Item: 12

Development and Infrastructure Committee: 12 November 2019.

Kirkwall Surface Water Management Plan.

Report by Executive Director of Development and Infrastructure.

1. Purpose of Report

To consider the draft Kirkwall Surface Water Management Plan.

2. Recommendations

The Committee is invited to note:

2.1.

That, following publication of the Orkney Local Flood Risk Management Plan in 2016, an action was identified to prepare a Kirkwall Surface Water Management Plan, with its purpose being to provide sufficient information to support development of an agreed strategic approach to management of surface water flood risk within Kirkwall.

2.2.

The Kirkwall Surface Water Management Plan, attached as Appendix 1 to this report, which is currently in draft form and requires further modelling input and consultation.

2.3.

That Scottish Water is currently updating the Kirkwall drainage network model in order to produce new flood risk maps.

2.4.

That, following receipt of the new flood risk maps from Scottish Water, it is proposed to engage consultants to review and model a range of options to reduce flood risk in Kirkwall, at an estimated cost of up to £50,000.

2.5.

That, to enable detailed design and scheme preparation of an approved option, a budget of up to £100,000 will be required.

2.6.

That, following receipt of the consultants' report, referred to at paragraph 2.4 above, a final version of the Kirkwall Surface Water Management Plan will be presented to the next available meeting of the Development and Infrastructure Committee.

It is recommended:

2.7.

That the Executive Director of Development and Infrastructure should submit a report, to the Policy and Resources Committee, seeking a budget of up to £150,000 in respect of detailed modelling work and technical design of a scheme to reduce flood risk in Kirkwall.

3. Background

3.1.

In 2010 the Council appointed consultants to prepare a drainage network model and study options to reduce surface water flood risk to Kirkwall. Scottish Water commissioned additional work to expand the scope of the study. The final report was issued in 2013 concluding that, while significant improvements had been made to reduce the flood risk, any complete solution would require joint action from the Council and Scottish Water, including upgrading of surface water pipes and the provision of a pumping station and outfall pipe to relieve the existing combined surface water and foul sewer in Junction Road, Kirkwall. Scottish Water advised it was not able to support this solution as it did not meet their criteria for funding.

3.2.

Preparation of a Kirkwall Surface Water Management Plan was identified as an action in the Orkney Local Flood Risk Management Plan, published in 2016, in accordance with the Council's duty (as lead authority) under Section 34 of the Flood Risk Management (Scotland) Act 2009.

3.3.

The purpose of the Kirkwall Surface Water Management Plan is to provide sufficient information to support development of an agreed strategic approach to management of surface water flood risk within Kirkwall by ensuring the most sustainable measures are identified (i.e. the most economically, socially and environmentally beneficial measures).

3.4.

To provide a baseline for the Kirkwall Surface Water Management Plan, the Scottish Environment Protection Agency required an assessment of flood risk from drainage systems to be carried out by Scottish Water. The assessment was received in March 2019. On examination, the model used for the assessment was found to have omitted some recent developments and did not fully assess the impact of tide on the Peedie Sea outfalls which is crucial in the estimation of flood risk to Kirkwall.

3.5.

Subsequently, the Council and Scottish Water have agreed changes required to the model and new flood maps are expected in early November 2019. The flood maps

will show the current flood risk and the updated model will be available for further analysis of options to reduce flood risk.

3.6.

The principle objectives of the draft Kirkwall Surface Water Management Plan, attached as Appendix 1 to this report, are as follows:

- To allow development in Kirkwall to continue in accordance with the Local Development Plan.
- To reduce risk of surface water flooding in Kirkwall.

4. Development in Kirkwall

4.1.

Development in Kirkwall is currently constrained due to under capacity in the Scottish Water combined sewer system which contributes to the flood risk in Junction Road.

4.2.

In November 2018, Scottish Water delivered a presentation on Development Impacts on the Kirkwall Sewer Network. This included medium and long term options for solving constraint issues in Kirkwall. The options are included in Section 16 of Appendix 1 to this report.

4.3.

In March 2019, it became apparent that Scottish Water would not accept any applications for new connections from development sites in Kirkwall and it would be necessary to find short term solutions if developments including the new care home were to be able to proceed.

4.4.

Throughout the summer, the Council and Scottish Water have been working together to identify areas where surface water can be removed from the combined sewer in Junction Road. Numerous sites which were initially considered promising were “dye tested” but on completion of the work were proven to already be separated.

4.5.

At the present time the site most likely to provide a significant area for surface water removal from the combined sewer is the old Balfour Hospital site. Initial discussions have been held with NHS Orkney and, subject to a detailed proposal being costed and finance being identified to free up areas of the site (ie demolition of buildings and/or car park areas), a solution for the short term development needs seems possible.

4.6.

Discussions are also ongoing between Scottish Water, a developer and the Council regarding a proposal to divert flows from Glaitness and Grainbank, which currently end up in the combined sewer in Junction Road, directly to the Ayre Road Pumping Station.

5. Surface Water Flooding

5.1.

Options to reduce the risk of surface water flooding in Kirkwall are given in Section 16 of Appendix 1. In general, these are the same options identified in the 2013 study referred to at section 3.1 above.

5.2.

To reduce external flood risk to the 1 in 200 years plus climate change level required by the Scottish Environment Protection Agency to allow development to proceed, the options identified would require significant investment from both Scottish Water and the Council. However Scottish Water only provide funding for schemes which are required to prevent internal flooding up to a 1 in 30 years return period. Scottish Water have therefore advised that they will not support the previously identified options to reduce flood risk to the Junction Road area.

5.3.

It is therefore proposed to revisit options to reduce flood risk in Junction Road area and investigate if alternative options, not dependent on Scottish Water, can be effective. This would include looking at a surface water pumping station from the Peedie Sea to the harbour and upgrades to the surface water pipe network between Junction Road and the Peedie Sea. This is specialist modelling work beyond the current section 16 modelling work provided by Scottish Water and will require revised flood maps and updated model, referred to at section 3.5 above.

5.4.

On completion of modelling work a report would be presented to the next available meeting of the Development and Infrastructure Committee seeking approval to proceed to a detailed design of any identified solution.

5.5.

Once the new flood maps are available, it is also proposed to discuss with the Scottish Environment Protection Agency whether development on any of the sites currently considered at risk in the lower areas of central Kirkwall can be considered, prior to further flood reduction measures being carried out. However, this would only be possible if it could be shown the flood risk was reduced due to works already carried out.

6. Proposed Action

6.1.

When the updated model and results, referred to at section 3.5 above are available, it is proposed to procure a consultant to carry out detailed modelling work and prepare a report on options to reduce existing flood risk in Kirkwall, at an estimated cost of up to £50,000. For the follow-on detailed design and scheme preparation of an approved option, a budget of up to £100,000 would be required.

6.2.

Following receipt of the consultant's report, the Kirkwall Surface Water Management Plan will be updated to include recommendations and circulated for consultation with Scottish Water and the Scottish Environment Protection Agency before a final version of the Plan is presented to the Development and Infrastructure Committee.

7. Links to Council Plan

7.1.

The proposals in this report support and contribute to improved outcomes for communities as outlined in the Council Plan strategic priority theme of Quality of Life.

7.2.

The proposals in this report relate directly to Priority 5.18d, namely Engage with the Scottish Government and Scottish Water to seek to identify viable solutions to reduce risk of flooding to communities, of the Council Delivery Plan.

8. Links to Local Outcomes Improvement Plan

The proposals in this report support and contribute to improved outcomes for communities as outlined in the Local Outcomes Improvement Plan priority of Strong Communities.

9. Financial Implications

9.1.

The report identifies a requirement to procure the services of a consultant for modelling and design work, at an estimated cost of up to £50,000, and follow on detailed design and scheme preparation, at a cost of up to £100,000, making a total budget requirement of up to £150,000.

9.2.

In accordance with the Council's policy of presumptions against new commitments, the Service Committee is required in the first instance to identify compensatory savings within relevant budgets such as the roads, environmental services and planning service budgets. It is proposed that, given the pressures and commitments for financial year 2019 to 2020, there is no capacity to fund these works from these

service areas or the Development and Infrastructure Directorate as a whole. Therefore, noting that this proposal is strategic in nature to address wider housing blight risks and impact on flooding, this should be considered by the Policy and Resources Committee.

10. Legal Aspects

Preparation of a Kirkwall Surface Water Management Plan was identified as an action in the Orkney Local Flood Risk Management Plan, published in 2016, in accordance with the Council's duty (as Lead Authority) under Section 34 of the Flood Risk Management (Scotland) Act 2009.

11. Contact Officers

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12. Appendix

Appendix 1 – Draft Kirkwall Surface Water Management Plan.

ORKNEY
ISLANDS COUNCIL

Kirkwall Surface Water Management Plan

Project No: 1002815

DRAFT v 0.4
30 October 2019

Engineering
Development and Infrastructure
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Document Record and Control

Project: Kirkwall Surface Water Management Plan

Project no.: 1002815

Version	Date	Description/Amendment	Prepared	Checked	Reviewed
0.1	June 2019	Working draft for consultation	Peter Woodward	Peter Bevan	Peter Bevan
0.2	June 2019	Revised working draft for consultation	Peter Woodward	Peter Bevan	Peter Bevan
0.3	Sep 2019	Next actions updated	Peter Bevan	Peter Bevan	Peter Bevan
0.4	Oct 2019	Revised following consultation with FRM partners.	Peter Woodward	Peter Bevan	Peter Bevan

Kirkwall Surface Water Management Plan

1. Background to SWMP

The Flood Risk Management (Scotland) Act 2009 (the FRM Act) establishes a flood risk management planning process for the assessment and sustainable management of flood risks with the aim of reducing the adverse consequences of flooding from all sources, including surface water flooding.

The surface water management plan will help to deliver the Scottish Government outcomes for sustainable flood risk management:

1. A reduction in the number of people, homes and property at risk of flooding as a result of public funds being invested in actions that protect the most vulnerable and those areas at greatest risk of flooding
2. Rural and urban landscapes with space to store water and slow down the progress of floods
3. Integrated drainage that decreases burdens on our sewer systems while also delivering reduced flood risk and an improved water environment
4. A well informed public who understand flood risk and adopt actions to protect themselves, their property or their businesses
5. Flood management actions undertaken that will stand the test of time and be adaptable to future changes in the climate

Surface water flooding is a significant problem in Scotland. The FRM Strategies published by SEPA in 2015 estimate that it is responsible for 23% of annual average flood damage. Moreover, the risk of surface water flooding is likely to increase in the future as a result of climate change, the loss of green space in urban areas and, potentially, new development. It is therefore important that land use planning policies take such risks into account when considering new development

The purpose of a Surface Water Management Plan (SWMP) is to provide sufficient information to support the development of an agreed strategic approach to the management of surface water flood risk within a given geographical area by ensuring the most sustainable measures are identified (i.e. the most economically, socially and environmentally beneficial measures). SWMPs can be implemented at any scale and should follow a risk-based approach, where most effort should be focused in areas of highest risk and where the most complex problems exist. SWMPs can therefore vary in detail to suit local requirements and the amount of detail that a SWMP contains should be proportionate to the surface water flood risk and the complexity of the problem.

2. Responsibilities

The FRM Act places duties on SEPA and Responsible Authorities (RAs), including Local Authorities (LAs) and Scottish Water in relation to the management of flood risk.

The Act requires that, as far as reasonably practicable, parties (Scottish Ministers, SEPA and RAs) adopt an integrated approach by co-operating with each other so as to co-ordinate the exercise of their respective functions.

The action to prepare a surface water management plan for Kirkwall was identified in the Local Flood Risk Management Plan for Orkney, prepared by OIC and published in June 2016.

Scottish Water Responsibilities
In general, Scottish Water is responsible for managing sewer systems that are designed to take 'usual' rainfall (currently interpreted to mean up to the 1:30 year rainfall event). Surface water flooding under the FRM Act is flooding that occurs when the sewer capacity is exceeded (e.g. by higher than usual rainfall or when the sewer system is affected by high river or sea levels). Surface water flooding can include waste water from sewers. Where this is the case and the return period of the rainfall event is less than 30 years then Scottish Water will assist in the subsequent clean-up and, if necessary, disinfection of property. Depending upon the circumstances of the flooding, compensation may also be payable to affected householders and businesses.

Local Authority Responsibilities - Flooding
Under the FRM Act, local authorities have general powers to manage flood risk (from all sources, including surface water flooding) in their area. This includes implementing actions described in the Local Flood Risk Management Plans, flood protection schemes or any other flood protection work. In general, surface water flooding under the FRM Act is flooding that occurs when the capacity of the sewer (or other drainage system) is exceeded (e.g. by higher than usual rainfall or when the sewer system is affected by high river or sea levels). The definition of surface water flooding under the FRM Act does not include flooding solely from a sewerage system. Under the Sewerage (Scotland) Act 1968), Scottish Water is responsible for managing flooding solely from a sewerage system (that is, sewerage systems that are designed to manage 'usual' rainfall events, currently interpreted to mean up to the 1:30 year rainfall event).

Local Authority Responsibilities – Land Use Planning
Local authorities (as planning authorities) have powers to grant or refuse planning applications and flood risk is a material consideration when determining planning applications. Strategic Development Plans and Local Development Plans should set out infrastructure required, including drainage infrastructure. Scottish Planning Policy promotes; a precautionary approach to flood risk from all sources, including surface water flooding and; avoidance of increased surface water flooding through requirements for Sustainable Drainage Systems (SuDS) and minimising the area of impermeable surface. Infrastructure and buildings should be designed to be free from surface water flooding in rainfall events where the annual probability of occurrence is greater than 0.5% (1:200 years). Surface water drainage measures should have a neutral or better effect on the risk of flooding both on and off the site, taking account of rain falling on the site and run-off from adjacent areas. Planning should protect, enhance and promote green infrastructure, including open space and green

networks, as an integral component of successful placemaking. Development plans should be based on a holistic, integrated and cross-sectoral approach to green infrastructure. They should be informed by relevant plans covering green infrastructure's multiple functions (including flood management). For development management green infrastructure should be treated as an integral element in how the proposal responds to local circumstances, including being well-integrated into the overall design layout and multi-functional.

Local Authority Responsibilities - Roads
Local authorities (as roads authorities) have duties to maintain and manage public roads under the Roads (Scotland) Act 1984. In order to do this, roads authorities have powers to drain roads and, if they construct a drain, a duty to maintain it (including sustainable urban drainage systems). The Roads Act sets out a vesting process for new roads that includes road drainage. It also provides powers to protect roads from flooding.

3. Definitions

For the purpose of this Plan the following definitions of the following terms remain as for the FRM Act, as follows:

- "flood" means the temporary covering by water from any source of land not normally covered by water, but does not include a flood solely from a sewerage system (and related expressions such as "flooding" are to be construed accordingly),
- "flood risk" means the combination of the probability of a flood and of the potential adverse consequences, associated with a flood, for human health, the environment, cultural heritage and economic activity,
- "flood solely from a sewerage system" means the temporary covering of land by sewage caused solely by a failure in or blockage of a sewerage system which is not connected with any loading on the system by external hydraulic factors (for example by heavier than usual rainfall or higher than usual river levels).

The term **surface water flooding** is often used to describe flooding from high intensity rainfall events that cause flooding from rainfall runoff flowing and ponding on the ground as well as flooding from sewers and other artificial drainage systems such as road drainage when the capacity of drainage systems is exceeded. It is distinct from flooding that occurs from larger rivers and the sea. In reality, the general term of surface water flooding is often a complex interaction of many sources of flooding, including flooding from the natural (e.g. smaller watercourses) and artificial (e.g. sewers) drainage systems and direct inundation of areas from surface water runoff. Other sources of flooding can exacerbate surface water flooding, for example where high sea levels or river levels prevent drainage systems from discharging freely. The term surface water flooding for the purpose of this Plan includes flooding from the following sources:

- Pluvial flooding – flooding as a result of rainfall runoff flowing or ponding over the ground before it enters a natural (e.g. watercourse) or artificial (e.g. sewer) drainage system or when it cannot enter a drainage system (e.g. because the system is already full to capacity or the drainage inlets have a limited capacity).
- Sewer flooding and other artificial drainage system flooding – flooding as a result of the sewer or other artificial drainage system (e.g. road drainage) capacity being exceeded by rainfall runoff or the drainage system cannot

discharge water at the outfall due to high water levels (river and sea levels) in receiving waters.

- Groundwater flooding – flooding as a result of the water table rising to the surface.
- Flooding from small urban watercourses (including culverted watercourses) – flooding which occurs from small watercourses (including culverted watercourses) that receive most of their flow from inside the urban area and perform an urban drainage function. It should be noted for consideration that SEPA will not be assessing flood risk from watercourses with a catchment area less than 3km².

4. SWMP Objectives

Within this SWMP the objectives that we intend to achieve are:

Objective 1: Enable development in Kirkwall to continue, in accordance with the current Local Development Plan.

Objective 2: Reduce risk of surface water flooding in Kirkwall.

Objective 3: Continue working with Scottish Water to manage internal and external sewer flooding.

Objective 4: Ensure that surface water is managed in a sustainable manner that delivers multiple benefits for the community.

Objective 5: Improve understanding of flood risk in Kirkwall.

5. Description of Kirkwall and Development Areas

Kirkwall is the largest settlement in Orkney, and is the primary service, residential and transport centre in the county. Main emergency and healthcare services for Orkney are based in Kirkwall.

The medieval town of Kirkwall was built along the original shoreline of the Peedie Sea prior to land reclamation, stretching from Bridge Street to Main Street. During the nineteenth century the town began to expand along main roads and the newly-constructed Junction Road.

The twentieth century saw the development of large areas of suburban housing in all directions, as well as the establishment of the former airfield at Hatston as a business park. Latterly the Peedie Sea area has been developed for large commercial and public buildings, as well as amenity green space.

Kirkwall continues to grow and a number of development areas have been identified in the current Orkney Local Development Plan (April 2017) to accommodate projected demand for housing and services.

Within central Kirkwall, development sites K23 and K24 the east side of the Peedie Sea are allocated for mixed use development but recognised to be currently at risk of flooding.

Site K22, the former Balfour Hospital is anticipated to become available for redevelopment in the near future although it is thought that a number of the existing buildings may need to be retained on this site.

Other sites within the current footprint of the town which are expected to become available for redevelopment include K25, K26 and K27 which together stretch between Bridge Street and Cromwell Road. These sites are to be considered under a single development brief and could be developed for a range of uses.

The development of housing allocation K6 to the west of Kirkwall is imminent. This is a major development that includes the construction of a residential care home plus 136 houses. Sites K5 and K7 in the same sub-catchment have potential for a further 85 houses and are listed as being for short term allocation.

Also to the west side, Sites K1 and K2 are listed for short term allocation and could together have capacity for up to 75 houses. Sites K1 and K2 are to be considered along with Site K21 which is listed as being for business and industrial use.

Within and around Hatson Industrial Estate, between sites K18, K19 and K21 a total of 27.6 ha is allocated for business and industrial use in the current Local Development Plan.

Further large areas designated for development as housing in the short term include sites K8, K9, K10 and K11 to the south side of Kirkwall. In total these sites could represent a further 245 houses.

In the longer term, the large sites K12, K13 and K14 to the south east of the town are earmarked for residential development with potential for 225 houses

To the east side of Kirkwall the development of K16 for up to 35 houses is shortly to commence and site K15 designated as a short term allocation for up to 80 houses.

6. Kirkwall Sewer System Description

The Kirkwall foul and combined sewerage system drains to the Kirkwall Wastewater Treatment Works. Currently the drainage catchment area served by the foul and combined system is 355ha, with a population of around 7500 people.

The existing sewer network is a mix of combined and separate systems and has developed through the years as the town has expanded. The sewerage network now spreads in a U shape around Weyland Bay. Starting on the north west side of the bay at Hatston Industrial Estate which is predominantly a separate system and drains towards Ayre Mills Wastewater Pumping Station (WWPS). The Ayre Mills WWPS passes flow towards the Ayre Road PS which is situated at Kirkwall Harbour.

Ayre Road PS also receives the majority of flows from the main Kirkwall residential area. The town centre is predominately combined, but as the town has expanded over the years the development areas have adopted separate systems. As a result of the way the sewer system has developed, the system is heavily reliant upon the combined sewer in Junction Road. In 2008 Scottish Water lined the Junction Road combined sewer to increase capacity by eliminating ground water infiltration. However, modelling work and evidence from recent storm events confirm that the sewer does not have sufficient capacity and overtopping from this sewer remains a major contributor to surface water flooding in Kirkwall.

The vast majority of flows from the town centre catchment drain by gravity towards Ayre Road PS. There are however two pumping stations which pump localised subcatchments and these pump flows into the town centre catchment; these are Pickaquoy Road PS and Glaitness PS. Pumped flows from Craigiefield in the north-east of the catchment drain to Weyland Bay WWPS which receives the remaining catchment drainage via gravity after being pumped from Ayre Road PS. All flow is transferred to the treatment works to the north-east via Weyland Bay PS.

Within the streets of central Kirkwall the largest surface water conduits are stone-built culverts with smaller diameter pipes from branches and gullies being built into the walls of the culverts. In many places culverts have been rebuilt and repaired (sometimes by inserting sections of pipe).

Dry weather flow rates within the stone culverts will be low and in places such as Junction Road flow is hindered further due to the water level at the discharge point to the Peedie sea being higher than culvert invert level. As a result of this the stone culverts are very susceptible to siltation and condition is difficult to monitor due to the difficulty of surveying culverts in a submerged condition.

Invasive plant roots and multiple modern service crossings also hinder flow and increase the risk that debris entering the surface water system will become trapped and create a blockage.

One of the dominant topographical elements in Kirkwall is the Peedie Sea, which is an inland waterbody formed by construction of a sea defence barrier which stretches between Ayre Mills and Burgh Road.

The Peedie Sea receives surface water from the majority of Kirkwall. The largest individual input is from the Burnmouth Road storm water culvert which receives flows from the Papdale Burn and localised surface water systems. Papdale Burn serves ditches and drains from fields to the south east of Kirkwall and starts as a 600mm dia. culverted pipe near Kirkwall Grammar School. It receives discharges from surface water systems serving the localised areas.

Other major inputs to the Peedie Sea are the surface water from the following sub-catchments: Junction Road/Central Kirkwall at ‘Powerbowl’, Glaitness Road/Muddiesdale Burn beside Pickaquoy Road and Grainbank/Pickaquoy. The discharge from Grainbank/Pickaquoy is split between two locations to the west side of the Peedie Sea depending upon flow levels.

By 1990 OIC had diverted surface water from central Kirkwall and other contributing sub-catchments to the Peedie Sea thus allowing it to serve as a balancing pond at times when discharge to the sea would be restricted due to high tide levels.

In 2009 a new adjustable weir was installed at the eastern Peedie Sea control chamber at Burgh Road. The default setting of this weir is 200mm lower than the previous Peedie Sea level, releasing additional storage capacity. Also at this time, both Peedie Sea outlet chambers were altered to allow them to work automatically by means of flap valves.

7. Assessment of current surface water flooding

Inspection of the Kirkwall SWMP area allows the town to be broken down into 7no. sub-catchments each with areas of significant risk based upon on assessment of current flooding data available. These are:

Junction Road/Central Kirkwall – including development sites K22, K23, K24, K25 and K26

This low-lying part of town includes the flooding hotspots of Main Street, Union Street, and Junction Road and borders on the Peedie Sea. Evidence from storm events and modelling work indicate that in extreme events surface water flooding in this area is a combination of overtopping from the combined sewer, roads surface water drainage and pluvial flows.

Glaitness Road/Muddiesdale Burn – including development sites K5, K6 and K7

Overtopping from Muddiesdale Burn and pluvial flows within the burn catchment are the currently the primary sources of flooding in this area although Pickaquoy Road beside Glaitness School and Orkney's three main supermarkets are also affected by overtopping from the combined sewer.
Development sites K5, K6 and K7 from the Orkney Local Plan lie within this area. Design and procurement for a new care home and 138 house sites are underway for site K6. The current arrangement of foul and combined sewers is served by the Junction Road system.

Grainbank/Pickaquoy – including development sites K3 and K4

This area is currently being developed for housing and during construction has been the subject of internal and external surface water flooding within the new development. Measures have been taken to address the source of that flooding but a historic problem of lack of capacity of a culvert regularly leads to overtopping of a watercourse which can result in external flooding of housing, a camping site , a section of Peerie Sea Loan and contribute to flooding in Pickaquoy Road.
Foul water from the housing developments in this area are directed to the combined system in Junction Road.

Papdale Burn - including development sites K12, K13, K14, K28 and K29

Historically Papdale Burn has been the source of a great deal of surface water Flooding in Kirkwall. Maintenance work and replacement of screens since major flooding in 2006 appear to have improved performance but modelling suggests that Papdale Burn remains a likely contributor to surface water flooding during high return period events.

Easthill/Weyland – Including K15, K16 and K30

Overtopping from Weyland Burn at the entrance to the culvert at Clumly Avenue resulted in external flooding to properties and roads in October 2006. The culvert here is calculated to be adequate in storms with return periods up to around 80 years.

Beside the entrance to the Clumly Avenue culvert, the property Burnside has experienced external flooding due to run off from the steeply sloping agricultural land to the south. Work to address this flooding will be carried out as part of a new footpath/cycleway here.

Easthill Road is also reported to experience flooding during heavy rain due to run off from the land above.

Foul water from the Weyland developments does not contribute to the system elsewhere in Kirkwall.

Hatston/Hatston Park – K1, K2, K18, K19, K20 and K21

Surface water flooding to the road at the junction of the A965 and Grainshore Road has been recorded regularly but other flooding from land to Grainshore Road at the Junction with Grainshore Drive has not been noted since remedial drainage work was undertaken by OIC.

Combined flows from Hatston are pumped across the ayre to Ayre Road pumping station – so do not contribute to flooding in the Junction Road area.

Kirkwall South - Including K8, K9, K10 and K11

This area is currently undeveloped and recent changes to the profile of the ground at the neighbouring hospital site which are likely to affect overland flow appear not to be represented in the available modelling. However, significant surface water flooding is considered unlikely for these sites.

All potential development sites in the Kirkwall South catchment are currently constrained due to a lack of public foul sewer.

Flood Risk in SWMP Area – Data to be obtained

Location	Assessment Type	Flood risk			
		Total Annual Average Damage (AAD) (all return periods)	Businesses 1:200yr	Homes 1:200yr	Infrastructure 1:200yr
Junction Road/Central Kirkwall					
Glaitness Road/Muddiesdale Burn					
Grainbank/Pickaquoy					
Papdale Burn					
Easthill/Weyland					
Hatston/Hatston Park					
Kirkwall South					

8. Development Areas

Currently Scottish Water is responding to planning consultations for developments within catchments which depend upon the combined sewer in Junction Road advising that that the sewer system in the part of town at the highest risk of flooding (the Junction Road area) has no remaining capacity to allow development. With the current sewer arrangement in Kirkwall so reliant upon the combined sewer system in Junction Road, it will be necessary to divert flows from, or increase the capacity of, the combined sewer in Junction Road to reduce flood risk and allow future development.

Kirkwall south, including development sites K8, K9, K10 and K11 is currently not served by a public foul sewer. Scottish Water has modelled and carried out preliminary design work and costing work for a foul system to pump from this area over the hill to the west of Kirkwall at Corse Farm in order to get the waste water to an extended gravity system within the Glaitness/Muddiesdale sub-catchment.

With the current arrangement of foul and combined sewers, flows from the south of Kirkwall could in future contribute to the load on the Junction Road combined system. However, Scottish Water have advised that alternative routes to the Ayre Road Pumping Station are being investigated.

9. Historical Surface Water Flooding

In October 2006, heavy rainfall resulted in flooding in Kirkwall affecting the Peedie Sea, Muddisdale Burn, Crantit Burn, Burn of Wideford, and Papdale Burn. During this event the volume of surface water entering the drainage system and water from overflowing watercourses resulted in the capacity of the drainage system being exceeded. Properties affected included three schools, a museum, four social clubs, a church and an art gallery. Roads and agricultural land were also affected.

The 2006 event was assessed as being a 1 in 212 year return period event during which 84mm of rainfall was recorded within 36 hours. Over the course of the event flooding was identified as resulting from the following sources:

- Blocked screens in watercourses
- Overtopping of watercourses due to limited capacity
- Pluvial flow
- Surcharging of surface water and combined sewers
- A high water level in the Peedie Sea due to restricted discharge.

Appendix B is a list of the most notable and recorded surface water flooding events in Kirkwall concentrating on the period from 2006 to 2018.

10. Actions Since 2006

Following the 2006 event, investigations into to the causes and handling of the flooding led to improvements in the condition, maintenance and operation of key parts of the surface water system. Since 2010 OIC and Scottish Water have been working together, as required by the Flood Risk Management (Scotland) Act 2009, to identify sustainable solutions to the surface water flooding problem and to enable future development.

Scottish Water refurbished the combined sewer in Junction Road 2008 in order to increase capacity by preventing groundwater entry into the sewer.

In 2010 OIC commissioned MWH consultants to produce a Kirkwall drainage network model which combined the existing Scottish Water foul & combined networks with the OIC surface water model. This unified model was verified and used to assess the performance of the system and to model options to remove flood risk to Kirkwall for a 1/200 year event.

The main source of flooding was identified as under-capacity in the combined sewer in Junction Road together with the inability of the surface water system to discharge to the Peedie Sea when water levels are high.

The recommended solution was a pumping station which would relieve the surcharging in both the combined and surface water systems by discharging storm flows directly to the sea. Scottish Water and OIC then commissioned a series of technical reports which looked at specific issues and some incremental improvements identified in the reports were carried out by OIC. A final report was issued in 2013 but no overall solution could be agreed with Scottish Water.

Since then OIC has carried out a programme of sewer inspections and cleaning in order to fully understand and maximise the efficiency of the existing surface water system.

In 2018 Scottish Water presented options for solving the capacity issues in their system for both the existing flooding hotspots and for development areas identified in the current Orkney Local Development Plan. The solutions for Junction Road were the same as in the 2013 report and again no solution could be agreed.

A list of the studies undertaken can be found in **Appendix B**.

11. Asset Management

When water and waste water responsibilities passed from OIC to the new North of Scotland Water Authority (NoSWA) in the mid-1990s, even though the Council remained responsible for road drainage and watercourses, information on the drainage network in Orkney was transferred to NoSWA with relatively little information being retained by OIC.

Although OIC had operational knowledge on the whereabouts and condition of road drainage and watercourses the information was incomplete.

In order to better understand the surface water system in Kirkwall a series of investigations were commissioned by OIC between 2008 and 2010 to determine the condition and detail of the surface water system.

The 2010 Kirkwall drainage network model created by MWH for OIC combined the existing Scottish Water foul & combined networks with the OIC surface water model

and would form the basis for further studies to assess performance and test solutions.

Targeted cleaning and CCTV inspections of key points in the network and known problem areas have been carried out since 2013. This information, along with information on new developments, has been incorporated into the updated model that was used for the 2019 'Section 16' study by Scottish Water - with further updates being incorporated into the subsequent 'enhanced Section 16' study joint funded by Scottish Water and OIC.

Since mid-2019 OIC Engineering has been using new QGIS software to view the Scottish Water Network Data that we have been issued with along with Section 16 model outputs and SEPA flood hazard and risk mapping.

OIC plans to adopt the SCOTS Roads Asset Management methodology in managing drainage and watercourse assets – with information being transferred between QGIS and WDM asset management software as required.

OIC Engineering now has a licence which allows viewing of model outputs prepared by Scottish water or Consultants using Infoworks ICM10.0 network modelling software.

12. Section 16 Model

Section 16 is the part of the Act that requires Scottish Water to assess flood risk from sewerage systems. In April 2019 Scottish Water released the Section 16 model results for Kirkwall.

A major flaw in the Section 16 model is that it does not model the discharge conditions for the surface water system at the point the Peedie Sea outlet chambers discharge to the Harbour. This means increased levels in the Peedie Sea when the discharge valves are closed is not modelled resulting in underestimation of surface water flood volumes.

Similarly, the Section 16 model does not model tidal influence on the CSO at the Ayre Road Pumping Station. This results in underestimation of surcharging and resultant flood volumes from the combined sewer in Junction Road.

To accurately model flood risk it is necessary to include tidal influence and perform a joint probability analysis for different return periods. Further work is currently being carried out by Scottish Water on the Kirkwall model to model the effects of tide during a range of scenarios. Key recent developments which were not included in the S16 modelling work are also in this 'enhanced S16' modelling work. Outputs from this 'enhanced S16' modelling work should as far as possible represent current flood risk in Kirkwall.

13. Sustainability, SuDS and Natural Flood Management

In order to remain effective in the long term and deliver the best value in economic, social and environmental terms, all actions in this Plan should be designed to work with, rather than against, natural processes.

New developments are required to incorporate Sustainable Drainage Systems (SuDS) to ensure that the new development does not increase flood risk within or outside the development. SuDS should be planned at the earliest stage and be designed to a high standard to work with the characteristics of the site and provide the highest social and environmental value possible whilst remaining effective in their primary role of reducing flood risk.

Looking at the entire Kirkwall catchment as a whole there appears to be scope to use Natural Flood Management (NFM) techniques in a number of the sub-catchments identified in this report.

NFM involves techniques aim to work with natural processes, features and characteristics to manage the sources and pathways of flood waters. The flood risk management benefits of NFM measures for sub catchments would need to be modelled in order to gauge their likely effectiveness but from inspection there appears to be potential to reduce flood risk to Kirkwall in the following ways:

- Retaining water on land to prevent it running to the watercourses that flow through and drain Kirkwall. This could be done using techniques such as aeration of agricultural land, creating vegetation bands along contours or spreading flow in minor watercourses over amenity land during significant rainfall events.
- Attenuation of flows in watercourses could be achieved by altering channels and by providing online or offline storage of surface water during storm events.
- Increase available storage in the lower catchment.

The range of possible NFM measures is broad but the accumulated effect of small changes to the way that land is managed together with subtle changes to overland flow could make a contribution to managing surface water flood risk in Kirkwall.

14. Objectives and Actions

Objective	Action ref.	Action	Responsibility	Funding	Standard of Protection	Short, medium or long term action?
Objective 1: Enable development in Kirkwall to continue, in accordance with the current Local Development Plan.	A1	Work in partnership with Scottish Water to agree and implement solutions that will be sustainable in the long term to enable development in Kirkwall to continue as set out in the Local Development Plan.	OIC/SW		1/200	short
	A2	Work with Scottish Water and developers through the land use planning system to ensure capacity in network to take waste water connections for new developments.	OIC/SW/ Developers		1/30 (Scottish Water)	short
	A3	Take receipt of enhanced Section 16 modelling from Scottish Water.	SW/OIC		N/A	short
	A4	Review and carry out further work to refine options detailed in Section 15 of this Plan.	OIC/SW		1:200	short
	A5	Ensure that all partners have been identified and seek funding to develop a scheme or schemes.	OIC		1:200	medium
Objective 2: Reduce risk of surface water flooding in Kirkwall.	A6	Ensure that all development within the Kirkwall SWMP area meets planning guidance.	OIC		1/200	ongoing
	A7	Take receipt of enhanced Section 16 modelling from Scottish Water	SW/OIC		N/A	short
	A8	Review and carry out further work to refine options detailed in Section 16 of this Plan.	OIC/SW		Short	short
	A9	Following analysis of new modelling and review of previous study reports, identify preferred solutions.	OIC/SW		Short	short

	A10	Ensure that all partners have been identified and seek funding to develop a scheme or schemes.	OIC		1:200	medium
Objective 3: Continue working with Scottish Water to manage internal and external sewer flooding.	A11	Ensure that all incidents of external and internal flooding of properties and infrastructure are reported. This will allow an appropriate response in the proper time-frame and keep records of flooding up to date and accurate.	OIC/SW		N/A	short
	A12	Ensure that an appropriate clean-up takes place following incidents of internal or external sewer flooding.	SW		N/A	short
	A13	Ensure that the likely causes of internal and external sewer flooding are identified and householder, business owners are informed.	SW/OIC		N/A	short
	A14	List and map all existing SuDS devices.	OIC		N/A	short
	A15	Ensure that maintenance responsibilities are clear for all of the surface water drainage network and SuDS devices.	OIC/SW/ Developers		N/A	short
	A16	Ensure that adoptions of all surface water networks and SuDS are completed.	OIC/SW/ Developers		N/A	medium/ ongoing
	A17	OIC to confirm acceptance of the principles of 'Section 7'.	OIC		N/A	short
Objective 4: Ensure that surface water is managed in a sustainable manner that delivers multiple benefits for the community.	A18	Continue working with SEPA and Scottish Water through the land use planning system in relation to new developments to ensure that surface water is managed in a sustainable manner that delivers multiple benefits for the community.	OIC/SEPA/SW		N/A	short/ ongoing
	A19	Provide local guidance to developers on the management of surface water management and encourage early engagement with OIC on the subject.	OIC		1:200 or 1:1000 as appropriate.	short/ ongoing
	A20	Manage surface water flooding in central Kirkwall (resulting from extreme rainfall and when the capacity of the urban drainage system is exceeded) above ground.	OIC/SEPA/SW		N/A	medium
Objective 5:	A21	Continue investigation work on the surface water system including dye-testing and CCTV surveys.	OIC/SW		N/A	short/ ongoing

Improve understanding of flood risk in Kirkwall.	A22	Maintain and improve inspection and maintenance regime including cleaning for all surface water networks.	OIC/SW		N/A	short/ongoing
	A23	Update records for Kirkwall to ensure accurate representation of the drainage network.	OIC/SW		N/A	ongoing/ as required
	A24	Update drainage model to take into account new developments and network changes within the SWMP area.	OIC/SW		N/A	ongoing
	A25	Undertake further modelling on the system to reflect changes and survey findings and take in current climate guidance.	OIC		N/A	ongoing
	A26	Management of GIS data. This is to include all flood data, water course data and works undertaken on watercourse.	OIC		N/A	short/ ongoing
	A27	Share model results with SEPA to allow flood hazard and risk maps to be updated as the network and surface water management develop.	OIC		N/A	ongoing

15. Option appraisal for Objective 1 to allow development in Kirkwall to continue in accordance with local development plan

* Indicates estimated cost from 2011 MWH TN2 with inflation applied to 2019.

** Indicates estimated cost from Scottish Water presentation 'Development Impacts on Kirkwall Sewer Network' 27.11.18

Junction Road/Central Kirkwall – including development sites K22, K23, K24, K25 and K26

Option	Description	Effect	Cost £M	References	Comment
1	Do nothing.	Development sites would remain constrained.	0		Not viable
2	Options are as per Objective 2.				In order to limit restriction on re-development types in this area. An overall reduction in flood risk, as per Objective 2 will need to be made.

Glaitness Road/Muddiesdale Burn – including development sites K5, K6 and K7

Option	Description	Effect	Cost £M	References	Comment
5	Do nothing	Development sites would remain constrained.	0		Not viable.
2	Surface Water Separation / SUDS.	There will be a reduction in flows to the combined system.	0.1	Kirkwall Flood Studies Options Report v04; TN2 Kirkwall SUDs retrofitting	Scottish Water will accept off setting of flows to permit new development.
28	Upgrade foul PS and new rising main to divert flows from Glaitness/Pickaquoy/ Muddiesdale to Ayre Road pumping station.	Relieves Junction Road combined sewer by removing input from Great Western Road.	?	OIC, Scottish Water and Local Developer engagement.	Concept being developed by local developer and Scottish Water.
7	Site specific surface water option required.	To solve local flooding.	?		To be considered.

Grainbank/Pickaquoy – including development sites K3 and K4

Option	Description	Effect	Cost £M	References	Comment
8	Do nothing	Development sites would remain constrained.	0		Not viable.
2	Surface Water Separation / SUDS.	There will be a reduction in flows to the combined system.	0.1	Kirkwall Flood Studies Options Report v04; TN2 Kirkwall SUDs retrofitting.	Scottish Water will accept off setting of flows to permit new development
28	Upgrade foul PS and new rising main to divert flows from Glaitness/Pickaquoy/ Muddiesdale to Ayre Road pumping station.	Relieves Junction Road combined sewer by removing input from Great Western Road.	?	OIC, Scottish Water and Local Developer engagement.	Concept being developed by local developer and Scottish Water.
10	Site specific surface water option required.	To solve local flooding.	?		To be considered.

Papdale Burn - including development sites K12, K13, K14, K28 and K29

Option	Description	Effect	Cost £M	References	Comment
11	Do nothing				Sites not constrained.
14	Site specific surface water option required.	To solve local flooding.	?		To be considered.

Easthill/Weyland – Including K15, K16 and K30

Option	Description	Effect	Cost £M	References	Comment
15	Do nothing	Development sites would remain constrained.	0		Not viable.
16	Foul storage increase	To solve local capacity issues.	0.09**	Development Impacts on Kirkwall Sewer Network 27.11.19 – Zone 6	Scottish Water/Developer responsibility.

Hatston/Hatston Park – K1, K2, K18, K19, K20 and K21

Option	Description	Effect	Cost £M	References	Comment
17	Do nothing	Development sites would remain constrained.	0		Not viable.
18	Foul sewer upgrades	To solve local capacity issues.	0.82**	Development Impacts on Kirkwall Sewer Network 27.11.19 – Zones 2 and 3.	Scottish Water/Developer responsibility.

Kirkwall South – K8, K9, K10 and K11

Option	Description	Effect	Cost £M	References	Comment
19	Do nothing	Development sites would remain constrained.	0		Not viable
20	Pumping station and foul sewer provision	To enable development.	2.23**	Development Impacts on Kirkwall Sewer Network 27.11.19 – Zone 1.	Scottish Water/Developer responsibility.

16. Option appraisal for Objective 2 to Reduce Risk of Surface Water Flooding in Kirkwall

Significant option appraisal work has been carried out as recorded in Appendix C. From this a long list of options has been identified.

Option	Description	Effect	Cost £M	References	Comment
21	Do nothing.	Flood risk would remain. Development in Kirkwall would remain constrained.	0		Not viable.
2(A)	Surface Water Separation / SUDS.	There will be some reduction to overall flood volumes, but there will be no removal of flooding through adopting SUDS.	9.18*	Kirkwall Flood Studies Options Report v04; TN2 Kirkwall SUDs retrofitting	Incremental effect.
2(B)	Natural flood management	Reduction and attenuation of runoff from land to watercourses and surface water drainage network. Increase in overall storage within catchment.		Potential identified in several sub-catchments.	Incremental effect.
22	Development of Storm Pump at Ayre Road PS combined with upgrade to section of combined sewer.	This could remove flooding from the combined system but the flood risk from the surface water system would remain.	5.496**	Kirkwall Flood Studies Options Report v04; TN4 Ayre Road Storm Pump Analysis v04; Development Impacts on Kirkwall Sewer Network 27.11.18 – Option 3B	To be considered with item 23. Not currently supported by Scottish Water.
23	Surface Water PS to pump from Peedie Sea combined with surface water pipe upgrades.	This could remove flooding from the surface water system but the flood risk from the combined sewer system would remain.	4.91*	Kirkwall Flood Studies Options Report v04 – Option 2 and 3	To be considered with item 22.
24	Surface Water PS to pump to Peedie Sea combined with surface water pipe upgrades.	This could remove some surface water flooding but would not prevent high levels in Peedie Sea and the flood risk from the combined sewer system would remain.	2.43*	Kirkwall Flood Studies Options Report v04 – Option 4	Not viable.
25	New culvert from Peedie Sea to Harbour.	Would allow Peedie Sea to draw down faster but would still be tidally constrained therefore only limited improvement to surface water flooding. The flood risk from the combined sewer system would remain.	1.09*	Kirkwall Flood Studies Options Report v04 – Option 1	Incremental improvement.

26	Upgrade existing combined and storm sewer systems.	Would improve pipe hydraulics to both surface water and combined systems when there is free discharge but would be tidally constrained and therefore flood risk would remain. Difficult to implement without major disruption.	3.79*	Kirkwall Flood Studies Options Report v04 – Option 3	Not viable on its own. Combined improvements not currently supported by Scottish Water.
27	New combined/surface water pumping station discharging to the harbour.	Would remove excess flows	5.925**	Kirkwall Flood Studies Options Report v04 – Option 5	Not currently supported by Scottish Water.

* Indicates estimated cost from 2011 with inflation applied to 2019.

** Indicates estimated cost from Scottish Water presentation 'Development Impacts on Kirkwall Sewer Network' 27.11.18

Appendices

Appendix A	Historical Flooding Events
Appendix B	Reports and Technical Studies
Appendix C	Key to Development Sites
Appendix D	Key to Sub-Catchments
Appendix E	Kirkwall Drainage Network Overview
Appendix F	Key Contacts

Appendix A – Historical Flooding Events

Date	Location	Source	Comment
1788 October	Papdale Burn and Kirkwall town centre	Papdale Burn (burst dam dykes following heavy rain)	From The Aberdeen Journal, 27th October 1788. "The Great Kirkwall Flood" led to 4 fatalities, significant flooding and damage up to Broad Street (where flood water was said to have been 600mm deep).
1909	Albert Street	Not known – most likely Papdale Burn	Known from photographic record.
1952 August 14th/15th	Willow Burn and Kirkwall Centre	Papdale Burn	The Orkney Herald reported that 74mm (2.9 inches) fell in 31hours leading to widespread flooding, including internal flooding to properties on 'The Street'.
1970-2006	Main Street	Surface water/sewer capacity exceeded	External flooding experienced on numerous occasions in this period with internal flooding recorded to at least 1no. property.
1971	Pickaquoy Road (Ayre Mills end)	Surface water	Flooding over full width of road known from photographic record.
2006 October 25th/26th	Kirkwall town	Multiple causes	Heavy rain, assessed as a 1 in 212 year return period event, led to water from overflowing watercourses and surface water entering sewers and resulted in the capacity of the drainage system being exceeded. Roads, residential properties, three schools, a museum, social clubs, a church and art gallery were all affected.
2006	Main Street	Surface water/sewer	Internal flooding recorded by OIC to 2 residential properties. External

October 25th/26th		capacity exceeded	flooding to 4 properties only recorded but full width of street flooded.
2006 October 25th/26th	Junction Road	Surface water/sewer capacity exceeded	At least 5 residential and commercial properties experienced internal flooding and, with the width and length of junction Road flooded, many more were affected by external flooding.
2006 October 25th/26th	Victoria Street	Surface water/sewer capacity exceeded	No records of internal flooding but full width of street flooded at foot of Victoria Lane from Sutherlands past Shearers.
2006 October 25th/26th	Crafty Car Park	Surface water/sewer capacity exceeded	Car park surface completely flooded
2006 October 25th/26th	Gunn's Close Car Park	Surface water/sewer capacity exceeded	Photographic evidence of flooding to Junction Road end of car park.
2006 October 25th/26th	Union Street	Surface water/sewer capacity exceeded	Full width and length of Union Street flooded. No record of internal flooding.
2006 October 25th/26th	Burnmouth Road	Burn overtopping, surface water and sewer capacity exceeded	Flooding over full width of road from Junction with Junction Road.
2006 October 25th/26th	Pickaquoy Road	Surface water/sewer capacity exceeded	Whole length and width of Pickaquoy Road flooded. No record of internal flooding.
2006 to 2017	Matches Square	Combined sewer	External flooding affecting several properties numerous times. Internal flooding to one property experienced on at least 4 occasions during this period.

2006 to 2017	Pickaquoy Road	Surface water/sewer capacity exceeded.	Localised flooding over full width of road recorded numerous times within the period. No record of internal flooding.
2012 December 23rd	Glaitness School and St Colm's	Surface water	External flooding to both St Colm's and Glaitness School.
2012 December 23rd	Pickaquoy Road	Surface water/sewer capacity exceeded	Whole length of Pickaquoy Road affected. Road not closed but cars driving on pavement between campsite and Ayre Mills.
2012 December 23rd	Muddiesdale Road and Rugby Club	Surface water/ditches overtopping	Roadside ditch overtopped flooding rugby club (externally), full with of Muddiesdale Road then on to training pitch and St Colm's.
2012 December 23rd	Pickaquoy camp site and Peerie Sea Loan.	Surface water	Flooding in camping site including externally around facility building. Overtopping from ditch.
2012 December 23rd	Peedie Sea	Surface water	Boating pond path submerged but new paths still usable.
2013 November 2nd	Queen Street	Surface water/sewer capacity exceeded	External flooding beside residential property and flooding to road.
2013 November 2nd	Weyland Bay Housing	Surface water	External flooding to residential property.
2013 November 3rd	A965/Grainshore Road	Surface water	A965 closed at junction of A965 and Grainshore Road
2013 November 3rd	Pickaquoy Road	Surface water	Pickaquoy Road closed between Ayre Mills and camping site entrance.
2014 January 16th	Grainshore Road	Surface water	Road flooded at junction with Grainshore Drive.

2014 May 21st	Main Street	Surface water/sewer capacity exceeded	Flooding to road – gully sucker attended.
2014 December 8th	Grainshore Road	Surface Water	Road flooded at junction with Grainshore Drive.
2015 January 9th	Papdale Stores	Surface water	Concerns of flooding at Papdale Stores. Flooding of Road at Heathery Loan.
2015 June 28th	Otterswick Crescent	Surface Water	External flooding
2015 August 18th	Sunnybank Road	Surface water	Flooding to road.
2015 October 24th	Otterswick Crescent	Surface Water	External flooding
2015 October 24th	A965/Grainshore Road junction	Surface water	Road flooded
2015 December 1st	A965/Grainshore Road junction	Surface water	Road flooded
2015 December 1st	A964/ Junction Road junction	Surface water	Road Flooded
2016 January 10th	A965 Hatston/Grainshore Road and Berstane Loan.	Surface Water	Road surface flooded
2016 January 29th	A965 Hatston/Grainshore Road	Surface water	Road surface flooded
2017 June	Matches Square	Combined sewer	External flooding to residential properties.
2017 August 18th	Matches Square	Combined sewer	External flooding to square and internal flooding to one residential property.

2017 August 18th	Junction Road	Combined sewer/surface water	Water rising from combined sewer manhole covers leading to flooding of Junction Road.
2017 September 11th	Junction Road	Combined Sewers/surface water	Water rising from combined sewer manhole covers leading to flooding of west side of road.
2017 September 11th	Matches Square	Combined sewer/surface water	External flooding to a residential property.
2018 January 22nd	Papdale School	Surface water	Sandbags requested by school.
2018 January 22nd	A965 Hatston/Grainshore Road	Surface water	Road surface flooded
2019 February 10th	Pickaquoy Road	Surface water	Pickaquoy Road flooded and closed between Ayre Mills and camping site.

Appendix B – Reports commissioned or produced by OIC and Scottish Water since October 2006 on the subject of surface water flooding in Kirkwall

Title	Commissioned by	Date	Subject
Investigation into Kirkwall Flooding 2006 – Murdo A. Murray	OIC	January 2009	Investigation into the flood event of 25th /26th October 2006 with particular reference to the Peedie Sea.
Kirkwall Flood Alleviation Study (FAS) Model Verification Report	OIC	March 2010	Model Verification Report – Stage 1 of the Kirkwall Flood Alleviation Study (FAS).
Kirkwall FAS Optioneering Report v2	OIC	Sept 2010	Optioneering report describing the various options with a recommended solution.
Kirkwall FAS Optioneering Report V4	OIC	April 2013	Final optioneering report
Needs Assessment Report	Scottish Water	Sept 2010	Identification of sewer network deficiencies
TN01 Rev.3	Scottish Water	Nov 2011	Catchment Improvement Assessment – Revision 3
TN02	Scottish Water	May 2011	SuDS retrofitting report
TN02 Appendix N	Scottish Water	Nov 2011	High level SuDS costing estimate
TN03	Scottish Water	July 2012	Outcome of CCTV Surveys – Impact to Hydraulic Performance – Model updated.
TN04 Rev.4	Scottish Water	August 2012	Ayre Road Storm Pump Overflow Analysis
TN05	Scottish Water	Nov 2011	Outcome Scottish Water Customer Interviews

TN06	Scottish Water	Nov 2011	Outcome of contributing area surveys
TN07	OIC	Dec 2011	Option 1 – Peedie Sea culvert outlet comparison analysis.
TN08	Scottish Water	Aug 2012	Long term flow survey review
TN09	OIC	May 2013	Main Street - Surface water flooding analysis
Presentation - Development Impacts on Kirkwall Sewer Network	Scottish Water	Nov 2018	Summary of modelling work undertaken by SW to solve existing SW flooding and enable development of sites identified in the Local Development Plan.
Kirkwall S16 Report	Scottish Water	April 2019	Report on Section 16 modelling for Kirkwall.

Appendix C – Kirkwall Development Sites from the April 2017 Orkney Local Development Plan

Kirkwall Surface Water Management Plan
Key to Development Sites

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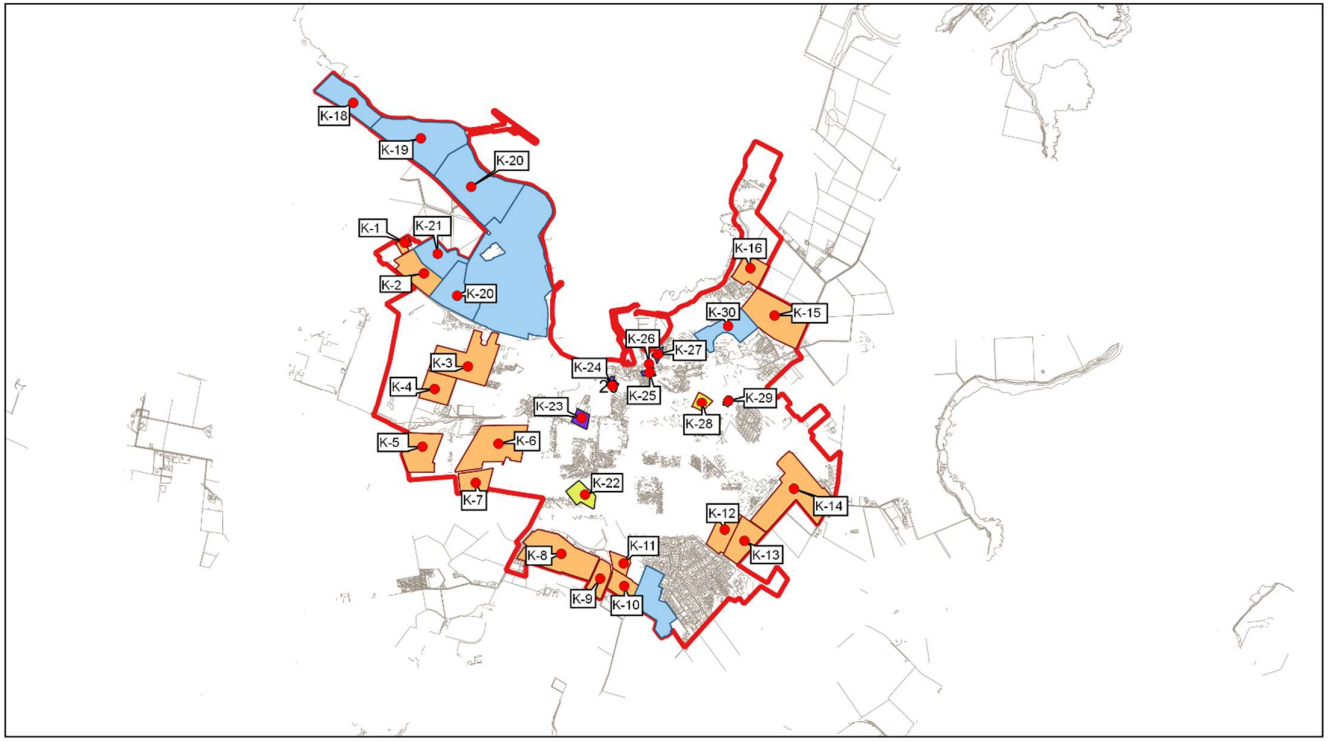

Appendix D – Kirkwall Sub-Catchments

Kirkwall Surface Water Management Plan - Appendix D
Key to Sub-Catchments

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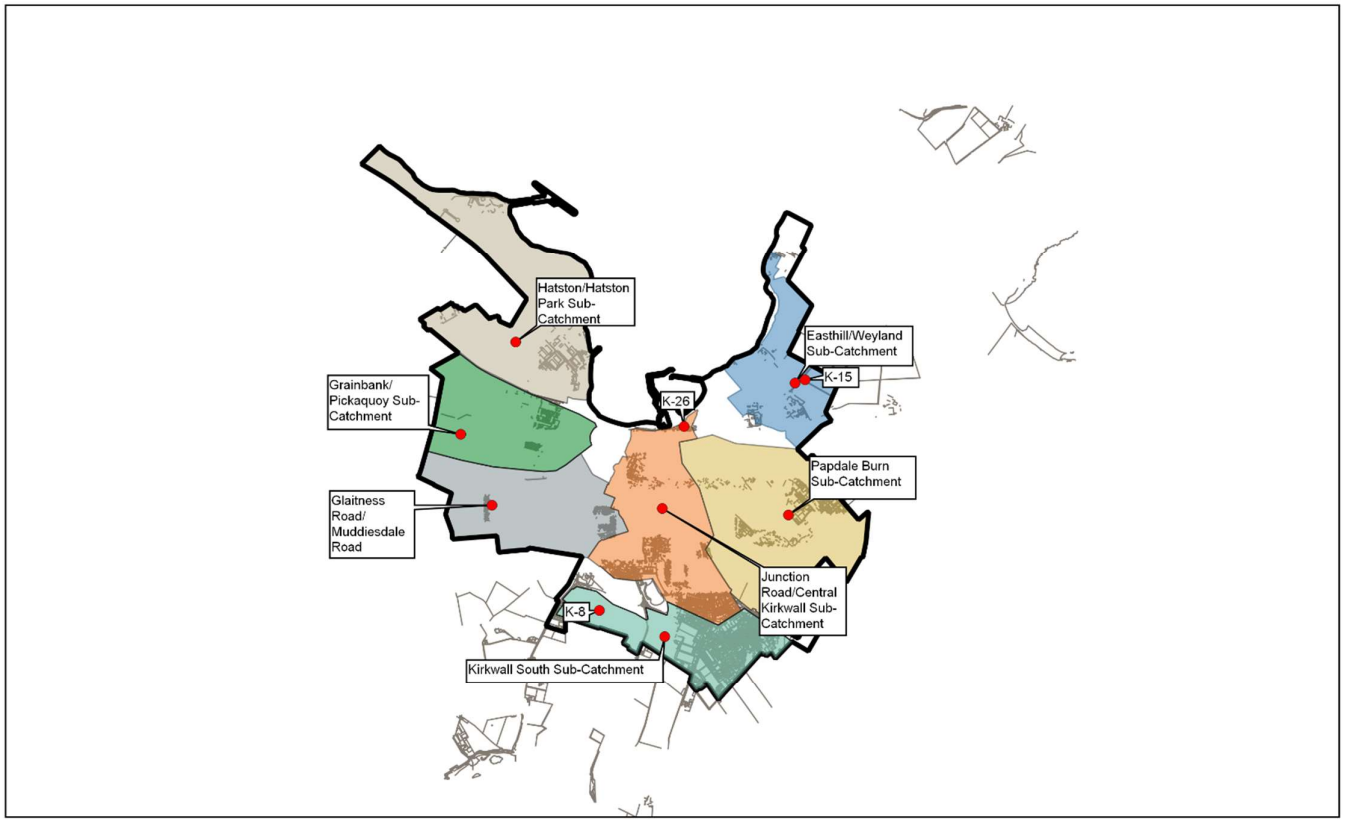
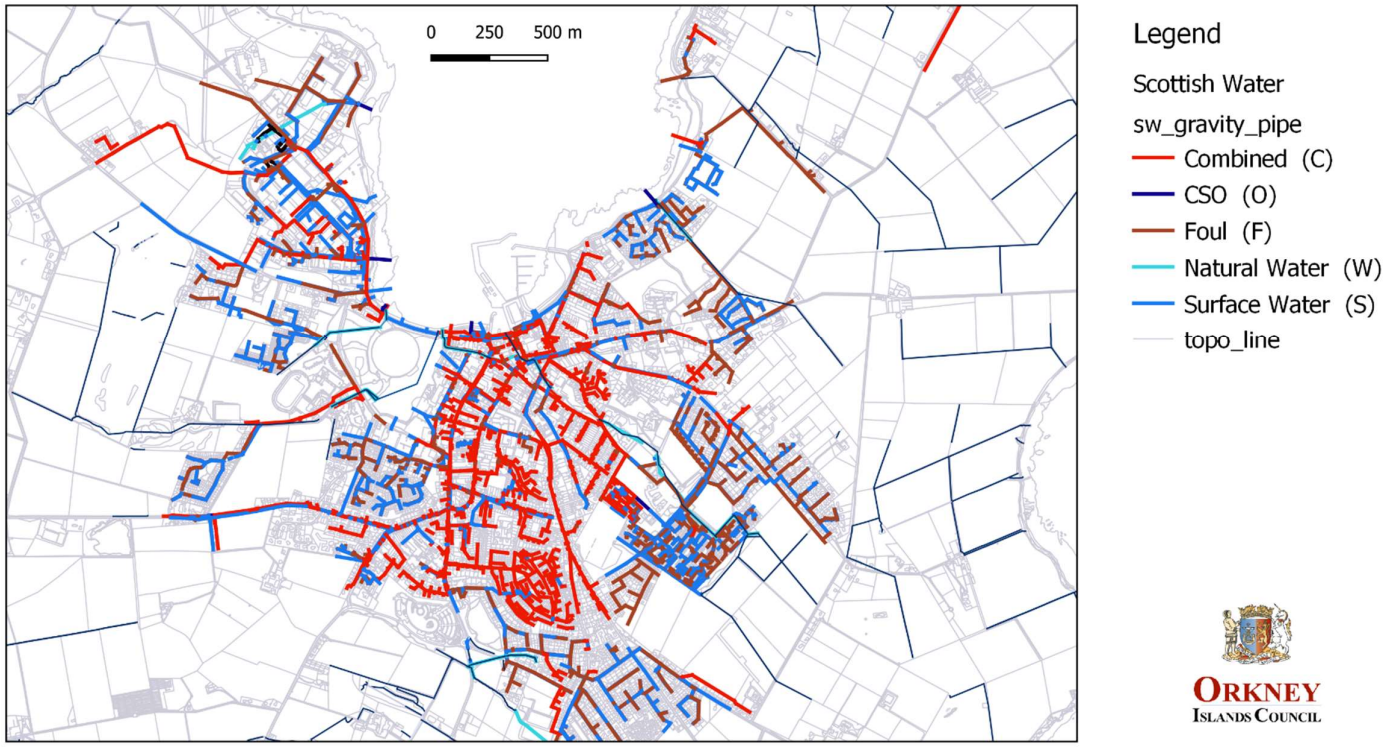


Appendix E – Overview of SW and OIC Networks

Kirkwall Surface Water Management Plan - Appendix E
Kirkwall Drainage Network Overview



Appendix F – Key Contacts.

Organisation	Role	Input	Contacts
Orkney Islands Council	Local Authority (LA) and Responsible Authority (RA) under the FRM Act.	Production of the Local Flood Risk Management Plan for Orkney. Production of the Kirkwall Surface water Management Plan.	Peter Bevan – Peter.Bevan@orkney.gov.uk Peter Woodward – peter.woodward@orkney.gov.uk
Scottish Water	Responsibility for waste water and Responsible Authority (RA) under the FRM Act.	Production of Section 16 model and further modelling to meet the requirements of the SWMP.	Annelies MacMillan - annelies.mcmillan@scottishwater.co.uk
SEPA (FRM)	Environmental regulator, advisors on flood risk and responsibility for flood warning.	Production of the Flood Risk assessment for Orkney. FRM guidance, mapping, advice and review.	Steve McFarland - steve.mcfarland@sepa.org.uk Iris Krammer - Iris.Krammer@sepa.org.uk