



ORKNEY
ISLANDS COUNCIL

**Jewsons Site Redevelopment
Flood Risk Assessment**

Project No: 1002803

**Revision B
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Jewsons Site Redevelopment - Flood Risk Assessment

1. Introduction

Orkney Islands Council are in the process of determining proposals for completing the redevelopment of the site previously occupied by builders merchant Jewsons, Junction Road, Kirkwall. The site is bounded by roads on all 4 sides namely Junction Road, Great Western Road, West Castle Street and Burnmouth Road. Phases 1 and 2 of redevelopment of the Jewsons site comprised the construction of a new Travel Centre for Kirkwall incorporating a Bus Station with 5 number bus stands. High quality redevelopment for the remaining site will complement and improve the urban street scope of the area and compliment recent construction projects such as the Orkney Library. Travel Centre, Police Station and Kiln Corner Development. A flood risk assessment to be approved by SEPA is required as part of the planning process.

2. The Site

Jewsons redevelopment site is located at OS grid ref HY44825/11114 please refer to location plan shown on drg. no 1002803/01. Photographs included in Appendix 3 indicate the present street conditions at the site perimeter.

Existing Levels

Adjacent road levels and existing site levels are shown to Ordnance Datum (Newlyn) on drawing 1002803/02. Other properties in close proximity have the following floor levels:

Post Office - +2.45m
Jewsons Office - +2.30m
Flat, 13 Junction Road - +2.45m

Site Drainage

Disposal of storm water and wastewater effluent from the site will be via the existing drainage systems at various locations round the site perimeter. During the planning process application will be made to the relevant authorities for permission to connect to the existing drainage infrastructure.

Recent Construction

Ground floor levels of recent major construction projects undertaken by Orkney Islands Council and private developers are as follows.

Kirkwall Library & Archive	+3.0m
Kirkwall Travel Centre	+2.45m
Kirkwall Police Station	+3.1m

The above developments were constructed prior to the requirement to provide flood risk assessments.

3. Methodologies

3.1 Method

The accepted methodology for deriving flood events in rivers etc are based on the application of the Flood Estimation Handbook. Coastal flood levels are derived by application of the POL 112 reports. SEPA have previously used a flood level for Kirkwall Harbour extrapolated using data from POL stations located along the North coast of mainland Scotland. In this assessment it is considered more appropriate to base the flood risk assessment on data recorded at Kirkwall Harbour which includes recent extreme storm events.

3.2 Sources of Flooding

Flooding is predominantly a natural process arising from various sources, the various types of flooding are defined as originating from the following sources;

- i) Fluvial – a watercourse
- ii) Coastal – the sea
- iii) Pluvial – ground conditions which inhibit free drainage
- iv) Groundwater – a significant rise in water table
- v) Drainage – surcharging of man made drainage systems
- vi) Infrastructure Failure – failure/collapse of man made infrastructure

In this case we are considering the redevelopment of a town centre site, flooding will result from a combination of events rather than the surcharging of a single culvert or the failure of a single man made structure. As the site is located on land reclaimed from the sea, groundwater levels are affected by tide levels in Kirkwall bay.

It is considered appropriate in this case to investigate the effects of flooding from coastal and drainage sources.

4. Existing Flood Defences

Current flood alleviation measures include coastal defences in the form of armoured embankments, sea walls and steel piled harbour structures which prevent the ingress of sea water from Kirkwall Bay into low lying areas of Kirkwall. These defence structures are currently in good condition.

Historically low lying areas of Kirkwall were subjected to flooding on a regular basis due to a combination of high tide levels and prolonged periods of rain, especially during the winter months. This was a direct result of the storm water and combined drainage systems discharging directly into the sea. During high tide conditions the system surcharged and water flowed out of the system onto adjacent roads and pavements. By 1990 Orkney Islands Council had diverted the majority of the storm water system into the Peedie Sea. The Peedie Sea had been converted into a balancing reservoir to store storm water during high tide periods, the level of the Peedie Sea being controlled by a series of manually operated flap and stop valves.

During the early 1990's flooding resulting from the surcharging of the combined storm water and wastewater system was to all intents resolved by the installation of a new pumped system adjacent to the west pier. This eliminated the requirement to discharge directly into Kirkwall Bay. During October 2008 the refurbishment of the main combined sewer running along Junction Road was completed by Scottish Water, removing issues associated with the infiltration of groundwater (originating from the sea) entering the system.

Orkney Islands Council in conjunction with Scottish Water are actively investigating how to improve the operation of the Peedie Sea as a balancing reservoir by considering various options from simply lowering the Peedie Sea level prior to a storm event to the installation of pumps to pump water direct to Kirkwall Bay irrespective of tide level. An initial report was presented to elected members during November 2008. The report was received positively by the elected members who have instructed the presentation of a feasibility report at a future meeting.

5. Coastal Flooding

5.1 Tide Levels.

Coastal flooding is defined as flooding originating from the sea. Orkney Islands Council have tidal data for the period 1993 to 2006, these records show a maximum tide level of +2.83m OD (N) during 2005. Using this data SEPA have recently carried out a single site assessment for Kirkwall using

annual maximum observed water level data following the method described in the Flood Estimation Handbook (NERC CEH, 2006). This statistical analysis resulted in SEPA promoting a revised coastal flood level of +3.23m OD (N) for a 1 in 200 year event. This analysis estimated the extreme tide level of 2.83m OD(N) as having a 22 year return period.

5.2 Tidal Data

The datum adopted for this assessment is Ordnance Datum (Newlyn), current admiralty charts confirm that O.D Newlyn is 1.40m above Chart Datum at Kirkwall. Admiralty Charts also confirm tidal levels are as follows;

Tide Level	Ordnance Datum	Chart Datum
HAT *	+ 2.2m	+ 3.6
MHWS	+ 1.6m	+ 3.0
MLWS	- 0.8m	+0.6
LAT	-1.4m	+0.0

* Orkney Islands Council Estimate

5.3 1 in 200 Year Coastal Flood Event

Consideration must be given to the protection provided by the level of the existing coastal defences at Kirkwall Harbour. Generally the Ayre Road is protected by a sea wall with an approximate crest level of +3.5m OD (N) along the majority of its length. However from the Shapinsay Ferry Terminal, adjacent to the west pier, to the roundabout at St. Catherines Place the critical level to prevent the ingress of sea water is considered to be +2.8m OD (N).

The existing sea defences are currently considered to be in a good state of repair and provide flood protection to a maximum tide level of 2.8m OD(N).

It is estimated a tide level of 3.23m OD(N) will result in the overtopping of the existing sea defences for approx 3 hours. During this 3 hour period calculations, based on a broad crested weir, estimate the total unrestricted volume of water overtopping the sea defences to be approx 540,000 cu.m. To put this in perspective the extreme flood event on 26 October 2006 resulted in a flood level of 2.6m OD(N). At this time the volume of flood water contained in the peedie sea and junction road was estimated at approx 213,000 cu.m

Initial calculations indicate the max flood level will be approx 3.1m OD(N), 0.5 m higher than the extreme flood level of 26 October 2006, occurring 30 minutes after high tide. After this time the tide level will be lower than the flood water level and flood water will flow back into the sea. Once the flood water level falls below 2.8m OD(N) the only available route to discharge is via the Peedie sea outfalls.

6. 1 in 200 Year Drainage Flood event

Drainage flooding is defined as flooding resulting from the surcharging of manmade drainage systems. The recent storm event of 26 October 2006 resulted in significant flooding of the low lying areas of Kirkwall. This storm event was categorised by the Met Office as having a 1: 212 year return period (a probability of 0.47%), please refer to Appendix 6 for confirmation of the Met Office classification.

The flooding resulted from a combination of various factors including the surcharging of existing storm water and combined storm and waste water networks at the south end of Junction Road, surcharging of the Peedie Sea at high tide and the inability to discharge water at a rate greater than the inflow rate. The maximum tide level recorded at this time was +2.0m OD (N) at 12.30hrs.

Photographs taken at this time, ref to Appendix 7, show water levels at the entrance to the Post Office and at the mouth of Victoria Street. These photographs indicate a flood water level of +2.5m OD (N). A photograph taken at the co-op entrance onto Picky Road indicates a Peedie Sea level of 2.6m OD (N), the Peedie Sea overflowing onto Picky Road opposite Glaitness Primary School.

It is considered that as the storm of 26 October 2006 was a 1:212 year storm, then the flood water level associated with this event can also be classed as having a 1:212 year return period.

7. Proposed Strategic Flood Defence Works

7.1 Drainage

Scottish Water are considering the installation of a new pumped storm overflow system, located in the Gunn's Close Car Park, to alleviate flooding from surcharging sewers due to incapacity of their combined system at the south end of Junction Road. Orkney Islands Council are considering proposals to reduce flooding from the surface water system in the same area and are also investigating ways of improving the effectiveness of the Peedie Sea as a balancing reservoir. It would also be reasonable to assume that the lowest sections of the coastal defences would be raised if higher tidal levels became the norm.

7.2 Coastal

The 1 in 200 year tide level of 3.23m OD(N), recently adopted by SEPA, will require the provision of new sea defences to prevent significant flooding of the low lying areas of Kirkwall.

These new defences are likely to consist of sea walls extending from the access to the Shapinsay Ferry Terminal to the roundabout at St. Catherine's place with openings left to maintain access to the piers and slipways. All openings would have the facility to be closed possibly using a series of steel posts and timber boards erected in advance of predicted extreme high tide events.

Minor modifications will be required to the surface water system along Ayre Road to prevent sea water surcharging back up through the system via the sea outfalls.

8. Conclusions

Orkney Islands Council have recorded a maximum tide level of +2.83m OD (N) at Kirkwall Pier. Analysis of existing tidal records by SEPA resulted in a revised 1 in 200 year tide level of 3.23m being adopted. Given that the critical level of existing flood defences is approx. +2.8 OD (N) it is reasonable to assume that these defences will be overtopped at some point in the future. It will therefore be necessary for OIC to raise the existing sea defences to protect the low lying areas of Kirkwall from the 1 in 200 year tide level of 3.23m OD(N). Assuming the sea defences are raised, direct tidal flooding will not be the critical factor in determining long term building levels.

A recent 212 year return period storm event resulted in significant flooding to low lying areas of Kirkwall, water levels identified adjacent to the Jewsons site on Junction Road indicate a flood level of +2.5m OD (N). At this time the flood water level of the Peedie Sea was approaching +2.6m OD (N). The critical flood level to be considered for this development should therefore be +2.6m OD (N). Again this could be reduced if new strategic drainage works are put in place.

Pedestrian and vehicular access to the Jewsons site is constrained on all four sides of the site by existing road and footpath levels. In this case there is no obvious solution to prevent residents of any new development from being surrounded by flood waters. The depth of any resultant flood waters should not provide any significant problems for pedestrians accessing or exiting the development

9. Recommendations

A critical flood level of +2.6m OD (N) was identified following an extreme storm event on 26 October 2006. This event was classified as having a return period of 1 in 212 years. SEPA and CIRIA both promote a freeboard of 600mm above design flood level/design finished floor level. As this assessment is based on a recorded extreme event a freeboard of 600mm is considered excessive, a freeboard of 300mm is considered adequate.

A minimum ground floor construction level of $+2.6\text{m} + 0.3\text{m} = +2.9\text{m}$ OD (N) is proposed for this development. This will result in a finished floor level typically 400-600mm above the surrounding pavements. This level compares favourably with recent major building projects and is significantly higher than floor levels in adjacent commercial and private properties.