PROPOSED STRATEGIC HOUSING DEVELOPMENT
'THE CONNOLLY QUARTER'

SITE-SPECIFIC FLOOD RISK ASSESSMENT

PROJECT NO. O635

30th SEPTEMBER 2019

OCSC
O'CONNOR | SUTTON | CRONIN
Multidisciplinary
Consulting Engineers

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NOTICE

DOCUMENT CONTROL & HISTORY

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APPENDICES

1. INTRODUCTION

1.1 O'Connor Sutton Cronin (OCSC) was appointed by Oxley Holdings Limited to carry out a site-specific flood risk assessment for the proposed redevelopment of the car-park site at Connolly Station, Dublin 1. The site is currently occupied by surface car-parking and low rise office and storage buildings associated with Connolly Station.

1.2 The site is bounded by Sherriff Street Lower and Commons Street to the south, Oriel Street Upper and Oriel Hall to the east and existing CIÉ development to the north and west – see ***Figure 1***. The total site comprises approximately 2.8 hectares.

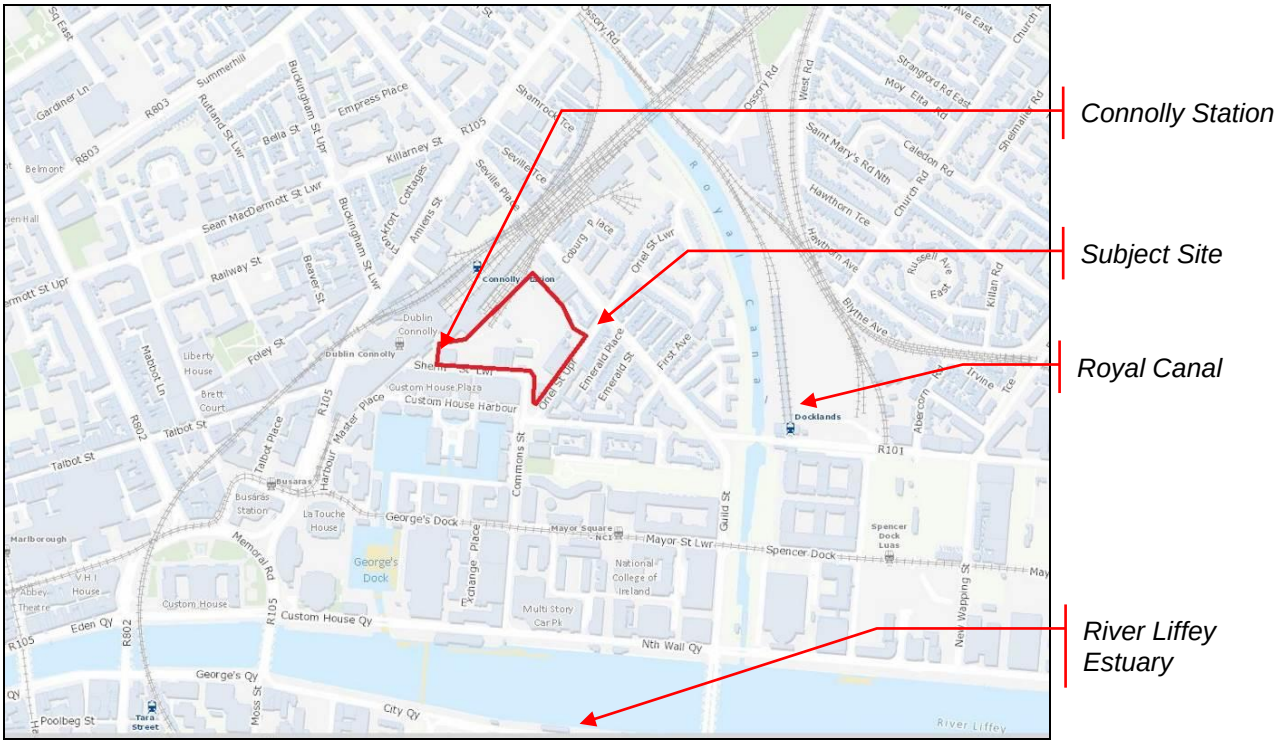


Figure 1: Site Location

1.3 The overall proposed masterplan will comprise mixed residential, commercial, amenity and community use with basement level car parking and associated infrastructure. Permission for this will be sought under separate applications. The first will be a Section 247 Strategic Housing Development (SHD) application to ABP for the

mainly residential elements of the scheme along with the basement. The second will be a standard Section 34 application to DCC for the non-residential elements of the scheme. An image of the proposed masterplan for the entire of the site (including the proposed Section 34 application to DCC) is shown in ***Figure 2***.

Figure 2: Masterplan View

1.4 This report is solely in respect of the SHD application, the red line boundary for which is shown in ***Figure 3***.

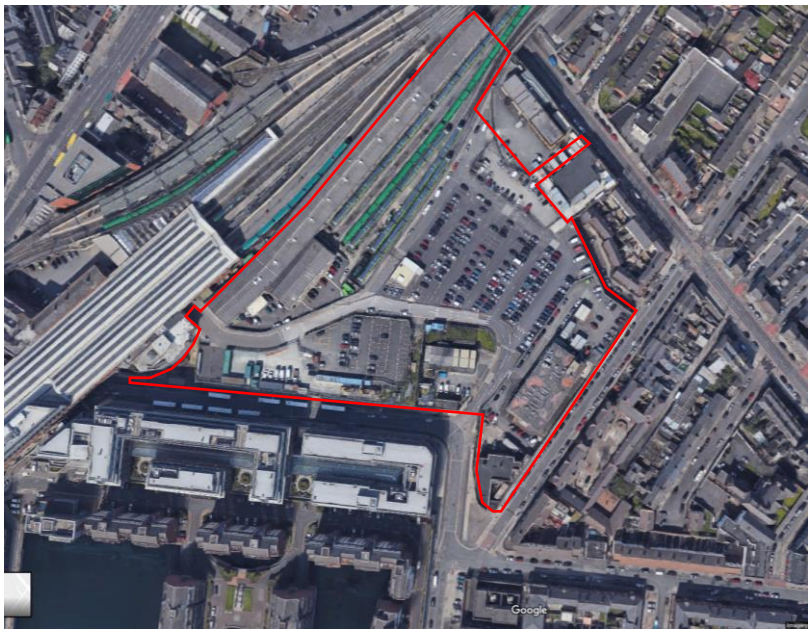


Figure 3: SHD Application Boundary

1.5 The proposed Schedule of Accommodation for the SHD application comprises the following:

- the demolition of 4 no. structures with a combined gross floor area of 3,028sq.m;
- the construction of 741 no. Build to Rent (BTR) residential units in 8 no. apartment blocks ranging in height from 4 storeys to 23 storeys with lower height buildings located adjacent to the northeast and east site boundaries, with a cumulative gross floor area of 68,535sq.m comprising:
    - Block B1 (maximum building height 54.917m, total gross internal floor area 11,260sq.m, Apartment Mix: Studio: 25, 1-bed: 37, 2-bed: 51);
    - Block B2 (maximum building height 54.917m, total gross internal floor area 10,831sq.m, Apartment Mix: Studio: 20, 1-bed: 35, 2-bed: 51,);
    - Block B3 (maximum building height 51.767m, total gross internal floor area 9,766sq.m, Apartment Mix: Studio: 22, 1-bed: 60, 2-bed: 27, 3-Bed: 1);
    - Block C1 (maximum building height 79,450m, total gross internal floor area 12,705sq.m, Apartment Mix: Studio: 84, 1-bed: 40, 2-bed: 41);
    - Block C2 (maximum building height 39,615 m, total gross internal floor area 4,890 sq.m, Apartment Mix: Studio: 9, 1-bed: 33, 2-bed: 3, 3-Bed: 4);
    - Block C3 (maximum building height 39,650 m, total gross internal floor area 6,775sq.m, Apartment Mix: Studio: 40, 1-bed: 18, 2-bed: 23);
    - Block D1 (maximum building height 53,392 m, total gross internal floor area 8,418 sq.m, Apartment Mix: Studio: 10, 1-bed: 25, 2-bed: 44, 3-Bed: 1);
    - Block D2 (maximum building height 30,950 m, total gross internal floor area 3,890 sq.m, Apartment Mix: Studio: 18, 1-bed: 8, 2-bed: 11);

- residential support amenities including 1 no. gyms, a resident's lounge, work areas, meeting rooms, dining rooms, recreational areas with a combined GFA of 1,444 sq.m;
- change of use from club house to pedestrian passageway of the existing vault (137sq.m GFA) fronting Seville Place, a Protected Structure (RPS No. 130);
- a basement of 7,253.4 sq.m with vehicular access from Oriel Street Upper incorporating residents' car parking (58 no. spaces), residents cycle parking (640 no. spaces) 7 no. plant rooms (combined 2,228sq.m), waste management facilities (393 sq.m)
- 766 no. covered cycle parking spaces for residents and visitors, concierge office (233 sq.m) and waste management facilities (126 sq.m);
- 'other uses' including 10 no. units providing retail, commercial, and community use with a combined GFA of 3,142 sq.m;
- A total of 18,562 sq.m of hard and soft landscaping comprising both public, communal and private open space located throughout the development;
- A service and emergency vehicle only access ramp from the Oriel Street Upper site entrance to serve CIE's transport needs at Connolly Station;
- Enabling works of a non-material nature to safeguard the existing vaults (Protected Structures - RPS No. 130) that form part of the subject site fronting Sherriff Street Lower, Oriel Street Upper, and Seville Place during the construction phase;
- All associated ancillary development works including drainage, 6 no. electricity substations, pedestrian access; and
- Works to the Masonry wall fronting Oriel Street and the Vaults fronting Seville Place (both a Protected Structure) consisting of the creation of a new vehicular and pedestrian entrance.

1.6 The Flood Risk Assessment was conducted in accordance with:

- *The Planning System and Flood Risk Management Guidelines for Planning Authorities* (Department of Environment, Heritage and Local Government and the Office of Public Works);
- *C624 Development and Flood Risk* (Construction Industry Research and Information Association, CIRIA) and;
- *Dublin City Development Plan 2016-2022.*

1.7 The Flood Risk Assessment was based on the following information:

- Architectural drawings of the development proposals;
- OPW Floodmaps.ie;
- OPW National Preliminary Flood Risk Assessment;
- OPW Irish Coastal Protection Strategy Study;
- OPW Eastern CFRAMS;
- DCC/OPW Flood ResilienCity Dublin Pluvial Study;
- DCC/IW Drainage and Watermain Records;
- GDSDS Sewer Performance Records;
- Geological Survey of Ireland (GSI) Maps.

1.8 OCSC carried out an initial site inspection in February 2019 and a follow up visit in September 2019 to identify potential pathways for floodwater to enter the site. The inspections consisted of a walkover and visual inspection outside the site and in the general area.

2. LEVEL OF SERVICE

2.1. The risk of a flood event is a function of the probability of occurrence in any given year. Traditionally, this has been expressed as a return period (e.g. 1-in-100-year return period). However, this has led to misconceptions about the likelihood of repeat occurrences. A less ambiguous expression of probability is the Annual Exceedance Probability (AEP), which may be defined as the probability of a flood event being exceeded in any given year. A 1-in-100-year return period flood event is therefore expressed as a 1% AEP flood event. Likewise, a 1-in-1-year return period flood event is expressed as a 100% AEP flood event.

2.2. The *Greater Dublin Strategic Drainage Study* (GDSDS) (published by the Local Authorities in the Greater Dublin Region) and *The Planning System and Flood Risk Management Guidelines for Planning Authorities* (published by DOEHLG, November 2009) set out the best practice standards for flood risk in Ireland. These are summarised in ***Table 1***.

Table 1: Summary of Level of Service

Flooding Source	Drainage	Fluvial (River)	Tidal (Coastal)
Residential	1% AEP	0.1% AEP	0.1% AEP
Commercial	1% AEP	1% AEP	0.5% AEP
Water-compatible	–	>1% AEP	>0.5% AEP

2.3. In addition, the GDSDS requires that ground floor levels of houses be provided with a 500mm freeboard over the 1% AEP fluvial flood level.

2.4. Both the GDSDS and *The Planning System and Flood Risk Management Guidelines for Planning Authorities* require that

account be taken of the effects of climate change over the design life of a development, normally 100 years. Design parameters to take account of climate change were established in the GDSDS and revised following later studies (as advised by Dublin City Council). The *Dublin City Development Plan 2016-2022* establishes additional requirements for drainage design. These parameters are set out in ***Table 2***.

Table 2: Climate Change - Impact on Drainage Design Parameters

Design Category	Impact of Climate Change
Drainage	20% increase in rainfall
Fluvial (River)	20% increase in flood flow

2.5. The Guidelines adopt a sequential approach to managing flood risk by reducing exposure to flooding through land-use planning. The approach adopted by the Guidelines establishes three zones (Guidelines paragraph 2.23) on a sliding scale of flood risk – see ***Table 3***.

Table 3: Flood Risk Zones

Zone A	**High Probability of Flooding** Where the annual probability of flooding is: greater than 1% for fluvial flooding or greater than 0.5% for coastal flooding
Zone B	**Moderate Probability of Flooding** Where the annual probability of flooding is: between 0.1% and 1% for fluvial flooding or between 0.1% and 0.5% for coastal flooding
Zone C	**Low Probability of Flooding** Where the annual probability of flooding is: less than 0.1% for fluvial flooding and less than 0.1% for coastal flooding

2.6. Flood risk zones are determined on the basis of the probability of river and coastal flooding only (Guidelines paragraph 2.24). Other sources of flooding (such as groundwater, infrastructure and pluvial) do not affect the delineation of flood risk zones. These other sources of flooding should be considered and mitigated in design. Flood risk zones are determined on the basis of the current flood risk, i.e. without the inclusion of climate change factors (Guidelines paragraph 2.24).

2.7. The Guidelines classify potential development in terms of its vulnerability to flooding. The types of development falling within each vulnerability class are described in Table 3.1 of the Guidelines, which is reproduced in ***Table 4*** over.

Table 4: Development Vulnerability Class

Vulnerability Class	Land uses and types of development which include:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

2.8. The Guidelines direct new development primarily towards areas at low risk of flooding. The Guidelines recognise that flood risks should not be the only deciding factor in zoning for development; the Guidelines recognise that circumstances will exist where development of a site in a floodplain is desirable in order to achieve compact and sustainable development of the core of urban settlements. In order to allow consideration of such development, the Guidelines provide a *Justification Test*, which establishes the criteria under which desirable development of a site in a floodplain may be warranted. The decision making process for undertaking a Justification Test is set out in paragraph 3.2, page 23 of the guidelines and is reproduced in ***Figure 4***.

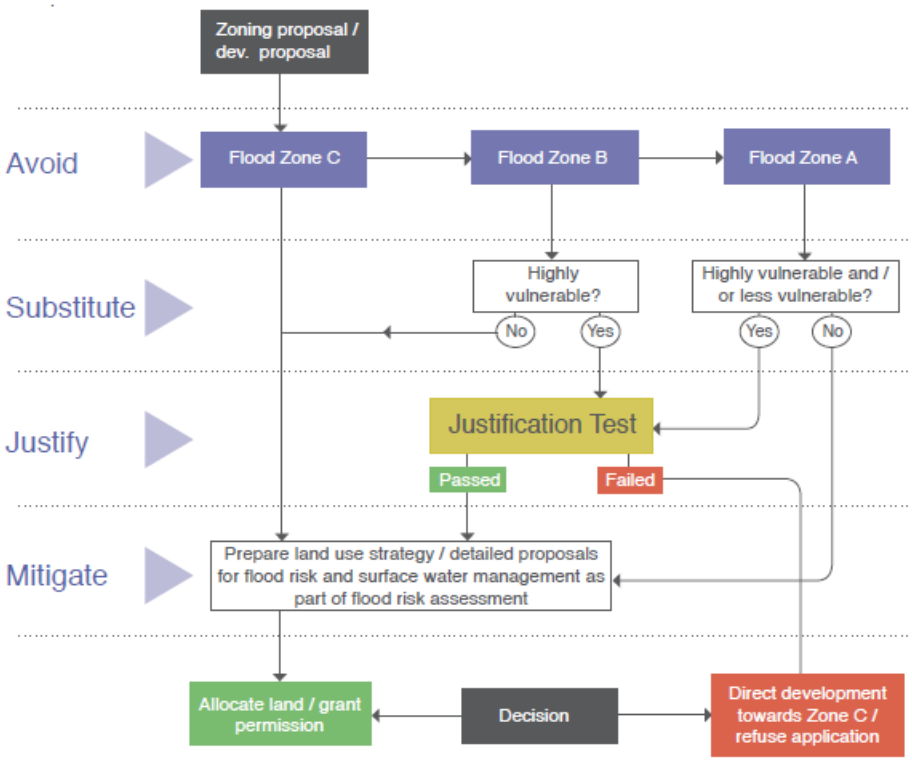


Figure 4: Sequential Approach and Justification Test

2.9. The proposed SHD development comprises mainly residential apartments with some ancillary retail and community uses over basement car-park. The residential apartments are classed as a "highly vulnerable development". The ancillary retail and community uses are classed as "less vulnerable development".

3. SITE CONTEXT

3.1. The subject site is located approximately 380m from the River Liffey Estuary, at a location upstream of the Samuel Beckett Bridge. The River Liffey Estuary flows into Dublin Bay (Irish Sea) at Dublin Port – see ***Figure 5***. The Royal Canal is located approximately 250m to the east and northeast of the site; the canal discharges to the River Liffey Estuary just downstream of the Samuel Beckett Bridge.

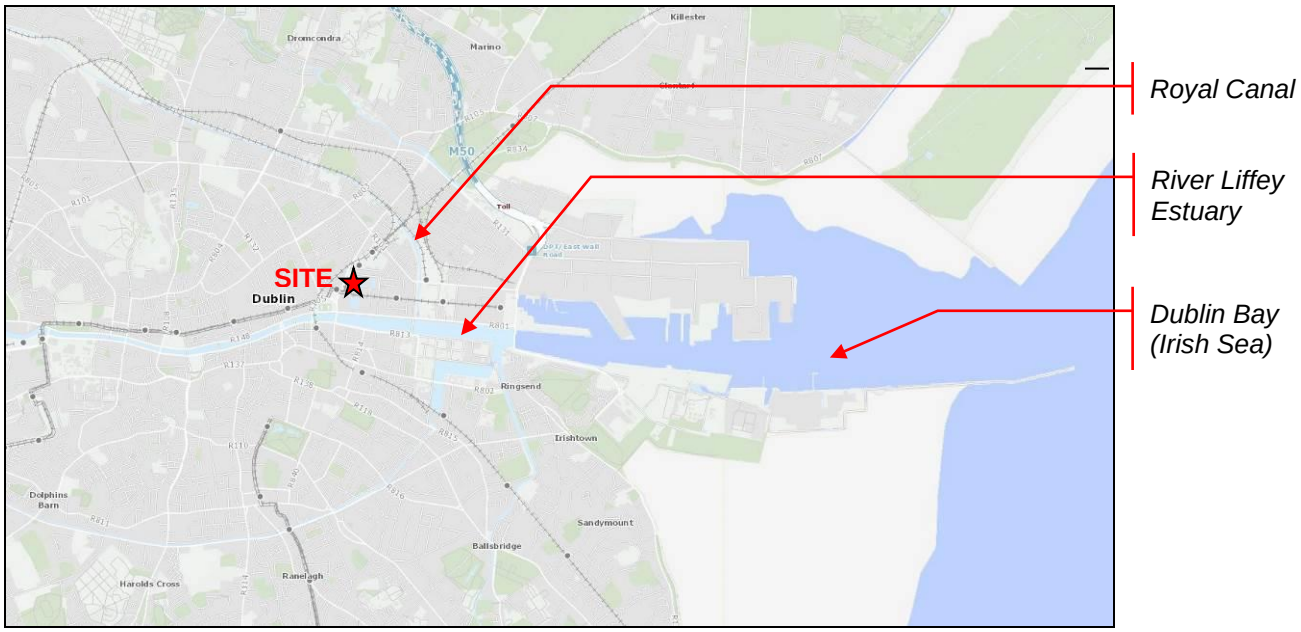


Figure 5: Site Context

3.2. The subject site is 2.8 ha in area and is currently accessed from Sherriff Street Lower. A topographical survey of the existing site (see ***Appendix A***) shows that the footpath levels around the site vary; 1.5-1.9mAOD on Sherriff Street Lower and 1.0-1.7mAOD on Oriel Street Upper.

3.3. The Office of Public Works (OPW) collates available reports on flooding from all sources (e.g. fluvial, pluvial, coastal, infrastructure) on a nationwide basis. The OPW's floodmaps.ie website was consulted to obtain reports of historical flooding within the vicinity of the subject site. The Map Report in ***Appendix B*** lists

reports of historical flooding within 2.5km of the subject site. Flooding in the areas nearby is recorded in several locations none of which directly impacted the subject site. There are no reports of flooding of the subject site.

3.4. In the Dublin City Development Plan 2016-2022 (DCDP), the site is zoned Z5 "to consolidate and facilitate the development of the central area, and to identify, reinforce, strengthen and protect its civic design character and dignity" – see ***Figure 6***. Furthermore, the site is located within Strategic Development and Regeneration Area 6 – Docklands.

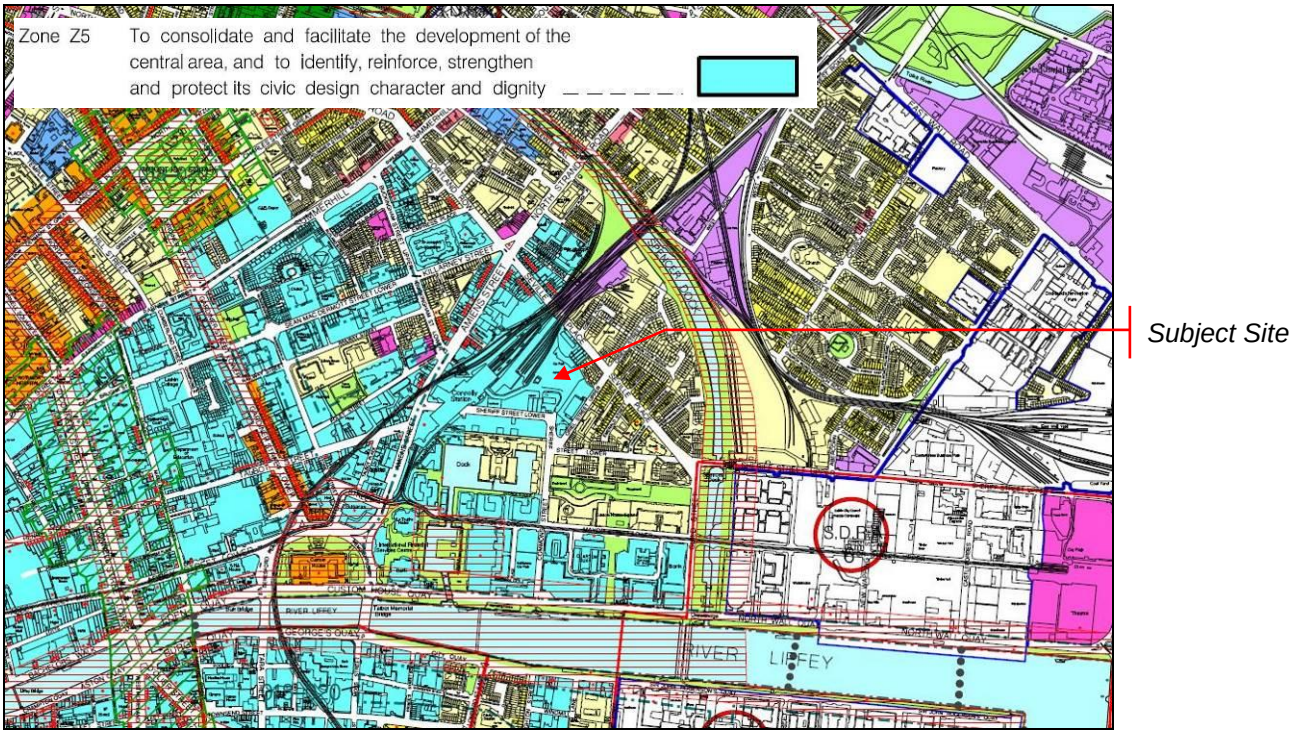


Figure 6: Extract from DCDP 2016-2022

3.5. The Strategic Flood Risk Assessment included in the DCDP contains a Composite Flood Zone Map; the Map is included in ***Appendix C*** and an extract is reproduced in ***Figure 7*** over. The Map shows that the site is partially located in Flood Zone C and partially within Flood Zones A/B. However, the site is also shown to be in a defended area.

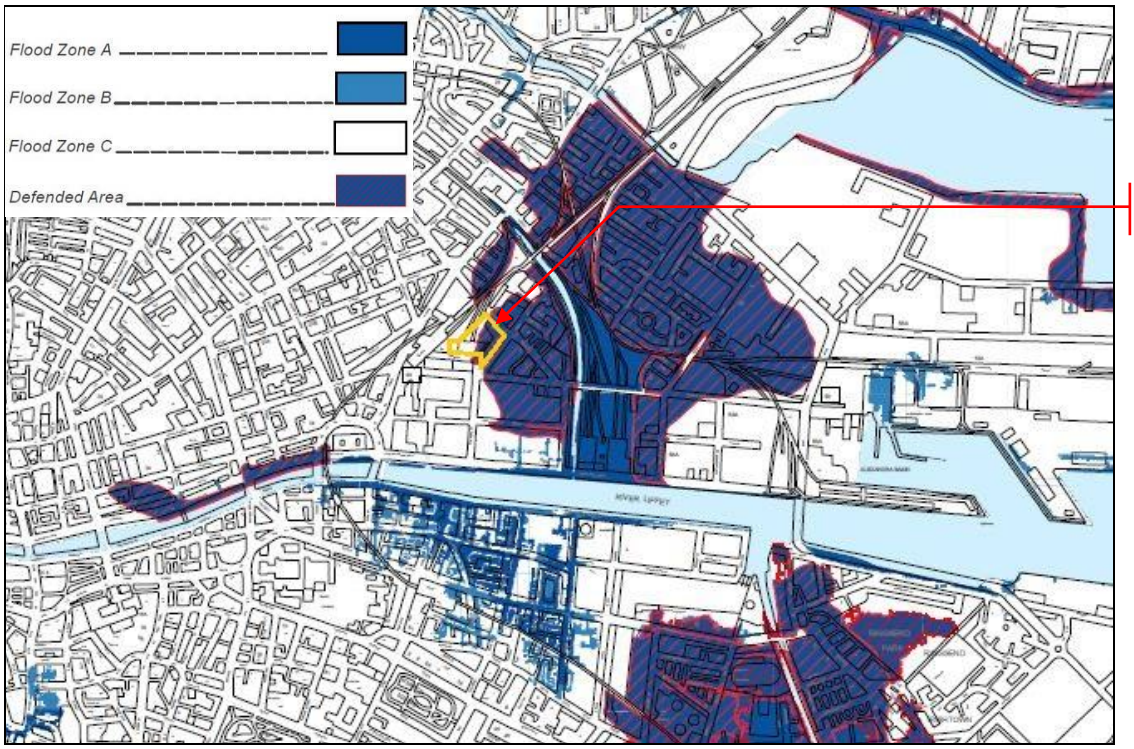


Figure 7: Extract from DCDP Composite Flood Zone Map

4. FLOOD RISKS & MITIGATION MEASURES

4.1. Tidal Flooding

4.1.1. The proposed development site is located approximately 380m from the nearest potential source of tidal flooding in the River Liffey Estuary. The Eastern Catchment Flood Risk Assessment and Management (CFRAM) Study tidal flood extent maps (drawing numbers e09lif_exccd_f1_03 and e09lif_exccd_f1_04) are included in ***Appendix D***. An extract from the OPW floodinfo.ie website showing the Eastern CFRAM flood extent is shown in ***Figure 8***. The tidal flood levels predicted by Eastern CFRAM are presented in ***Table 5*** over.

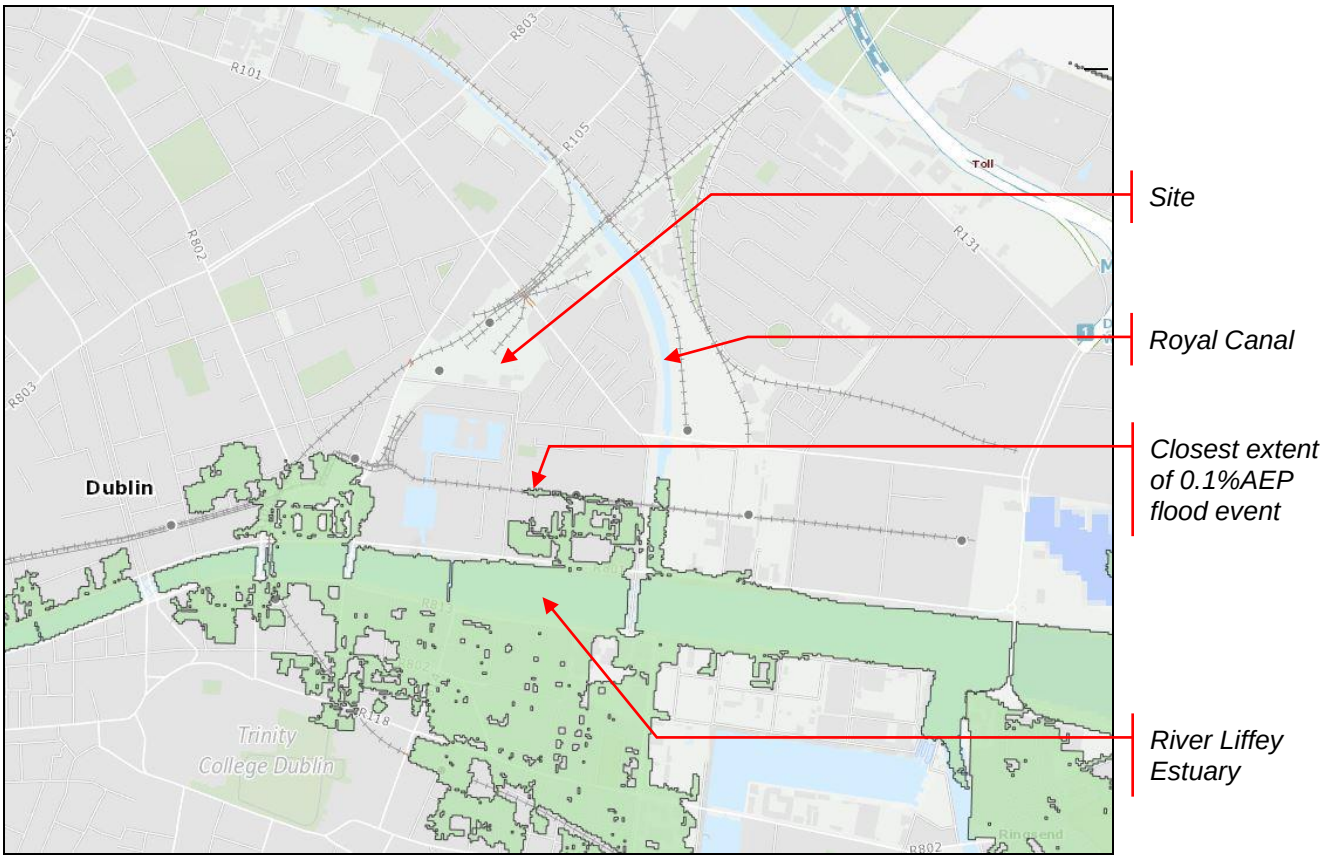


Figure 8: CFRAM Tidal Flood Extent 0.1% AEP Current Climate

Table 5: River Liffey Tidal Flood Levels

Annual Exceedence Probability (AEP)	1.0%	0.1%
09LIFF00230	3.12mAOD	3.35mAOD
09LIFF00180	3.12mAOD	3.35mAOD

4.1.2. The sea level data in the CFRAM studies is based on the OPW's *Irish Coastal Protection Strategy Study* (ICPSS). ICPSS drawing number NE/RA/EXT/19 (see ***Appendix E***) shows the predicted sea levels extended across the adjacent land, without consideration of obstructions to potential floodwater pathways. The drawing shows that the Sherriff Street Lower and Oriel Street Upper, which bound the site are within the potential tidal/coastal floodplain.

4.1.3. The existing ground levels on the perimeter of the site varies between 1.0mAOD and 1.9m AOD. However, the Eastern CFRAM map shows that the subject site is outside the active functional floodplain of the 0.1% AEP tidal flood event (see ***Figure 8*** earlier). As described in Section 3.5 earlier, the DCDP SFRA identifies the site as being in a defended area. The subject site is therefore located within Flood Zone A for tidal flooding (see Section 5 later for Justification Test) and is in a defended area.

4.1.4. This area has a long history of urban development and is located within the city centre of Dublin. As such, it is considered that the value of the defended area will justify continued maintenance of the flood defences for the design life of the proposed development. It is therefore reasonable to expect that the future tidal flood risk to the site will be largely mitigated by the flood defences and that only a residual risk (of flood defence failure) will exist.

4.1.5. All proposed Highly Vulnerable development in residential units will be provided at first floor level and above. The first floor will have a FFL of 6.0mAOD, which is well above the minimum FFL of

4.0mAOD recommended in the DCDP SFRA to mitigate tidal flood risk. It is further proposed to provide a walkway at first floor level linking all the proposed blocks. Access to the residential blocks will be provided at both ground floor level and at first floor level; this walkway will link to Connolly Station and provide an alternative route for access/egress to residential areas.

4.1.6. It is a design priority for the proposed development to integrate with existing development in the surrounding area and provide a vibrant thoroughfare through the development to facilitate and encourage connectivity between Seville Place and Oriel Street Upper to the east and Connolly Station and Amiens Street to the west. As such, the provision of active street level development is considered a design objective. It is therefore proposed to provide a thoroughfare through the development with ground level Finished Floor Level (FFL) at 1.85m AOD; the thoroughfare will slope down to meet Oriel Street Upper on the eastern boundary of the site. Accommodation at this level of 1.85m AOD will be limited to Less Vulnerable development uses.

4.1.7. It is proposed to include demountable flood barriers to provide an additional line of defence against flooding (details of a sample demountable barriers are included in ***Appendix F***). The height of the barriers should reach at least 4.0mAOD to provide the required flood defence level for tidal flooding. All possible entry points for water (doors, vents, windows, etc.) will be fitted with sealed de-mountable barriers also to prevent water entry. It is envisaged that the demountable barriers would be erected by Estate Management personnel in response to flood risk warning. It is recommended that the Management Company subscribe to available weather and flood risk warning services.

4.1.8. The basement floor level will be below the flood water level and will accommodate no residential units. The entrance to the

basement car park will be from the existing road level of approximately 1.0mAOD at Oriel Street Upper. It is proposed to provide a mechanised flood gate to the entrance of the basement (details of a sample flood gate system are included in ***Appendix G***). Flood gates can be configured for automatic operation (i.e. in response to local water level sensor), push-button operation and manual operation. It is envisaged that the proposed flood gate would be configured for automatic operation and push-button operation, with activation again by Estate Management personnel in response to flood risk warning.

4.1.9. Flood resilient building techniques and materials will be employed in the ground floor units and in the basement to minimize disruption to the operation of the building and facilitate shorter clean up times caused by a flood event. In the detailed design process, reference should be made to the UK guidance documents *Preparing For Floods* (Office of the Deputy Prime Minister, 2003) and *Improving the Flood Performance of New Buildings – Flood Resilient Construction* (EA & DEFRA, 2007). Some techniques include:

- structural walls and columns will be designed for short-term immersion;
- electrical sockets rated IP67 for immersion in water;
- materials, details and finishes are selected and designed for durability and ease of maintenance and will therefore be consistent with flood resilience.

4.1.10. As the site is in a defended area, it is considered that evacuation routes and access for emergency services will not be impeded during flood events, as flood waters will be contained by the flood defence infrastructure. In the unlikely event of a breach of these flood defences, flood waters could encroach on the roads surrounding the proposed development. Access and egress to the

residential areas of the development will be facilitated by the first floor level walkway.

4.1.11. As the site is in a defended area, the proposed development will not result in the loss of active functional floodplain; therefore, there will be no change to the residual risk profile in adjacent areas and compensatory storage is not required.

4.1.12. As part of the Eastern CFRAM Study, the potential effects of climate change were considered. The impact of the Mid-Range Future Scenario on tidal flood extents is reproduced in ***Figure 9***. As can be seen, the study predicts a substantial change to the tidal flood extents.

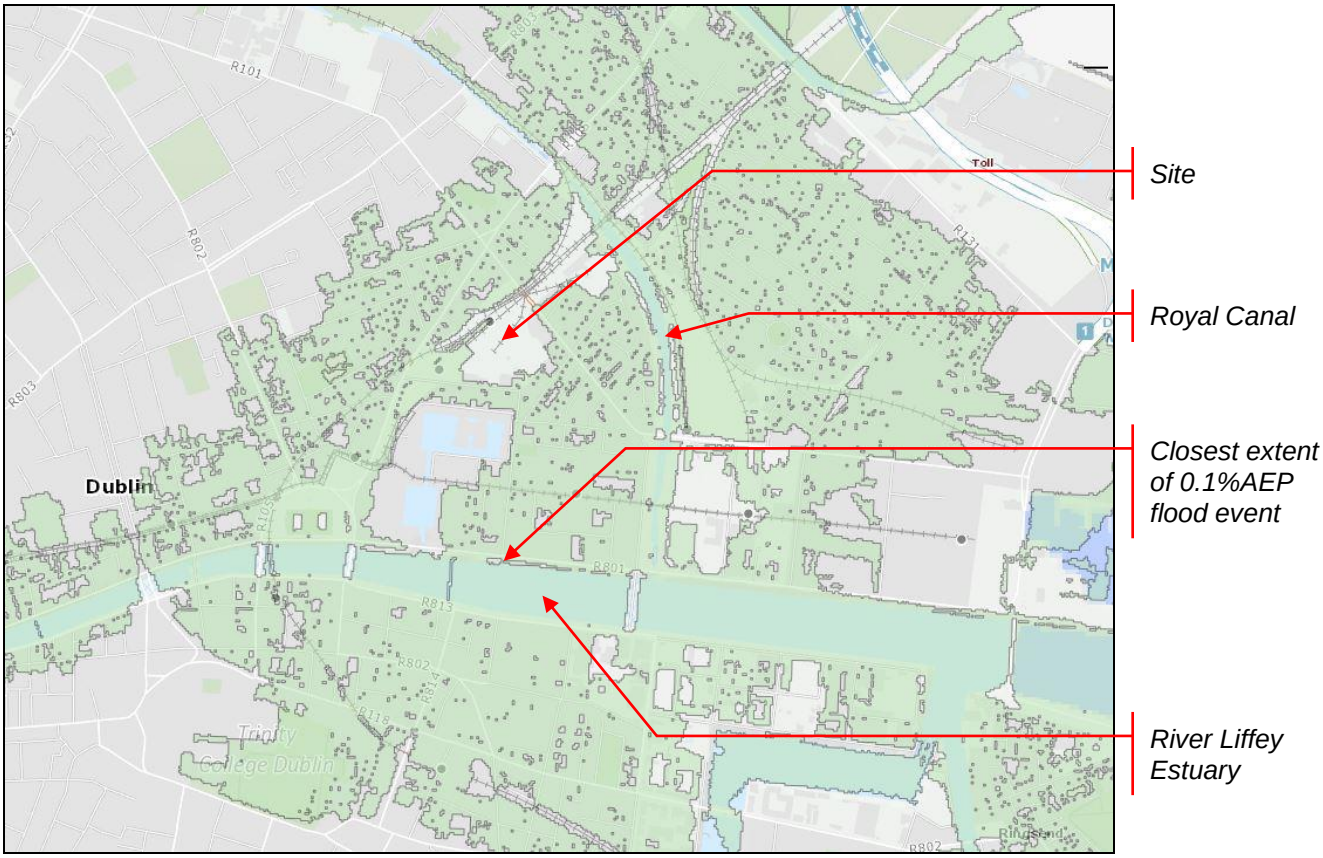


Figure 9: CFRAM Tidal Flood Extent 0.1% AEP Mid-Range Future Scenario Climate

4.1.13. ICPSS drawing number NE/RA/EXT/MRFS/19 (see ***Appendix H***) shows the predicted sea levels in the Mid-Range Future Scenario for climate change. Comparison with ICPSS drawing number

NE/RA/EXT/19 (see ***Appendix E***) indicates a predicted sea level rise of 500mm in both the 0.5% AEP and 0.1% AEP events.

4.1.14. The minimum FFL of 4.0mAOD recommended by the DCDP SFRA includes provision for the impacts of climate change. As described earlier in Section 4.1.5, all Highly Vulnerable development will be provided with a FFL of 6.0mAOD or higher. The flood defences included in the proposed development (as described in Sections 4.1.7 and 4.1.8 earlier) will provide a flood defence of 4.0mAOD, which includes provision for the impacts of climate change.

4.1.15. Based on the above, it is concluded that the site of the proposed development is within Flood Zone A/B (defended area) for tidal flooding, in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities*. A Justification Test is included in Section 5 later. As the site is in a defended area, the development will not impact on the active functional floodplain of the River Liffey. Mitigation measures for residual flood risk are included in the proposed development.

4.2. Fluvial Flooding

4.2.1. The site is located approximately 380m from the River Liffey Estuary. The Eastern Catchment Flood Risk Assessment and Management (CFRAM) Study fluvial flood extent maps (drawing numbers e09lif_exfcd_f1_03 and e09lif_exfcd_f1_04) are included in ***Appendix I***. An extract from the OPW floodinfo.ie website showing the Eastern CFRAM flood extent is shown in ***Figure 10***. The fluvial flood levels predicted by Eastern CFRAM are presented in ***Table 6***.

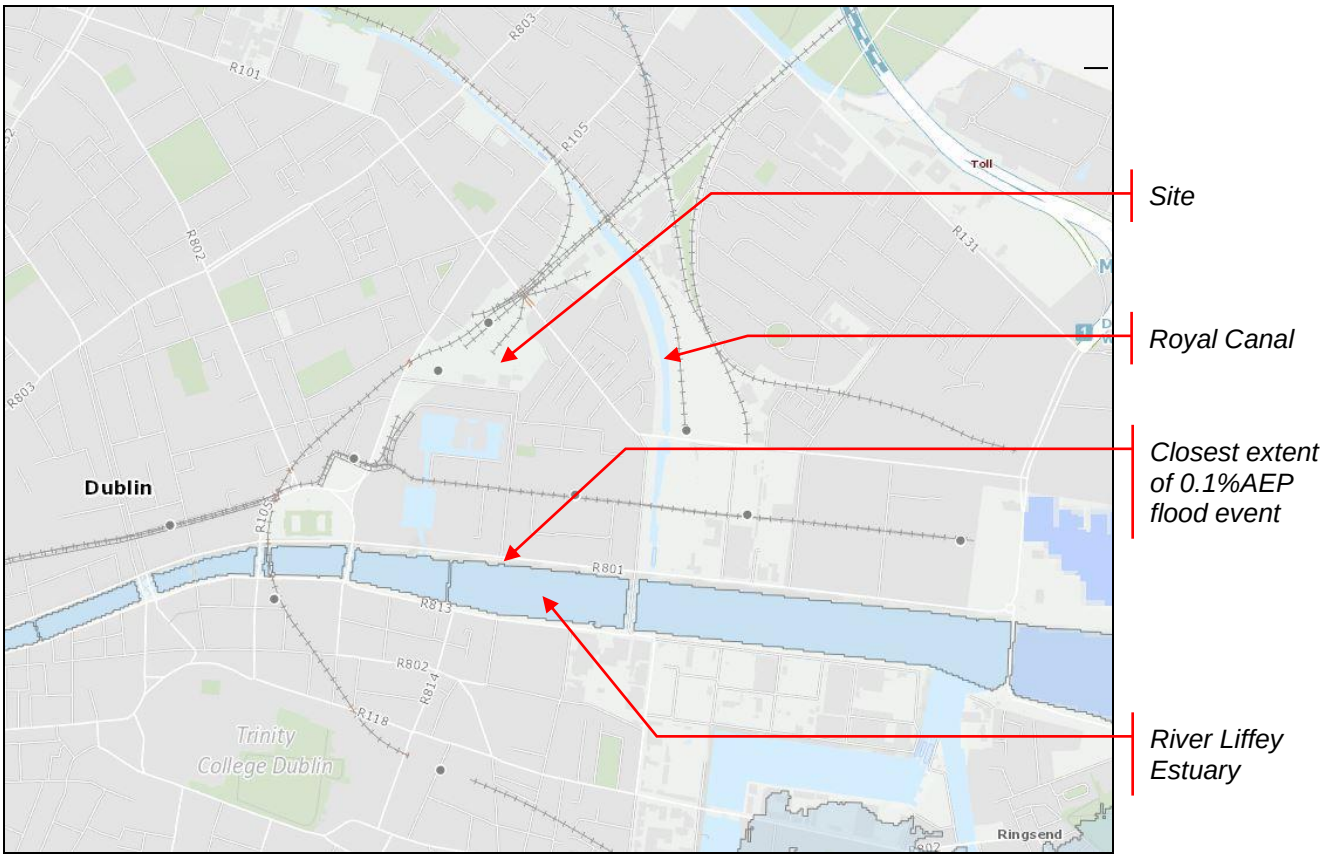


Figure 10: CFRAM Fluvial Flood Extent 0.1% AEP Current Climate

Table 6: River Liffey Fluvial Flood Levels

Annual Exceedence Probability (AEP)	1.0%	0.1%
09LIFF00230	2.44mAOD	2.44mAOD
09LIFF00180	2.45mAOD	2.45mAOD

4.2.2. It is noted that the predicted fluvial flood presented in the CFRAM flood extent mapping indicates a very marginal hydraulic gradient in the River Liffey at this location; this is characteristic of estuarial waters and indicates a strong tidal influence in the River Liffey Estuary at this location. It is further noted that the fluvial flood levels presented in ***Table 6*** are significantly lower than the tidal flood levels presented in ***Table 5***.

4.2.3. The existing ground levels on the perimeter of the site vary between 1.0mAOD and 1.9m AOD. However, the Eastern CFRAM map shows that the subject site is outside the active functional floodplain of the 0.1% AEP fluvial flood event (see ***Figure 10*** earlier). As described in Section 3.5 earlier, the DCDP SFRA identifies the site as being in a defended area. The subject site is therefore located within Flood Zone A for fluvial flooding (see Section 5 later for Justification Test) and is in a defended area.

4.2.4. This area has a long history of urban development and is located within the city centre of Dublin. As such, it is considered that the value of the defended area will justify continued maintenance of the flood defences for the design life of the proposed development. It is therefore reasonable to expect that the future fluvial flood risk to the site will be largely mitigated by the flood defences and that only a residual risk (of flood defence failure) will exist.

4.2.5. All proposed Highly Vulnerable development in residential units will, as noted, be provided at first floor level and above. The first floor will have a FFL of 6.0mAOD, which provides well in excess of the 500mm freeboard to the 1.0%AEP fluvial flood level recommended in the GDSDS. The first floor FFL of 6.0mAOD is also well above the minimum FFL of 4.0mAOD recommended in the DCDP SFRA to mitigate tidal flood risk. It is further proposed to provide a walkway at first floor level linking all the proposed

blocks. Access to the residential blocks will be provided at both ground floor level and at first floor level; this walkway will link to Connolly Station and provide an alternative route for access/egress to residential areas.

4.2.6. It is a design priority for the proposed development to integrate with existing development in the surrounding area and provide a vibrant thoroughfare through the development to facilitate and encourage connectivity between Seville Place and Oriel Street Upper to the east and Connolly Station and Amiens Street to the west. As such, the provision of active street level development is considered a design objective. It is therefore proposed to provide a thoroughfare through the development with ground level Finished Floor Level (FFL) at 1.85m AOD; the thoroughfare will slope down to meet Oriel Street Upper on the eastern boundary of the site. Accommodation at this level of 1.85m AOD will be limited to Less Vulnerable development uses.

4.2.7. It is proposed to include demountable flood barriers to provide an additional line of defence against flooding (details of a sample demountable barriers are included in ***Appendix F***). The height of the barriers should reach at least 4.0mAOD to provide the required flood defence level for tidal flooding. All possible entry points for water (doors, vents, windows, etc.) will be fitted with sealed de-mountable barriers also to prevent water entry. It is envisaged that the demountable barriers would be erected by Estate Management personnel in response to flood risk warning.

4.2.8. The basement floor level will be below the flood water level and will accommodate no residential units. The entrance to the basement car park will be from the existing road level of approximately 1.0mAOD at Oriel Street Upper. It is proposed to provide a mechanised flood gate to the entrance of the basement (details of a sample flood gate system are included in ***Appendix***

E). Flood gates can be configured for automatic operation (i.e. in response to local water level sensor), push-button operation and manual operation. It is envisaged that the proposed flood gate would be configured for automatic operation and push-button operation, with activation by Estate Management personnel in response to flood risk warning.

4.2.9. Flood resilient building techniques and materials will be employed in the ground floor units and in the basement to minimize disruption to the operation of the building and facilitate shorter clean up times caused by a flood event. In the detailed design process, reference should be made to the UK guidance documents *Preparing For Floods* (Office of the Deputy Prime Minister, 2003) and *Improving the Flood Performance of New Buildings – Flood Resilient Construction* (EA & DEFRA, 2007). Some techniques include:

- structural walls and columns will be designed for short-term immersion;
- electrical sockets rated IP67 for immersion in water;
- materials, details and finishes are selected and designed for durability and ease of maintenance and will therefore be consistent with flood resilience.

4.2.10. As the site is in a defended area, it is considered that evacuation routes and access for emergency services will not be impeded during flood events, as flood waters will be contained by the flood defence infrastructure. In the unlikely event of a breach of these flood defences, flood waters could encroach on the roads surrounding the proposed development. Access and egress to the residential areas of the development will be facilitated by the first floor level walkway.

4.2.11. As the site is in a defended area, the proposed development will not result in the loss of active functional floodplain; therefore,

there will be no change to the residual risk profile in adjacent areas and compensatory storage is not required.

4.2.12. As part of the Eastern CFRAM Study, the potential effects of climate change were considered. The impact of the Mid-Range Future Scenario on fluvial flood extents is reproduced in ***Figure 11***. As can be seen, there is no significant change to the predicted flood extents with respect to the subject site.

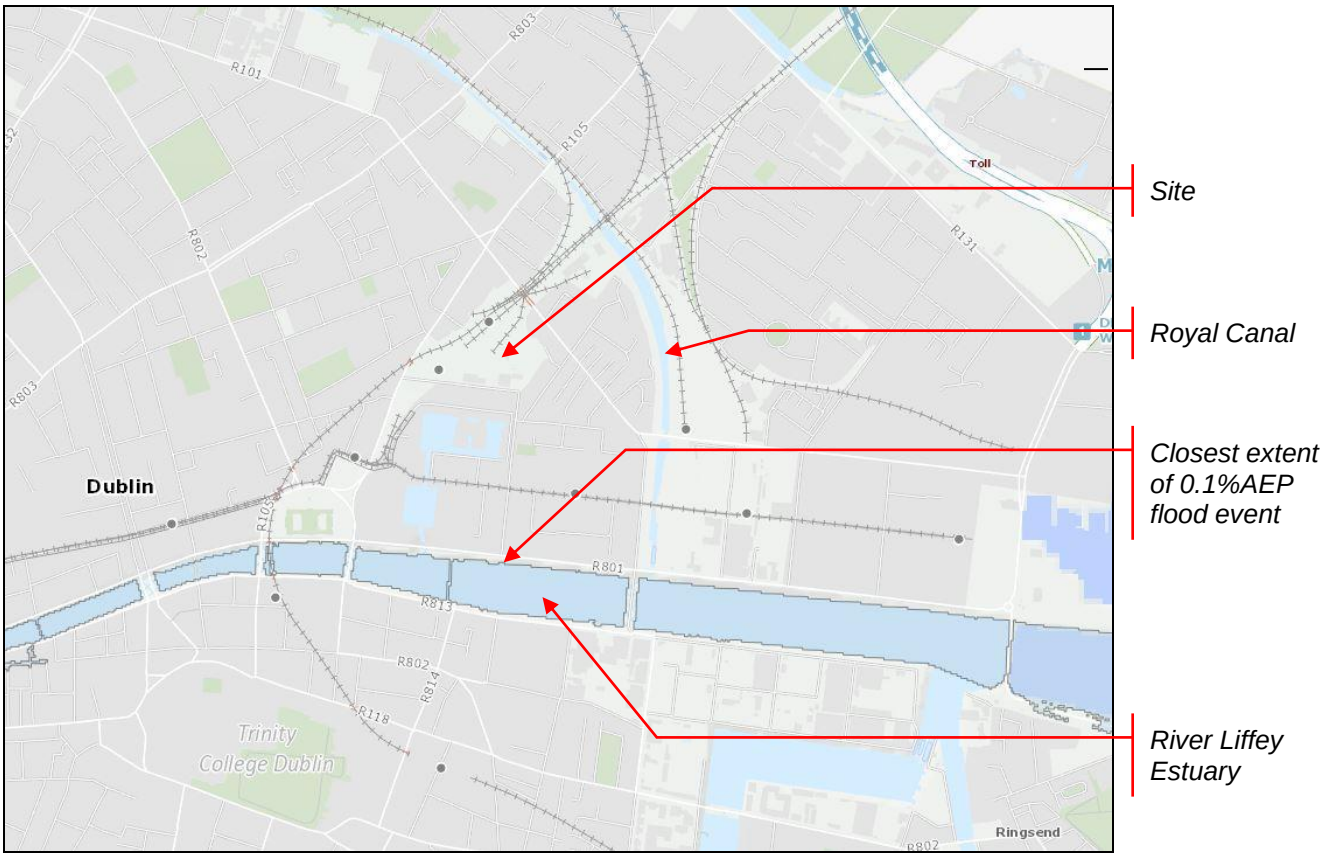


Figure 11: CFRAM Fluvial Flood Extent 0.1% AEP Mid-Range Future Scenario Climate

4.2.13. The minimum FFL of 4.0mAOD recommended by the DCDP SFRA includes provision for the impacts of climate change. As described earlier in Section 4.2.5, all Highly Vulnerable development will be provided with a FFL of 6.0mAOD or higher. The flood defences included in the proposed development (as described in Sections 4.2.7 and 4.2.8 earlier) will provide a flood defence of 4.0mAOD, which includes provision for the impacts of climate change.

4.2.14. Based on the above, it is concluded that the site of the proposed development is within Flood Zone A/B (defended area) for fluvial flooding, in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities*. A Justification Test is included in Section 5 later. As the site is in a defended area, the development will not impact on the active functional floodplain of the River Liffey. Mitigation measures for residual flood risk are included in the proposed development.

4.3. Pluvial Flooding

4.3.1. As part of the European Union's Flood ResilienCity Project, Dublin City Council and the Office of Public Works undertook a study of pluvial flooding in Dublin City. The study produced flood risk mapping; see drawing e09dcc_expcd_f0_03 in ***Appendix J*** and extract in ***Figure 12*** below.

Figure 12: Extract from Flood ResilienCity Pluvial Study (shaded areas represent areas of pluvial flood risk)

4.3.2. The Strategic Flood Risk Assessment included in the DCDP contains a Pluvial Flood Depth and Flood Hazard Maps – extracts are reproduced in ***Figure 13*** and ***Figure 14*** over.

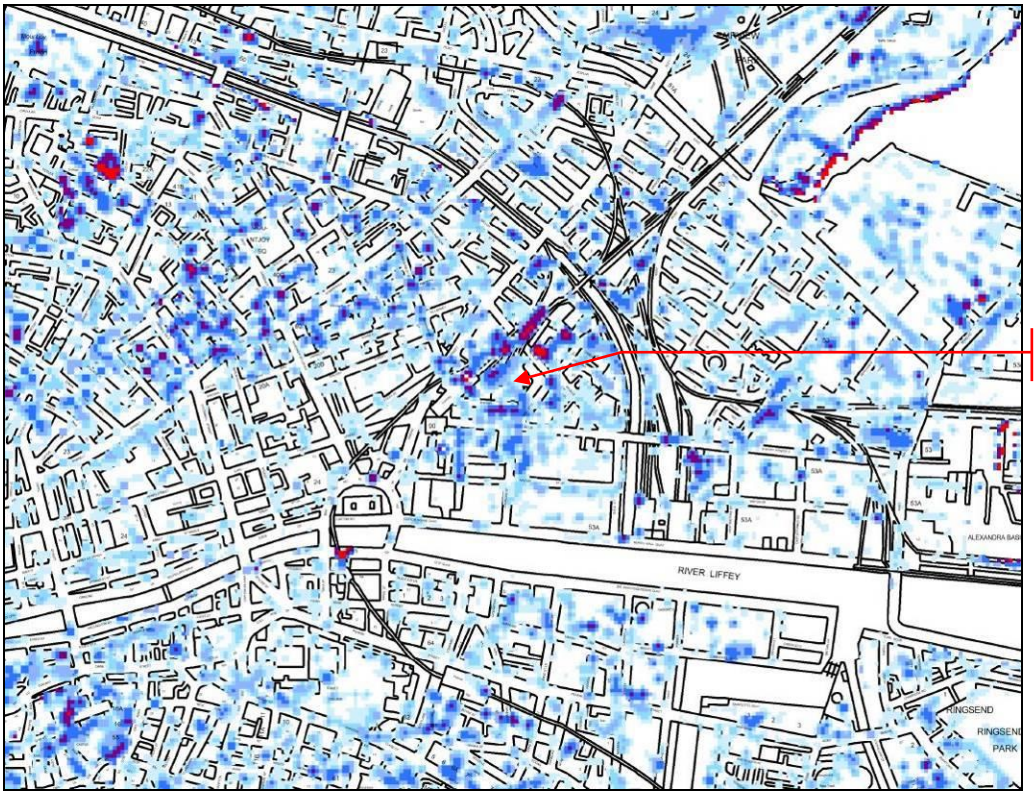


Figure 13: Extract from Flood ResilienCity Type 1 Pluvial Flood Depth Map (DCDP SFRA)

Figure14: Extract from Flood ResilienCity Type 1 Pluvial Flood Hazard Map (DCDP SFRA)

4.3.3. These maps, along with the topographical survey and a walkover of the site and surrounding area, were used to assess the potential risk to the site from pluvial flooding.

4.3.4. The Flood ResilienCity pluvial flood mapping shows small pockets of moderate pluvial flood risk present on the subject site; this corresponds to minor undulations in the ground level within the undeveloped site. In developing the site, the ground levels will be re-profiled, removing these undulations. The maps also show pockets of pluvial flooding on existing public roads around the subject site. The development proposals provide building thresholds above adjacent road levels, thus mitigating the pluvial flood risk to proposed development.

4.3.5. The site is currently occupied by surface car-parking and low rise office and storage buildings; the site is largely in hardstand and is provided with no attenuation facility or flow control mechanism. The proposed drainage system will be designed to modern design standards and will collect surface water runoff from the site and attenuate to equivalent greenfield runoff rates; this will mitigate the potential pluvial flood risk arising from the subject site.

4.3.6. Furthermore, as described earlier in Sections 4.1 and 4.2, flood resilient building technologies will be used in the ground floor level units and in the basement car-park. These mitigation measures will also mitigate the risk from pluvial flooding.

4.4. Existing Drainage and Watermains

4.4.1. There is an existing drainage network in place serving the area around the proposed development. Irish Water records (see ***Appendix K***) show the location of the existing drainage within the vicinity of the site. As-constructed drawings of services in the LUAS corridor are provided in ***Appendix L***. GDSDS Sewer Performance drawing GDSDS/MAR3079/F005/P3-003/ TILE 2 (see ***Appendix M***) shows the expected performance of the sewerage system in the future scenario.

4.4.2. The Records show that the sewers in the wider area are combined (collecting both foul sewage and surface water runoff) and that surcharging leads to flooding at a number of locations in the locality. As the sewer is located in the existing public roads, any flooding that might occur would result in overland flow similar to pluvial flooding (as described in earlier Section 4.3); the mitigation measures described earlier would protect the development from overland flow.

4.4.3. The proposed development will be provided with separate foul and surface water gravity drainage systems serving the ground floor levels and above. Drainage at basement level will be served by a pumped connection to the main sewerage network, removing the risk of surcharging in the sewerage system backing-up into the basement.

4.4.4. There is an existing watermain network in place serving the area around the proposed development and wider region. DCC records (see ***Appendix K***) show the location of the existing watermains within the vicinity of the site. The watermains in the immediate vicinity of the site are relatively small in size. Larger diameter watermains are located remote from the site; in the event of leaks in the watermains resulting in local flooding, water would flow

overland along the local road network. This would result in overland flow similar to pluvial flooding (as described in earlier Section 4.3); the mitigation measures described earlier would protect the development from overland flow.

4.5. Proposed Drainage Infrastructure

4.5.1. The design of the proposed drainage adheres to the hydraulic performance criteria set out in the *Greater Dublin Strategic Drainage Study* and in the *Building Regulations Part H,* in order to achieve self-cleansing velocity, minimising the potential for blockages leading to flooding.

4.5.2. The site is currently in hardstand and is drained by a piped gravity drainage system that provides no attenuation of runoff. The proposed drainage system will incorporate Sustainable Drainage Systems (SuDS) that will control the discharge rate from the site to equivalent greenfield runoff rates. The proposed development therefore represents a significant betterment of the existing scenario and, as such, there will be a significant reduction in the risk of flooding on the site and off the site as a result of the proposed drainage infrastructure.

4.5.3. All pumped connections, and connections to public drainage, will be fitted with non-return valves to prevent flooding within the building should the drainage network surcharge or flooding occur.

4.5.4. The flood risks arising from the proposed drainage infrastructure will be negligible and no further mitigation is required.

4.6. Groundwater Flooding

4.6.1. The OPW's *Draft Preliminary Flood Risk Assessment* (DPFRA) includes an assessment of groundwater flood risk. The DPFRA flood risk map included in ***Appendix N*** indicates no groundwater flood risk to the site or to the surrounding area.

4.6.2. According to data obtained from the *Geological Survey of Ireland* (http://www.gsi.ie), the subject site is located on made ground subsoil on top of Lucan formation limestone and shale (calp). It is located on a locally important aquifer with bedrock which is moderately productive only in local zones. The groundwater vulnerability assessment of the site shows that the vulnerability of groundwater in the area is low (see ***Appendix O***).

4.6.3. There is no record of groundwater flooding for the subject site.

4.6.4. The proposed development includes a one-storey basement below ground level. The walls and floors of this basement will be tanked to exclude ground water and protect the basement from groundwater ingress.

4.6.5. The probability of groundwater rising above ground levels is considered extremely low. In any such event, water would follow overland flow routes (see Section 4.3) and mitigation measures described earlier would protect the development.

4.6.6. It is concluded therefore that the flood risk represented by ground water is negligible and no further mitigation is required.

4.7. The Royal Canal & George's Dock

4.7.1. The Royal Canal is located approximately 250m to the east and northeast of the site; the canal discharges to the River Liffey Estuary just downstream of the Samuel Beckett Bridge

4.7.2. Waterways Ireland is the responsible body for the Royal Canal. To inform the OPW's National PFRA, Waterways Ireland produced a PFRA for the canal system, including the Royal Canal (see extract in ***Appendix P***). This report was completed in 2011 and examined the historical flooding events, potential flooding mechanisms and the possible future flooding events. With regard to the Royal Canal, the report concludes that "the only area of potentially significant flood risk" is in Mullingar, Co. Westmeath.

4.7.3. The Royal Canal represents a potential pathway for tidal flood waters. The high tidal event of 1st February 2002 caused the Royal Canal to overtop its banks at Spencer Dock due to the inflow of water from the River Liffey estuary. The Dublin Coastal Flooding Protection Project (DCFPP) produced a report on this event which included maps showing the extent of the flooding in Dublin – see ***Appendix Q***. An extract of this drawing is reproduced in ***Figure 15*** over.

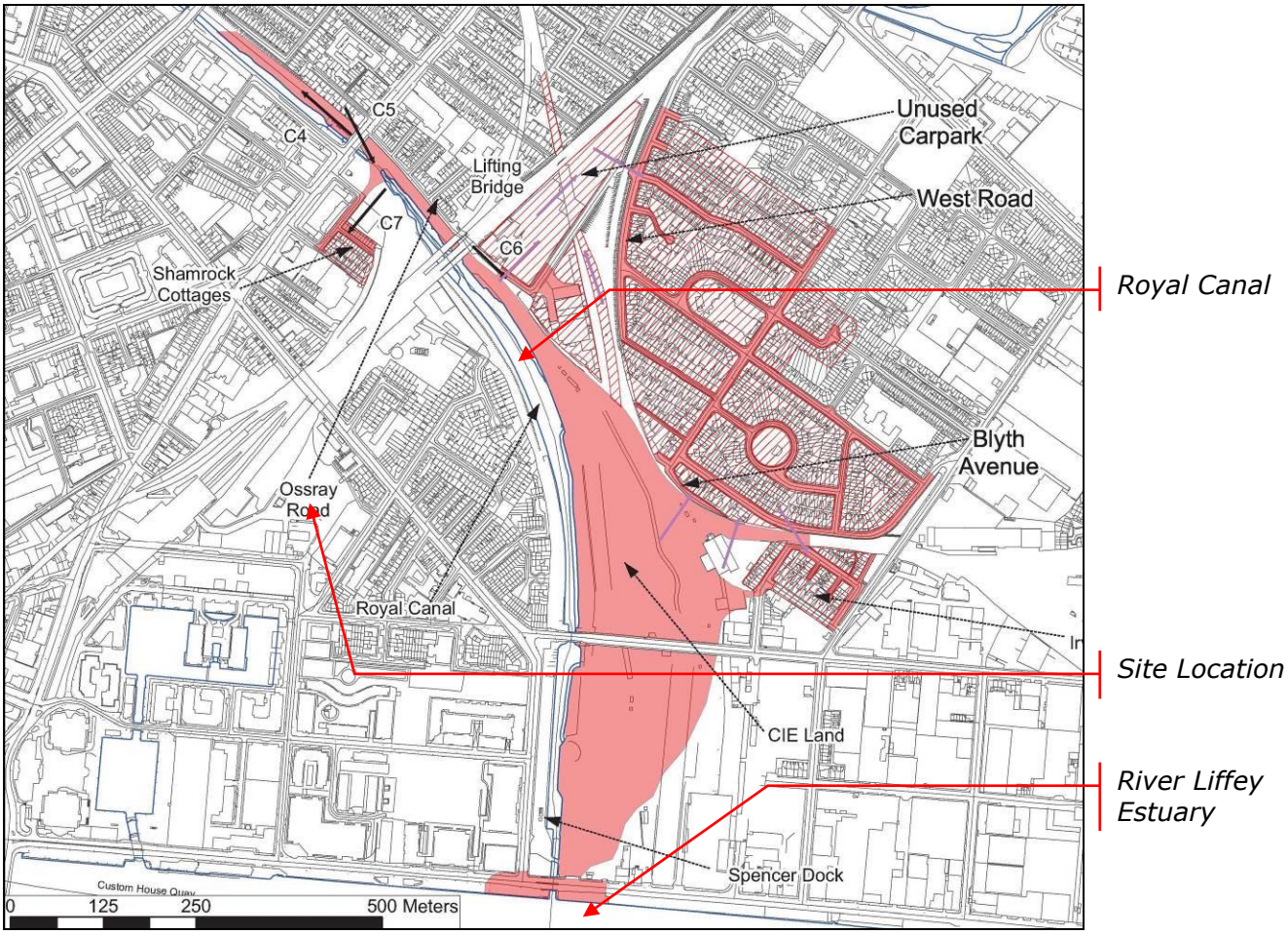


Figure 15: Extract of DCFPP map showing 2002 extent of tidal flooding via Royal Canal pathway

4.7.4. This drawing shows that the majority of the overtopped water flowed to the east of the canal and not in the direction of the subject site. Waterways Ireland's 2011 report states that, at Spencer Dock, "a new sea lock and flood protection system was constructed so that high tides can no longer cause this type of flooding". The risk from tidal flooding via all pathways is assessed in Section 4.1.

4.7.5. One of the mechanisms for canal flooding identified by Waterways Ireland relates to canal lock failure. Lock No.1 is approximately 1.0km upstream from Spencer Dock. Lock No.2 is approximately 1.0km further upstream at Drumcondra Road. The next four locks are located within the next 1.2km upstream from Drumcondra

Road. The distance upstream from the subject site to Lock No.1 significantly mitigates the impact of sudden failure of the canal lock. Lock failure at Lock No.1 would likely result in the downstream canal overtopping the banks of the canal. The tidal flood event of 2002 (as shown in ***Figure 15*** earlier) indicates that excess water leaving the canal flows to areas east of the canal, away from the subject site.

4.7.6. The disused dock at George's Dock, to the southwest of the site, is similar to the Royal Canal in that it is separated from the River Liffey by a series of mitre gates. However, there is no upstream canal and there are no upstream lock gates.

4.7.7. The risk of flooding from the Royal Canal and George's Dock is minor and therefore no additional mitigation measures are proposed.

5. JUSTIFICATION TEST

5.1. In November 2009, Planning Guidelines on *The Planning System and Flood Risk Management* were published by the Department of the Environment, Heritage and Local Government (DOEHLG).

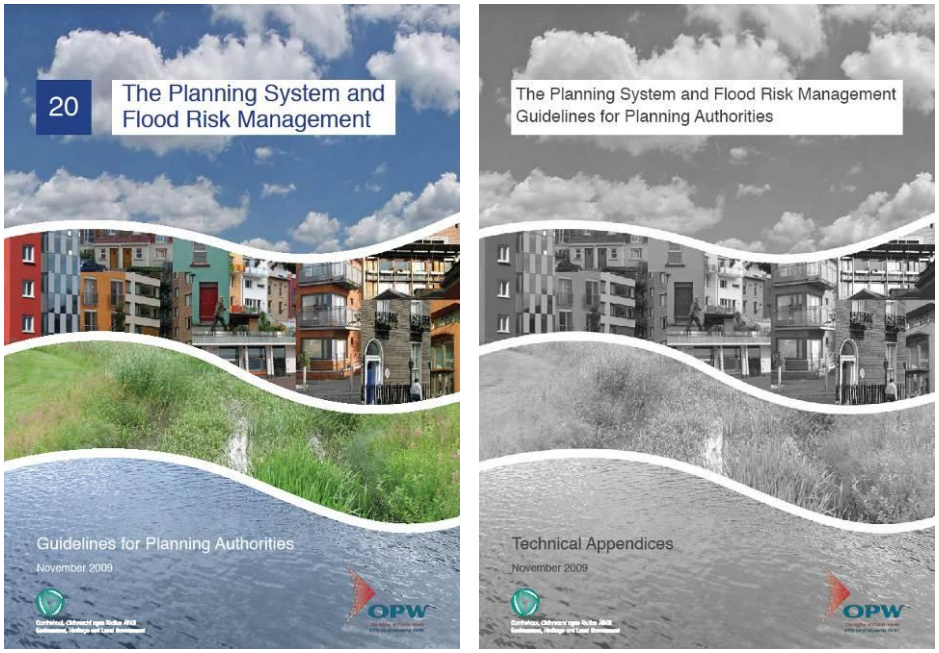


Figure 16: The Planning System and Flood Risk Management

5.2. As described in Section 2 earlier, the proposed development comprises mixed uses including Highly Vulnerable and Less Vulnerable development, in accordance with Table 3.1 of the Guidelines.

5.3. Based on the assessment in Sections 4.1 and 4.2 earlier, it is concluded that the site of the proposed development is within Flood Zone A/B and is in a defended area. Therefore, a Justification Test is required for the proposed development.

5.4. As noted previously, all proposed Highly Vulnerable development will be provided at first floor level and above. The first floor will have a FFL of 6.0mAOD, which provides well in excess of the 500mm freeboard to the 1.0%AEP fluvial flood level recommended

in the GDSDS. The first floor FFL of 6.0mAOD is also well above the minimum FFL of 4.0mAOD recommended in the DCDP SFRA to mitigate tidal flood risk. It is further proposed to provide a walkway at first floor level linking all the proposed blocks. Access to the residential blocks will be provided at both ground floor level and at first floor walkway level; this walkway will link to Connolly Station and provide an alternative route for access/egress to residential areas.

5.5. A thoroughfare through the development is proposed with ground level Finished Floor Level (FFL) at 1.85m AOD; the thoroughfare will slope down to meet Oriel Street Upper on the eastern boundary of the site. Accommodation at this level of 1.85m AOD will be limited to Less Vulnerable development uses. Ground Floor units will be constructed using flood resilient building techniques. Furthermore, it is proposed to include demountable flood barriers to provide an additional line of defence against flooding.

5.6. The entrance to the proposed basement car-park will be provided with a mechanised flood gate and the basement will be constructed using flood resilient techniques.

5.7. As part of the Dublin City Development Plan (2016-2022) Strategic Flood Risk Assessment, the Justification Test for Development Plans was prepared for various areas of the city; the subject site is located within an area identified as Site 3 – see DCDP SFRA Justification Test in ***Appendix R***.

5.8. The Justification Test is divided in two: (1) Justification Test for Development Plans and (2) Justification Test for Development Management:

JUSTIFICATION TEST FOR DEVELOPMENT PLANS

1. Urban settlement is targeted for growth.

Yes: The subject site is within Dublin City, which is targeted for growth in the National Spatial Strategy 2002-2020, Regional Planning Guidelines for the Greater Dublin Area 2010-2022 and in the Dublin City Development Plan 2016-2022.

2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and, in particular:

i. Essential to facilitate regeneration and / or expansion of the centre of the urban settlement.

Yes: The site is located within Strategic Development and Regeneration Area 6 – Docklands. The proposed development provides high density development with land-use consistent with the surrounding area and the Dublin City Development Plan 2016-2022.

ii. Comprises significant previously developed and / or underutilised lands.

Yes: The existing development on the subject site comprises surface car-parking and low-rise office and storage buildings. The existing use therefore represents under-utilisation of the site at a key location in Dublin City Centre. The proposed development provides higher density occupation at the site.

iii. Is within or adjoining the core of an established or designated urban settlement.

Yes: The subject site is within the urban core of Dublin City.

iv. Will be essential in achieving compact and sustainable urban growth.

Yes: The proposed development will provide high-density development within the urban core of Dublin City. The site is located on existing public transport routes; it is located immediately beside a major commuter and intercity rail hub and is within easy walking distance of national bus hub, light rail services and city bus services. It is within easy walking distance of retail and leisure functions in Dublin City. High density development of the site will contribute to sustainable travel patterns. Limited parking spaces and secure bicycle parking are provided to encourage sustainable travel patterns. The surrounding area is serviced by existing utilities and water services infrastructure, so a minimum of new infrastructure will be required. **v. There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.** Yes: The subject site is located within the urban core of Dublin City and all land in the vicinity is currently in urban use. **3. A flood risk assessment to an appropriate level of detail has been carried out.** Yes: The current report comprises a detailed site-specific flood risk assessment for the subject site that identifies and recommends mitigation measures.
Conclusion: The subject site passes the Justification Test for Development Plans.

JUSTIFICATION TEST FOR DEVELOPMENT MANAGEMENT

1. The subject lands have been zoned for the particular use.

Yes: In the Dublin City Development Plan 2016-2022, the site is zoned Z5 "to consolidate and facilitate the development of the central area, and to identify, reinforce, strengthen and protect its civic design character and dignity".

2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:

Yes: This report comprises a site-specific flood risk assessment – see preceding sections.

(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;

Yes: The preceding sections of this report demonstrate that the permitted development will not increase flood risk elsewhere.

(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;

Yes: The proposed new development will provide Highly Vulnerable uses at a higher level, with a connected high level walkway providing alternative access/egress routes. The entrance to the basement car-park will be provided with a mechanised flood gate. Less Vulnerable development at ground floor level will be provided with demountable flood barriers and be constructed using flood resilient building technologies. Attenuation is provided to reduce the rate of runoff from the development, improving on the existing risk scenario. The preceding sections of this report describe mitigation measures to minimise flood risk.

(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to

an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and Yes: The preceding sections of this report describe mitigation measures to minimise flood risk. **(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.** Yes: The recommended mitigation measures are contained within the development site and do not impact on the flood risk to adjacent properties. The mitigation measures have no impact on the character of the proposed development.
Conclusion: The subject site passes the Justification Test for Development Management.

6. DUBLIN CITY COUNCIL FLOW CHARTS

6.1. Reference is made to the flow charts enclosed as Appendix 4 of the Strategic Flood Risk Assessment for the Dublin City Development Plan 2016-2022. Flow Chart 1 is reproduced in ***Figure 17*** with highlighted flow path lines for the subject development. It is noted that the subject development includes both Highly Vulnerable and Less Vulnerable development uses.

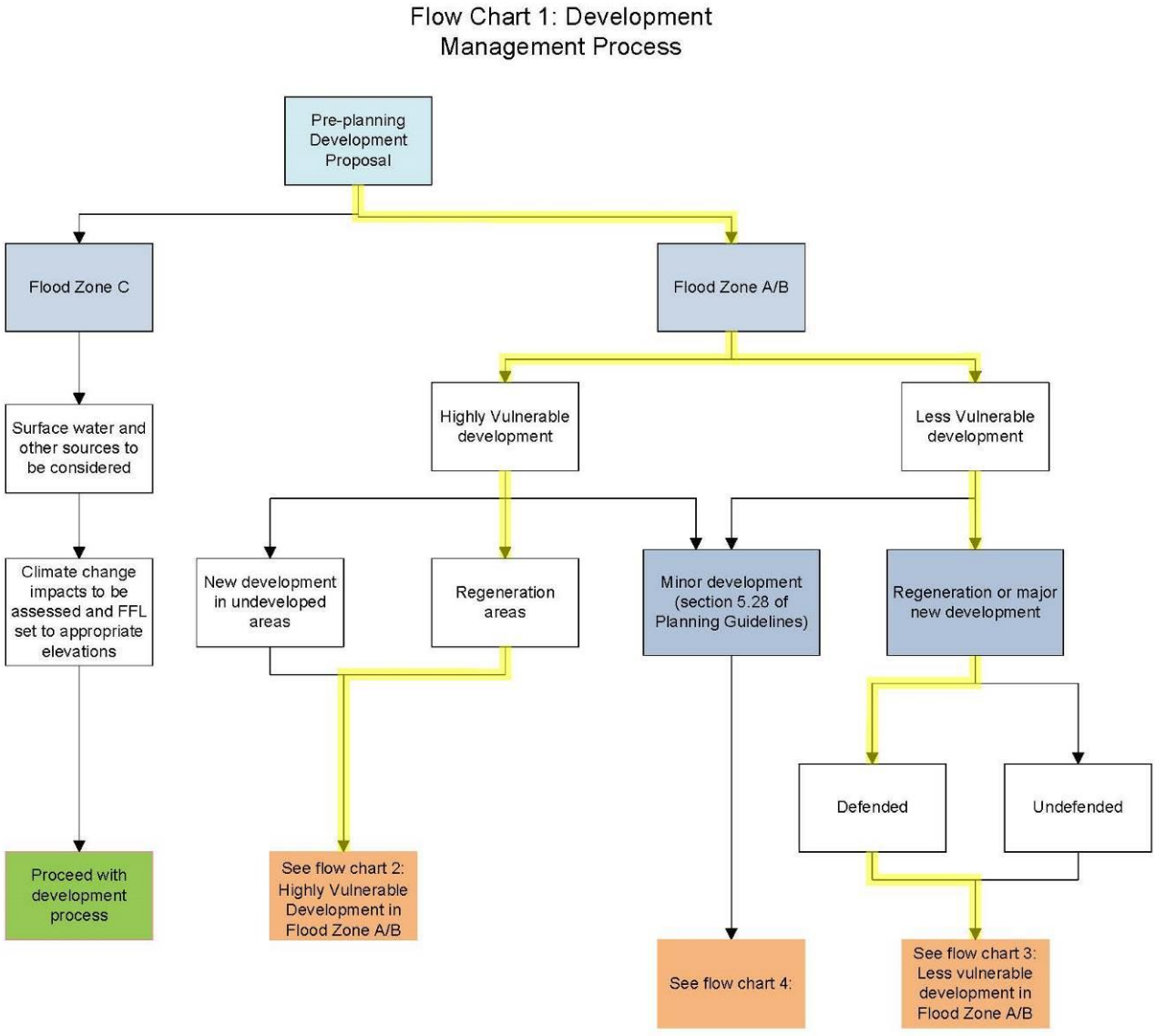


Figure 17: Flow Chart 1 from the DCDP SFRA

6.2. Flow Chart 1 requires reference to Flow Chart 2 for the Highly Vulnerable development uses. Flow Chart 2 is reproduced in ***Figure 18*** with highlighted flow path lines for the subject development.

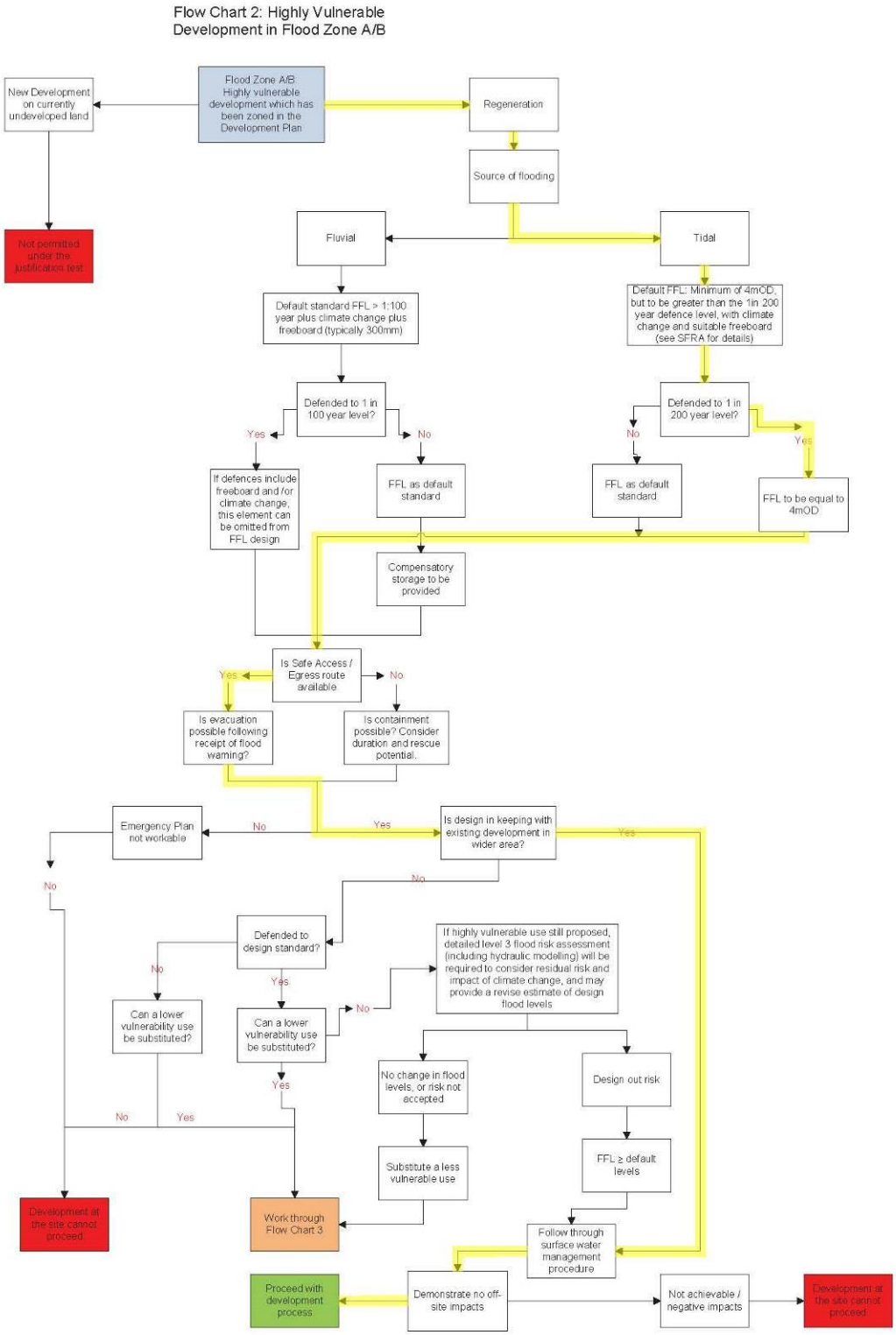


Figure 18: Flow Chart 2 from the DCDP SFRA

6.3. Flow Chart 1 requires reference to Flow Chart 3 for the Less Vulnerable development uses. Flow Chart 3 is reproduced in ***Figure 19*** with highlighted flow path lines for the subject development.

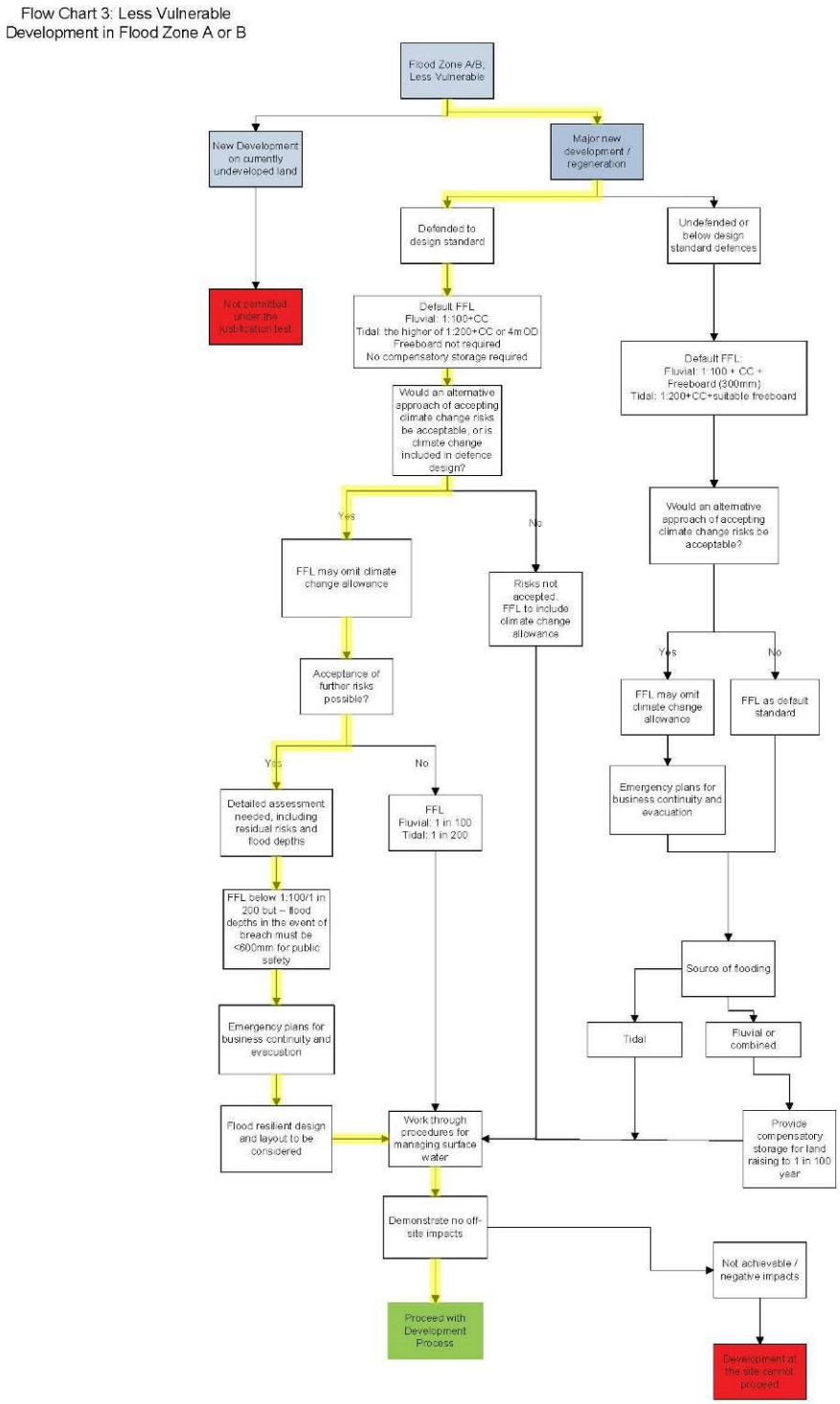


Figure 19: Flow Chart 3 from the DCDP SFRA

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. The proposed development is residential led with some ancillary commercial use and therefore includes Highly Vulnerable and Less Vulnerable development uses, in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities*.

7.2. The available data indicates that the site is within Flood Zone A/B for fluvial and tidal flooding and is in a defended area.

7.3. A Justification Test has been carried out in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities*. The results show that the subject development passes the Justification Test.

7.4. As the site is in a defended area, development works will not lead to a loss of active functional floodplain storage and so compensatory storage is not required. Residual risk is mitigated by: provision of Highly Vulnerable development uses above the recommended minimum of 4.0mAOD with a high-level walkway for access/egress; provision of flood defences and use of flood resilient construction technologies for Less Vulnerable development uses at a lower level.

7.5. The roads adjacent to the site are subject to potential overland flow and ponding arising from pluvial, drainage infrastructure and watermain infrastructure sources. The provision of ground level FFLs at a level higher than the surrounding street levels and the mitigation measures outlined above will be effective in mitigating these risks to the site.

7.6. The proposed drainage system has been designed in accordance with the relevant standards and regulations. The flood risks arising from the proposed drainage infrastructure is negligible and no further mitigation is required. The provision of attenuation of runoff

from the subject site represents a betterment of existing and a reduction in associated flood risk.

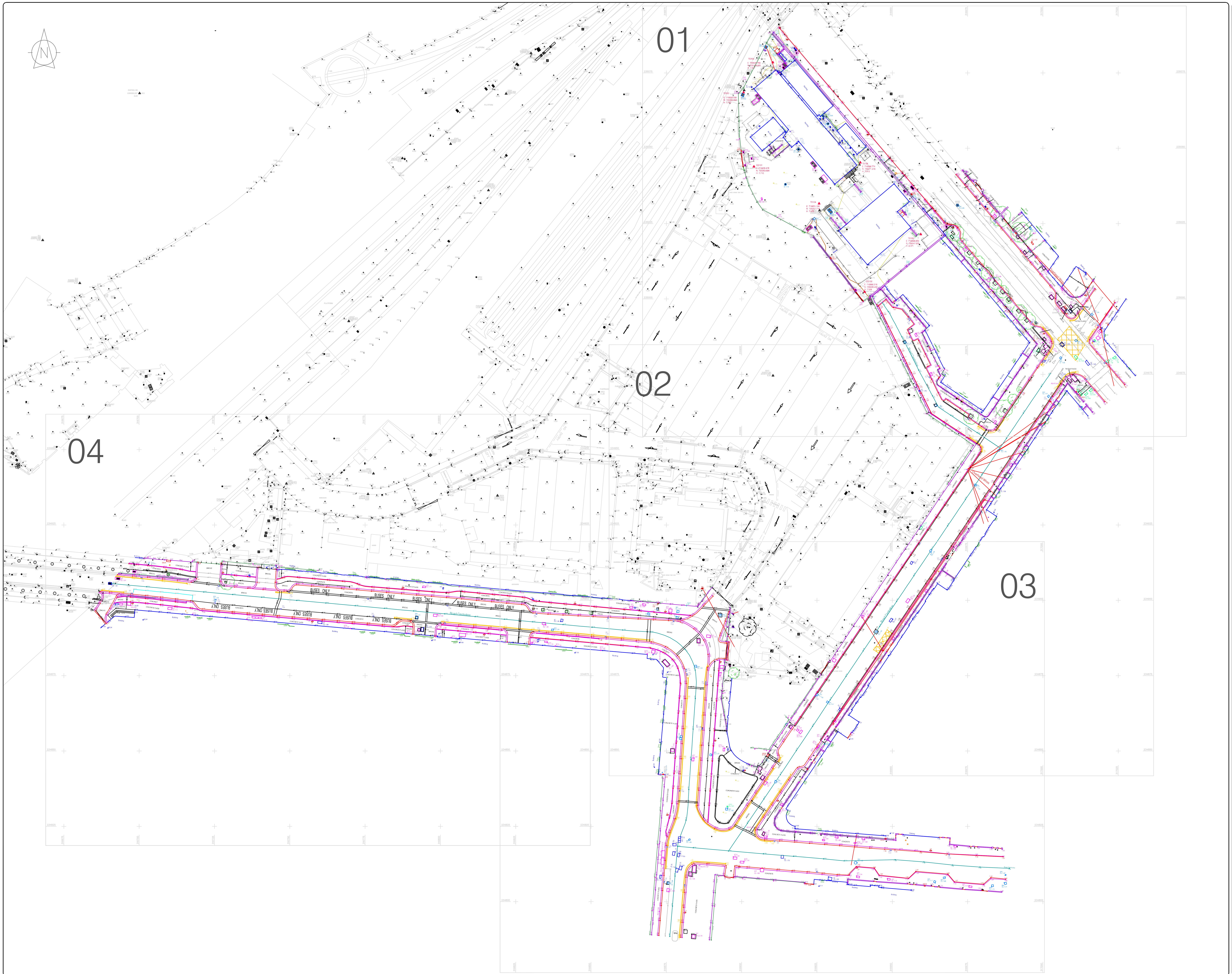
7.7. The flood risk represented by ground water will be mitigated by providing tanked waterproofing to the basement level; no further mitigation is required.

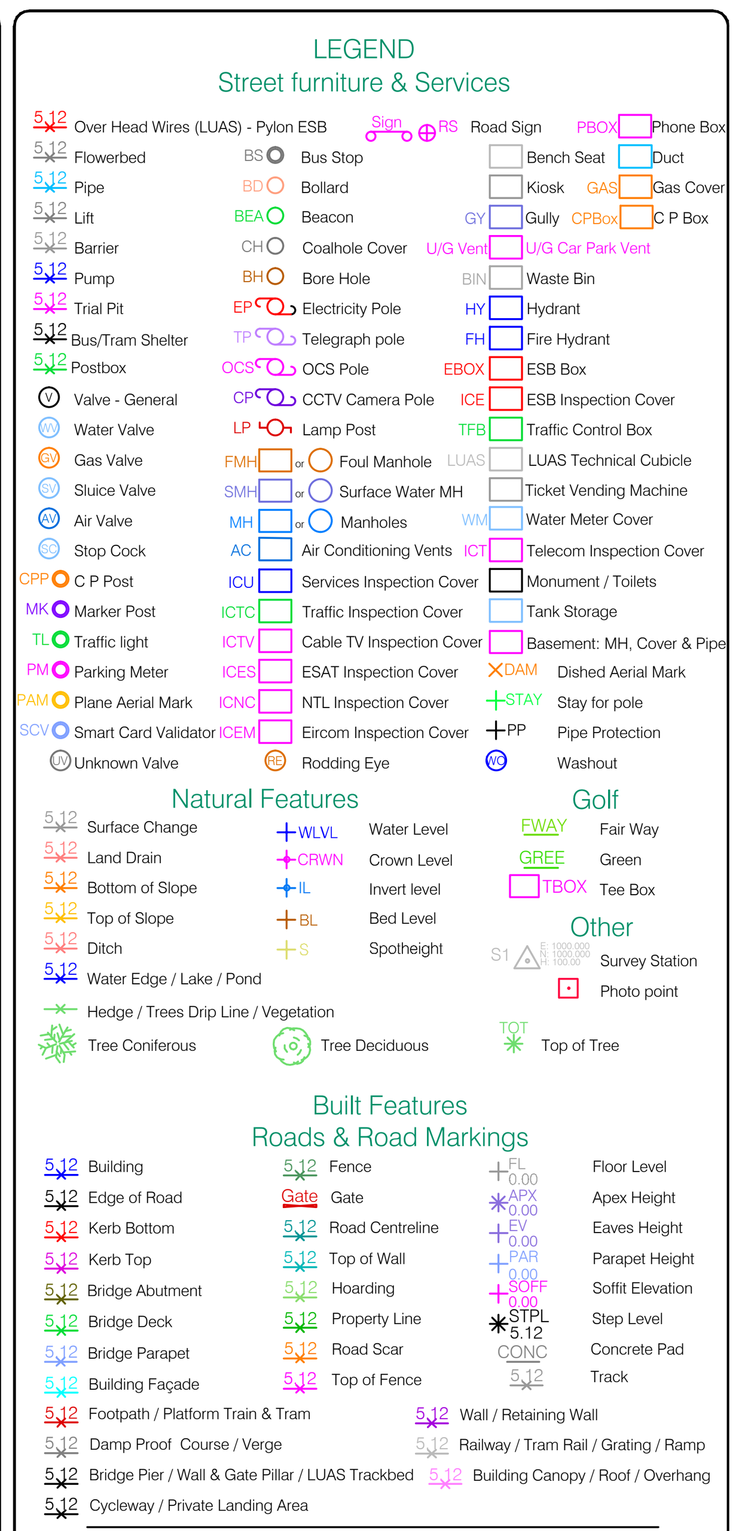
7.8. The flood risk represented by the Royal Canal and George's Dock is negligible and no further mitigation is required.

Niall McMenamin
Chartered Engineer
Associate
O'Connor Sutton Cronin

APPENDIX A

Topographical Survey





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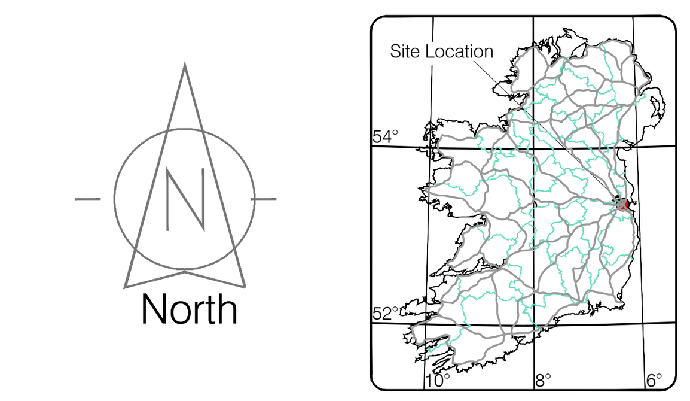
The Client must promptly notify the Company of any errors in mapping of which it becomes aware. If misleading, inaccurate or otherwise inappropriate information is brought to the Company's attention or the Company itself identifies any such imprecision or error in a survey, it shall use its reasonable endeavours to fix or remove it and if necessary in certain instances, the Company being on notice of any such misleading, inaccurate or otherwise inappropriate information, it will re-conduct the survey and reproduce the data to within the specified scale or accuracy.



Map Sheet Layout:

Surveyed by : ED — Date: 02.08.2018 — Datum : Malin Head
Drawn by : LR — Date: 15.08.2018 — Grid System:
Checked by : PK — Date: 15.02.2018 — Irish National Grid ☒ ITM(15) ☐

Revisions

No.	Date	Description
0	15.08.2018	First Drawing

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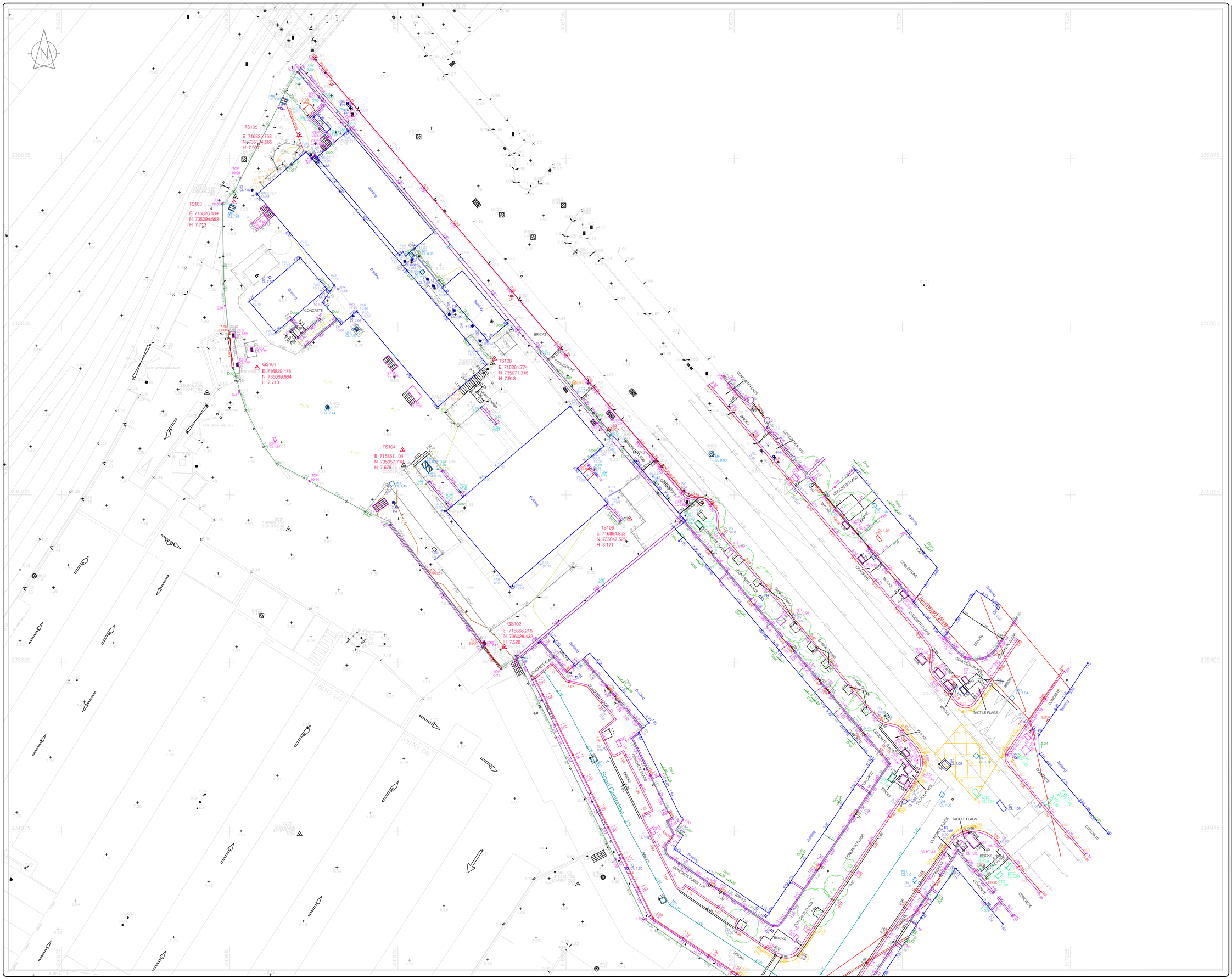
Client : O Connor Sutton Cronin

Project : Additional Survey At Connolly Station

Date : 15.08.2018 **Scale :** NTS

Description : Topographical Survey
Sheet 4

Drawing Number : MSL26950_T_3D_Rev0



LEGEND

Street furniture & Services

- Over Head Wires (LUAS) - Pylon ESB
- Flowerbed
- Pipe
- Lift
- Barrier
- Pump
- Trial Pit
- Bus/Tram Shelter
- Postbox
- Valve - General
- Water Valve
- Gas Valve
- Sluice Valve
- Air Valve
- Stop Cock
- C P Post
- Marker Post
- Traffic light
- Parking Meter
- Plane Aerial Mark
- Smart Card Validator
- Unknown Valve
- Bus Stop
- Bollard
- Beacon
- Coalhole Cover
- Bore Hole
- Electricity Pole
- Telegraph pole
- OCS Pole
- CCTV Camera Pole
- Lamp Post
- Foul Manhole
- Surface Water MH
- Manholes
- Air Conditioning Vents
- Services Inspection Cover
- Traffic Inspection Cover
- Cable TV Inspection Cover
- ESAT Inspection Cover
- NTL Inspection Cover
- Eircom Inspection Cover
- Rodding Eye
- Road Sign
- Bench Seat
- Kiosk
- Gully
- Waste Bin
- Hydrant
- Fire Hydrant
- ESB Box
- ESB Inspection Cover
- Traffic Control Box
- LUAS Technical Cubicle
- Ticket Vending Machine
- Water Meter Cover
- Telecom Inspection Cover
- Monument / Toilets
- Tank Storage
- Basement: MH, Cover & Pipe
- Dished Aerial Mark
- Stay for pole
- Pipe Protection
- Washout
- Phone Box
- Duct
- Gas Cover
- C P Box
- LUAS Car Park Vent

Natural Features

- Surface Change
- Land Drain
- Bottom of Slope
- Top of Slope
- Ditch
- Water Edge / Lake / Pond
- Hedge / Trees Drip Line / Vegetation
- Tree Coniferous
- Water Level
- Crown Level
- Invert level
- Bed Level
- Spotheight
- Tree Deciduous

Golf

- Fair Way
- Green
- Tee Box

Other

- Survey Station
- Photo point
- Top of Tree

Built Features

Roads & Road Markings

- Building
- Edge of Road
- Kerb Bottom
- Kerb Top
- Bridge Abutment
- Bridge Deck
- Bridge Parapet
- Building Façade
- Footpath / Platform Train & Tram
- Damp Proof Course / Verge
- Bridge Pier / Wall & Gate Pillar / LUAS Trackbed
- Cycleway / Private Landing Area
- Fence
- Gate
- Road Centreline
- Top of Wall
- Hoarding
- Property Line
- Road Scar
- Top of Fence
- Floor Level
- Apex Height
- Eaves Height
- Parapet Height
- Soffit Elevation
- Step Level
- Concrete Pad
- Track
- Wall / Retaining Wall
- Railway / Tram Rail / Grating / Ramp
- Building Canopy / Roof / Overhang

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North

Site Location

Map Sheet Layout:

Surveyed by :	ED	Date: 02.08.2018	Datum: Main-Head
Drawn by :	LR	Date: 15.08.2018	Grid System:
Checked by :	PK	Date: 15.02.2018	Irish National Grid ☒ ITM15☐

Revisions

No.	Date	Description
0	15.08.2018	First Drawing

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Phone: (+353) 045 484040
Fax: (+353) 045 484004
Email: info@murphysurveys.ie

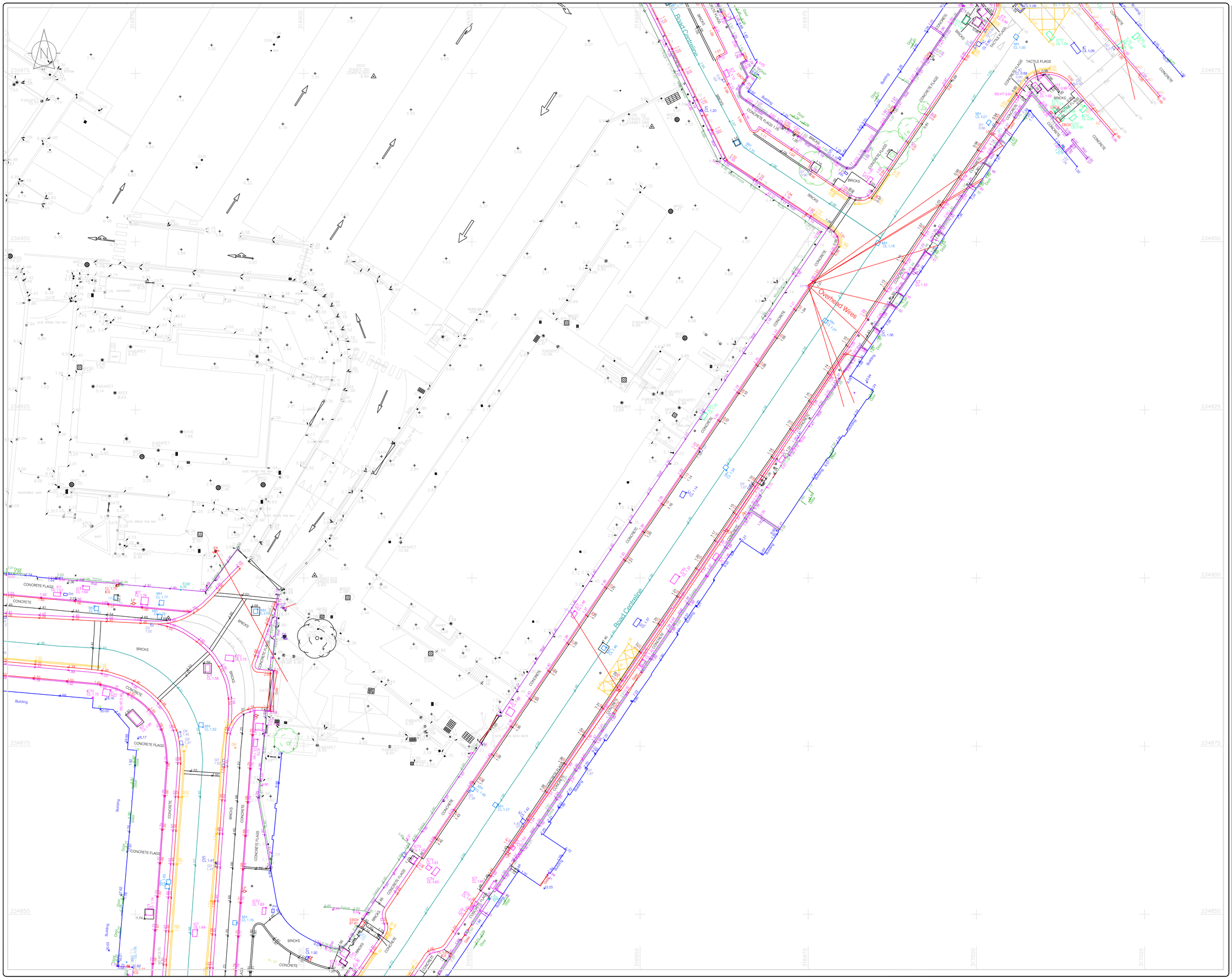
Client : O Connor Sutton Cronin

Project : Additional Survey At Connolly Station

Date : 15.08.2018 **Scale :** 1:250@A1

Description : Topographical Survey
Sheet 1 of 4

Drawing Number : MSL26950_T_3D_Rev0



LEGEND

Street furniture & Services

- Over Head Wires (LUAS) - Pylon ESB
- Flowerbed
- Pipe
- Lift
- Barrier
- Pump
- Trial Pit
- Bus/Tram Shelter
- Postbox
- Valve - General
- Water Valve
- Gas Valve
- Sluice Valve
- Air Valve
- Stop Cock
- C P Post
- Marker Post
- Traffic light
- Parking Meter
- Plane Aerial Mark
- Smart Card Validator
- Unknown Valve
- Road Sign
- Bench Seat
- Bollard
- Beacon
- Coalhole Cover
- Bore Hole
- Electricity Pole
- Telegraph pole
- OCS Pole
- CCTV Camera Pole
- Lamp Post
- Foul Manhole
- Manholes
- Air Conditioning Vents
- Services Inspection Cover
- Traffic Inspection Cover
- Cable TV Inspection Cover
- ESAT Inspection Cover
- NTL Inspection Cover
- Eircom Inspection Cover
- Rodding Eye
- Phone Box
- Duct
- Kiosk
- Gully
- Waste Bin
- Hydrant
- Fire Hydrant
- ESB Box
- ESB Inspection Cover
- Traffic Control Box
- LUAS Technical Cubicle
- Ticket Vending Machine
- Water Meter Cover
- Telecom Inspection Cover
- Monument / Toilets
- Tank Storage
- Basement: MH, Cover & Pipe
- Dished Aerial Mark
- Stay for pole
- Pipe Protection
- Washout

Natural Features

- Surface Change
- Land Drain
- Bottom of Slope
- Top of Slope
- Ditch
- Water Edge / Lake / Pond
- Hedge / Trees Drip Line / Vegetation
- Tree Coniferous
- Tree Deciduous

Golf

- Fair Way
- Green
- Tee Box

Other

- Survey Station
- Photo point
- Top of Tree

Built Features

Roads & Road Markings

- Building
- Edge of Road
- Kerb Bottom
- Kerb Top
- Bridge Abutment
- Bridge Deck
- Bridge Parapet
- Building Façade
- Footpath / Platform Train & Tram
- Damp Proof Course / Verge
- Bridge Pier / Wall & Gate Pillar / LUAS Trackbed
- Cycleway / Private Landing Area
- Fence
- Gate
- Road Centreline
- Top of Wall
- Hoarding
- Property Line
- Road Scar
- Top of Fence
- Floor Level
- Apex Height
- Eaves Height
- Parapet Height
- Soffit Elevation
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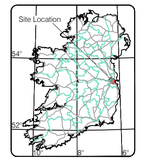
North

Site Location



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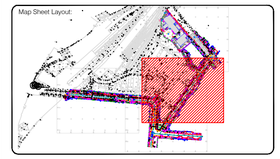

Surveyed by :	ED	Date: 02.08.2018	Datum: Malin Head
Drawn by :	LR	Date: 15.08.2018	Grid System:
Checked by :	PK	Date: 15.02.2018	Irish National Grid ☒ ITM:18☐

Revisions

No	Date	Description
0	15.08.2018	First Drawing

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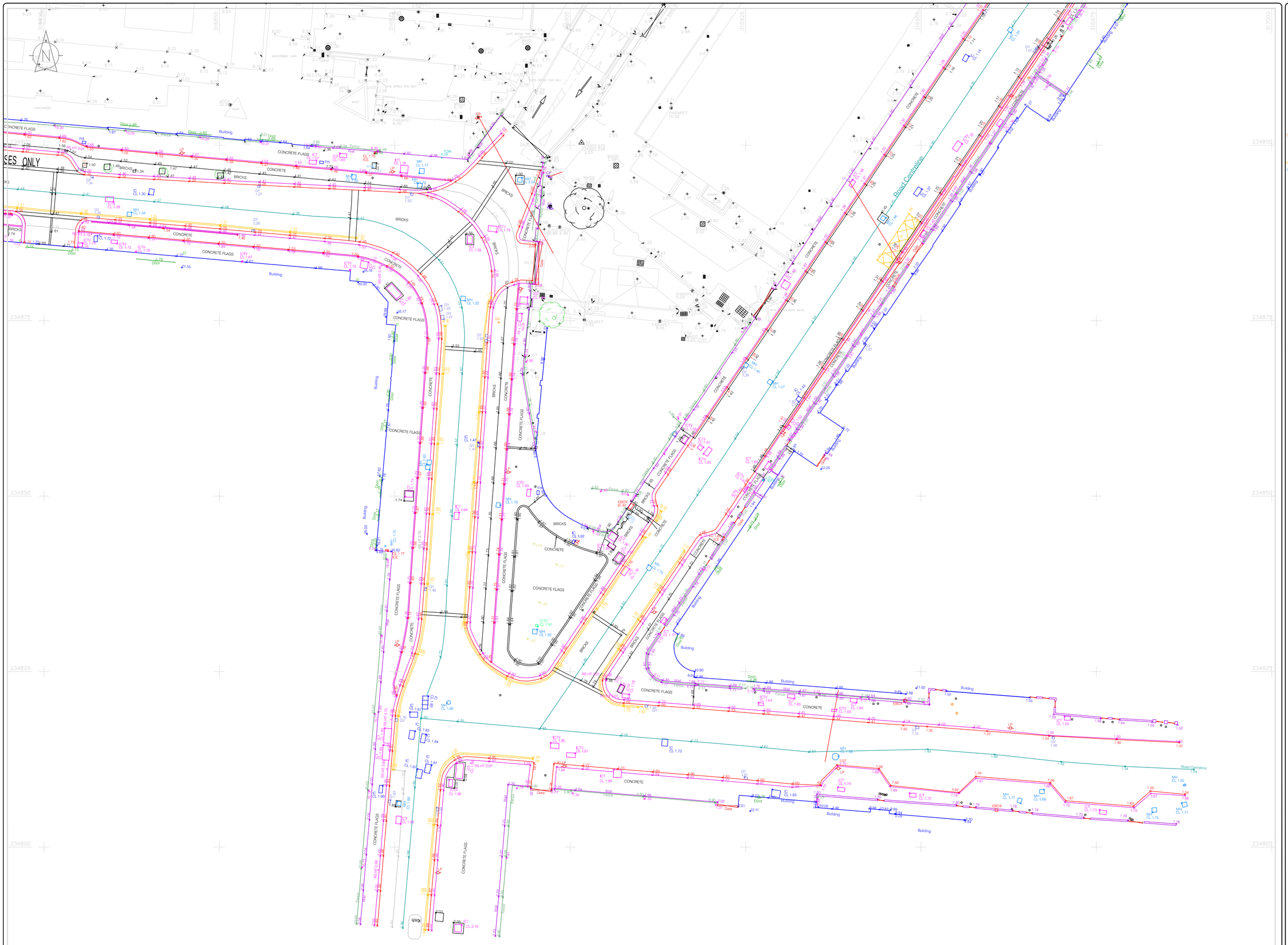
Client : O Connor Sutton Cronin

Project : Additional Survey At Connolly Station

Date : 15.08.2018 **Scale :** 1:250@A1

Description : Topographical Survey
Sheet 2 of 4

Drawing Number : MSL26950_T_3D_Rev0



LEGEND

Street furniture & Services

- Over Head Wires (LUAS) - Pylon ESB
- Flowerbed
- Pipe
- Lift
- Barrier
- Pump
- Trial Pit
- Bus/Tram Shelter
- Postbox
- Valve - General
- Water Valve
- Gas Valve
- Sluice Valve
- Air Valve
- Stop Cock
- C P Post
- Marker Post
- Traffic light
- Parking Meter
- Plane Aerial Mark
- Smart Card Validator
- Unknown Valve
- Bus Stop
- Bollard
- Beacon
- Coalhole Cover
- Bore Hole
- Electricity Pole
- Telegraph pole
- OCS Pole
- CCTV Camera Pole
- Lamp Post
- Foul Manholes
- Surface Water MH
- Manholes
- Air Conditioning Vents
- Services Inspection Cover
- Traffic Inspection Cover
- Cable TV Inspection Cover
- ESAT Inspection Cover
- NTL Inspection Cover
- Eircom Inspection Cover
- Rodding Eye
- Road Sign
- Bench Seat
- Kiosk
- Gully
- Waste Bin
- Hydrant
- Fire Hydrant
- ESB Box
- ESB Inspection Cover
- Traffic Control Box
- LUAS Technical Cubicle
- Ticket Vending Machine
- Water Meter Cover
- Telecom Inspection Cover
- Monument / Toilets
- Tank Storage
- Basement: MH, Cover & Pipe
- Dished Aerial Mark
- Stay for pole
- Pipe Protection
- Washout
- Phone Box
- Duct
- Gas Cover
- C P Box
- LUAS Car Park Vent

Natural Features

- Surface Change
- Land Drain
- Bottom of Slope
- Top of Slope
- Ditch
- Water Edge / Lake / Pond
- Hedge / Trees Drip Line / Vegetation
- Tree Coniferous
- Water Level
- Crown Level
- Invert level
- Bed Level
- Spotheight
- Tree Deciduous

Golf

- Fair Way
- Green
- Tee Box

Other

- Survey Station
- Photo point
- Top of Tree

Built Features

Roads & Road Markings

- Building
- Edge of Road
- Kerb Bottom
- Kerb Top
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- Bridge Deck
- Bridge Parapet
- Building Façade
- Footpath / Platform Train & Tram
- Damp Proof Course / Verge
- Bridge Pier / Wall & Gate Pillar / LUAS Trackbed
- Cycleway / Private Landing Area
- Fence
- Gate
- Road Centreline
- Top of Wall
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North

Site Location

Map Sheet Layout:

Surveyed by : ED	Date: 02.08.2018
Drawn by : LR	Date: 15.08.2018
Checked by : PK	Date: 15.02.2018

Datum : Malin Head
Grid System: Irish National Grid ITM15

Revisions

No	Date	Description
0	15.08.2018	First Drawing

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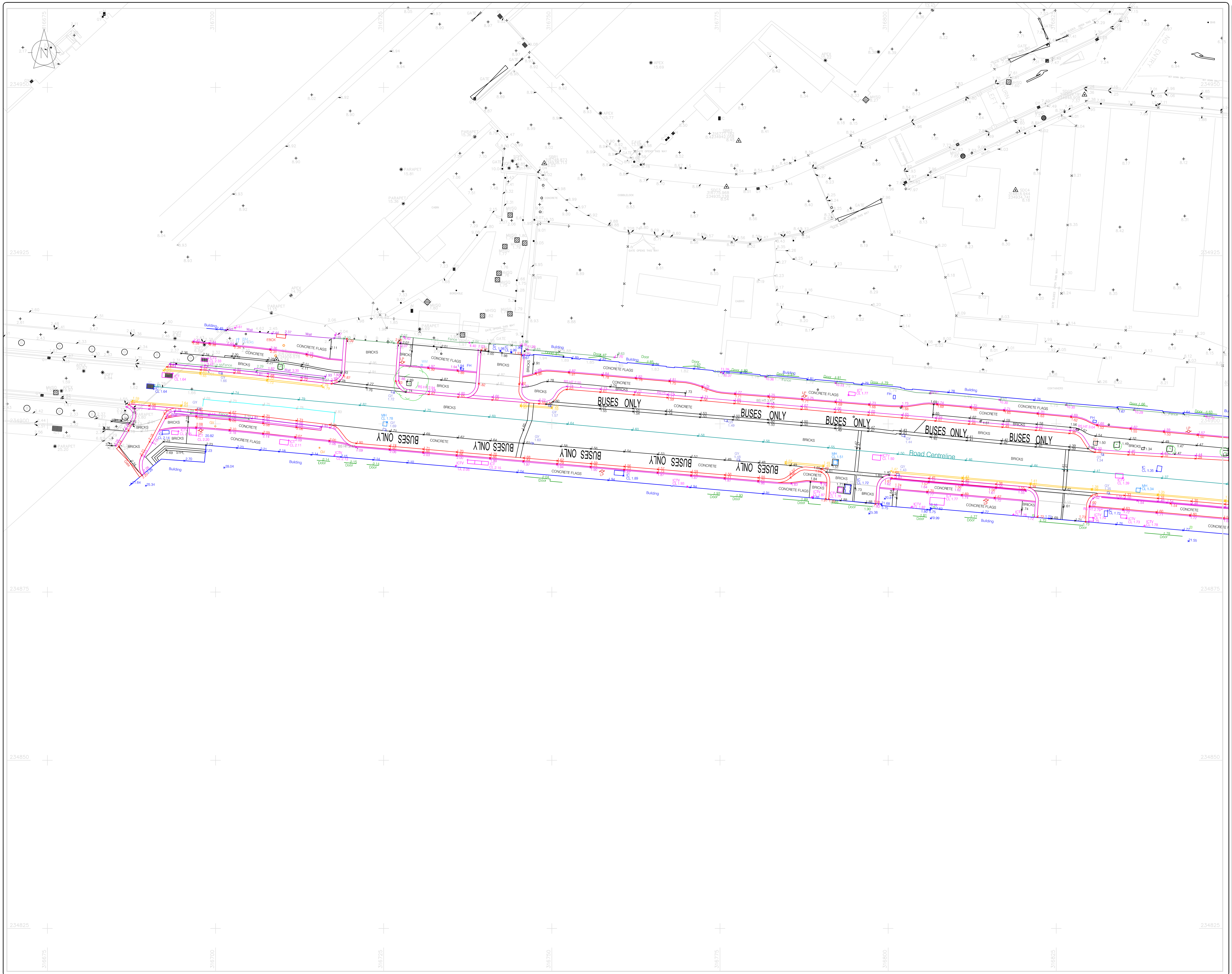
Client :	O Connor Sutton Cronin
Project :	Additional Survey At Connolly Station
Date : 15.08.2018	**Scale :** 1:250@A1
Description :	Topographical Survey Sheet 3 of 4
Drawing Number :	MSL26950_T_3D_Rev0



LEGEND

Street furniture & Services

Over Head Wires (LUAS) - Pylon ESB
Flowerbed
Pipe
Lift
Barrier
Pump
Trial Pit
Bus/Tram Shelter
Postbox
V Valve - General
WV Water Valve
GV Gas Valve
SV Sluice Valve
AV Air Valve
SC Stop Cock
CPP C P Post
MK Marker Post
TL Traffic light
PM Parking Meter
PAM Plane Aerial Mark
SCV Smart Card Validator
UV Unknown Valve
BS Bus Stop
BD Bollard
BEA Beacon
CH Coalhole Cover
BH Bore Hole
EP Electricity Pole
TP Telegraph pole
OCS OCS Pole
CP CCTV Camera Pole
LP Lamp Post
FMH or Foul Manhole
SMH or Surface Water MH
MH or Manholes
AC Air Conditioning Vents
ICU Services Inspection Cover
ICTC Traffic Inspection Cover
ICTV Cable TV Inspection Cover
ICES ESAT Inspection Cover
ICNC NTL Inspection Cover
ICEM Eircom Inspection Cover
RE Rodding Eye
Sign RS Road Sign
Bench Seat
Kiosk
GY Gully
U/G Vent U/G Car Park Vent
BIN Waste Bin
HY Hydrant
FH Fire Hydrant
EBOX ESB Box
ICE ESB Inspection Cover
TFB Traffic Control Box
LUAS LUAS Technical Cubicle
Ticket Vending Machine
WM Water Meter Cover
ICT Telecom Inspection Cover
Monument / Toilets
Tank Storage
Basement: MH, Cover & Pipe
DAM Dished Aerial Mark
STAY Stay for pole
PP Pipe Protection
WO Washout
PBOX Phone Box
Duct
GAS Gas Cover
CPBox C P Box

Natural Features

Surface Change
Land Drain
Bottom of Slope
Top of Slope
Ditch
Water Edge / Lake / Pond
Hedge / Trees Drip Line / Vegetation
Tree Coniferous
WLVL Water Level
CRWN Crown Level
IL Invert level
BL Bed Level
S Spotheight
Tree Deciduous

Golf

FWAY Fair Way
GREE Green
TBOX Tee Box

Other

S1 Survey Station
Photo point
TOT Top of Tree

Built Features
Roads & Road Markings

Building
Edge of Road
Kerb Bottom
Kerb Top
Bridge Abutment
Bridge Deck
Bridge Parapet
Building Façade
Footpath / Platform Train & Tram
Damp Proof Course / Verge
Bridge Pier / Wall & Gate Pillar / LUAS Trackbed
Cycleway / Private Landing Area
Fence
Gate Gate
Road Centreline
Top of Wall
Hoarding
Property Line
Road Scar
Top of Fence
Wall / Retaining Wall
Railway / Tram Rail / Grating / Ramp
Building Canopy / Roof / Overhang
FL 0.00 Floor Level
APX 0.00 Apex Height
EV 0.00 Eaves Height
PAR 0.00 Parapet Height
SOFF 0.00 Soffit Elevation
STPL 5.12 Step Level
CONC Concrete Pad
Track

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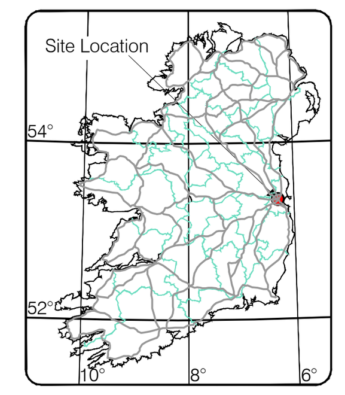
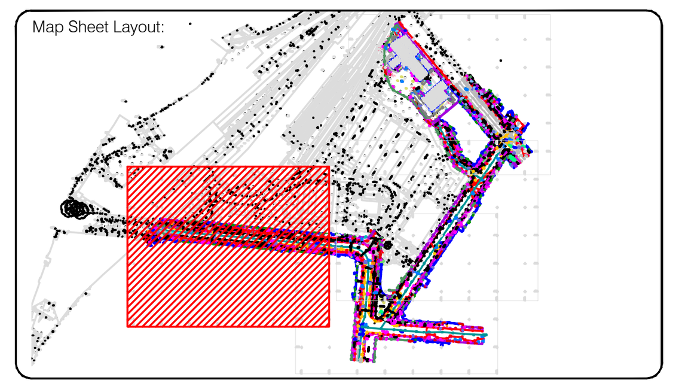
North

Site Location



Map Sheet Layout :



Surveyed by : ED Date: 02.08.2018
Drawn by : LR Date: 15.08.2018
Checked by : PK Date: 15.02.2018
Datum : Malin Head
Grid System: Irish National Grid ☒ ITM(15) ☐

Revisions

No.	Date	Description
0	15.08.2018	First Drawing

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Client : O Connor Sutton Cronin

Project : Additional Survey At Connolly Station

Date : 15.08.2018 **Scale :** 1:250@A1

Description : Topographical Survey
Sheet 4

Drawing Number : **MSL26950_T_3D_Rev0**

APPENDIX B

OPW floodmaps.ie Map Report

OPW National Flood Hazard Mapping

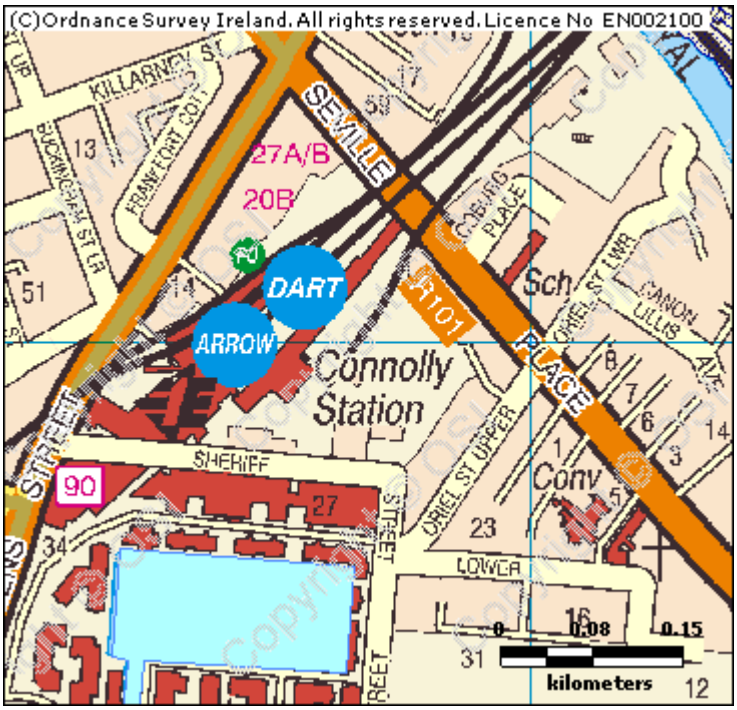
Summary Local Area Report

This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Dublin

NGR: O 168 349



Map Scale 1:6,331

Map Legend	
	Flood Points
	Multiple / Recurring Flood Points
	Areas Flooded
	Hydrometric Stations
	Rivers
	Lakes
	River Catchment Areas
	Land Commission *
	Drainage Districts *
	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

24 Results

1. Flooding at Bessborough Avenue, North Strand, Dublin 3 on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code:3
Additional Information: Reports (1) More Mapped Information

2. Tolka December 1954
County: Dublin
Start Date: 08/Dec/1954
Flood Quality Code:1
Additional Information: Photos (2) Reports (13) Press Archive (9) More Mapped Information

3. Tolka November 2002
County: Meath, Dublin
Start Date: 13/Nov/2002
Flood Quality Code:1
Additional Information: Photos (126) Reports (9) Videos (3) Press Archive (13) More Mapped Information

4. Dublin City Tidal Feb 2002
County: Dublin
Start Date: 01/Feb/2002
Flood Quality Code:1
Additional Information: Photos (32) Reports (10) Press Archive (27) More Mapped Information

5. Tolka Richmond Road Drumcondra Nov 2000
County: Dublin
Start Date: 05/Nov/2000
Flood Quality Code:3

Additional Information: Reports (5) Press Archive (5) More Mapped Information

---

6. Tolka Richmond Road August 1986 — Start Date: 25/Aug/1986
County: Dublin — Flood Quality Code: 1

Additional Information: Reports (4) More Mapped Information

---

7. Tolka Botanic Ave area August 1986 — Start Date: 25/Aug/1986
County: Dublin — Flood Quality Code: 1

Additional Information: Photos (6) Reports (5) Press Archive (1) More Mapped Information

---

8. Tolka Nov 1965 — Start Date: 25/Nov/1965
County: Dublin — Flood Quality Code: 3

Additional Information: Photos (2) Reports (6) Press Archive (2) More Mapped Information

---

9. Tolka September 1946 — Start Date: 20/Sep/1946
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (10) More Mapped Information

---

10. Tolka September 1931 — Start Date: 03/Sep/1931
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (10) Press Archive (1) More Mapped Information

---

11. Tolka November 1915 — Start Date: 12/Nov/1915
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (10) More Mapped Information

---

12. Tolka November 1901 — Start Date: 12/Nov/1901
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (9) More Mapped Information

---

13. Tolka November 1898 — Start Date: 23/Nov/1898
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (9) More Mapped Information

---

14. Tolka October 1880 — Start Date: 28/Oct/1880
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (7) More Mapped Information

---

15. Fenian Street June 1963 — Start Date: 11/Jun/1963
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (3) Press Archive (2) More Mapped Information

---

16. Grafton Street June 1963 — Start Date: 11/Jun/1963
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (3) Press Archive (2) More Mapped Information

---

17. North Strand Road June 1963 — Start Date: 11/Jun/1963
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (3) Press Archive (2) More Mapped Information

---

18. Ringsend June 1963 — Start Date: 11/Jun/1963
County: Dublin — Flood Quality Code: 3

Additional Information: Reports (3) Press Archive (2) More Mapped Information

---

19. Flooding at Havelock Square, Sandymount, Dublin 4 on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code: 2

Additional Information: Reports (1) More Mapped Information

20. Flooding at Bath Avenue, Sandymount, Dublin 4 on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code: 2

Additional Information: Reports (1) More Mapped Information

21. Flooding at ESB Sportsco, Ringsend, Dublin 4 on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code: 2

Additional Information: Reports (1) More Mapped Information

22. Clontarf Rd Seaview Avenue August 2004
County: Dublin
Start Date: 23/Aug/2004
Flood Quality Code: 3

Additional Information: Reports (3) More Mapped Information

23. Bath Avenue June 1963
County: Dublin
Start Date: 11/Jun/1963
Flood Quality Code: 2

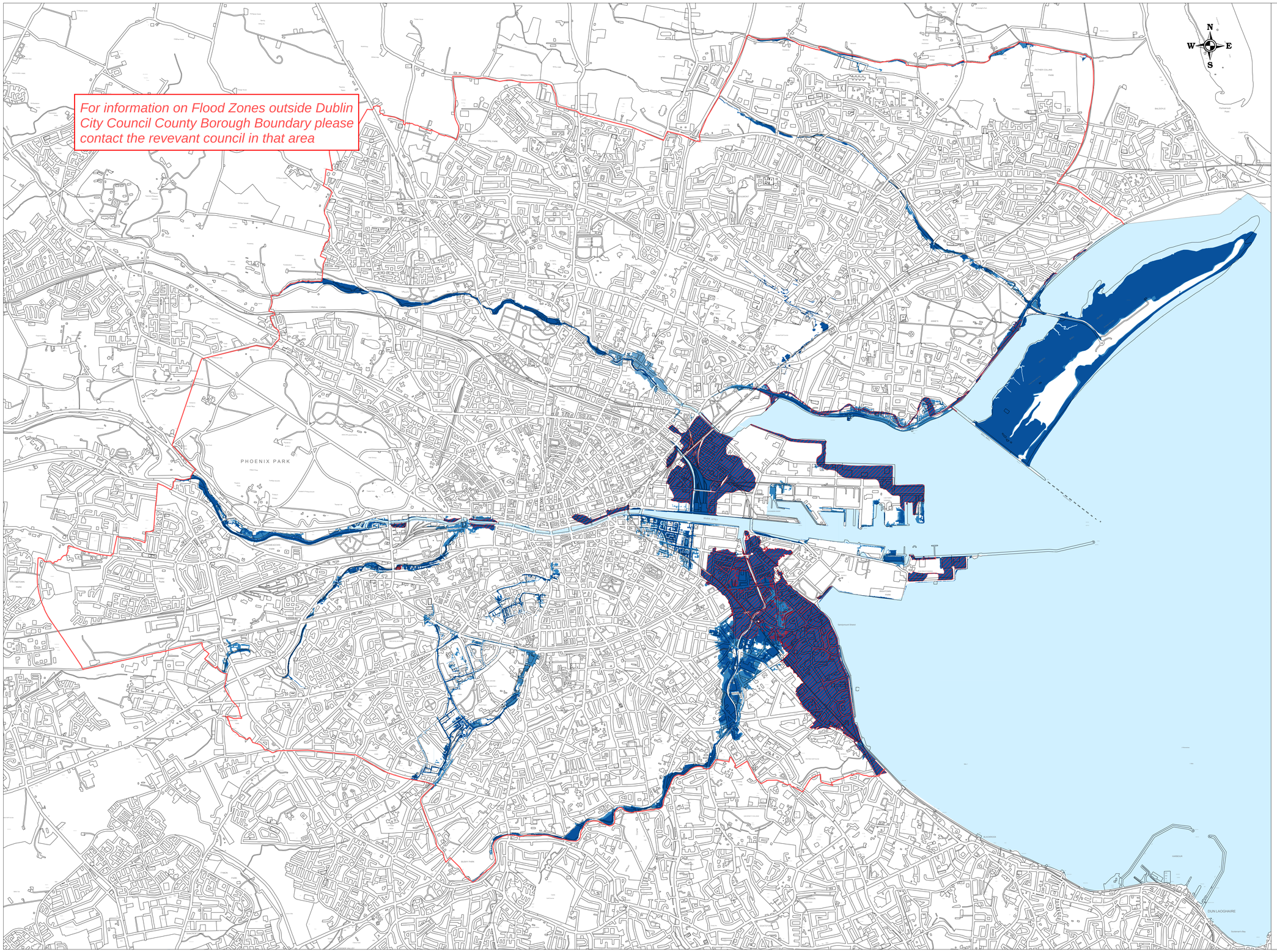
Additional Information: Photos (1) Reports (2) More Mapped Information

24. Tolka April 1909
County: Dublin
Start Date: 03/Apr/1909
Flood Quality Code: 4

Additional Information: Reports (4) More Mapped Information

APPENDIX C

DCDP SFRA - Composite Flood Map



No Window

Dublin City Development Plan 2016-2022

Dublin City Council

Composite Flood Map

Flood Zone A _____

Flood Zone B _____

Flood Zone C _____

Defended Area _____

County Borough Boundary _____

See Appendix 3 Strategic Flood Risk Assessment report for details

John O'Hara

Head of Land Use Policy

APPENDIX D

Eastern CFRAMS Tidal Flood Extent Mapping

Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 0.5% AEP	Flow (m³/s) 0.5% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09LIFF00371	2.73	N/A	3.16	N/A	3.38	N/A
09LIFF00328	2.71	131.89	3.14	135.63	3.37	137.96
09LIFF00280	2.68	N/A	3.12	N/A	3.35	N/A
09LIFF00230	2.67	N/A	3.12	N/A	3.35	N/A

315000 315200 315400 315600 315800 316000 316200 316400

235000 234800 234600 234400 234200 234000 233800

09LIFF00280

09LIFF00230

09LIFF00371

09LIFF00328

For river Poddle flood extents and depths refer to Poddle HPW maps.

0 50 100 200 300 400 500 Metres

IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Tidal AEP Event
- 0.5% Tidal AEP Event
- 0.1% Tidal AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID Node Label

FINAL

REV:	NOTE:	DATE:
01	Amendments to Flood Extents.	05/12/16

EASTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

RPS

The Office of Public Works
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F +44(0) 28 90 668286
W www.rpsgroup.com
E ireland@rpsgroup.com

Map:
Liffey Tidal Flood Extents

Map Type:	EXTENT
Source:	TIDAL
Map Area:	COASTAL
Scenario:	CURRENT
Drawn By :	C.C. Date : 9 May 2017
Checked By :	A.S. Date : 9 May 2017
Approved By :	S.P. Date : 9 May 2017

Drawing No. :
E09LIF_EXCCD_F1_03

Map Series : Page 3 of 8

Drawing Scale : 1:5,000 @ A3

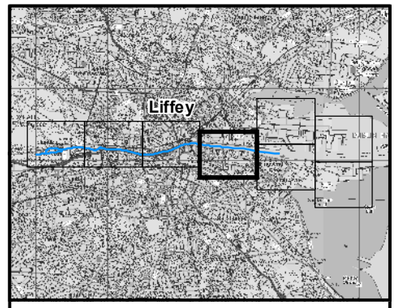
Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 0.5% AEP	Flow (m³/s) 0.5% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09LIFF00180	2.67	N/A	3.12	N/A	3.35	N/A
09LIFF00131	2.67	N/A	3.11	N/A	3.34	N/A
09LIFF00072	2.67	199.56	3.11	205.11	3.34	208.47

09LIFF00180

09LIFF00131

09LIFF00072

For river Dodder flood extents and depths refer to Dodder maps.



IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Tidal AEP Event
- 0.5% Tidal AEP Event
- 0.1% Tidal AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID Node Label

FINAL

REV:	NOTE:	DATE:
01	Amendments to Flood Extents.	05/12/16

EASTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

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F +44(0) 28 90 668286
W www.rpsgroup.com
E ireland@rpsgroup.com

Map:
Liffey Tidal Flood Extents

Map Type:	EXTENT
Source:	TIDAL
Map Area:	COASTAL
Scenario:	CURRENT
Drawn By : C.C.	Date : 9 May 2017
Checked By : A.S.	Date : 9 May 2017
Approved By : S.P.	Date : 9 May 2017

Drawing No. :
E09LIF_EXCCD_F1_04

Map Series : Page 4 of 8

Drawing Scale : 1:5,000 @A3

0 50 100 200 300 400 500 Metres

APPENDIX E

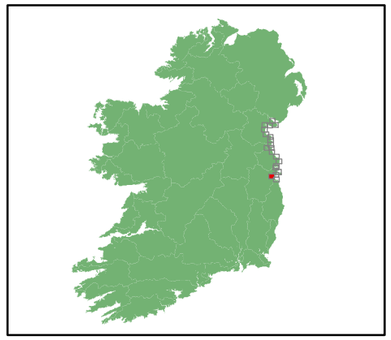
ICPSS Current Climate Tidal Flood Extent Mapping

NOTE: MORE DETAILED MAPS SHOWING COMBINED TIDAL AND FLUVIAL FLOOD HAZARD FOR PART OF THIS AREA (DODDER CATCHMENT ONLY) HAVE BEEN PREPARED UNDER THE RIVER DODDER CATCHMENT FRAM STUDY. PLEASE REFER TO WWW.DUBLINCITY.IE/PAGES/DODDERFLOODINGSTUDY.ASPX FOR MORE INFORMATION

	Water Level (mOD Malin) per AEP		
Node Label	WL 10%	WL 0.5 %	WL 0.1 %
Point 22	2.67	3.07	3.28

0.5 0.25 0 0.5 1 1.5 2 Kilometers

Location Plan :



EXTENT MAP

Legend:

- 0.5% AEP FLOOD EXTENT (1 in 200 chance in any given year)
- 0.1% AEP FLOOD EXTENT (1 in 1000 chance in any given year)
- Very High Confidence (0.1% AEP)
- High Confidence (0.1% AEP)
- Medium Confidence (0.1% AEP)
- Low Confidence (0.1% AEP)
- Very Low Confidence (0.1% AEP)
- Very High Confidence (0.5% AEP)
- High Confidence (0.5% AEP)
- Medium Confidence (0.5% AEP)
- Low Confidence (0.5% AEP)
- Very Low Confidence (0.5% AEP)
- High Water Mark (HWM)
- Node Point
- Point 34 Node Label (refer to table)

USER NOTE :

USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF A BOUND VOLUME, IT SHOULD NOT BE USED FOR ANY PURPOSE.

RPS
Elmwood House
74 Boucher Road
Belfast
BT 12 6RZ
Northern Ireland

OPW
Office of Public Works
17-19 Lower Hatch Street
Dublin 2
Ireland

Project :
IRISH COASTAL PROTECTION STRATEGY STUDY - PHASE III

Map :
NORTH EAST COAST FLOOD EXTENT MAP

Map Type :	FLOOD EXTENT		
Source :	TIDAL FLOODING		
Map area :	RURAL AREA		
Scenario :	CURRENT		
Figure By :	PJW	Date :	Jan 2010
Checked By :	JMC	Date :	Jan 2010

Figure No. : NE / RA / EXT / 19

Revision 1

Drawing Scale : 1:25,000

Plot Scale : 1:1 @ A3

APPENDIX F

Details of Sample Demountable Barriers

FLOODCONTROL

PRODUCT DATA SHEET

Slot-In Barriers

Modular design, interlocking components and custom manufacturing, combine to make this system the most versatile and advance slot-in flood-board system currently available.

With a host of design features and the ability to protect openings of up to 6 metres wide against flood depths of up to 2.4 metres, this system is ideal for protecting doorways, loading bays, pedestrian walkways, shop fronts, in fact, virtually any opening that requires dependable defence against flooding.

The modular components, simplicity of design and aluminium beams with ergonomically positioned carrying handles, enable the system to be easily and quickly erected - without the need for special skills or training.

Single slot-in systems can be installed on any flat watertight surface by any competent builder or DIYer as they require no specific skills or training to erect.

The components are manufactured from construction grade steel and aluminium with stainless steel options for salt water environments. The systems are suitable for constant daily use and can be left semi-permanently installed. There are fully removable options for listed buildings.

Versatile flush-threshold barriers suitable for most openings - flood depths up to 2.4m.

Applicability

- Heights 300mm to 2400mm (in 300mm increments).
- Opening width any size up to 6500mm in a single span.
- Can be extended using removable intermediate supports.
- Reveal, Face or Corner mounted support channels.
- Custom stand-offs (up to 350mm) to clear weatherboards etc.
- Can also be installed behind doors (eg for Emergency Exits).
- Vandal resistant covers and security clamps to lock systems.
- Can be finished in RAL colour to match décor.
- Fully removable options for listed buildings.
- Stainless steel options for salt water environments.

Key Benefits

- Aluminium beams weigh less than 8kg per linear metre.
- Ergonomically positioned carrying handles.
- Quickly and easily erected by one person requiring no specific training.
- Storage brackets available for beams and components.

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email: info@floodgateireland.com • web: www.floodgateireland.com

FLOODCONTROL

FLOODCONTROL

PRODUCT DATA SHEET

DESIGN CONSIDERATIONS

Sizes

- Unsupported spans possible up to 2500mm.
- Maximum spans of up to 6500mm possible with back bracing.
- Standard maximum flood control height of 2400mm, using 300mm standard beams.
- Beam weights of 8kg/m allow safe single person lifting of 2.5m beams.

Configurations

- Intermediate posts are available to extend flood control barrier to any length.
- Sill brackets and stand-offs allow fitment of flood control barrier to windows, recesses and any non-standard situation.
- Barriers can be mounted internally.

INSTALLATION REQUIREMENTS

- End posts can be surface mounted or recess mounted. Architectural coverplates can be applied to match building finishes when barriers not in use.
- High compression seals enable barriers to work on any level non-porous existing surface.
- Systems can be retrospectively fitted to any suitable foundation.

DESIGN STANDARDS

Quality Management System is accredited to BS EN ISO 9001:2008. Each installation is individually designed.

- Manufactured and tested to exceed DIN19569-4.
- Steel sections manufactured to EN10027.
- Fabrications hot-dip galvanised to ISO 1461:1999.
- Heat treated aluminium extrusions to BS1474.
- Stainless steel sections manufactured to EN10088.
- Seals all Ethylene Propylene Diene Monomer (EPDM).
- All fixings Load Rated Hilti™ or Fischer™.

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tel: 061 603700 • mobile: 087 2222557 • fax: 061 603722
email: info@floodgateireland.com • web: www.floodgateireland.com

FLOODCONTROL

Slot-In Flood Barriers

Modular design, interlocking components and custom manufacturing, combine to make this system the most versatile and advanced slot-in flood-board system currently available.

Versatile Flood Protection

....robust and unobtrusive

With a host of design features (*see facing page*) and the ability to protect openings of up to 6 metres wide against flood depths of up to 2.4 metres, this system is ideal for protecting doorways, loading bays, pedestrian walkways, shop fronts, in fact, virtually any opening that requires dependable defence against flooding.

The modular components, simplicity of design & aluminium beams with ergonomically positioned carrying handles, enable the system to be easily and quickly erected by one person - without the need for special skills or training.

FLOOD CONTROL

Slot-In Flood Barriers

Introduced in 1994, thousands of slot-in barriers are currently installed in the UK and throughout Europe, and with a policy of continuous development and improvement the systems remain at the forefront of flood defence design……

Designed for APPLICATION

- *Can be installed on any flat watertight surface*
- *Heights 300mm to 2400mm (in 300mm increments)*
- *Opening width any size up to 6500mm in a single span*
- *Can be extended using removable intermediate supports*
- *Reveal, Face or Corner mounted support channels*
- *Custom stand-offs (up to 350mm) to clear weatherboards etc.*
- *Can also be installed behind doors (e.g. for Emergency Exits)*
- *Vandal resistant covers & security clamps to lock systems*
- *Can be finished in RAL colour to match décor*
- *Fully removable options for listed buildings*
- *Stainless steel options for salt water environments*
- *Can be left semi-permanently installed*

Designed for CONVENIENCE

- *Can be installed by any competent builder or DIYer*
- *Aluminium beams weigh less than 8kg per linear metre*
- *Ergonomically positioned carrying handles*
- *Quickly and easily erected by one person*
- *Modular design requires no specific skills or training to erect*
- *Storage brackets available for beams & components*

Designed for DURABILITY

- *Construction grade steel & aluminium components*
- *Steel fabrications hot-dip galvanised*
- *Patented seal design stops silt clogging*
- *All seals made with EPDM for weather and UV resistance*
- *Seals fixed in preformed channels and easily replaceable*
- *Twinned seals for extreme flood/impact conditions*
- *Suitable for constant daily use*

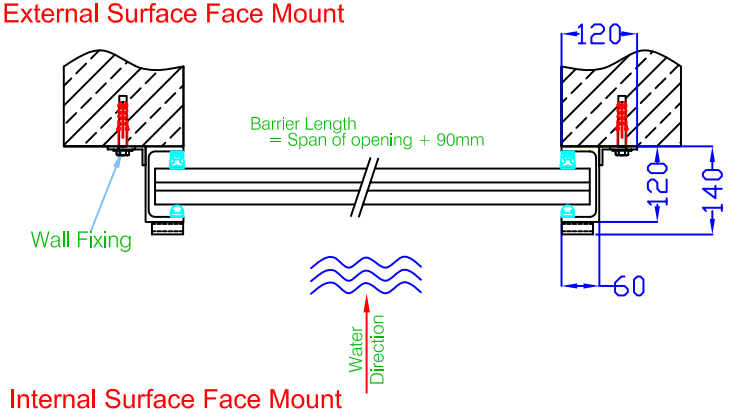
Designed to STANDARDS

- *Manufactured & tested to exceed DIN19569-4*
- *Steel sections manufactured to EN10027*
- *Fabrications hot-dip galvanised to ISO 1461:1999*
- *Heat treated aluminium extrusions to BS1474*
- *Stainless steel sections manufactured to EN10088*
- *Seals all Ethylene Propylene Diene Monomer (EPDM)*
- All fixings Load Rated Hilti ™ or Fischer ™

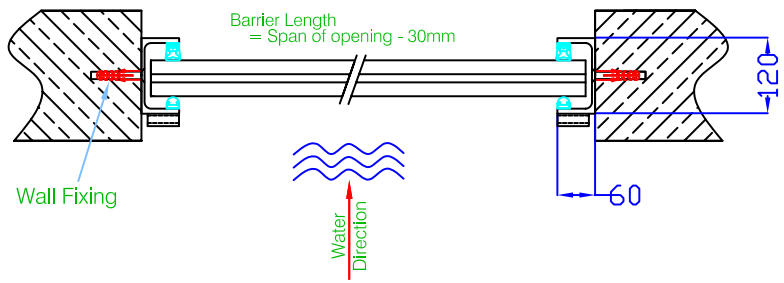
FLOOD CONTROL

RevNo	Revision note	Date	Signature	Checked

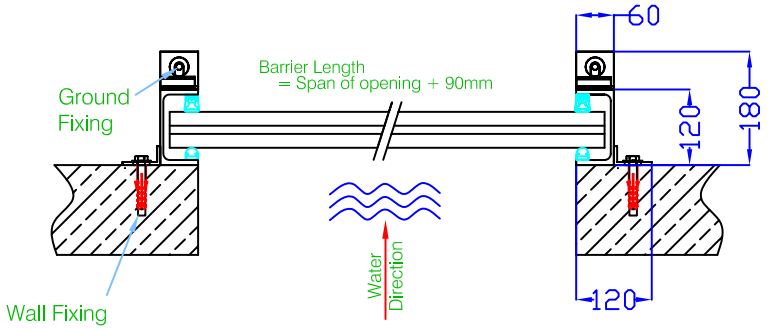
External Surface Face Mount



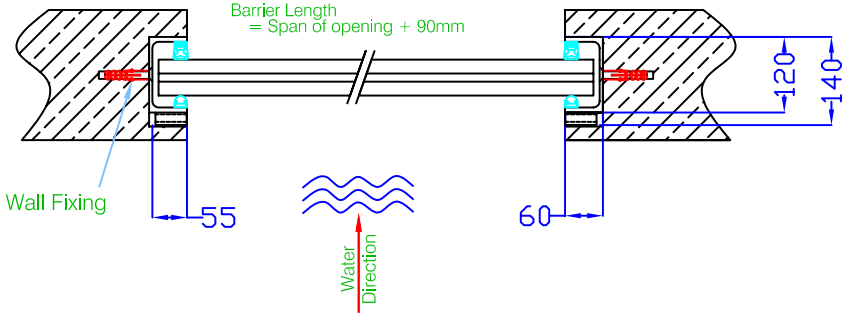
Recess Mount



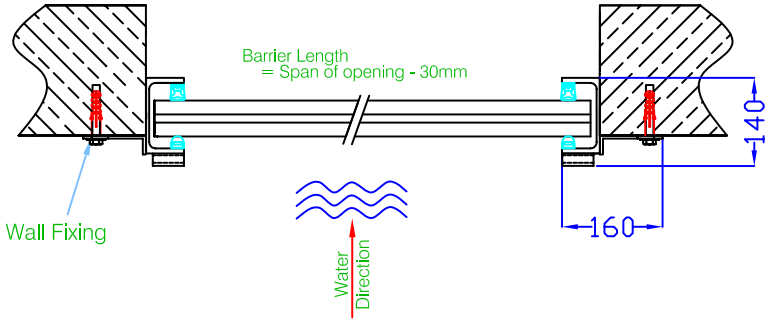
Internal Surface Face Mount



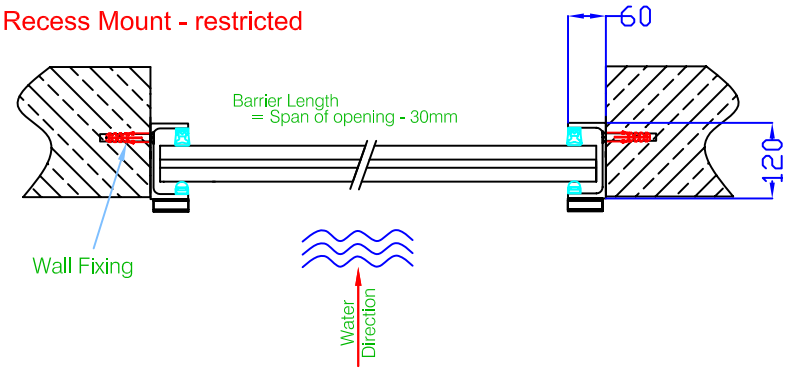
Recess Embedded



External Surface Face Mount - recess system



Recess Mount - restricted



Drawn By	Checked by	Approved by - date	File name	Date	Scale
Andrew Yates	T. Watkins	JR - 09/07/04	SBS	09/07/04	1:12

FLOOD CONTROL LTD

Standard Mounting Options

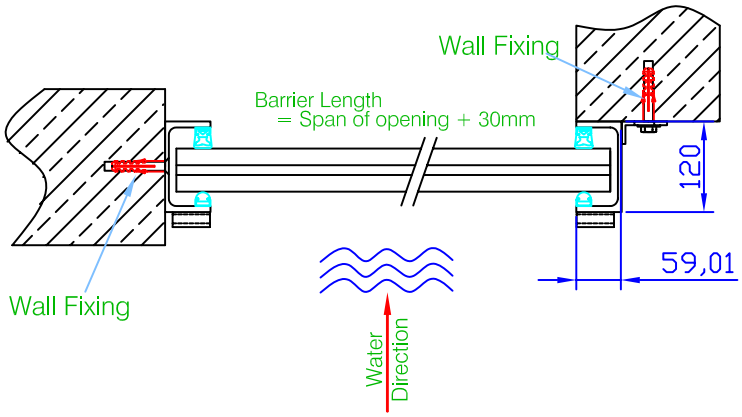
FLOOD CONTROL operate a policy of continuous improvement & reserve the right to amend specifications without notice.

SBS00309-03

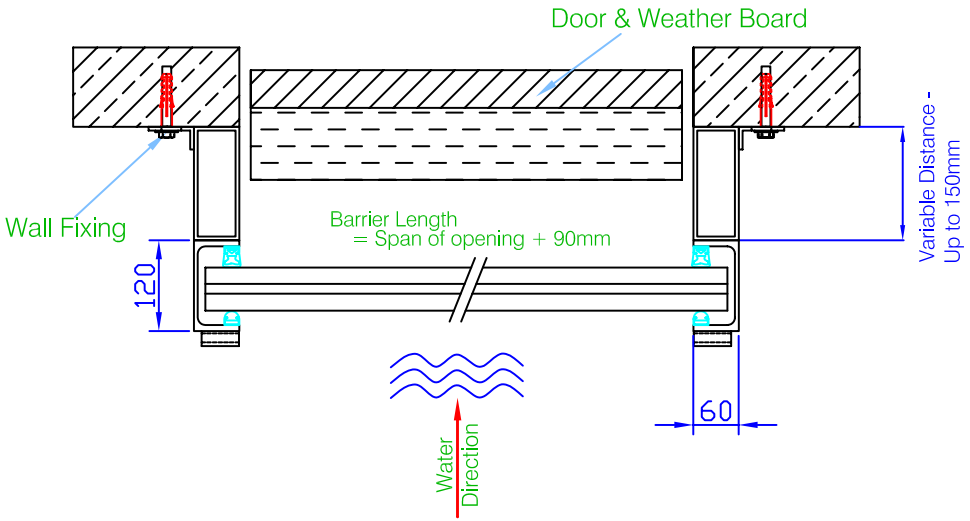
Edition	Sheet
1	1/2

RevNo	Revision note	Date	Signature	Checked

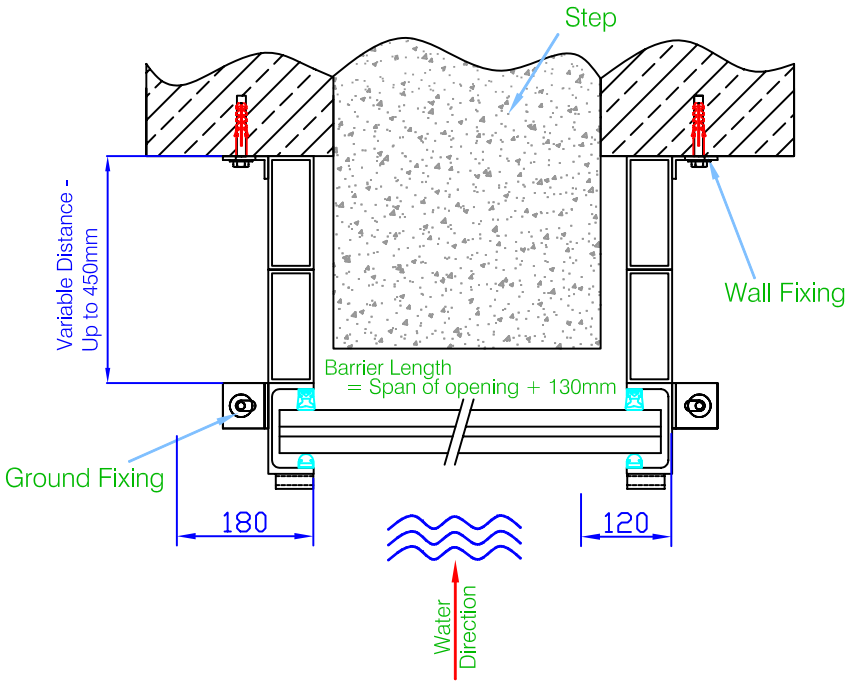
Recess & Surface Face Mount



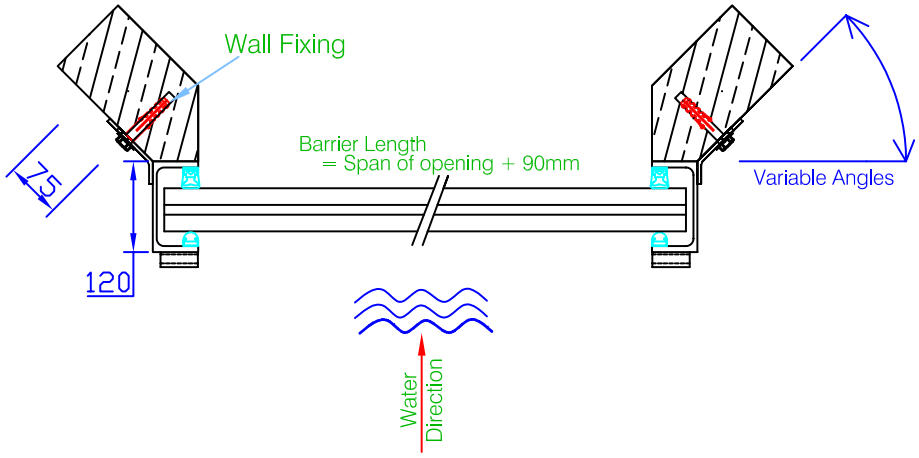
Surface Face Mount - Stand off For Door



Surface Face Mount - Stand off For Step



Surface Mount Angled



Drawn By	Checked by	Approved by - date	File name	Date	Scale
Andrew Yates	T. Watkins	JR - 09/07/04	SBS	09/07/04	1:10

FLOOD CONTROL LTD

Standard Mounting Options

SBS00308-03

Edition 1

Sheet 2/2

APPENDIX G

Details of Sample Flood Gate

FLOODCONTROL INTERNATIONAL

FLIP-UP BARRIERS

Designed to provide totally unrestricted access to pedestrian and vehicle entrances, this self-raising flood barrier is fully recessed in to the ground when not in use. A range of surface finishes is available; from skid resistant epoxy coatings to timber cladding or paving to fit in with the external hard landscaping.

These flood barriers can rise automatically with the rising flood waters or by push button in advance keeping you in control for complete peace of mind. Uninterruptible Power Supply (UPS) and manual backups mean these barriers will not let you down.

A single system can protect openings up to 12m wide and multiple systems can be linked with intermediate posts to create a flood defence run of almost any length. Depending on span, flood defence heights of up to 4m are available.

Movement and weight sensors prevent the barriers opening if the entrance is obstructed whilst optional audio/visual alarms sound prior to and during operation.

Optional 24 volt back-up systems are available for use in the event of mains failure and permanently installed security grates cover the housing pit - serving as both a safety platform for traffic and pedestrians and as protection for the hydraulic system while the barrier remains raised.

These barriers are designed for pedestrian and vehicle entrances, or anywhere where unrestricted level access is required.

Fully automatic flood barriers that fully recess into the ground - flood depths up to 4m as standard, up to 12m length per unit.

USES

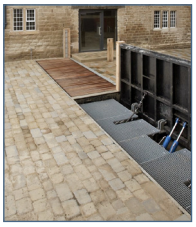
- Public area flood protection schemes.
- Underground garage or car park entrances.
- Anywhere where unrestricted level access is required.
- Integrated into new developments for full time unobtrusive defence.

BENEFITS

- Fully recessed when not in use.
- No restrictions to openings or access.
- Fully automatic operation available.
- Push-button operation available to put you in control.
- Quick erection of large flood barrier.
- No deep excavations required as barrier lays flat when not in use.
- Flood barrier can be linked to alarm systems.
- Safety systems include visual / audible alarms when operating, dead stops activated by movement sensors.
- Totally vandal resistant as no exposed seals or components.

FLOODCONTROL INTERNATIONAL

DESIGN



SIZES

- Single systems are able to span up to 12m.
- Maximum flood control heights of 4m are achievable.

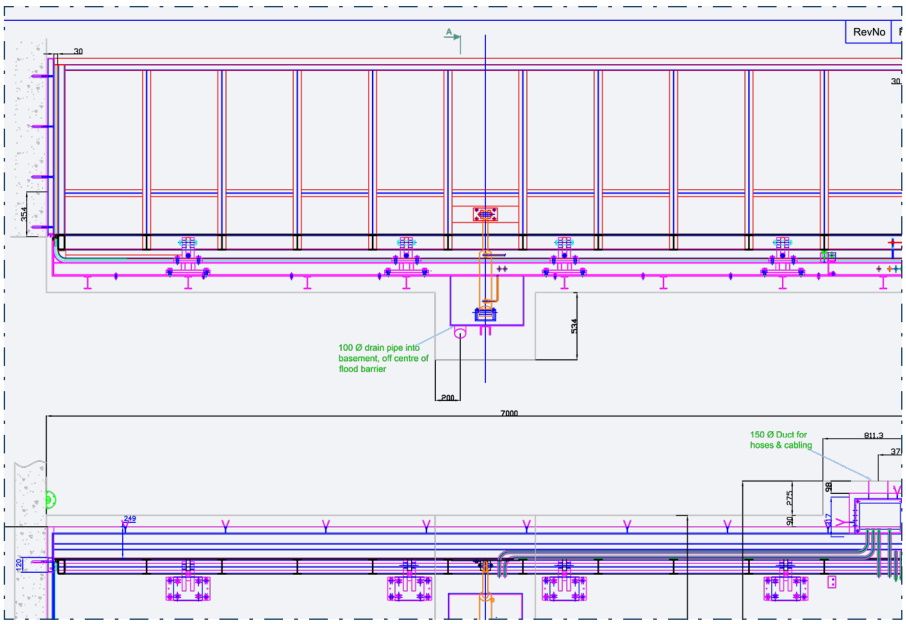
CONFIGURATIONS

- Any length or layout is achievable using multiple span systems.
- Intermediate posts can be fixed or raised with previous spans.
- Surface finish to barrier can be non-slip epoxy coated, timber decked or clad to architect's specification.
- Various levels of automation available with remote connection or sensor control and/or push button operation.
- Barriers able to be raised manually in the event of a power failure.

INSTALLATION

- Barriers are mounted within a reinforced concrete pit. Barrier includes for a galvanised steel grating 200mm below external surface level.

BESPOKE CAD DRAWINGS



APPENDIX H

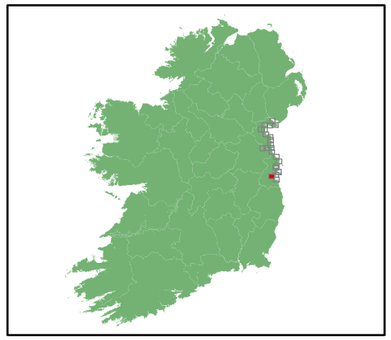
ICPSS MRFS Tidal Flood Extent Mapping

NOTE: MORE DETAILED MAPS SHOWING COMBINED TIDAL AND FLUVIAL FLOOD HAZARD FOR PART OF THIS AREA (DODDER CATCHMENT ONLY) HAVE BEEN PREPARED UNDER THE RIVER DODDER CATCHMENT FRAM STUDY. PLEASE REFER TO WWW.DUBLINCITY.IE/PAGES/DODDERFLOODINGSTUDY.ASPX FOR MORE INFORMATION

	Water Level (mOD Malin) per AEP		
Node Label	WL 10%	WL 0.5%	WL 0.1%
Point 22	3.17	3.57	3.78

0.5 0.25 0 0.5 1 1.5 2 Kilometers

Location Plan :



EXTENT MAP

Legend:

- 0.5% AEP FLOOD EXTENT (1 in 200 chance in any given year)
- 0.1% AEP FLOOD EXTENT (1 in 1000 chance in any given year)
- High Water Mark (HWM)
- Node Point
- Point 34 — Node Label (refer to table)

USER NOTE :

USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF A BOUND VOLUME, IT SHOULD NOT BE USED FOR ANY PURPOSE.

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Northern Ireland

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17-19 Lower Hatch Street
Dublin 2
Ireland

Project :
IRISH COASTAL PROTECTION STRATEGY STUDY - PHASE III

Map :
NORTH EAST COAST FLOOD EXTENT MAP

Map Type :	FLOOD EXTENT		
Source :	TIDAL FLOODING		
Map area :	RURAL AREA		
Scenario :	MID RANGE FUTURE SCENARIO		
Figure By :	PJW	Date :	Aug 2012
Checked By :	JMC & JR	Date :	Aug 2012

Figure No. : NE / RA / EXT / MRFS / 19

Revision 1

Drawing Scale : 1:25,000

Plot Scale : 1:1 @ A3

APPENDIX I

Eastern CFRAMS Tidal Flood Extent Mapping

Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09LIFF00371	2.55	160.64	2.63	213.22	2.77	280.83
09LIFF00333	2.52	165.79	2.58	217.56	2.68	284.77
09LIFF00328	2.51	166.49	2.57	218.17	2.66	285.34
09LIFF00280	2.46	172.70	2.47	224.47	2.49	291.84
09LIFF00230	2.44	180.89	2.44	232.15	2.44	299.59

315000 315200 315400 315600 315800 316000 316200 316400

235000 234800 234600 234400 234200 234000 233800

09LIFF00230

09LIFF00280

09LIFF00328

09LIFF00371

09LIFF00333

For river Poddle flood extents and depths
Refer to Poddle HPW maps.

0 50 100 200 300 400 500 Metres

IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Fluvial AEP Event
- 1% Fluvial AEP Event
- 0.1% Fluvial AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID Node Label

FINAL

REV:	NOTE:	DATE:
01	Amendments to Flood Extents.	05/12/16

EASTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

OPW Oifig na nOibreacha Poiblí The Office of Public Works

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W www.rpsgroup.com
E ireland@rpsgroup.com

Map:
Liffey Fluvial Flood Extents

Map Type:	EXTENT
Source:	FLUVIAL
Map Area:	HPW
Scenario:	CURRENT
Drawn By : C.C.	Date : 9 May 2017
Checked By : A.S.	Date : 9 May 2017
Approved By : S.P.	Date : 9 May 2017

Drawing No. :
E09LIF_EXFCD_F1_03

Map Series : Page 3 of 8

Drawing Scale : 1:5,000 @ A3

316600 316800 317000 317200 317400 317600 317800 318000

234800 234600 234400 234200 234000 233800 233600

09LIFF00180

09LIFF00131

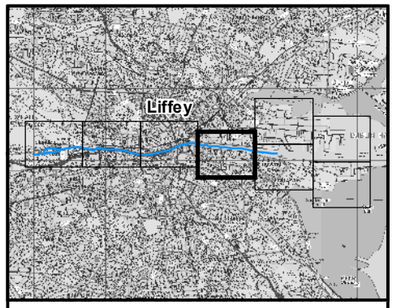
09LIFF00072

For river Dodder flood extents and depths
Refer to Dodder maps.

Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09LIFF00180	2.45	194.47	2.45	245.61	2.45	313.04
09LIFF00131	2.44	211.11	2.44	262.02	2.45	329.68
09LIFF00072	2.44	233.19	2.44	283.68	2.44	351.20

316600 316800 317000 317200 317400 317600 317800 318000

0 50 100 200 300 400 500 Metres



IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Fluvial AEP Event
- 1% Fluvial AEP Event
- 0.1% Fluvial AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID Node Label

FINAL

REV:	NOTE:	DATE:
01	Amendments to Flood Extents.	05/12/16

EASTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

OPW Oifig na nOibreacha Poiblí The Office of Public Works

RPS

The Office of Public Works
Jonathan Swift Street
Trim
Co Meath

Elmwood House
74 Boucher Road
Belfast
BT12 6RZ

T +44(0) 28 90 667914
F +44(0) 28 90 668286
W www.rpsgroup.com
E ireland@rpsgroup.com

Map:
Liffey Fluvial Flood Extents

Map Type:	**EXTENT**	
Source:	**FLUVIAL**	
Map Area:	**HPW**	
Scenario:	**CURRENT**	
Drawn By :	**C.C.**	**Date : 9 May 2017**
Checked By :	**A.S.**	**Date : 9 May 2017**
Approved By :	**S.P.**	**Date : 9 May 2017**

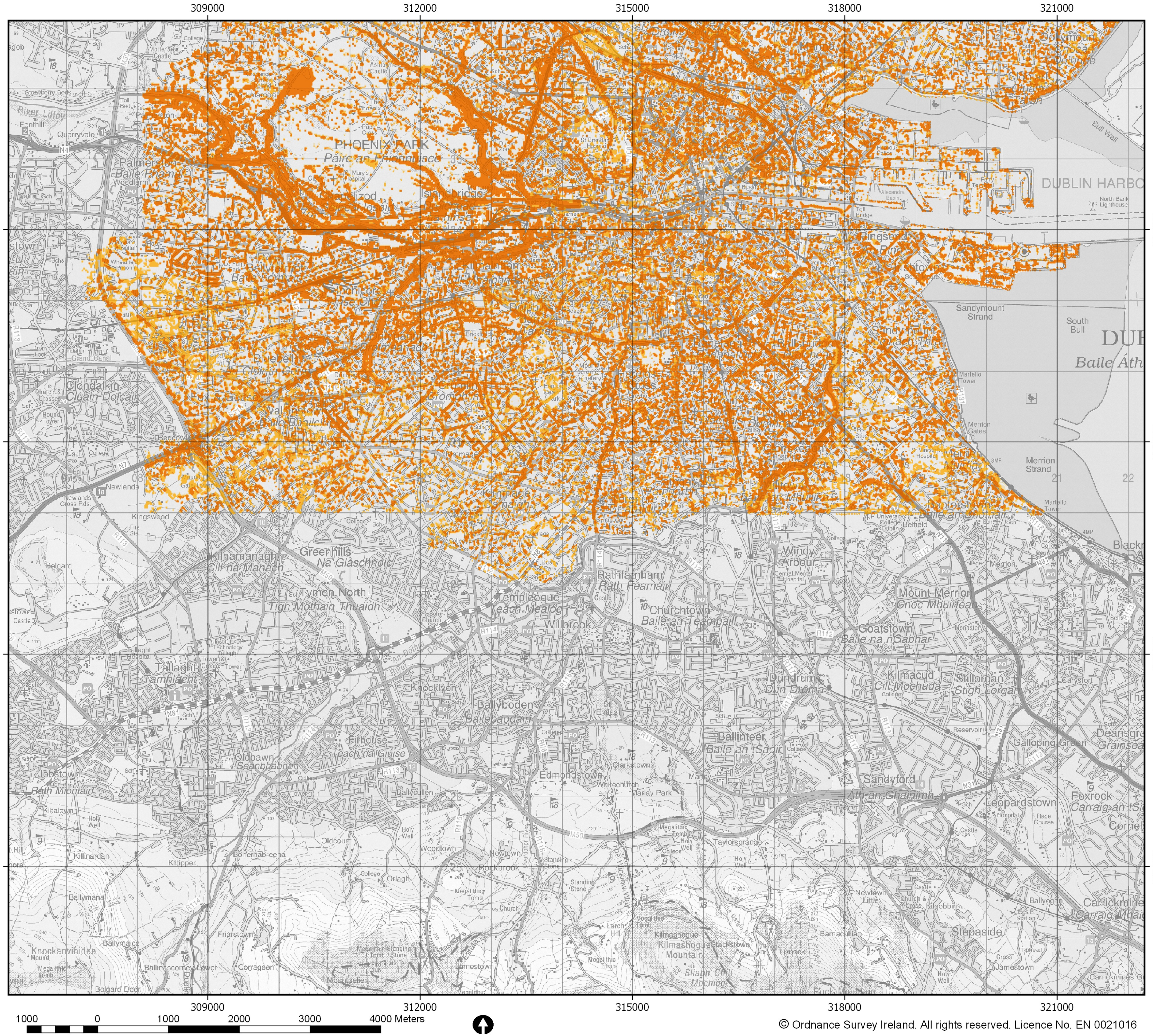
Drawing No. :
E09LIF_EXFCD_F1_04

Map Series : Page 4 of 8

Drawing Scale : 1:5,000 @A3

APPENDIX J

Flood ResilienCity Pluvial Flood Mapping



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Location Plan:

LEGEND

- 10% AEP Pluvial
- 1% AEP Pluvial
- 0.5% AEP Pluvial

IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

The Office Of Public Works	Dublin City Council
Jonathan Swift Street	Civic Offices
Trim	Wood Quay
Co. Meath	Dublin 8

Project:
DUBLIN PLUVIAL STUDY (FloodResilienCity)

Map:	DUBLIN CITY - PLUVIAL FLOOD EXTENT MAP		
Map Type:	EXTENT - 180min Rainfall		
Source:	PLUVIAL		
Map Area:	URBAN		
Scenario:	CURRENT		
Drawn by:	IH	Date:	Aug - 2016
Checked by:	MC	Date:	Aug - 2016
Approved by:	JM	Date:	Aug - 2016
Map No.: E09DCC_EXPCD_F0_03			
Revision: F0			
Map Scale: 1:50,000		Plot Scale: 1:1 @ A3	

APPENDIX K

Irish Water Drainage and Watermains Record Map

UISCE ÉIREANN : IRISH WATER

Legend

- Unknown Meter ; Other Meter
- Sluice Valve Open
- Sluice Valve Closed
- Butterfly Valve Open
- Sluice Valve Closed

Water Hydrants

Hydrant Function

- Fire Hydrant
- Cap
- Other Fittings

Water Distribution Mains

Owned By

- Distribution Water Main
- Water Abandoned Lines

Sewer Manholes

Manhole Type

- Standard

Sewer Discharge Points

Discharge Type

- Other; Unknown

Sewer Inlets

Inlet Type

- Catchpit
- Gravity - Combined
- Gravity - Foul
- Gravity - Overflow
- Pumping - Combined

Storm Manholes

Manhole Type

- Standard
- Surface Gravity Mains

1:500 at A0

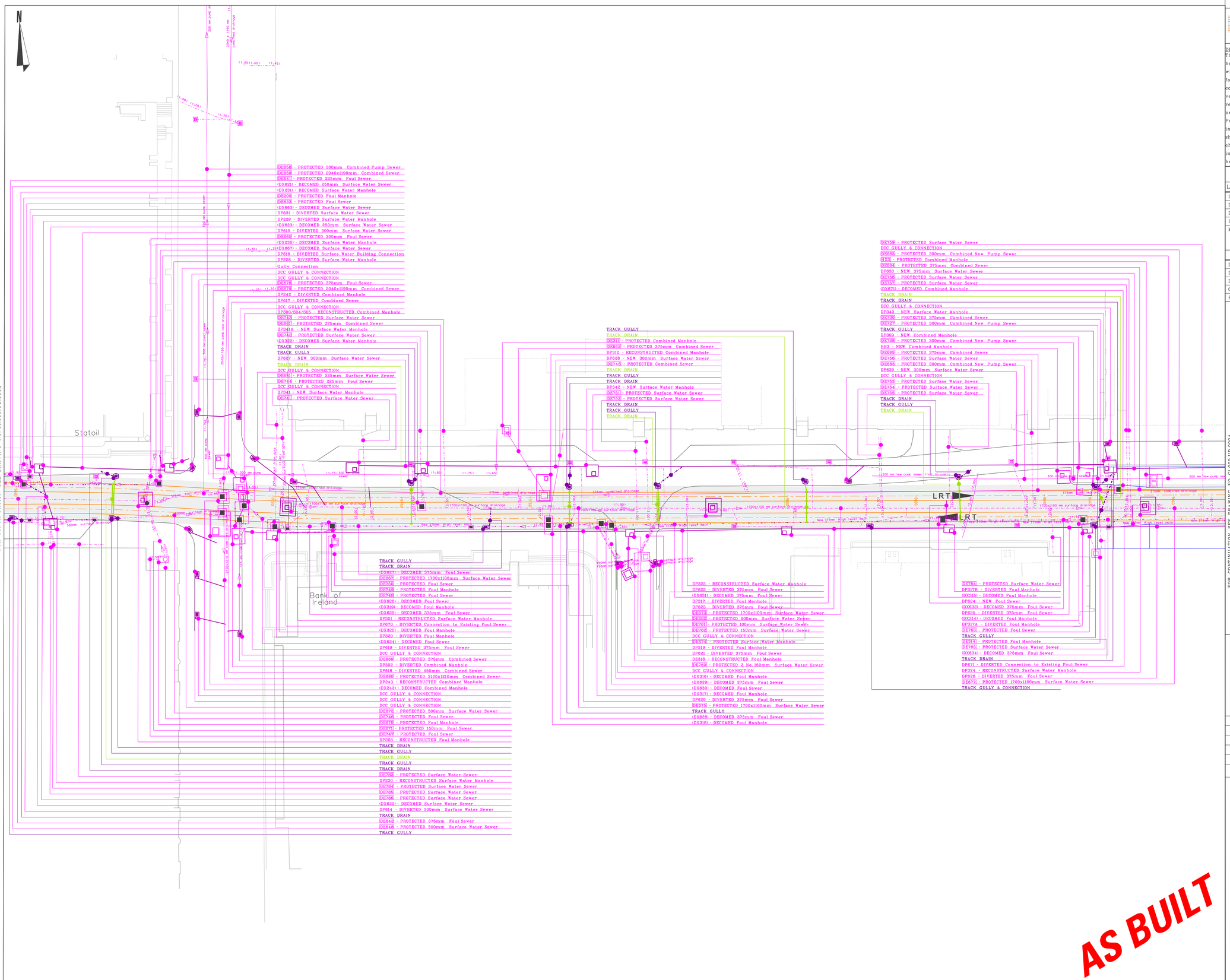
Last edited: 12/06/2018

Metres

0 25 50 100

APPENDIX L

Luas As-Constructed Services Drawings



LOCATION PLAN
Scale 1 : 200

AS BUILT CIVILS - REFERENCE ONLY

AS BUILT TRACKS

CH0 — TRACK/CARRIAGEWAY CHAINAGE

DISCLAIMER:
The information contained in this drawing has been prepared by RPA in conjunction with Mott MacDonald Pettit Ltd in good faith but does not purport to be comprehensive, to have been independently verified or to contain accurate information regarding, in particular, ownership of the network infrastructure on these lands. Persons should not rely on the information contained in the drawing and should carry out their own due diligence checks and verify the accuracy of the information themselves. Any liabilities are hereby expressly disclaimed.

UTILITY TAGGING

ALL TAGS ARE COLOURED ACCORDING TO UTILITY

TAGxxx	INDICATES EXISTING /RETAINED UTILITY
(TAGxxx)	INDICATES EXISTING UTILITY DECOMMISSIONED
TAGxxx	INDICATES AS BUILT UTILITY

DRAINAGE LEGEND

Local Authority Drainage	Existing	Decom'd	As Built
Drainage - Combined			
Drainage - Foul			
Drainage - Surface			
Gully & Connection			
Manhole/Chamber or Valve As Tagged (Coloured according to level)			

Track Drainage	As Built
Drainage - Track	
Drainage - Kerb	
Drainage to Local Authority	
Gully & Connections	
Rodding Eye & Connections	

NOTES:

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2. _ _ _ Designed by MMP.

3. _ _ _ _ As Built by SIAC and M-PACT or either.

Mott MacDonald | ARUP | SIAC CONSTRUCTION | MPact | LAING O'ROURKE

REV	DATE	DESCRIPTION	BY	CHK	APD
Z01	31/08/10	AS BUILT	CCU	MM	HF

RPA Railway Procurement Agency
Gníomhaireacht Um Fháil Iarnród
Parkgate Business Centre
Parkgate Street,
Dublin 8, Ireland
Phone +353 1 646 3400
Fax +353 1 646 3401
www.rpa.ie

LUAS

CONTRACT NO	AREA	CHAINAGE
C1-000	AREA 16 & 17	9680-9860

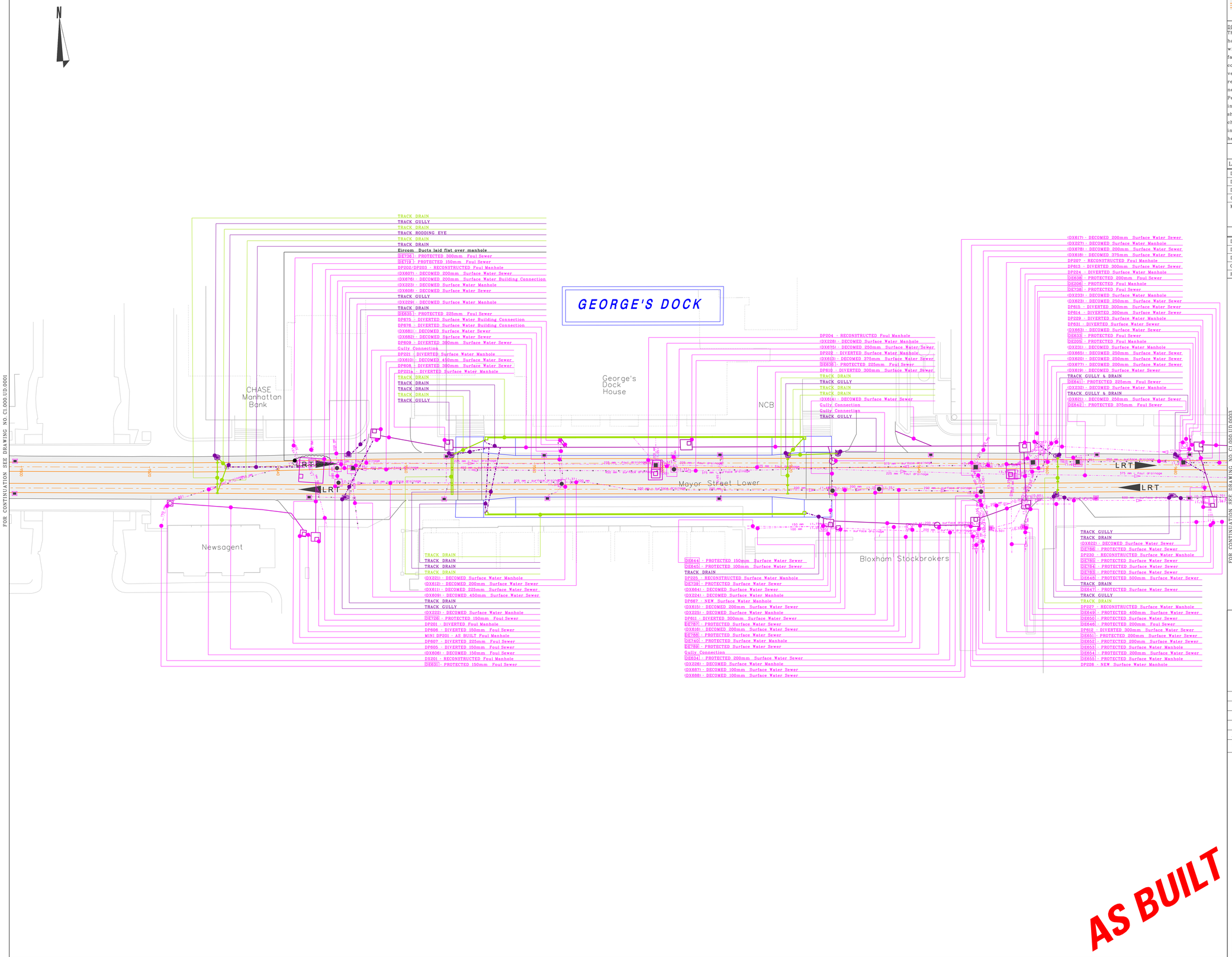
LOCATION
Commons Street to Mayor Square Stop

DRAWING TITLE
Utility Services Drawing Sheet 3 of 9
Drainage Layouts

PREPARED: RPA	DESIGNED BY	APPROVED BY HF	
CHECKED CCU	CHECKED MM	AS BUILT BY	
DATE: 30/04/10	SCALES: 1:200	SHEET SIZE A0	

STAGE	LINE	CONTRACT	ELEMENT	DRW NO	DRW REV
Z	C1	000	UD	0003	Z01

AS BUILT



AS BUILT

LOCATION PLAN
Scale 1 : 200

AS BUILT CIVILS - REFERENCE ONLY

AS BUILT TRACKS

CH0 — TRACK/CARRIAGEWAY CHAINAGE

DISCLAIMER:
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UTILITY TAGGING

ALL TAGS ARE COLOURED ACCORDING TO UTILITY

TAGxxx	INDICATES EXISTING /RETAINED UTILITY
(TAGxxx)	INDICATES EXISTING UTILITY DECOMMISSIONED
TAGxxx	INDICATES AS BUILT UTILITY

DRAINAGE LEGEND

Local Authority Drainage	Existing	Decom'd	As Built
Drainage - Combined			
Drainage - Foul			
Drainage - Surface			
Gully & Connection			
Manhole/Chamber or Valve As Tagged (Coloured according to level)			

Track Drainage	As Built
Drainage - Track	
Drainage - Kerb	
Drainage to Local Authority	
Gully & Connections	
Rodding Eye & Connections	

NOTES:

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2. _ _ _ _ Designed by MMP.

3. _ _ _ _ As Built by SIAC and M-PACT or either.

Mott MacDonald | ARUP | SIAC CONSTRUCTION | MPact | LAING O'ROURKE

REV	DATE	DESCRIPTION	BY	CHK	APD
Z01	31/08/10	AS BUILT	CCU	MM	HF

RPA Railway Procurement Agency
Gníomhaireacht Um Fháil Iarnród
Parkgate Business Centre
Parkgate Street,
Dublin 8, Ireland
Phone +353 1 646 3400
Fax +353 1 646 3401
www.rpa.ie

LUAS

CONTRACT NO	AREA	CHAINAGE
C1-000	AREA 16	9500-9680

LOCATION
Mayor St Bridge to Commons St Junction

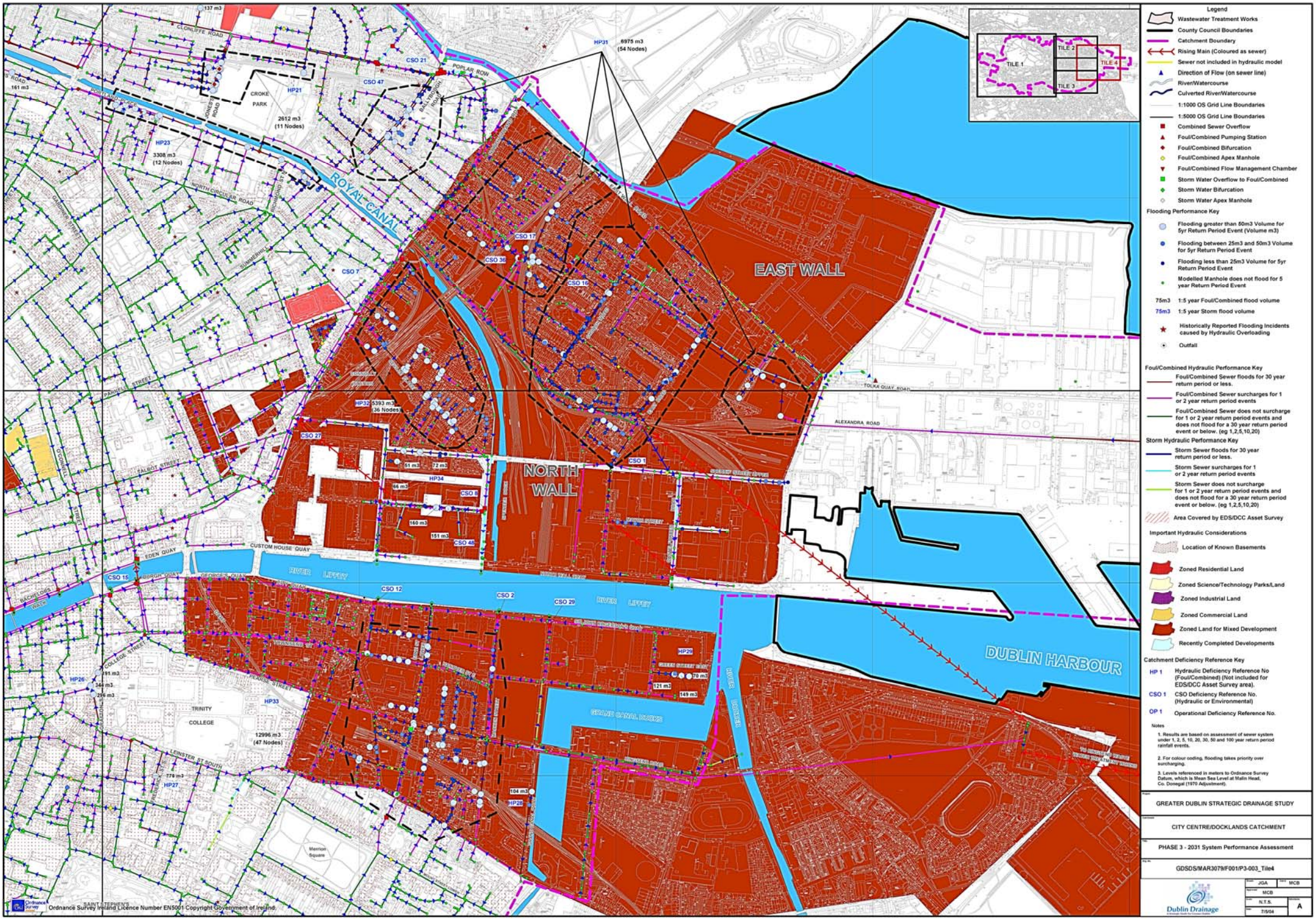
DRAWING TITLE
Utility Services Drawing Sheet 2 of 9
Drainage Layouts

PREPARED: RPA	DESIGNED BY	APPROVED BY HF	
CHECKED CCU	CHECKED MM	AS BUILT BY	
DATE: 30/04/10	SCALES: 1:200	SHEET SIZE A0	

STAGE	LINE	CONTRACT	ELEMENT	DRW NO	DRW REV
Z	C1	000	UD	0002	Z01

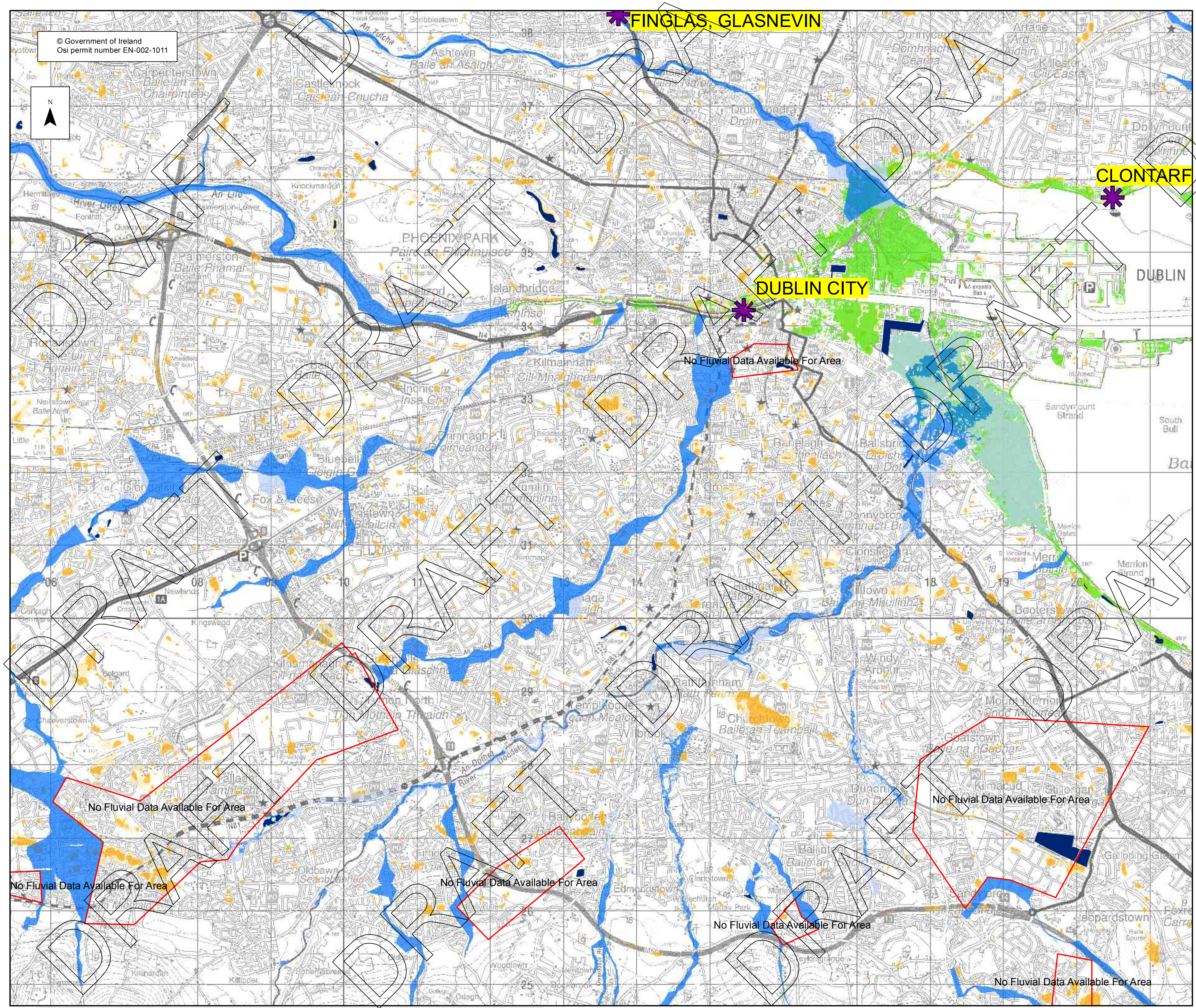
APPENDIX M

GDSDS Drainage Performance Assessment Drawing



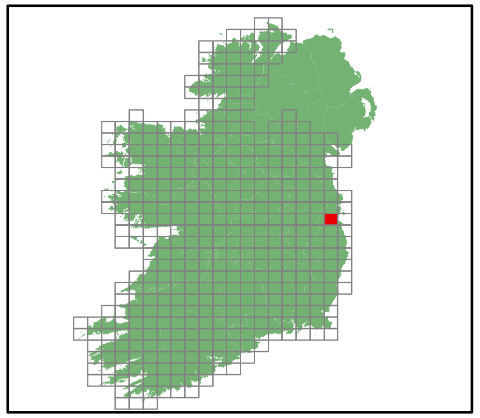
APPENDIX N

OPW Draft Preliminary Flood Risk Assessment



0.5 0.25 0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 Kilometers

Location Plan :



Legend:

Flood Extents

- Fluvial - Indicative 1% AEP (100-yr) Event
- Fluvial - Extreme Event
- Coastal - Indicative 0.5% AEP (200-yr) Event
- Coastal - Extreme Event
- Pluvial - Indicative 1% AEP (100-yr) Event
- Pluvial - Extreme Event
- Groundwater Flood Extents
- Lakes / Turloughs

PFRA Outcomes

- Probable Area for Further Assesment
- Possible Area for Further Assesment

Important User Note:

The flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location. Information on the purpose, development and limitations of these maps is available in the relevant reports (see www.cfram.ie). Users should seek professional advice if they intend to rely on the maps in any way.

If you believe that the maps are inaccurate in some way please forward full details by contacting the OPW (refer to PFRA Information leaflets or 'Have Your Say' on www.cfram.ie).

Office of Public Works
Jonathon Swift Street
Trim
Co Meath
Ireland

OPW

Project :
PRELIMINARY FLOOD RISK ASSESMENT (PFRA)

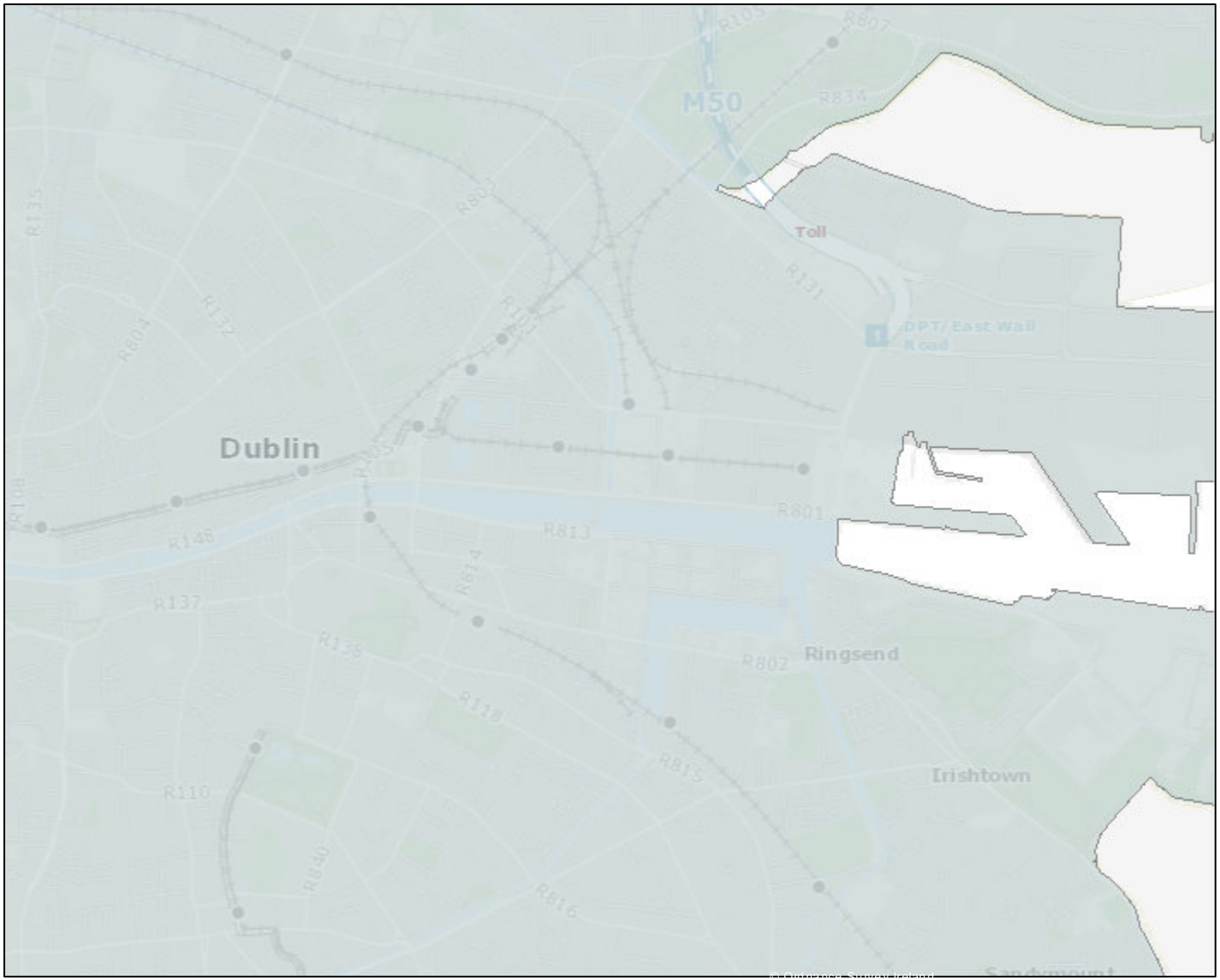
Map :
PFRA Indicative extents and outcomes
- Draft for Consultation

Figure By : PJW	Date : July2011
Checked By : MA	Date : July 2011
Figure No. : 2019 / MAP / 238 / A	Revision 0
Drawing Scale : 1:50,000	Plot Scale : 1:1 @ A3

APPENDIX O

Geological Survey of Ireland Maps

GSI - Bedrock



Scale: 1:25,000

Geological Survey Ireland

PSI Licence

0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 717,153 734,493

11/03/2019, 12:36:03

Legend

Structural Symbols 100K ITM 2018

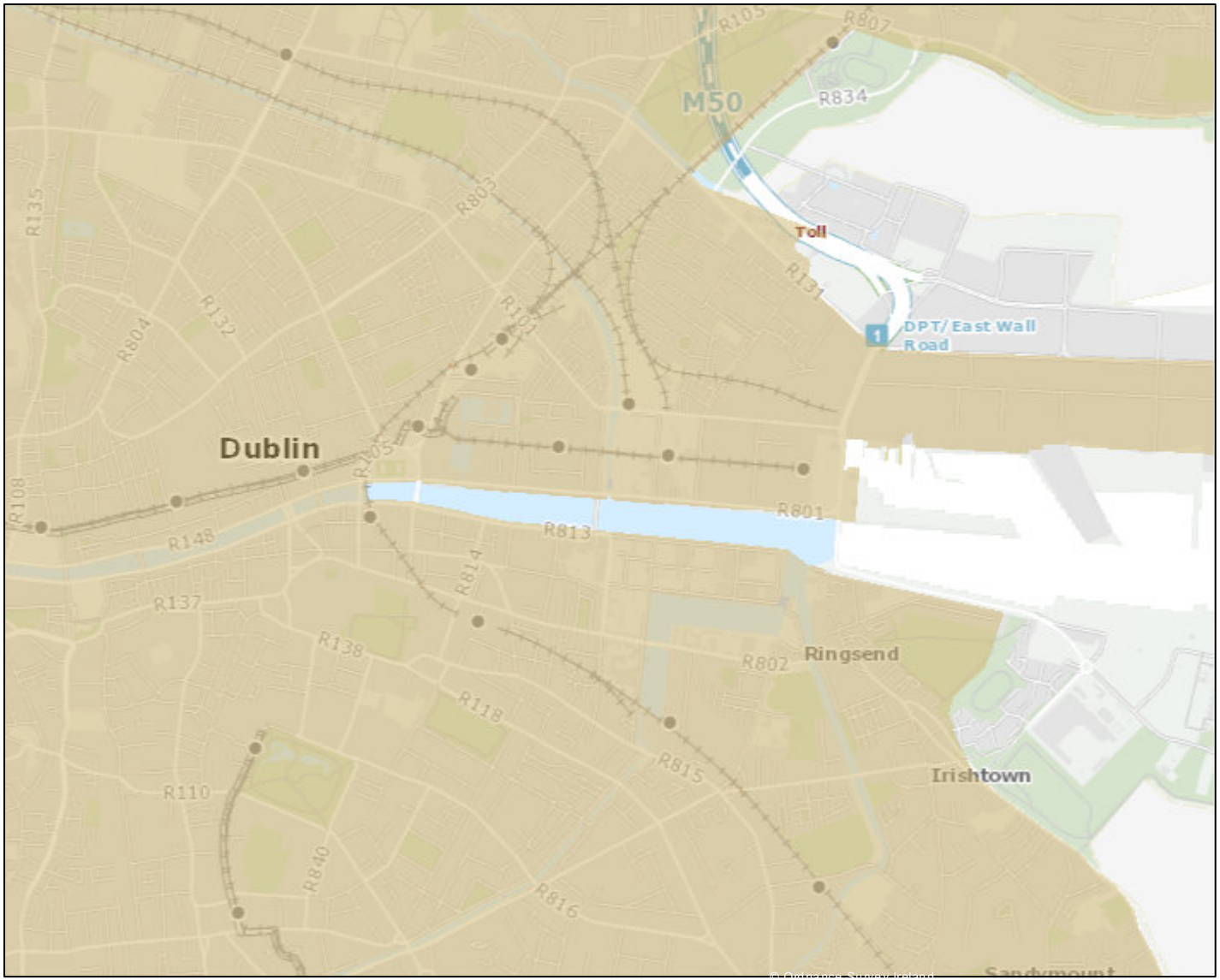
- <all other values>
- Dip of bedding or main foliation, old GSI data
- First foliation parallel to bedding
- Foliation trend, Thorr and Rosses Granites
- Horizontal Bedding
- Strike and dip of bedding, right way up
- Strike and dip of bedding, way up unknown
- Strike and dip of first foliation
- Strike and dip of overturned bedding
- Strike and dip of second foliation
- Strike and dip of third foliation
- Strike and plunge of first generation fold axis
- Strike and plunge of second generation fold axis
- Strike and plunge of third generation fold axis
- Strike of vertical bedding/foliation
- Strike of vertical first foliation
- Bedrock Outcrops 100 ITM 2018

Bedrock Linework 100k ITM 2018

- Anticlinal Axis
- Antiformal axis
- Aquifer Boundary
- Area
- Coal seam
- Dyke
- Fault
- Ghost Line
- Goniatite marine band (R1-R4)
- Lithological boundary offshore
- Metadolerite sheet, mainly sills
- Paleogene/ Tertiary Dyke
- Synclinal Axis
- Synformal axis
- Tectonic Slide, barbs on hanging-wall
- Thin stratigraphical unit, diagrammatic
- Thrust, barbs on hanging-wall side
- Tuff band
- Unconformity, dots on younger side
- X-Section

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

GSI - Aquifer



Scale: 1:25,000

Geological Survey Ireland

PSI Licence

N W E S

0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 717,153 734,493

11/03/2019, 12:34:49

Legend

Bedrock Aquifer
Faults

Gravel Aquifer

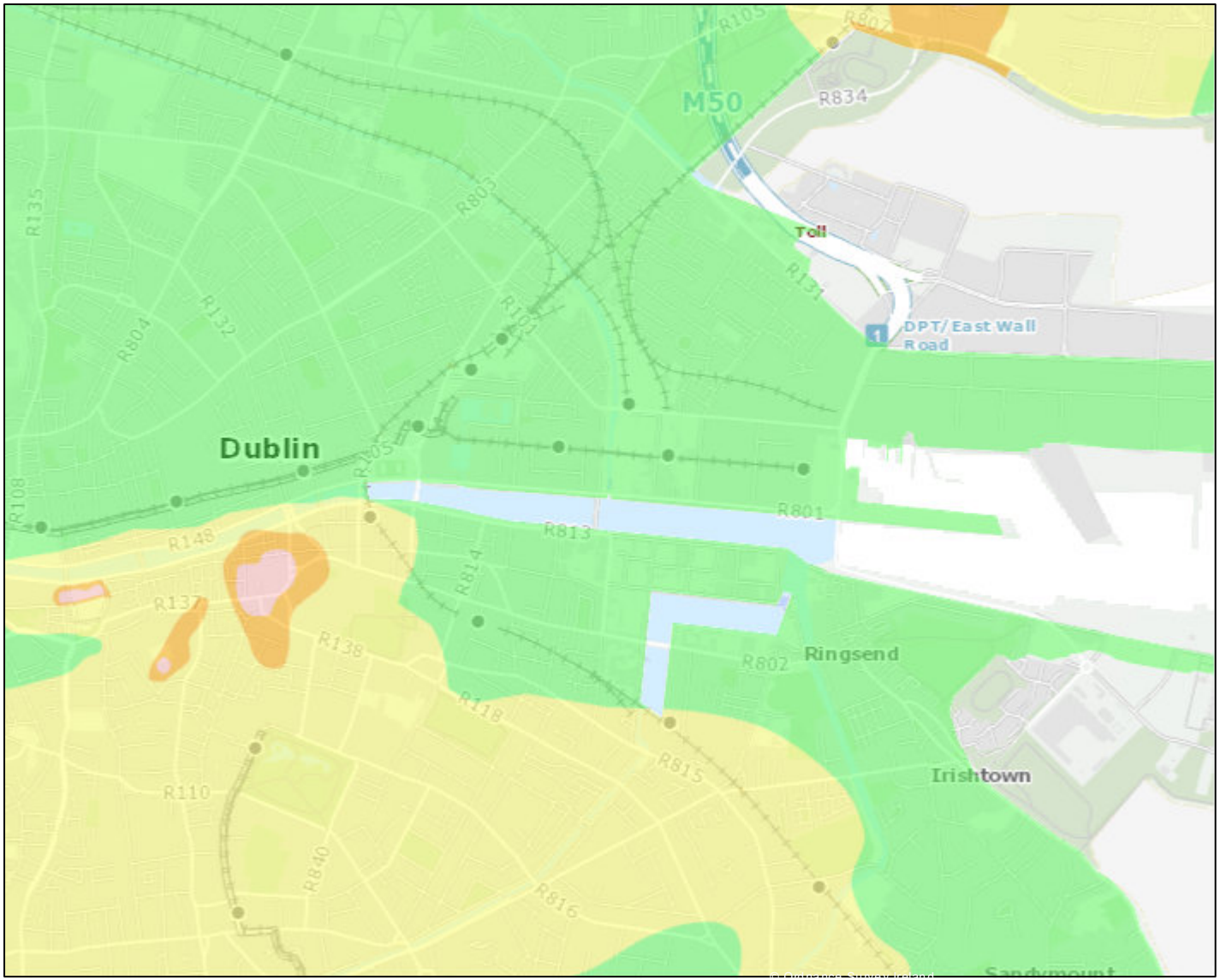
Locally Important Gravel Aquifer
Regionally Important Gravel Aquifer

Bedrock Aquifer

Rkc - Regionally Important Aquifer - Karstified (conduit)
Rkd - Regionally Important Aquifer - Karstified (diffuse)
RK - Regionally Important Aquifer - Karstified
Rf - Regionally Important Aquifer - Fissured bedrock
Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
Lk - Locally Important Aquifer - Karstified
Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
Pu - Poor Aquifer - Bedrock which is Generally Unproductive
Lake

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

GSI - Groundwater Vulnerability



Legend

Groundwater Vulnerability

- X - Rock at or near surface or Karst
- E - Extreme
- H - High
- M - Moderate
- L - Low
- W - Water

Scale: 1:25,000

Geological Survey Ireland

PSI Licence

N W E S

0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 717,153 734,493

11/03/2019, 12:35:27

APPENDIX P

Waterways Ireland Preliminary Flood Risk Assessment

Preliminary Flood Risk Analysis Report

Waterways Ireland

18th July 2011

Table of Contents

Executive Summary

The statutory function of Waterways Ireland, the largest of the six North/South Implementation Bodies established under the British-Irish Agreement Act 1999, is to manage, maintain, develop and restore specified inland navigable waterways; the Barrow Navigation, the Lower Bann Navigation, the Royal Canal, the Erne System, the Shannon-Erne Waterway, the Grand Canal and the Shannon Navigation principally for recreational purposes.

The Statutory instrument transposing EU 'Floods' Directive into Irish law identifies roles for organisations such as local authorities, Waterways Ireland and ESB to undertake certain duties with respect to flood risk within their area of responsibility. Such risks must be identified through a preliminary flood risk assessment by December 2011. The PFRA is a high level screening exercise which involves collecting existing and readily available information on historic and potential floods, assembling it into a preliminary assessment report and using it to identify Flood Risk Areas which are areas where the risk of flooding is significant.

This report looks at the possible flooding mechanisms arising from the 'artificial water bearing infrastructure' and includes an analysis of historic flooding and potential future flooding of the Grand and Royal Canals and other smaller canals linked to the Shannon Navigation, the Lough Allen Canal, the Jamestown Canal and the River Blackwater / Erina-Plassey Canal.

Conclusion

The analysis of historic data shows that, while there have been incidences of flooding caused by failure of embankments and operational issues on the Grand and Royal Canals, they have generally occurred in rural areas with very limited damage to property. In only 2 cases a small number of houses and businesses were affected but for the remainder of cases the damage has been limited to temporary flooding of bog or farmland. In Tullamore and Edenderry the ground levels are lower than the canal in some areas and there is a potential for some flooding of property but the only area where the consequences of an embankment failure is relatively high is the embanked section of canal close to Mullingar, Co. Westmeath where up to 200 houses could be flooded. However this embankment has no history of failure, has been strengthened and partially lined in recent years, is inspected weekly for any sign of a potential breach and remedial action would be put in place immediately so while the consequences would be significant the likelihood of failure is extremely low and therefore this is not considered to be an area of significant flood risk.

Waterways Ireland is committed to continuing to work with the Office of Public Works and the ESB to deliver the Assessment and Management of Flood Risks on designated waterways as required by EC Dir 2007/60/EC.

1.0 Background and Introduction

Between 1998 and 2004 Europe suffered over 100 major damaging floods including the catastrophic floods along the Danube and Elbe rivers in Summer 2002. Further severe floods in 2005 further reinforced the need for a co-ordinated approach to the management of the problem. Since 1998 floods in Europe have caused up to 700 deaths, the displacement of 500,000 people and at least €25 billion in insured economic losses. Catastrophic floods endanger human lives and cause human tragedy as well as heavy economic losses and can have severe environmental consequences. Floods are natural phenomena but through the right measures it is possible to reduce their likelihood and lessen their impact.

Directive 2007/60/EC on the assessment and management of flood risks aims to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. Under S.I. 122 of 2010 European Communities (Assessment and Management of Flood Risks) Regulations 2010, the Statutory Instrument transposing the EU Directive into Irish Law, the Commissioners of Public Works in Ireland are appointed as the Competent Authority for flood risk management and other local authorities and organizations are named. Waterways Ireland, as the statutory body responsible for the majority of Ireland's inland navigable waterways, is obliged to undertake tasks the first of which is to prepare a Preliminary Flood Risk Assessment (PFRA) of the potential flood risk posed by the structural or operational failure of any of its infrastructure.

The PFRA is a high level screening exercise which involves collecting existing and readily available information on historic and potential floods, assembling it into a preliminary assessment report and using it to identify Flood Risk Areas which are areas where the risk of flooding is significant. This PFRA concentrates on flooding which has arisen or is likely to arise from the Royal and Grand Canals, classified in the legislation as 'artificial water bearing infrastructure'.

2.0 Waterways Ireland

Waterways Ireland is the largest of the six North/South Implementation Bodies which was established by means of an international treaty made on 8 March 1999 between the British and Irish Governments. This treaty was given domestic effect by means of the North/South Co-operation (Implementation Bodies) (Northern Ireland) Order 1999, and the British-Irish Agreement Act 1999 respectively.

As a Cross Border body, Waterways Ireland operates under the policy direction of the North / South Ministerial Council and the two Governments, and is accountable to the Northern Ireland Assembly and the Houses of the Oireachtas.

The statutory function of Waterways Ireland is to manage, maintain, develop and restore specified inland navigable waterways, principally for recreational purposes.

Waterways Ireland has responsibility for approximately 1,000 km of navigable waterways (Figure 1) comprising;

- the Barrow Navigation
- the Lower Bann Navigation
- the Royal Canal
- the Erne System
- the Shannon-Erne Waterway
- the Grand Canal
- the Shannon Navigation

Waterways Ireland's remit was extended by the North South Ministerial Council in July 2007 to include responsibility for the reconstruction of the Ulster Canal from Upper Lough Erne to Clones and following restoration for its management, maintenance and development principally for recreational purposes.

Of the water bodies listed above the artificial water bodies are the Grand Canal, the Royal Canal, part of the Shannon-Erne Waterway and a number of smaller canals linked to the Shannon Navigation namely the Lough Allen Canal, the Jamestown Canal and the Erina Plassey canal. The other navigation systems are a mix of River/Lake navigation with short lateral canals. Flooding on these systems is being dealt with under the fluvial PFRA being prepared by the Office of Public Works.


Ireland's Waterways
Coleraine
Lough Foyle
Londonderry
Foyle
Strabane Canal
Strabane
Lower Bann Navigation
Larne
Lough Beg
Antrim
Donegal
Omagh
Tyrone Navigation
Lough Neagh
BELFAST
Lisburn
Lagan Navigation
Ballyshannon
Belleek
Lower Lough Erne
Blackwater
Benburb
Upper Bann
Portadown
L. Melvin
Enniskillen
Erne
Upper Lough Erne
Armagh
Newry Canal
Poyntz Pass
Belmullet Canal
Sligo
Ulster Canal
Clones
Newry
Newry Ship Canal
Lough Allen
Lough Allen C.
L. Key
Ballinamore
Belturbet
Dundalk
Boyle
Shannon-Erne Waterway
Lough Oughter
Carrick-on-Shannon
Westport
Tarmonbarry
Longford
Drogheda
Boyne
Navan
Lough Mask
Roscommon
Ballymahon
Abbeyshrule
Mullingar
Royal Canal
Cong Canal
Lecarrow Canal
Lough Corrib
Lough Ree
Killinure Lough
Ballykeeran
Athlone
Kilbeggan
Maynooth
Clonmacnois
Edenderry
Ballinasloe
Grand Canal
Robertstown
DUBLIN
Galway
Eglinton Canal
Suck Navigation
Navigation
Tullamore
Naas Branch
Galway Bay
Shannon
Banagher
Milltown Feeder
Naas
Portumna
Mountmellick
Lough Derg
Mountmellick Branch
Athy
Scarriff
Barrow Navigation
Ennis
Fergus Navigation
Killaloe
Carlow
Shannon Estuary
Castleconnell
Bagenalstown
Kilrush
Limerick
Foynes
Tarbert
Graiguenamanagh
St Mullins
Slaney
New Ross
Tralee
Carrick-on-Suir
Suir
Wexford
Rosslare
Tralee Ship Canal
Bridgetown C
Waterford
Lismore Canal
Fermoy
Bride Navigation
Munster Blackwater
Cork
Lee Navigation
Bantry
Kinsale
0
50
100 km
N
LEGEND
Waterways Ireland network
Other navigations
Tidal navigations
Disused navigations
Restoration in progress
Border
Cartography © EUROMAPPING 2009

Figure 1

3.0 Potential Flooding Mechanisms

The possible flooding mechanisms arising from canal infrastructure are:

3.1 Failure or Breach of an Embankment

A large proportion of the Grand and Royal Canals are built in embanked sections running at a higher level than the surrounding countryside. These embankments were constructed of local readily available material, sometimes stone and clay but in some cases they are soft peat embankments which require considerable maintenance. Failure or breach of these embankments results in water from the level being released but the impact of the flood waters very much depends on the time of year and the level of saturation of the surrounding area. The tables in Appendix 1 & 2 shows the maximum volume of water which would be released by a failure of each of the levels of the Grand and Royal Canals.

3.2 Overtopping of the Banks

During periods of intense or prolonged heavy rainfall the volume of water running into the canal can exceed the volume of water which can be racked off using the overflows, the land tunnels and the gate sluices. This excess water overtops the banks and can cause flooding of surrounding areas if it cannot be discharged through the drainage network. The primary risk to the canal system of water entering at a rate which cannot be discharged or managed is that the canal water levels rise and will overtop. In embanked areas there is then a risk of failure particularly due to the erosion of the top bank level.

3.3 Operational Issues

Water has to be managed through the canal system to keep all levels at their optimum depth and sluices in the gates are used to carefully monitor the amount of water flowing from one level to the next. Overtopping from a long level to a shorter level can result in the shorter level being unable to discharge the volume of water and resultant flooding of the surrounding areas. Any failure of the lock-gates or interference with the sluices whether deliberate through acts of vandalism or accidental can result in overtopping of a short level as described above.

5.0 The Royal Canal

5.1 History of Construction

The Royal Canal was the second canal to be built across the country from Dublin to the River Shannon. Work started in 1790 and the canal reached the Shannon in 1817. Spencer Dock in Dublin was not complete until 1873. The navigation starts at Spencer Dock and the canal rises steeply out of the city through a succession of double locks. From the 10th lock, although still in Dublin, it begins to assume a rural aspect through an attractive tree lined stretch. It climbs up to a summit level through Mullingar at 94.3m higher than the entry level at Spencer Dock , then drops down to the River Shannon at approximately 40m above sea level. The canal is 146km in length with 46 locks 10 of which are double chambered and there is also a sea lock where the canal joins the River Liffey in Dublin. Approximately 55% of the Royal canal is embanked with 3 peat embankments at Cloonbreany, Begnagh and Ballymaclavy and a 3km embankment running around the town of Mullingar, Co. Westmeath. The Royal Canal was closed to navigation from 1960 and was only fully reopened in 2010 following a lengthy period of reconstruction.

5.2 Historic Flooding on the Royal Canal

5.2.1 Flooding due to embankment failure

The only significant breach of the Royal Canal embankments in recent years occurred in June 1993 on the 32.4km long level of the Royal Canal near the Longwood Aqueduct at Ballycooley, Longwood, Co. Meath. The breach was approximately 15m wide and occurred in a 6m high embankment. The water flowed through the breach into a low-lying strip of waste land and from there through a culvert under the railway and flooded a lane and some fields. A large area of land was flooded however the floods receded within 2 days and the breach did not result in any significant damage. A similar breach occurred in this area in the 1920s.

5.2.2 Flooding due to overtopping and operational issues

The most significant flooding due to overtopping was in the Spencer Dock area in Dublin city in 2002 when, due to the very high tide levels, the River Liffey was 0.4m higher than the level in the Royal Canal. The water flowed back up the Royal Canal and caused flooding of a maximum of 20 houses and 5 business premises.

Other flood events were extremely minor in nature Maynooth Harbour has occasional flooding of 1 garden if sluices in the lock gates are not left in the correct position and there is also occasional flooding of the road east of Darcy's Bridge and near Ferns Lock.

5.3 Remedial Action

Immediate repairs were made to the Longwood embankment which was rebuilt and sealed with a HDPE liner and puddle clay. The embankment is inspected regularly for any signs of a further breach.

In Spencer dock a new sea lock and flood protection system was constructed so that high tides can no longer cause this type of flooding.

5.4 Inspection and Maintenance Regime

All of the embankments in the Royal Canal are inspected regularly. Because of the level of risk the Mullingar embankments are inspected weekly while the Longwood, Downs and Ballymaclavy embankments are inspected monthly. Any necessary repairs are carried out immediately.

5.5 Potential Future Floods

The only area of potentially significant flood risk identified by this study is Mullingar where up to 200 houses could be flooded in the event of a failure of the embankment however

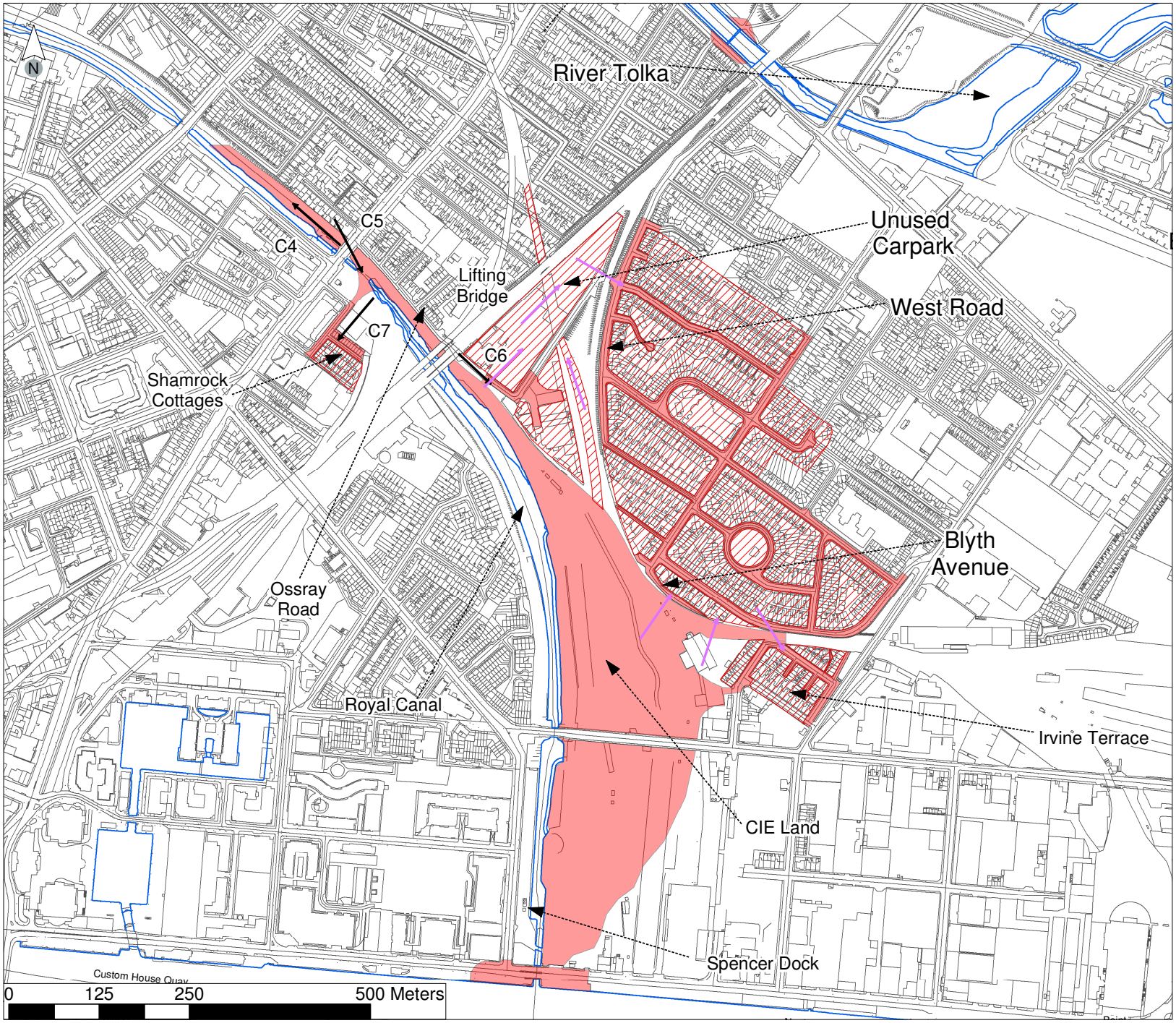
- this embankment has no history of failure
- has been strengthened and partially lined in recent years
- is inspected weekly for any sign of a potential breach
- remedial action would be put in place immediately

while the consequences of failure would be significant the likelihood of failure is extremely low and therefore this is not considered to be an area of significant flood risk.

Appendix 2 lists all reaches of the Royal Canal system giving dimensions, embankment details, inflows and potential flooding volumes.

APPENDIX Q

DCFPP Historical Flood Extent – Royal Canal



Key:

C1 — Location and direction of photograph C1 in Appendix C2

Possible flood paths

Flood areas as identified by FCC & DCC staff

Additonal Flood areas identified by site inspection and through discussions with public but not confirmed

Title:
AREAS KNOWN TO HAVE FLOODED ON 1st FEBRUARY 2002: 5 of 9

Project:
DUBLIN COASTAL FLOODING PROTECTION PROJECT

Client:
DUBLIN CITY COUNCIL

IN ASSOCIATION WITH :

FINGAL COUNTY COUNCIL
THE DEPARTMENT OF COMMUNICATIONS, MARINE AND NATURAL RESOURCES IN ASSOCIATION WITH OFFICE OF PUBLIC WORKS

Date:
OCT 2004

Scale:
Nominal Scale

Figure:
C1.5

Dublin City Council
Comhairle Cathrach Bhaile Átha Cliath

safer
STRATEGIES AND ACTIONS FOR FLOOD EMERGENCY RISK MANAGEMENT

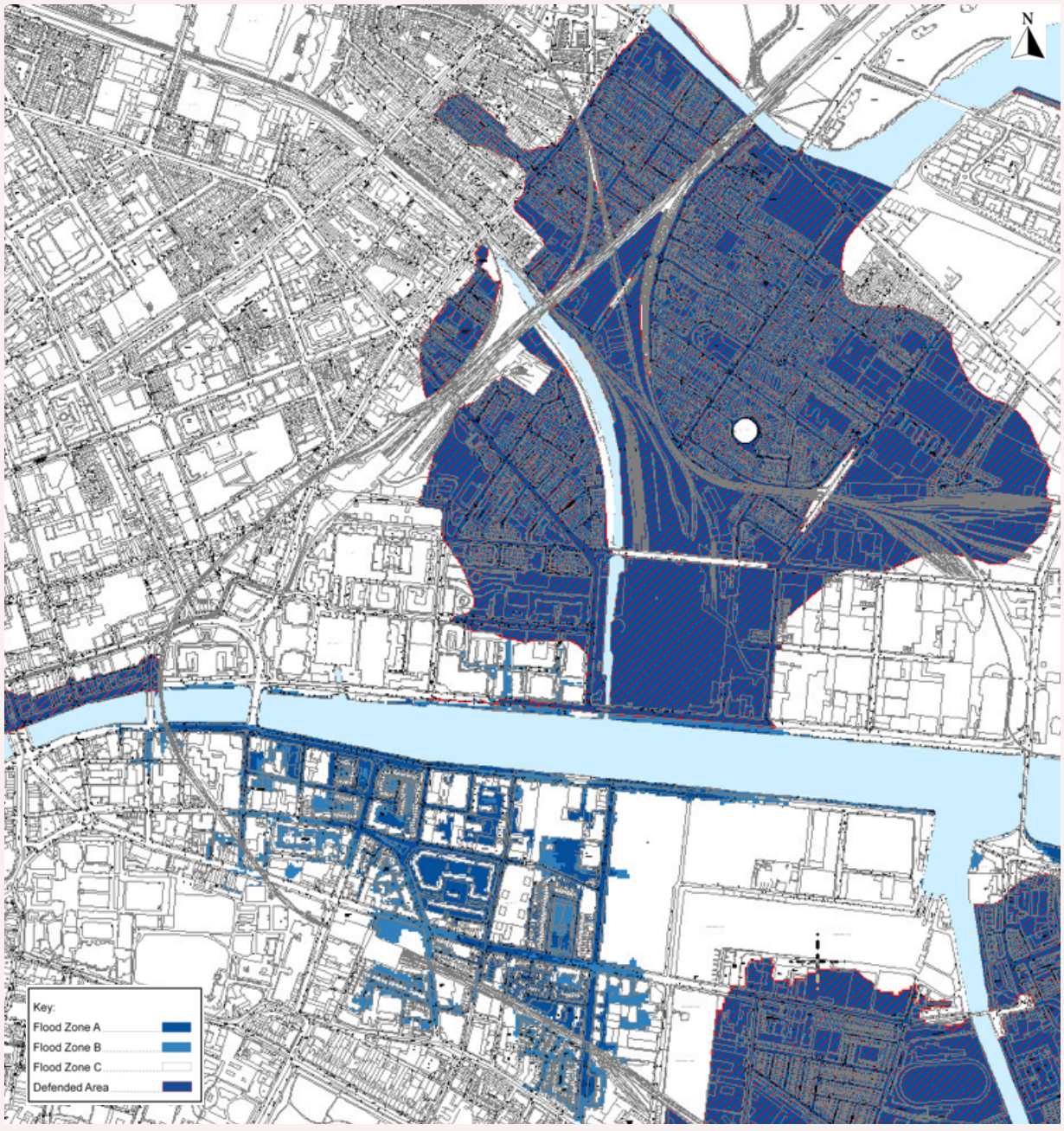
Department of Communications, Marine and Natural Resources
Roinn Cumarsáide, Mara agus Acmhainní Nádúrtha

OPW

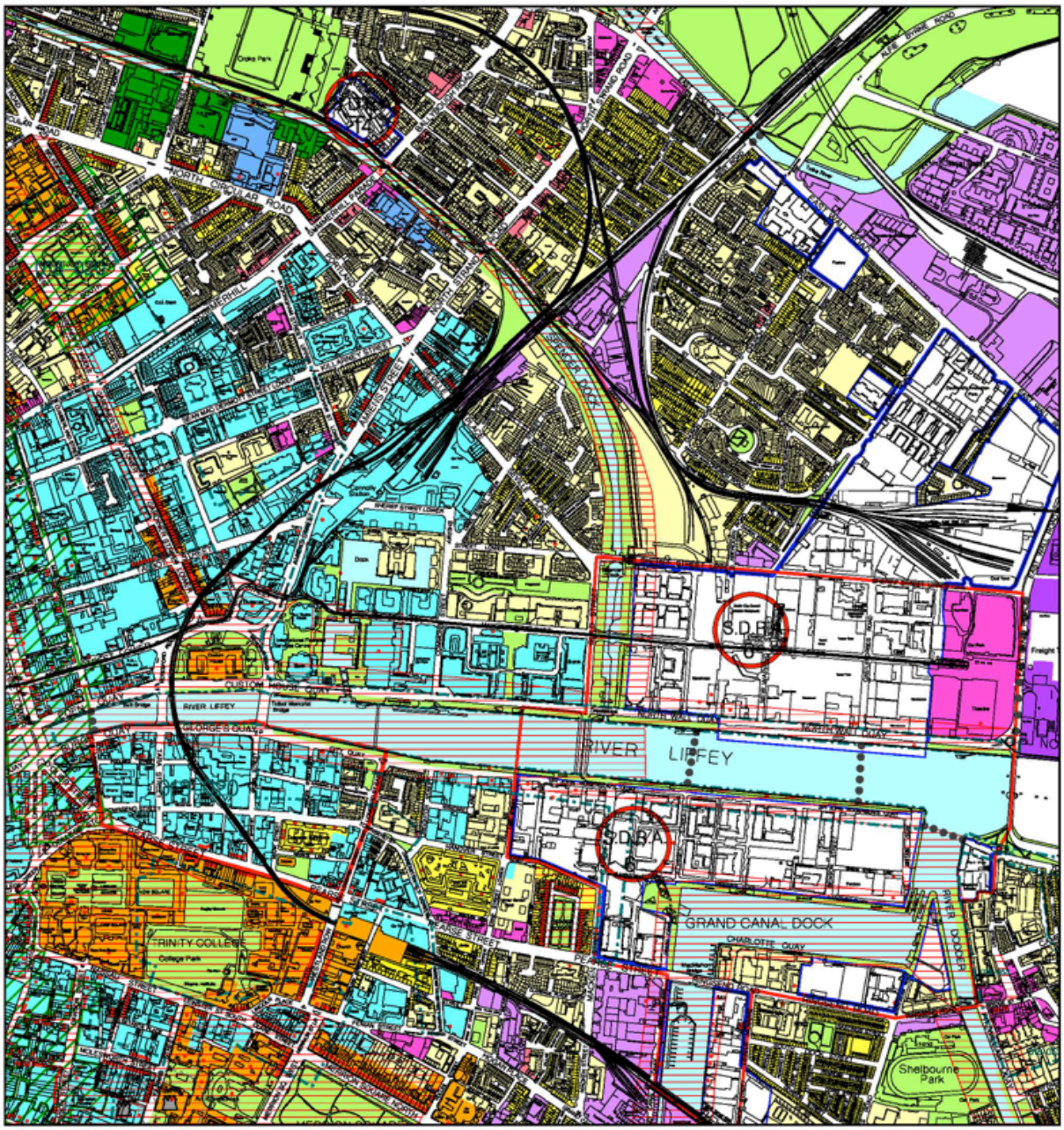
APPENDIX R

Justification Test from DCDP SFRA

Site: 3. Liffey: O'Connell Bridge to Tom Clarke Bridge



Site: 3. Liffey: O'Connell Bridge to Tom Clarke Bridge



Dublin City Council Development Plan 2016–2022 (zoning map key at back of tables)

Site Description	The area on the south side (right bank) includes Sir John Rogerson's Quay, City Quay, George's Quay and Burgh Quay and areas south of these roughly to the railway line. On the north side (left bank) it includes North Wall Quay, Custom House Quay, Eden Quay and areas north of these including areas adjacent to the Royal Canal flooded in 2002. The areas include the Docklands Strategic Development Zone (SDZ) and the Royal Canal exit to the Liffey Estuary. Development in this area is a mixture of high density Commercial and Residential.

Site: 3. Liffey: O'Connell Bridge to Tom Clarke Bridge	
Benefitting from Defences (flood relief scheme works)	Some areas to the west of this area have existing Quay Walls but their design standards and capacity for flood defence is unknown. Georges Quay has recently had flood defences constructed to a level of 4.0m Malin head. A new sea lock (triple gate) was installed at Spencer Dock to reduce the risk of tidal waters flooding houses and commercial building to the north of it. This sea lock is maintained by Waterways Ireland. City Quay and Sir John Rogerson's Quay to Cardiff Lane have flood defences programmed for construction in 2015 and 2016.
Sensitivity to Climate Change	Climate change impacts of +0.5–1.0m on sea levels would have a significant impact on the area.
Residual Risk	Any proposed developments in the protected areas on Georges Quay and elsewhere require residual risk from overtopping or other cause to be mitigated against. Where defences are formal, of recent construction and maintained by DCC / OPW, the risk of breach is likely to be low and assessment can be quantitative rather than involving detailed modelling.
Historical Flooding	The flood maps attached are consistent with previous flooding of this section of the Liffey Estuary.
Storm (surface) water	All storm (surface) water in this area needs to be carefully managed and provision made for significant rainfall events during high tides. A one year high tide event should be assumed during a 100-year rainfall event. Should development be permitted, best practice with regard to storm (surface) water management should be implemented across the development area, to limit storm (surface) water runoff to current values. All Developments shall have regard to the Pluvial Flood Maps in their Site Specific Flood Risk Assessment, see Flood ResilienCity Project, Volume 2 City Wide Pluvial Flood Risk Assessment at http://www.dublincity.ie/main-menu-services-water-waste-and-environment-drains-sewers-and-waste-water/flood-prevention-plans

Commentary on Flood Risk:
The flood extents indicate flow paths generally coming directly out of the tidal region, some are through quay walls and underground chambers near quay walls.
The flood maps were produced based on the OPW CFRAMS Study and checked against historic flooding in the area. The south Campshires area which has a flood defence under construction from Butt Bridge to Cardiff Lane is the most at risk area. The North Campshires will require flood defences to combat 0.5–1.0m estimated climate change in the future. This is being further reviewed under the Eastern CFRAM Study, and recommendations for defence works will be reported on in the resulting Flood Risk Management Plan.

Development Options:
High density Commercial and Residential development (some infill and some redevelopment) would be a natural extension of existing development. Development will be required within both Flood Zones A and B so the Justification Test has been applied. Development will be permitted in Flood Zone C.

Site: 3. Liffey: O'Connell Bridge to Tom Clarke Bridge

Justification Test for Development Plans

1. Section 1 is covered elsewhere in this SFRA justifying all of Dublin City

2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and, in particular:

(i) Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement
Answer: Yes: This part of the City is a key redevelopment area. Part of the area identified above (where the Flood Cell is identified) forms part of the George's Quay Local Area Plan, 2012. The George's Quay LAP area is framed by the iconic River Liffey to the north and by the unique built heritage footprint of Trinity Campus to the south. The area is highly connected to other parts of Dublin and beyond with two of the busiest heavy rail stations in Dublin, Tara Street Station and Pearse Street station serving the area. This area is strategically located and important for a number of reasons including (i) its role as a location of headquarter and Government Departments, (ii) adjoining Trinity College and its associated innovation centres and (iii) located at the bridging point between the City centre and Docklands, means that this area is of significant economic importance to both the City, the Region and the State. The LAP area has capacity to facilitate significant new employment centres as it can provide locations for high quality new office, mixed use and innovation space in the heart of the City centre, attracting new economic activity and headquarter facilities. The area to the east of the George's Quay LAP, is the Grand Canal Dock area which forms part of the North Lotts and Grand Canal Dock Strategic Development Zone (SDZ), which was approved by An Bord Pleanala in 2014. The SDZ offers a coherent spatial and urban planning approach and is considered the most appropriate and effective mechanism to deliver the remaining parts of this area of economic and social importance to the city and State. This area also forms part of the Strategic Development and Regeneration Area 6 (SDZ and Wider Docklands Area, see section 15.1.1.6 of the written statement), which are areas capable of delivering significant quantums of homes and employment for the City, either through the development of green field sites or through the regeneration of the existing built City. The SDZ Docklands site is zoned Z14 within the Development Plan, where the overall focus is To seek the social, economic and physical development and/or rejuvenation of an area with mixed use, of which residential and "Z6" [enterprise and employment use] would be the predominant use.

(ii) Comprises significant previously developed and/or under-utilised lands
Answer: While the George's Quay Area is largely developed there are a few large key development sites within the LAP, which would be mostly brownfield sites. Within the SDZ boundary (which forms part of SDRA 6, see section 15.1.1.6 of the written statement), there are also a number of large development sites. In total the SDZ area comprises 66 hectares, between North Lotts and Grand Canal Dock, the remaining sites for redevelopment equate to 22ha, which represents significant development potential for major economic and community expansion.

(iii) Is within or adjoining the core of an established or designated urban settlement
Answer: Yes: This area is located adjacent to the core of the City, and located in a strategic position in close proximity to major transport infrastructure. The George's Quay area is strategically located adjacent to the retail core, where large numbers of former industrial or entertainment sites provided the opportunity for comprehensive office development. The North Lotts Grand Canal Dock SDZ lands extend north and south of the river at a strategic location; North Lotts immediately adjoins the IFSC and Grand Canal Dock is in close proximity to the city's central business district and south city retail core area.

Site: 3. Liffey: O'Connell Bridge to Tom Clarke Bridge

(iv) **Will be essential in achieving compact and sustainable urban growth**
A**nswer: Yes:** This area is a key redevelopment area in the city. Part of the lands above form part of the George's Quay LAP and part of the lands form part of the SDZ for the North Lotts Grand Canal Dock. This area is key in achieving compact and sustainable urban growth.

(v) **There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.**
Answer: There are no suitable alternative lands for the particular uses or development type in areas at lower risk of flooding, within or adjoining the urban settlement. This area is essential for the future expansion of Dublin City.

3. Strategic Flood Risk Assessment for Flood Zones A and B (for defended Flood Zones A and B see section 4.8)

- Where possible, small scale redevelopment and refurbishment should be focused behind flood defences where flood risks are more limited. Such development should be accompanied by a site specific assessment flood risk assessment which should consider the likelihood and impact of defence failure, which may be through overtopping (either due to an extreme event in the current situation or through sea level risk linked to climate change). Where appropriate, consideration should be given to the impacts of demountable sections of flood defence not being erected. Whilst it is unlikely that the findings of such an assessment will indicate development should not go ahead, an emergency plan may be required, fully considering the issue and receipt of flood warnings and emergency evacuation routes and procedures as well as how the operation will ensure it can retain functionality / recover following an extreme flood event.
- Management of risks may be through design of access levels, flood resilient construction techniques and avoiding locating vulnerable development at ground flood level. Climate change risks will need to be considered, but it may not be possible to fully mitigate against these in an already developed situation.
- The assessment and design should include appropriate consideration of sea level rise and climate change impacts.
- Compensatory storage is not required as risks along the Quays are linked to tidal flooding.
- FRA's should be carried out for all basements and underground structures with respect to any human access.

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