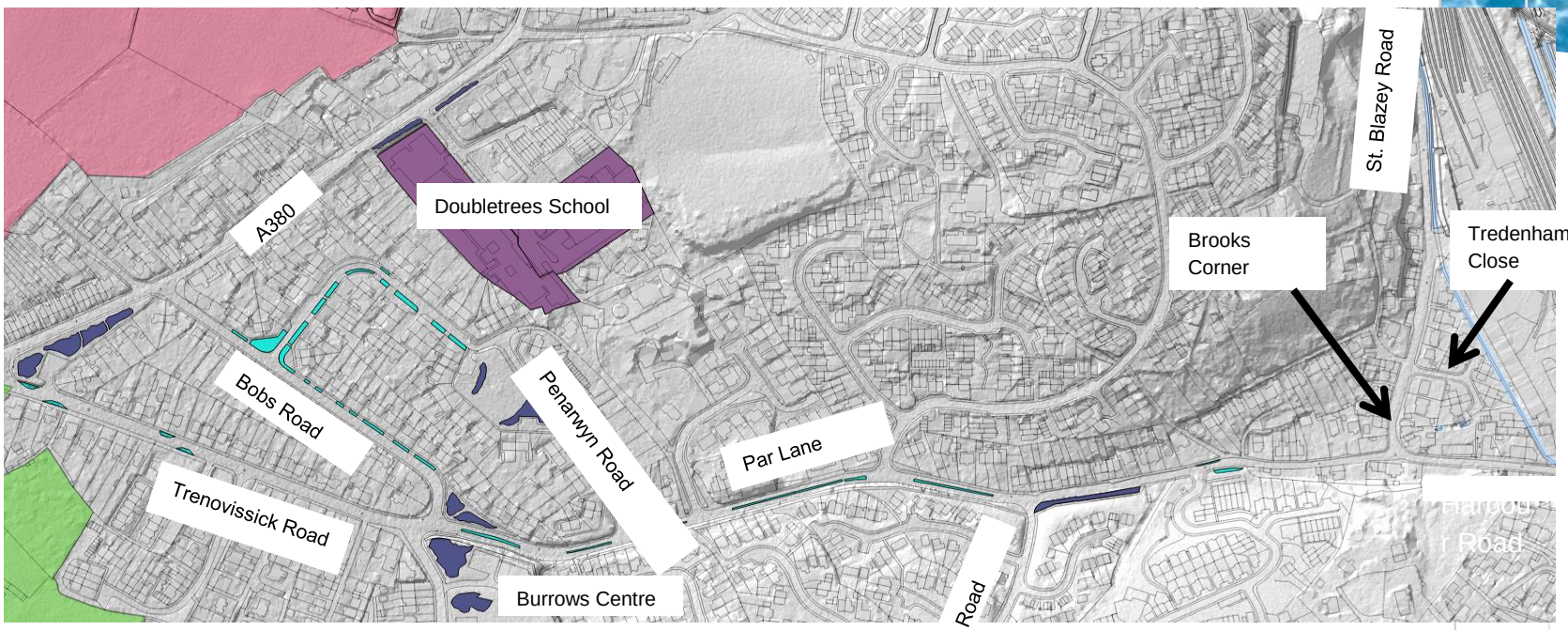
# Concepts Modelled

- Limiting Flows Within The St. Blazey Stream to 1.1 $m^3/s$;
- Intercepting & Storing Runoff In The Upper Catchment (Incl. Detention Basins / Raingardens);
- Diverting Overland Flow Paths From Brooks Corner;
- Increased Pump Rate Of Biscovey Stream and modifications to the Tredenham Close CSO.

# Limiting Flows Within The St. Blazey Stream

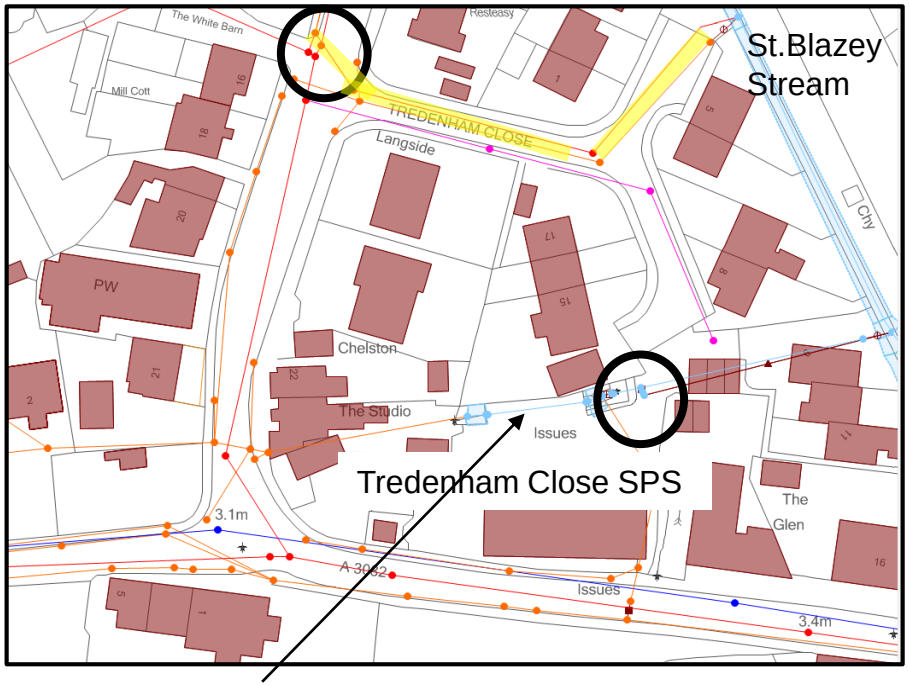


# Intercepting Flows In Upper Catchment

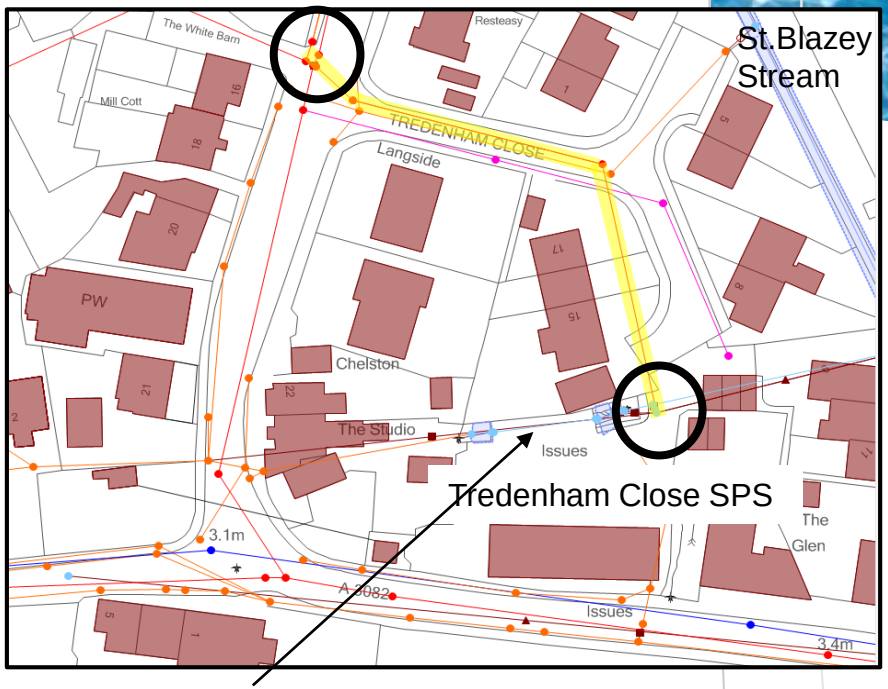


# Increased Pump Rate At Tredenham Close SPS & Diversion Of CSO

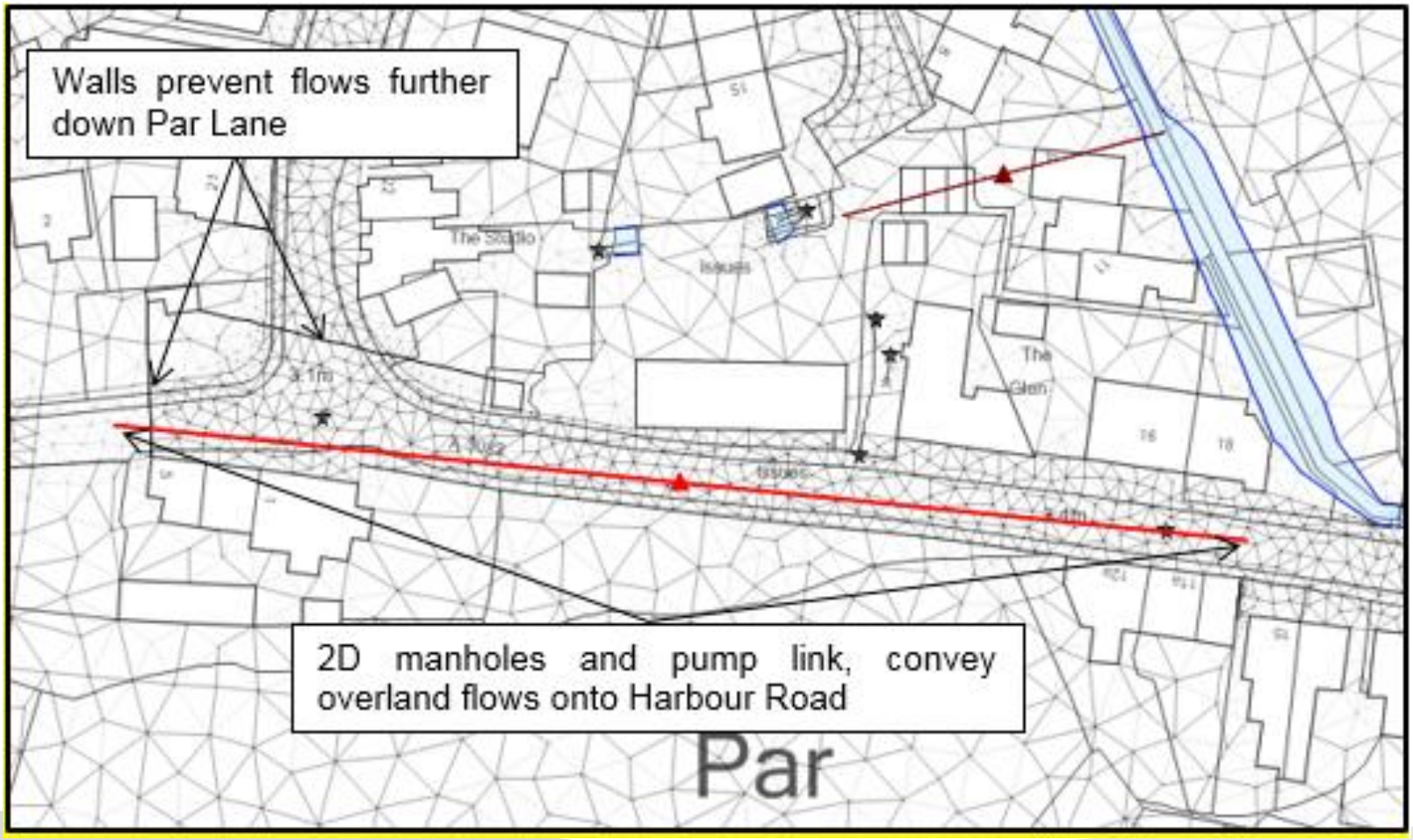
Tredenham Rd CSO

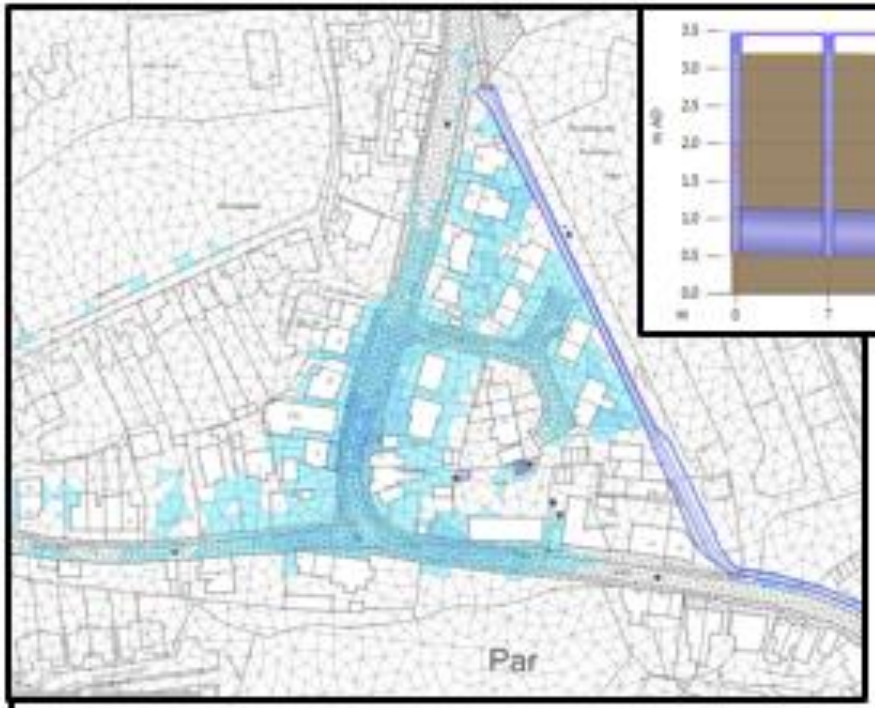


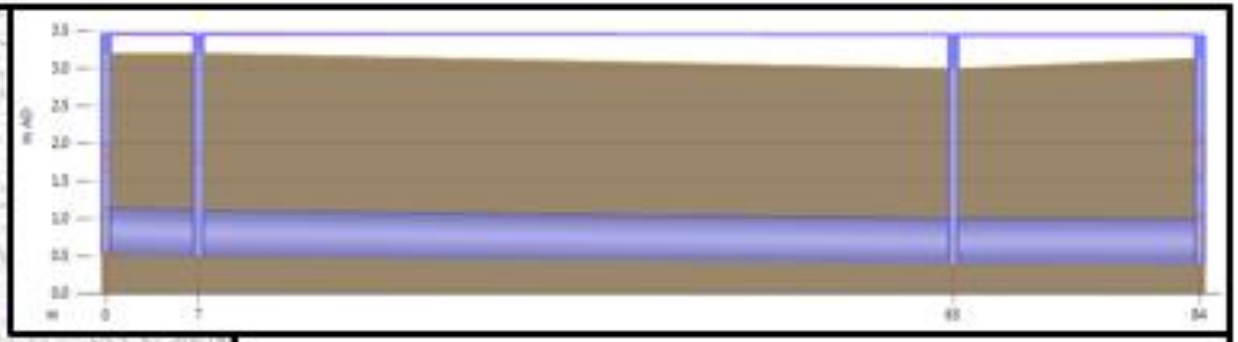

Tredenham Rd CSO



# Diverting Overland Flow Paths

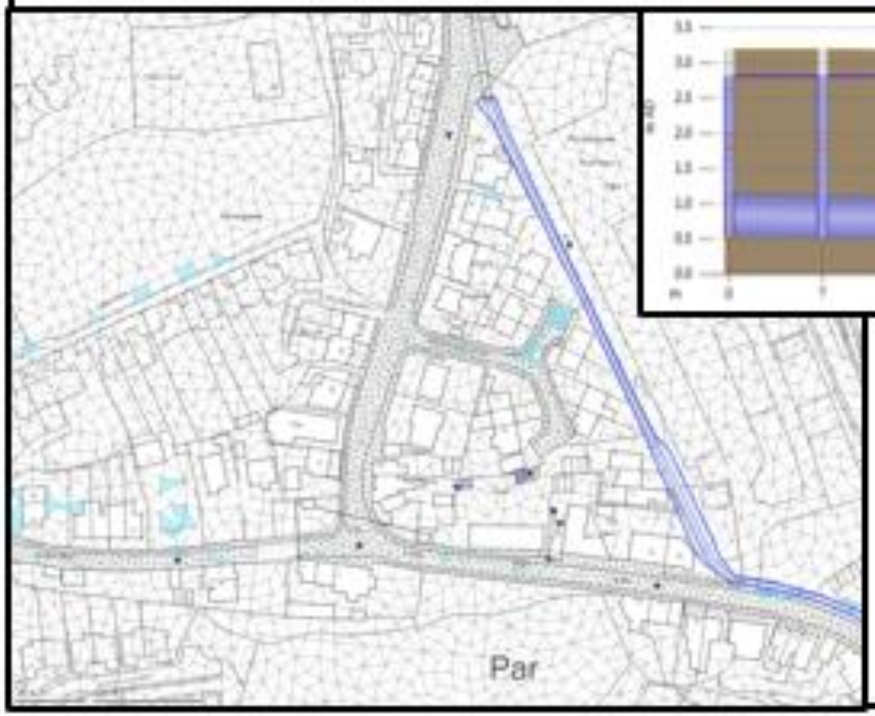


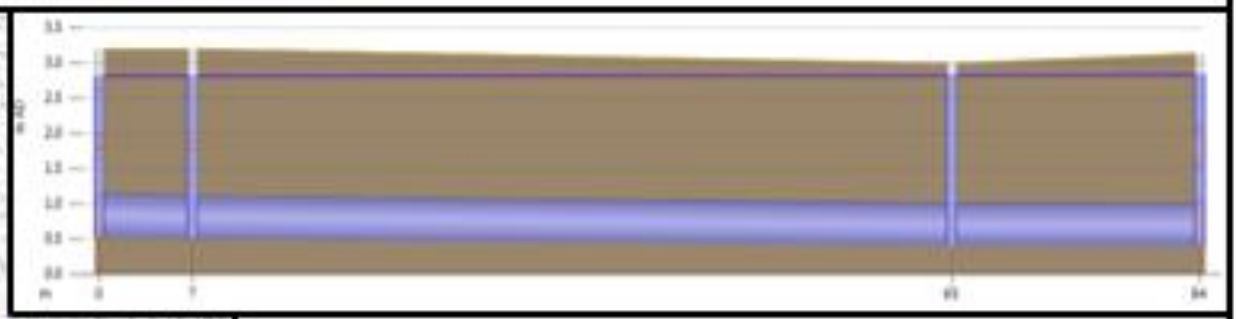


Existing 30-year event

Flood extents (left), maximum level within combined sewer in St. Blazey Road (above)



Proposed 30-year event

Flood extents (left), maximum level within combined sewer in St. Blazey Road (above)

# Latest Options

## Scheme 1 – Least Cost / Highest Risk Option

Mitigate hot-spots where raising kerbs may provide a design exceedance route;
Burrows Centre Detention Basins
5 x rural basins (capacity ~30cu.m each) to be installed north of Biscovey
Attenuation in Double Trees school ('soft / green' areas only)
1 x 10m wide contour tree planting strip across full width of fields north of Biscovey

## Scheme 2 – Medium Cost / Medium Risk Option Incl. Scheme 1, PLUS:

Harbour Road exceedance route
Rain Gardens (Par Lane section only)
5x ADDITIONAL rural basins to be installed north of Biscovey (10 total)
1 x ADDITIONAL 10m wide contour tree planting strip across full width of fields north of Biscovey (2 TOTAL)
Attenuation in Double Trees school (ADDITIONAL attenuation under carparks)

## Scheme 3 – High Cost / Low Risk Option Incl Scheme 2, PLUS

All other rain garden opportunities;
Maximise attenuation in Doubletrees School
1 x ADDITIONAL 10m wide contour tree planting strip across full width of fields north of Biscovey (3 TOTAL)
All other detention basin opportunities

## UPPER CATCHMENT
let water slow

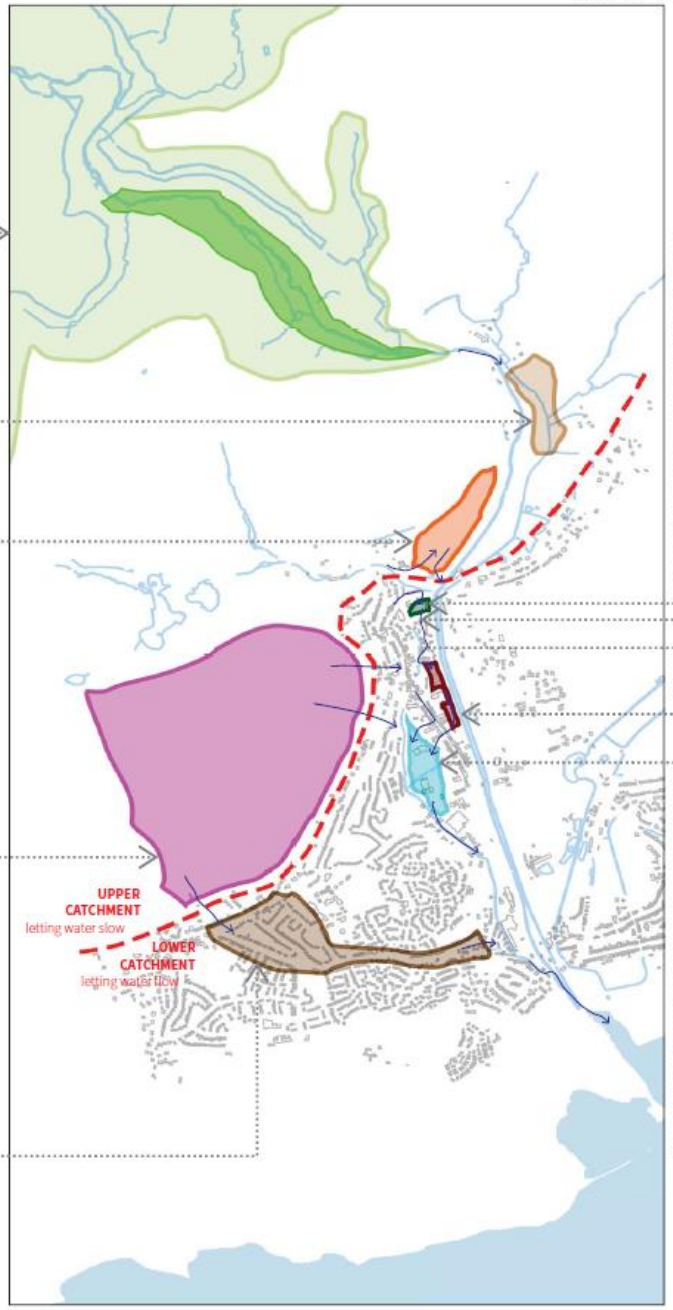
**LUXULYAN VALLEY AND UPPER VALLEY STORAGE**
Utilise available storage in the valley to reduce peak flows downstream

**HIGHWAY DAM STORAGE**
Optimise flood storage, increasing the connectivity between the channel and flood plain making use of available land

**PRIDEAUX STREAM SPILL**
Intercept and divert flows from the Prideaux Stream and upper St Blazey Stream into a storage area creating wetland habitat and increasing capacity in the St Blazey system

**HILLSIDE MANAGEMENT**
Divert and slow flows using catchment management solutions to reduce overland flow routes to St Blazey

**PAR LANE**
Strengthen conventional engineering solutions in Par Lane by creating additional storage using green open space, verges and traffic calming structures




## LOWER CATCHMENT
let water flow

**ABERDEEN CLOSE STORAGE**
Create storage areas in the green open space diverting flows away from the A390 and adjacent property

**ST BLAZEY CHANNEL IMPROVEMENTS**
Improve the existing channel so that flows are transferred to the proposed storage area at the rear of Aberdeen Close

**EXCEEDANCE ROUTES**
Create safe flow pathways for excess flood water through Aberdeen Close and Station Road

**STORAGE AREAS**
Create new storage areas in green open space and work with existing amenity space so that its potential for storing and moving flood flows towards existing flood plain is maximised during extreme events

**AMENITY SPACE AND FLOOD PLAIN**
Connect flood water back into the St Blazey's natural storage area with an opportunity to create considered landscaping in a high profile location which demands strong design principles with integrated, multifunctional solutions

# Conclusions / Lessons Learnt

- Good survey data is required e.g. MH, IAS, CCTV;
- Use of long term flow monitors / sensors and raingauges to better understand performance and to trigger maintenance;
- Sewer ownership issues need to be discussed and resolved. Who will own / maintain assets?;
- Use of long term flow monitors / sensors and raingauges to better understand performance and to trigger maintenance;

# Next Steps

- Further modelling / meetings to discuss, agree and refine options (Complete Phase 3 SWMP);
- Review constructability (Phase 4 SWMP);
- Cost options;
- Agree preferred solution and phasing;
- Public engagement;
- Secure funding;
- Progress detailed design;
- Engage contractor and implement solution;
- Review performance.

# Questions ?