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EIAR Chapter 7 Hydrology

Suir Island Infrastructure Links

Comhairle Contae Thiobraid Árann
Tipperary County Council

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Document Control Sheet

Project Name:	Suir Island Infrastructure Links
Project Number:	20_071
Report Title:	EIAR Chapter 7 Hydrology
Filename:	RPT-20_071-035

Issue No.	Issue Status	Date	Prepared by	Checked by
0	Final	22.09.2023	HB	LP

Table of Contents

List of Figures

List of Tables

7 Hydrology

7.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) presents the hydrological assessment of the Suir Island Infrastructure Links proposed development located in Clonmel, Co. Tipperary. This chapter sets out the likely impact of the proposed development on the surrounding surface water and hydrogeological environments (including flood risk, surface water drainage, foul drainage and water supply) as well as identifying proposed mitigation measures to minimise any impacts..

7.2 Methodology

7.2.1 Legislation and Guidelines

This chapter has been prepared having due regard to relevant legislation guidance documents which are listed below:

- EPA (Environmental Protection Agency) Guidelines on the Information to be contained in Environmental Impact Statements, May 2022;
- NRA (TII) Guidelines for the crossing of watercourses during the construction of National Road Schemes, (2008);
- NRA (TII) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, (2009);
- NRA (TII) Environmental Impact Assessment of National Road Schemes – A Practical Guide, November 2008;
- NRA (TII) Guidelines for Assessment of Ecological Impacts of National Roads Schemes, Revision 2, June 2009;

7.2.2 Hydrology Assessment Methodology

The National Roads Authority (NRA), now Transport Infrastructure Ireland (TII) Guidelines on the Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2009), Section 5.6 and 5.7, were used as reference to ascertain the impact category, duration and nature of impact in this assessment. The range criteria for assessing the importance of hydrological features within the study area and the criteria for quantifying the magnitude of impacts follow the guidelines.

The NRA/TII guideline document recommends that the study area should encompass an overall width of 500-metres i.e. 250-metres from the centreline of the route corridor when undertaking geological, hydrological and hydrogeological studies. For the proposed development, taken due consideration for the potential impact of the proposed development on the existing flood water levels in the River Suir, the study area or zone of influence was extended 250-metres upstream of Stretchers Island and 200-metres downstream of the Old Waterford Road Gashouse Bridge. This equates to a total distance of 1.2-kilometres along the River Suir as shown in Figure 7-1.

The hydrological assessment includes gathering relevant information of published literature sourced from web-based search, similar studies completed for projects on the Suir River and information provided by Local Authorities and Governing Bodies. Site-specific topographical information, aerial photography and published maps were used to identify potential features of significance in order to assess the likelihood of environmental impacts.

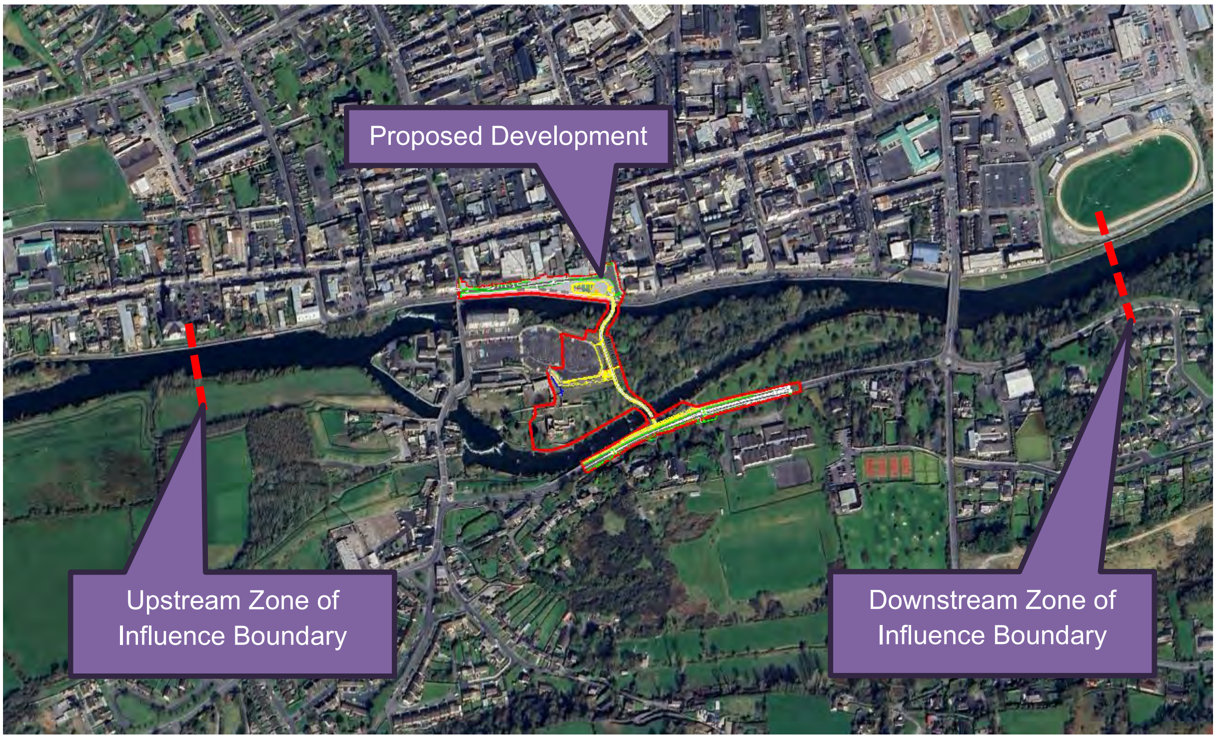

Figure 7-1: Hydrological assessment Zone of Influence

Available topographical and hydrometric information (field and desk based) has been used to perform a hydrological impact assessment of the existing infrastructure and proposed watercourse crossing. All watercourses and water bodies which could be affected temporarily (construction phase) or permanently (operation phase) were assessed. The proposed works include a pedestrian bridge crossing over from Suir Island to The Quay/Quay Street/Sarsfield Street on the north riverbank and a second pedestrian bridge from Suir Island to Raheen Road (Denis Burke Park) on the south riverbank. The proposed works will also be in the vicinity of the river on the North Plaza (Quay/Sarsfield Street) and South Arrival Point (Raheen Road). The NRA (TII) guidelines recommend a 500m study area (250m upstream and downstream) from the proposed crossing, which was increased to 250m upstream of the existing Suir River weir situated upstream of Suir Island and 250m downstream of the Old Waterford Road Gashouse Bridge. This equates to a study area of 1.2km measured along the main river reach.

Assessment of the likely impact of the proposed development on the surrounding surface water and hydrogeological environments included the following activities:

- Site inspections;
- Review of existing topographic survey information;
- Acquisition of topographic and bathymetric survey information;
- Review of Irish Water utility plans (surface water drainage, foul drainage and water supply);
- Ground investigations including trial pits and environmental testing (waste acceptance criteria for landfills);
- Review of information available on the Environmental Protection Agency (EPA) online mapping service;
- Review of information available on the Geological Survey of Ireland (GSI) online mapping service;
- Consultations with the Office of Public Works;
- Submission of OPW Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010;

- Undertook Stage 1 and 2 Flood Risk Assessments;
- Undertook Hydraulic Modelling of the Suir River including a detailed Hydrological Review;
- Review of Office of Public Works (OPW) National Flood Hazard Mapping and CFRAM Studies (Catchment Flood Risk Assessment and Management Studies);
- Consultation with Tipperary County Council Water Services Section;
- Consultation with Irish Water; and
- Submission of a Pre-Connection Enquiry Application to Irish Water

7.2.3 Sources of Information

Information was obtained on Geology, Hydrology and Hydrogeology from the following sources:

- Geological Survey Ireland (GSI) – Bedrock and Web Mapping;
- Teagasc – Subsoil Map;
- Aerial Photography;
- Environmental Protection Agency (EPA) – Surface Water Quality, Water Features and Regions and Monitoring Stations;
- EPA – Catchments Data;
- River Basin Management Plan for Ireland 2018-2021.
- *Draft* River Basin Management Plan for Ireland 2022-2027.
- The Planning System and Flood Risk Management, Guidelines for Planning Authorities (Department of the Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW));
- Greater Dublin Strategic Drainage Study: Technical Documents of Regional Drainage Policies. Dublin: Dublin City Council; and
- ‘Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors’ (CIRIA 532, 2001);
- National Parks and Wildlife Services (NPWS) – Protected Site Register
- Office of Public Works (OPW) – Preliminary flood Risk Assessment Mapping (RFRA);
- The Greater Dublin Strategic Drainage Study (GDSDS) published in March 2005;
- TII Road Drainage and the Water Environment (including Amendment No.) DN-DNG-03065 published in June 2015;
- TII Determination of Pipe and Bedding Combinations for Drainage Works (including Amendment No. 1) DN-DNG-03070 published in June 2015;
- TII Hydraulic Design of Road-Edge Surface Water Channels (including Amendment No. 1) DN-DNG-03068 published in June 2015;
- TII Spacing of Road Gullies (including Amendment No. 1) DN-DNG-03067 published in June 2015; and
- Department of Housing, Local Government and Heritage (DHLGH) Nature-based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas Water Sensitive Urban Design Best Practice Interim Guidance Document.
- OPW – Catchment Flood Risk Assessment and Management Mapping (CFRAMs);
- Floodmaps.ie – Flood Mapping.

7.3 Description of Proposed Development

A full description of the proposed development is provided in Chapter 2 Project Description and Policy Context of this EIAR document. Refer to Figure 7-2 for a plan layout and locality map of the proposed development.

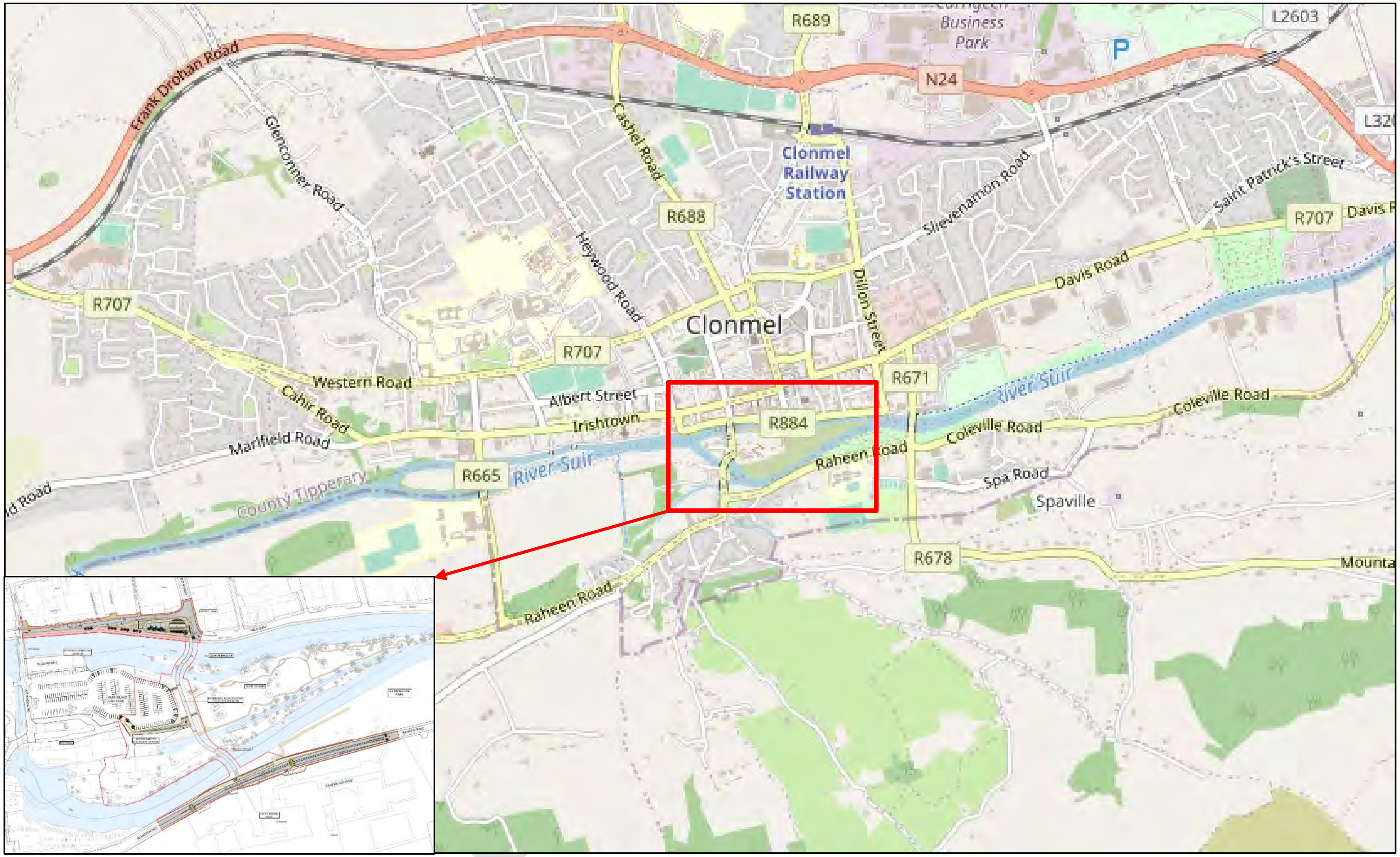

Figure 7-2: Project locality map and layout extent

7.4 *Description of Receiving Environment*

7.4.1 Site Description

The site is located south of Clonmel Town Centre, Co. Tipperary. The mixed-use urban area consists of road infrastructure, shops, leisure facilities and residential homes. The proposed bridges linking the North Plaza to Suir Island and Suir Island to Raheen Road will provide direct access for pedestrians and cyclists to the Town Centre.

Clonmel is a large town on the River Suir at the foot of the Comeragh Mountains. Suir Island is low-lying, consisting of four islands: Little Island, Suir Island, Willow Island and Stretches Island. It has been an important crossing point since medieval times, linking the Anglo-Norman walled town of Clonmel to County Waterford on the southern side of the river.

The island is surrounded by the River Suir on all sides and is accessible from the town centre via Old Bridge Road located to the west of the island. The island, from its mid-section to eastern end is largely undeveloped and overgrown. The proposed development will encompass areas zoned as "Town Centre" located on The Quays and Suir Island car park and areas zoned for Amenity located to the east of the Suir Island car park and including a small section of Denis Burke Park as shown on Figure 7-3.

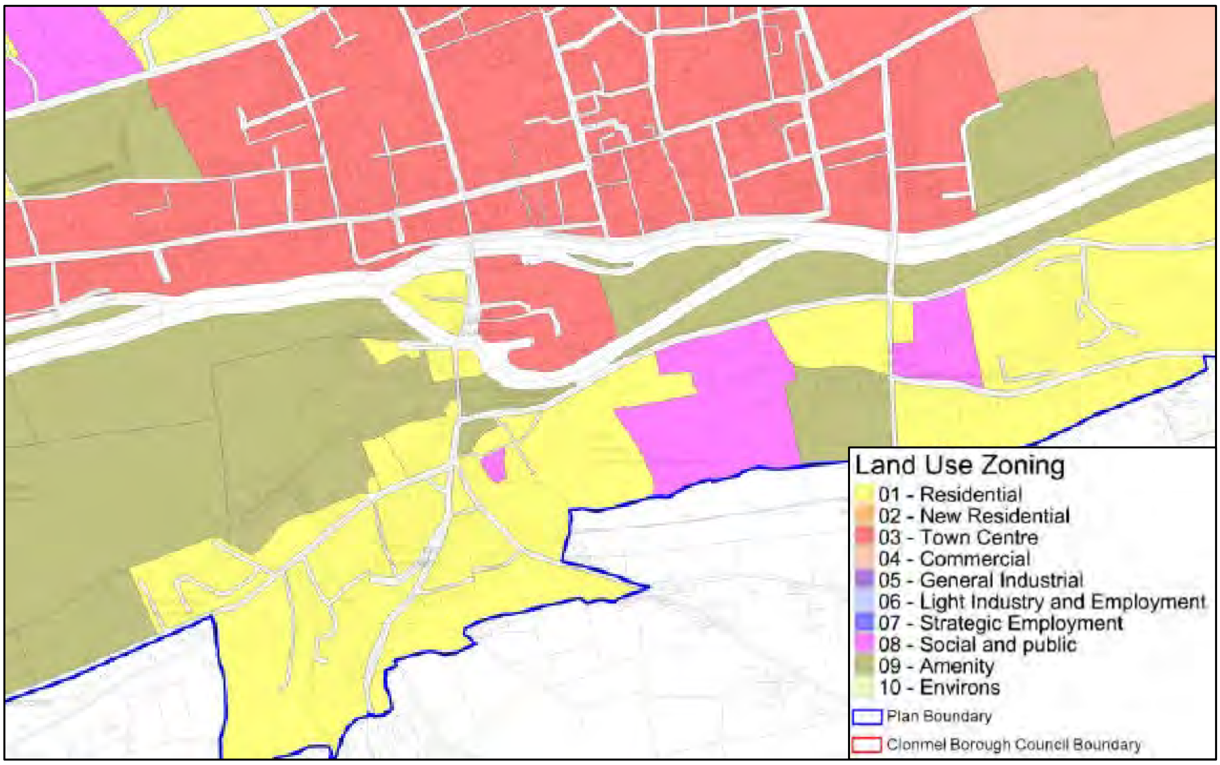

Figure 7-3: Clonmel zoning map (Clonmel & Environs Development Plan 2013)

The northern bank of the island is fully bordered by the River Suir and Clonmel town. To the south of the site, the area consists mainly of residential areas and agricultural lands. Clonmel has experienced significant flooding in the past. Flood risk is addressed in the reports highlighted in Table 1-1 and briefly summarised in **Section 7** of this report.

The site is located within part of the European site, Lower River Suir Special Area of Conservation (SAC), Site Code 002137 and Zone of Archaeological Potential as designated by the National Inventory of Architectural Heritage (NIAH), with a number of other sites of cultural and architectural heritage significance in the surrounding area. The impacts of the proposed development on the different environmental receptors are addressed in the various Environmental Impact Assessment Report (EIAR) Chapters completed as part of the planning application.

7.4.2 Topography

The existing surface elevations of the North Plaza varies from c. 17 meters Ordnance Datum (mOD) to c. 18 mOD with a flood defence wall constructed at elevations 18.68 mOD (min) and 19.12 mOD (max). The topography generally drains north to south towards the Suir River.

The surface elevations of Suir Island at the proposed bridge crossing varies from c. 16 mOD (near river) to c. 20 mOD on top of the flood protection berm. The proposed bridge will span the river sections and connect to a walkway constructed on top of the flood protection berm. The drainage grade generally falls towards the north and south river reaches from the centre of the island.

The southern landing at Raheen Road elevations varies from c. 20.2 mOD, with a flood protection wall constructed at 20.23 mOD to 20.25 mOD. The topography generally drains north to the Suir River (southern river reach).

7.4.3 Wastewater

As shown in Figure 7-4, the existing wastewater network drains eastwards to the Clonmel Waste Water Treatment Plan located approximately 1.3-kilometres downstream of the study area. The existing drainage network is shown for the Quays and Raheen Road. The existing infrastructure located on Suir Island is currently not connected to a wastewater system. The sewers discharge into septic tanks with overflows to the Suir River. As shown below, six (6) number urban waste water/combined sewer emission points drains directly to the River Suir during extreme flow events within the development zone of influence.

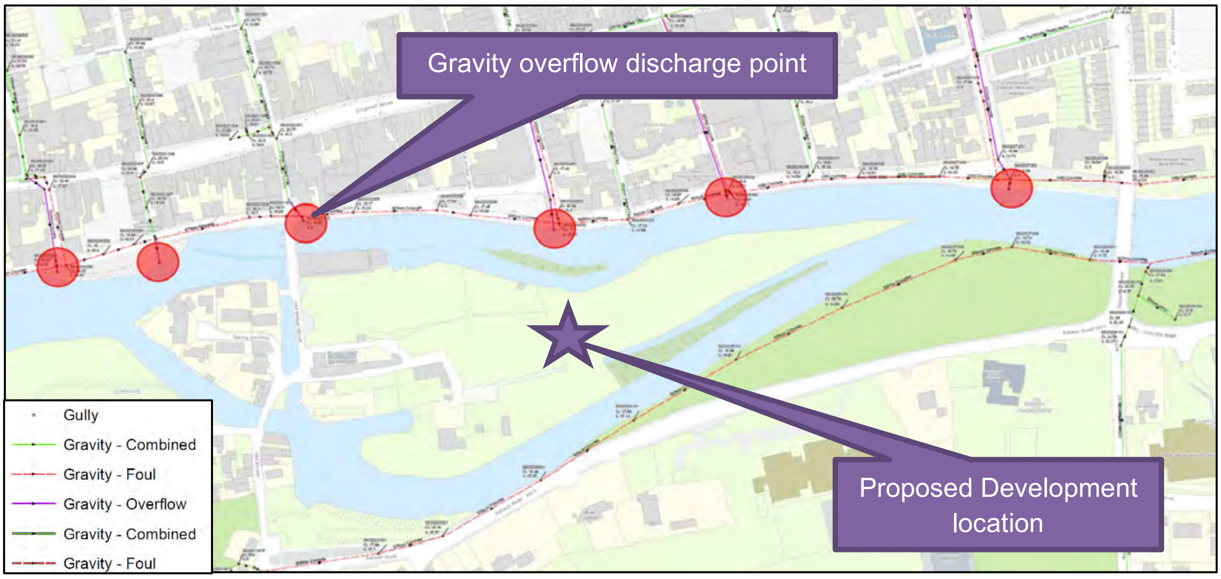

Figure 7-4: Existing wastewater/foul network (Irish Water Drawing No IW-AGG-2017-000)

The proposed infrastructure makes provision to collect wastewater from the existing residential buildings located on Suir Island by means of a collection sump and pump station that will be connected to the wastewater system on the north quay via a foul rising main pipeline installed on the soffit level of the proposed northern bridge crossing. A connection application to Irish Water has been submitted for approval as part of the Planning Application (Ref. No. CDS21008413) and a Confirmation of Feasibility letter has been received from Irish Water with regard to the foul pumping station design proposals.

7.4.4 Water Supply

Water supply to Suir Island is provided via 100mm diameter pipelines from the northern and southern quays via the existing Old Bridge Road. The pipe material is expected to be High Density Polyethylene (HDPE) installed c. 2012. The existing water supply network for the North Plaza, Suir Island and South Arrival Point is shown on Figure 7-5. The River Suir is categorised as a Drinking Water River under the EU Water Framework Directive (WFD) (2000/60/EC), but no abstraction points are located within the proposed development zone of influence.

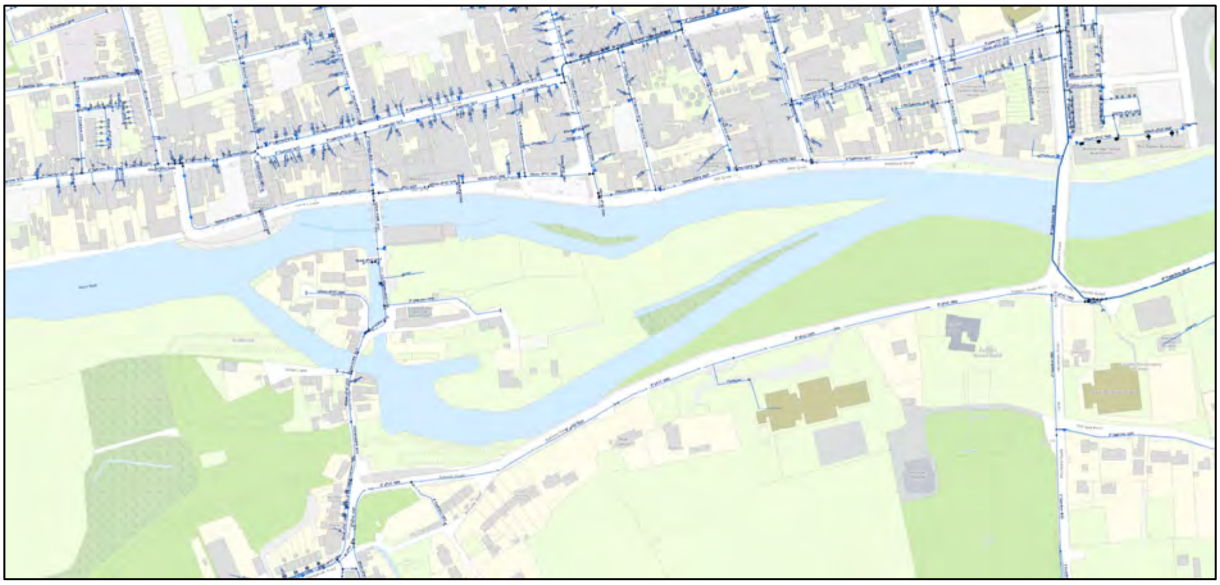

Figure 7-5: Existing water supply network (Irish Water Drawing No IW-AGG-2017-000)

7.4.5 Regional Overview of Hydrology

The Suir River originates from eastern slopes of Benduff and Northwest Templemore in Co. Tipperary. The river becomes tidal (transitions from River Waterbodies Risk to Coastal Waterbodies Risk) before reaching Carrick-on-Suir (source: EPA Maps). The Suir River estuary is situated through Waterford harbour between Dunmore East and Hook Head.

There are three (3) no. notable waterbodies in close vicinity of the proposed development site. These are the Suir River, Scrothea East Stream and the Oldbridge stream. The Scrothea East and the Oldbridge streams are tributaries to the main waterbody – Suir River. The Suir River and the two smaller tributaries are located within the proposed development site.

Surface water features located in the vicinity of the proposed development are located in the following catchment delineations:

- Water Framework Directive (WFD) – Catchment I.D. - 16
- WFD – Sub-Catchments – SUIR_SC_140
- WFD – River Sub Basin – SUIR_190

The following National Water Monitoring Station (NWMS) and Hydrometric Gauging Stations are situated in the vicinity of the proposed development and 1.2km study area:

- NWMS - RS16S022500 - SUIR - East Br Clonmel (RHS)
- NWMS - RS16S022510 - SUIR - East Br Clonmel (LHS)
- Hydrometric Gauge – 16147 - Joyce's Lane
- Hydrometric Gauge – 16011 – Clonmel

Hydrometric Gauge – 16011 – Clonmel is situated downstream of the Old Waterford Road Gashouse Bridge, located c. 450 m downstream of the proposed development. Refer to Table 7-1 below for gauge details.

Table 7-1: Hydrometric Gauge_16011_Clonmel details

Station number	**16011**
Station name	Clonmel
Latitude	52.35152528
Longitude	-7.694598056
River	Suir
Catchment	Suir
Catchment size	2143.97 km²
River Basin District	South Eastern
Current gauge datum	16.95 AOD Poolbeg
Station type	General Surface water
Diary	1940-01-14 00:00:00: Station Installed
Gauging Authority	OPW
Classification Key	A1*
Record length (years)	71

* A1 - Confirmed ratings good for flood flows well above Qmed with the highest gauged flow greater than 1.3Qmed and/or with a good confidence of extrapolation up to 2 times Qmed, bank full or using suitable survey data, including flows across the flood plain.

The historical data provided by the NWMS and hydrometric gauges are assessed as part of the EIAR, which provides key insights to determine the existing hydrometric conditions of the watercourse in terms of surface water quality, ecology and historical flood magnitudes/levels. Refer to Figure 7-6 showing the nearest rivers with references.

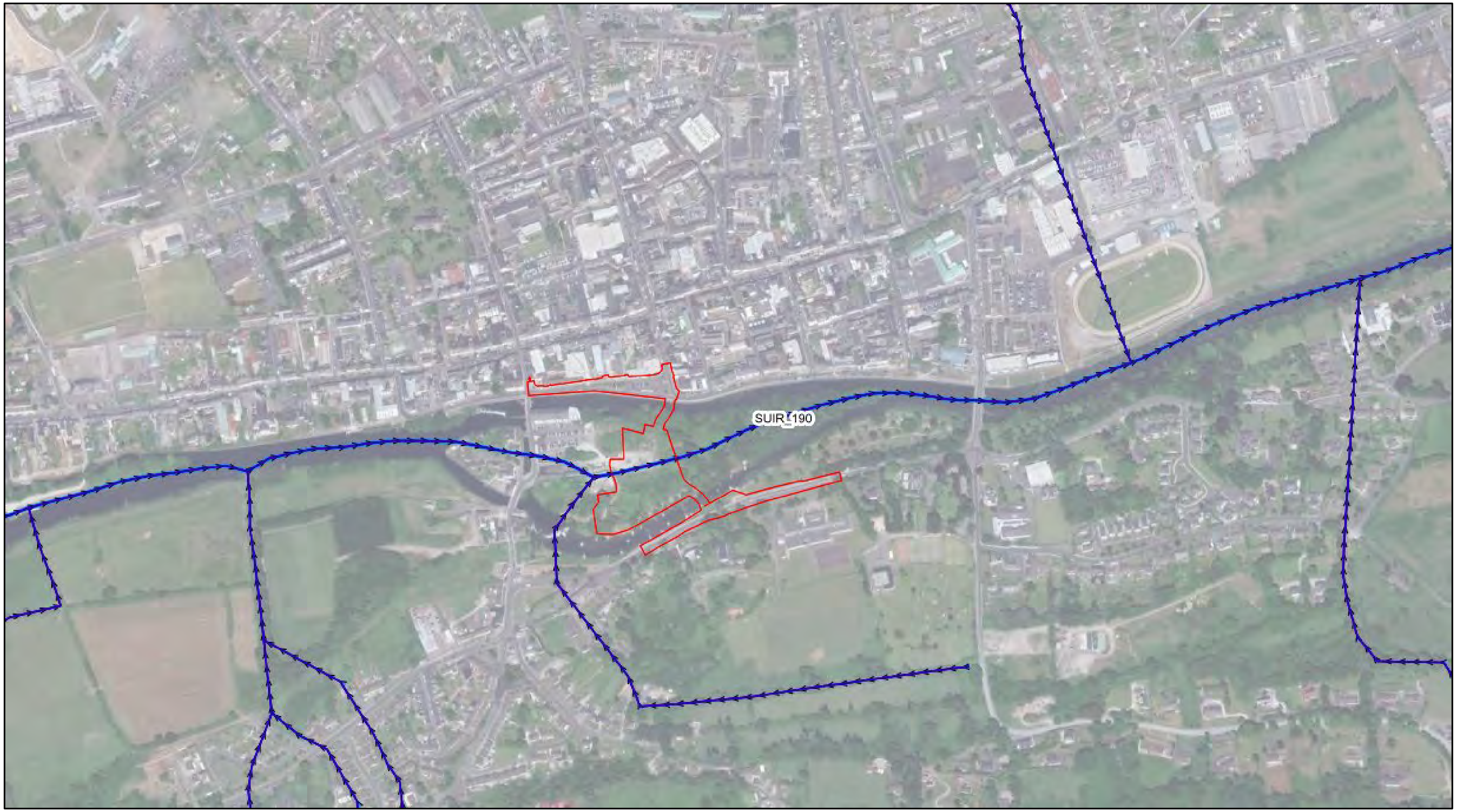

Figure 7-6: Local Hydrological Environment (EPA, 2022)

7.4.6 Existing Surface Water Drainage

The north quay, Suir Island and Raheen Road consist of existing hardstanding areas that drain to the river with existing drainage systems and/or overland flow. No formal drainage systems have been installed on Suir Island besides the car park.

7.4.7 Flood Risk

The Flood Risk at the proposed Suir Island Infrastructure Pedestrian Bridge crossings has been assessed as part of the EIAR. Previous Flood Risk Assessments (FRA) studies have been undertaken as part of the PFRAMs, CFRAMS and Clonmel Flood Defence Scheme. The Stage 1 & 2 FRA is highlighted in report No. RPT-20_071-058 and a detailed FRA which includes hydraulic modelling to determine the increase in flood water levels is summarised in report No. RPT-20_071-055.

7.4.8 Preliminary Flood Risk Assessment

To inform the Flood Risk Assessment (FRA), the OPW Preliminary Flood Risk Assessment (PFRA) mapping was consulted as an initial screening. As required by the Article 18 of the Water Framework Directive and the 2007 EU Floods Directive, the OPW carried out a PFRA to identify areas where the risk of flooding may be significant. THE PFRA is a broad scale assessment based on historic flooding, predictive analysis and consultation with local communities and experts. As part of the PFRA, maps of the country were produced showing fluvial, pluvial and tidal flood extents. Areas for Further Assessment (AFA's) were identified.

The PFRA map at the proposed development location indicates the site is located within fluvial 1% AEP flood extents. The PFRA mapping does not include coastal, pluvial or groundwater flooding within the vicinity of the proposed development. The PFRA mapping identified Clonmel (I.D. 160216) as an Area of Further Assessment (AFA).

7.4.9 Catchment Flood Risk Assessment and Management (CFRAM)

Following the PFRA Study, the OPW commissioned the South Eastern CFRAM Study Flood Risk Review which highlighted Clonmel as an AFA for fluvial flooding. This was based on a review of historic flooding and the extents of flood risk determined by the PFRA study.

The published Final CFRAM (2016) mapping indicates that the locations of the proposed north and south bridge landings have the potential to flood in 1% Fluvial AEP flood events. As part of the Suir CFRAM Study, Fluvial Flood Extent Maps were generated. Refer to Map No. O16CLN_EXFCD_F0_45 and O16CLN_EXFCD_F0_46 included in the Engineering Planning Report.. The maps contain key nodes with corresponding flows (m^3/s) and water level (mOD) for various AEP flood events. The key nodes/levels for the proposed development are listed in Table 7-2.

Table 7-2: Clonmel Scheme Fluvial Flood Extent Maps – Hydraulic Modelling Node Data (2016)

Description	**Node Label**	**Water Level (mOD) 10% AEP**	**Flow (m^3/s) 10% AEP**	**Water Level (mOD) 1% AEP**	**Flow (m^3/s) 1% AEP**	**Water Level (mOD) 0.1% AEP**	**Flow (m^3/s) 0.1% AEP**
Upstream Boundary of Study Area	223	19.605	238.365	20.393	246.403	21.038	-

Location of proposed bridge crossing (North)	23A	18.522	151.072	19.414	217.63	20.257	-
Location of proposed bridge crossing (South)	42	18.842	206.436	19.541	281.123	20.358	-
Hydrometric Gauge (16011 – Clonmel)	17	18.046	357.323	18.779	498.561	19.420	-
Downstream Boundary of Study Area	17D	17.939	357.299	18.661	498.534	19.292	-

7.4.10 Clonmel Flood Defence Scheme

The Clonmel Flood Defence Scheme (Suir River Drainage Scheme) was constructed between 2008 to 2012. The Scheme comprises of flood defence walls, demountable elements, embankments, channel conveyance improvements and pumping stations for stormwater that would otherwise accumulate behind defences. It provides protection against 1-in-100-year flood events (1% AEP) for 500 properties against flooding from the River Suir. Flood defence techniques can be raised above the modelled flood level at low additional costs and in a short timeframe to provide protection for the 1% AEP + Mid-Range Future Climate Change Scenario.

7.5 Baseline Assessment

7.5.1 Water Quality Assessment

EPA River Monitoring Program

The EU Water Framework Directive (WFD) (2000/60/EC) established a framework for community action in the field of water policy. The WFD requires ‘Good Water Status’ for all European Waterbodies, through a system of river basin management planning and extensive monitoring. ‘Good’ status refers to acceptable ecological conditions and chemical composition.

The EPA carries out water quality assessments of rivers, transitional and coastal water bodies as part of a nationwide monitoring programme to comply with the WFD goals for 2027. Data is collected from physico-chemical and biological surveys, sampling both river water and the benthic substrate (sediment). The data is reviewed and summarised below as part of the EIAR for the proposed Suir Island Infrastructure project.

Water sampling is carried out throughout the year and the main parameters analysed include conductivity, pH, colour, alkalinity, hardness, dissolved oxygen, biochemical oxygen demand (BOD), ammonia, chloride, ortho-phosphate, oxidised nitrogen and temperature.

As is the case for rivers and lakes the impact of nutrient enrichment and the process of eutrophication is also a major concern in the water environment. The direct negative effects of excessive nutrient enrichment include increases in the frequency and duration of phytoplankton blooms and excessive growth of attached opportunistic macroalgae. The subsequent breakdown of this organic matter can lead to oxygen deficiency which in turn can result in the displacement or mortality of marine organisms. As such the effects of over enrichment can severely disrupt the normal functioning of tidal water ecosystems.

The status of individual estuarine and coastal water bodies is assessed using the EPAs Trophic Status Assessment Scheme (TSAS). This assessment is required for the Urban Waste Water Treatment

Directive and Nitrates Directive. The scheme compares the compliance of individual parameters against a set of criteria indicative of trophic state. Refer to Table 7-3 below. These criteria fall into three different categories which broadly capture the cause effect relationship of the eutrophication process, namely nutrient enrichment, accelerated plant growth, and disturbance to the level of dissolved oxygen normally present.

Table 7-3: Biological River Quality Classification System

Trophic State	Pollution Status	Condition
Unpolluted	Unpolluted	Unpolluted water bodies are those which do not breach any of the criteria in any category
Intermediate	Unpolluted	Intermediate status water bodies are those which breach one or two of the criteria
Potentially Eutrophic	Slightly polluted	Potentially Eutrophic water bodies are those in which criteria in two of the categories area breached and the third falls within 15% of the relevant threshold value
Eutrophic	Polluted	Eutrophic water bodies are those in which criteria in each of the categories are breached, i.e. where elevated nutrient concentrations, accelerated growth of plants and undesirable water quality disturbance occur simultaneously.

A water quality gauge (Code IE_SE_16S022600) is located downstream of Old Waterford Road Gashouse Bridge within the study-area boundary. The water quality record for the Suir River is summarised in Table 7-4 below and trophic state identified as per Table 7-3 above. Refer to Table 7-5 below for the status of the groundwater bodies.

Table 7-4: Water quality record and classification (Measurement Gauge IE_SE_16S022600)

River Station IE_SE_16S022600 (Waterbody: SUIR_190; Sub catchments 16_16_Suir_SC 140)				
Measurement Period	**Status**	**WFD 2027 Risk**	**Objective**	**Trophic State**
SW 2013 – 2018	Moderate	At risk	Restore 2022	Potentially Eutrophic
SW 2010 – 2015	Good	Not at risk	Protect	Intermediate
SW 2010 – 2012	Good	Not at risk	Protect	Intermediate
SW 2007 – 2009	Good	Not at risk	Protect	Intermediate

Table 7-5: Potentially Dependent Groundwater Waterbodies

Code	Name	Type	2007-12	2010-15	2013-18	WFD Risk
IE_SE_G_040	Clonmel	Groundwater	Good	Good	Good	Review

The available results of the biological water quality monitoring at the EPA water quality measurement gauge located inside the study area is provided in Table 7-6 below. The legend to explain the Biological Rating System (Q-values) are provided in Table 7-7 below.

Table 7-6: EPA Q-Ratings for the Suir River

Station Code	Location	Waterbody Code	Location in relation to site	2017
RS16S022500	Downstream of Gashouse Bridge	IE_SE_16S022600	500m d/s	3-4

Table 7-7: Monitoring quality classifications

Q Value	WFD Status	Pollution Status	Condition
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2	Bad	Seriously polluted	Unsatisfactory

As seen from the monitoring data, the section of the Suir River located in the study area boundary is classified as “Moderate” with the area “At Risk” not to comply with the WFD 2027 goals. The EPA have identified the Lower-Suir River as an area for restoration with a start year of 2022. Refer to EPA Catchment Maps.

7.6 Areas of Conservation

The Lower River Suir is designated as a Special Area of Conservation (SAC) by the National Parks & Wildlife Services (NPWS). Special Areas of Conservation (SACs) are considered prime wildlife conservation areas throughout the country, and important on a European as well as Irish level. Detailed conservation objectives are available for some SACs and as additional ones are approved; they will be posted on the NPWS website (www.npws.ie). For further information regarding biodiversity, refer to Chapter 5 of the EIAR and the NIS.

There are no Special Protection Areas (SPAs) or National Heritage Areas (NHAs) within or close to the proposed development and study area. The River Suir is categorised as a Drinking Water River under the EU Water Framework Directive (WFD) (2000/60/EC).

7.7 Rating of Site Importance in terms of Hydrological Features

The NRA guideline (2009) provides a set of criteria for rating site attributes to determine the importance of hydrological features. Following the methodology, and considering the SAC of the Lower River Suir, the macro-scale importance of the area is rated as ‘Extremely High’ and on a local scale of *‘High’* to ‘*Very High’* importance considering the typical examples provided by the NRA guidelines.

The Qualifying Interests of the River Suir SAC are summarised below:

- Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]
- Mediterranean salt meadows (Juncetalia maritimi) [1410]
- Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]
- Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]
- Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]

- Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]
- Taxus baccata woods of the British Isles [91J0]
- Margaritifera margaritifera (Freshwater Pearl Mussel) [1029]
- Austropotamobius pallipes (White-clawed Crayfish) [1092]
- Petromyzon marinus (Sea Lamprey) [1095]
- Lampetra planeri (Brook Lamprey) [1096]
- Lampetra fluviatilis (River Lamprey) [1099]
- Alosa fallax fallax (Twaite Shad) [1103]
- Salmo salar (Salmon) [1106]
- Lutra lutra (Otter) [1355]

The hydrological attributes of the River Suir SAC that impact on the Qualifying Criteria, located within the proposed development study area are summarised below:

- Hydrological regime: River Flow

The object of the National Parks and Wildlife Services (NPWS) aims to maintain the natural hydrological regime, which is required for both plant communities and channel geomorphology to be in favourable condition, exhibiting typical dynamics for the river type (Hatton-Ellis and Grieve, 2003). For many sub-types, high flows are required to maintain the substratum necessary for the characteristic species. Flow variation can be particularly important, with high and flood flows being critical to the hydromorphology. Other aspects of hydrology, such as tidal regime, are important for certain sub-types of the habitat. The rivers in the SAC vary from naturally flashy, through depositing to tidal reaches.

- Hydrological regime: Groundwater discharge

Refer to EIAR Chapter 6 Land, Soils, Geology and Hydrogeology.

- Hydrological regime: Tidal Influence

The section of the river located within the proposed development is not tidally influenced as noted in the Stage 1 & 2 Flood Risk Assessment Report (RPT-20_071-058) included in the planning application Appendix F of the Planning Engineering Report (RPT-20_071-059).

- Water Quality:

The NPWS aims to maintain appropriate water quality to support the natural structure and functioning of the habitat. The specific targets may vary among sub-types. Depositing and tidal stretches of rivers may, naturally, be more nutrient-rich and, therefore Water Framework Directive (WFD) good status may suffice in terms of nutrient and oxygenation standards, and EQRs (Ecological Quality Ratios) for macroinvertebrates and phytobenthos.

- Floodplain Connectivity:

River connectivity with the floodplain is important for the functioning of habitat. Channels with a naturally functioning floodplain are better able to maintain habitat and water quality. Floodplain connectivity is particularly important in terms of sediment sorting and nutrient deposition. High conservation value rivers are intimately connected to floodplain habitats and function as important wildlife corridors, connecting otherwise isolated or fragmented habitats in the wider countryside.

7.8 Potential Impact Assessment

7.8.1 Introduction

This section highlights the impacts associated with the proposed development before mitigation measures are applied. Both direct and indirect impacts will be addressed for the Construction and Operation (post construction) Phases. As per the NRA Guidelines (2009), the nature, extent and duration of the impacts will be assessed.

7.8.2 Methodology

The procedure to identify and quantify impacts of the proposed development is based on the publication 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' in 2009 by the NRA (TII). The analysis is based on the interpretation of information acquired at desktop level, site walkover and investigations, topographical and bathymetrical surveys and consultation with interested and affected parties and specialist consultants.

Key hydrological receptors identified in the vicinity of the proposed development include:

- The Lower River Suir Special Area for Conservation (SAC);
- Ecologically sensitive surface water features and catchment areas;
- Water Quality sensitivity as the river is categorised as a Drinking Water source;
- Flood Risk Areas.

As per the NRA (TII) guidelines, impacts on hydrological features should be estimated and rated as per Table 7-8 below. Further examples are provided in the guidelines on page 104 in Box 5.2 to determine the Magnitude of Impact on Hydrology Attributes.

Table 7-8: Impact assessment criteria

Magnitude of Impact	Description
Imperceptible	An effect capable of measurement but without noticeable consequences
Slight	An effect that alters the character of the environment without affecting its sensitivities
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing or emerging trends
Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Profound	An effect which obliterates all previous sensitive characteristics

* Impacts identified as *positive*, *neutral* or *negative*

** Duration stated as *temporary*, *short-*, *medium-*, *long-term* or *permanent*

7.8.3 Types of Impacts

Hydrological impacts can be classified in the following broad-termed categories:

Quantitative

Improper design of hydraulic structures (bridges, weirs, culverts and channels) can adversely affect upstream water levels and downstream flows of a waterbody. Surface water drainage from new developments and the increase of hardstanding surface areas can lead to localised flows and flooding in receiving watercourses.

Qualitative Impacts

The increase or alteration of surfaces that convey surface water runoff convey contaminants to receiving waterbodies. The nature of the proposed development as a pedestrian and cycle access bridge means that the potential contaminant load and accidental spillage risk is minimal. Depending on the hydrological and ecological sensitivities of the proposed receiving waterbodies, treatment of the storm water via silt traps and petrol interceptors is required upstream of discharge locations to protect the water quality.

7.9 Construction Impacts

The construction of infrastructure near watercourses poses a significant risk in terms of contamination arising from spillages and sediment transport areas which can lead to degradation of water quality, ecological damage and flooding. It should be noted that the bridge support structures will not be constructed in-stream, but rather in the flood plains. Given that there are no instream works and no structures will be provided in stream there will be no potential for changes to hydrological regime.

The main contaminants arising from construction activities and runoff includes the following:

- Increase of silt and sediment loading arising from construction site runoff and erosion of stockpiles or unprotected embankments. Elevated silt loading can lead to long-term damage of aquatic ecosystems by overloading spawning grounds and gravel beds. Increase silt loads reduces aquatic plant growth, limits dissolved oxygen capacity and overall reduces the ecological quality with the most critical period associated with low-flow conditions. Other pollutants in the watercourse can bind to silt which can lead to increased bioavailability of these pollutants.
- Spillage of cementitious products such as concrete, grout and epoxies. Cementitious based products are highly alkaline and extremely corrosive which can result in significant impact to watercourses by altering the pH, smothering stream beds and physically damaging fish though chemical burning and clogging of gills.
- Accidental Spillage of hydrocarbons from construction plant and storage depots.
- Faecal contamination arising from inadequate treatment of on-site ablution and washing facilities.

7.9.1 Erosion and Sediment Transport

During the construction phase, there is a potential for the works to impact on the water quality arising from erosion and sediment transport caused by the works situated within the River Suir floodplain located on Suir Island and the southern bank of the Slalom Course. The works which could potentially give rise to erosion and sediment transport revolves around the construction of the bridge foundation structures i.e. piling and pier supports which will require localised sheet piling, minor excavations and the construction vehicle equipment.

The above construction activities will require localised clearance and removal of topsoil which increase the erosion potential of the area during heavy rainfall and flooding events during which sediment can be transferred to the river via overland flow. Without the implementation of mitigation measures and best-practice guidelines, the potential impact is *Negative*, *Temporary* and *Not significant*.

For the works located on the Quays (North Plaza) and Raheen Road, there is a *Neutral*, *Temporary* and *Imperceptible* risk of erosion and sediment transport to the river arising from the works. This is due to the works taking place behind the existing Clonmel Flood Defence Scheme concrete masonry walls which would prevent runoff from draining to the river. During the works it is not proposed that the existing surface water network will be utilised as a discharge point for groundwater removed from construction excavations. In the event that surface water during the construction works needs to be pumped to the existing drainage systems, the runoff will be pretreated by on-site filtration (silt-buster units) prior to discharging into existing systems.

7.9.2 Impact on Flooding

There is minimal impact on flooding during the construction phase. The volumes displaced by the proposed bridge piers, abutments and localised temporary sheet piling during construction phase are extremely small relative to the flow volumes in the receiving waterbody and will result in an *imperceptible* effect.

Construction sites can have an impact on the damage a flood event can cause, both to the wider environment and the site itself. During construction, drainage can be altered, and land use is changed. This can alter the dynamics of any flood water in terms of capacity, attenuation, runoff and quality. Poor planning and preparation for flood events can have a significant impact and cause increased damage to the environment, surrounding areas as well as damage to structures on and off site and cause programme delays.

Sites are typically cleared of all structures and vegetation at the start of the works, increasing the capacity for flood waters to pick up sediment and reducing attenuation of the area. Additionally, any stockpiles can increase the sediment within the water greatly. Sediment rich flood waters can cause erosion of riverbanks, they can block gullies, pipes and other drainage systems resulting in increased flood risk and cause damage to the aquatic environment by settling in ecosystems. Flood waters can also pick-up pollutants as they pass through a construction site. A flood event may cause excavations, boxes, shafts and tunnels to fill with water. These structures are able to collect a significant quantity of water which will be contaminated and need treatment prior to disposal. This will also have a significant impact on the programme as time will be needed to treat and pump out the water and return the site to safe work conditions.

The temporary works sheet piling around the 3 No. piers is shown on Drawing 20_071-CSE-00-XX-DR-C-2460 included in Volume C – Drawings of the planning application suite of documents. For the proposed access route over the existing flood defence berm on Suir Island, a precast concrete culvert and localised sheet piling will be utilised to span the old millrace channel to reduce the footprint of the access route and maintain ecological water requirement flows through this sensitive area.

The sheet piling will be localised around each pier (c. 50m^2) with access routes as shown on the drawing. The main purpose of the localised sheet piling is to:

- Provide protection against rising river water levels up to the 50% AEP levels plus an additional 300mm freeboard; and
- To minimise the ingress of groundwater into the works area and to reduce the volume of groundwater to be pumped, filtered and discharged during the construction phase.

The 50% AEP levels plus 300mm freeboard scenario was selected based on the inundation extents of more extreme events. For the 20% AEP event, the access routes to the pier locations will be inundated for all piers, which would require large-scale sheet piling and/or protection berms to be constructed. The foundation works in the floodplains shall only be permitted during summer months.

The effect of the proposed temporary structures (Drawing 20_071-CSE-00-XX-DR-C-2460) on the existing flood water surface elevations (WSE) has been determined in the Hec-Ras model and analyses the worst-case scenario, i.e. all three temporary works areas in place at the same time.

For both the northern and southern river reaches, there is little to no variations in WSE when comparing the existing scenario (baseline) and the temporary works scenario, but with the reduction in flow area, the flow velocities increased by circa 14% to 18% and 5% to 11% for the northern and southern reaches, respectively, during extreme flooding events for the 1-in-100-year and 1-in-1000-year recurrence interval flood. Refer to the Hydraulic Modelling Report (RPT-20_071-055) for more information.

Overall, the potential impact on flooding in the River Suir during the construction phase is *Negative*, *Imperceptible* to *Not significant* and *Temporary*.

7.10 Operational Impactions

7.10.1 Predicted Impact of Storm Discharge on Flooding/Morphology

The existing surface water drainage systems on the North Plaza and Southern Arrival Point will be maintained as part of the development. Storm runoff discharge into the existing drainage system will not contribute to flooding in the Suir River. The interception of rainfall by the c. 500 m^2 bridge deck will be *imperceptible* in terms of runoff reduction. The potential impact is *Permanent, Neutral* and *Imperceptible*.

7.10.2 Predicted Impact of Storm Discharge of Pollutants

The proposed pedestrian and cyclists bridge would be lightly trafficked and the application of salts and grit to mitigate ice/snow conditions is not expected. Salts/grit could be applied to hardstanding surfaces on the North Plaza and Raheen Road (South Arrival Point), which will be discharged through the proposed and existing surface water network to the River Suir. The proposed development does not result in an increased hardstanding area, thus not increasing the potential for salts/grit to be discharged to the river. The predicted impact of pollutants discharged into the watercourse from the proposed hardstand surfaces is considered *Permanent, Negative* and *Imperceptible*.

7.10.3 Predicted Impact of Accidental Spillage

The risk of pollution to both surface and groundwater resulting from accidental spillage is considered negligible, as the bridge crossing would only accommodate pedestrians and cyclists. It is not anticipated that any chemicals or hydrocarbons will ever be transported across the bridge. Accidental spillage on the North Plaza and South Arrival Point would be contained behind the flood protection walls and existing sewer utilities network. Accidental spillage risk is considered *Temporary* and *Imperceptible*.

7.11 Mitigation and Monitoring Measures

7.11.1 Construction Phase

As part of the EIAR, an Outline Construction Environmental Management Plan (OCEMP) has been prepared for the proposed development and is included in **Appendix 7.1**. The OCEMP includes the following:

- A requirement for an outline Incident Response Plan detailing the procedures to be undertaken in the event of chemical, fuel or hazardous waste spillage.
- All necessary permits and licences for in stream construction works for provision of bridge abutments and piers will be obtained prior to commencement of construction.
- Inform and consult with Inland Fisheries Ireland (IFI) and Waterways Ireland (WI).
- Implement the OCEMP contained in **Appendix 7.1** of this EIAR.
- Implement the OC&DWMP contained in **Appendix 12.1** of this EIAR.

The OCEMP will be further developed by the selected contractor to suit the detailed construction methodology and allocate responsibilities to competent individuals of the construction team. The measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the current outline version of the Plans is sufficient to allow an assessment of the assessed impacts. The Contractor will be required to compile a CEMP based on the OCEMP and C&DWMP, which sets out the overall management and administration of the construction activities and project. The CEMP and C&DWMP will be prepared prior to the commencement of any construction activities to ensure commitments in the statutory approvals are adhered to, and that it integrates the requirements of the outline CEMP and C&DWMP.

During construction, cognisance will have to be taken of the following guidance documents for construction work near watercourse/bodies:

- Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites (Eastern Regional Fisheries Board);
- Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers;
- CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors;
- CIRIA C648 Control of Water Pollution from Constructional Sites;
- Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (NRA/TII, 2006).

Based on the above guidance documents concerning control of construction operational impacts on the water environment, the following outlines the construction phasing and the principal mitigation measures that will be prescribed for the construction phase in order to protect all catchment, watercourse and ecologically protected areas from direct and indirect impacts:

- Stage 1 – Site establishment and clearance.
- Stage 2 – Construction of temporary sheet piling and permanent piles below river bed.
- Stage 3 – Construction of reinforced concrete permanent bridge piers and abutments on the flood protection berm located on Suir Island.
- Stage 4 – Complete North Plaza and South Arrival Point reinforced concrete abutments
- Stage 5 – Install north and south bridge deck sections.
- Stage 6 – Complete North Plaza, Suir Island and South Arrival Point landings, access ramps and hardstand surfacing and miscellaneous items such as pipelines/pump stations and finishing.
- Stage 7 – Site de-establishment and reinstatement.

Proposed General Mitigation Measures

- The duration and extent of in-stream works shall be kept to a minimum to avoid disruptions to aquatic life and short-term changes to river morphology;
- Discharge of surface water from sumps, excavations and exposed soil surfaces shall include the use of silt traps or settlement ponds;
- Silt traps, settlement ponds, hydrocarbon interceptors shall be constructed in the early stages of the construction programme;
- Bare soil surfaces shall be protected from erosion by placing granular material on the surfaces to prevent sediment transport to watercourses;
- Storage areas of fuel, oil and chemicals shall be on impermeable surfaces and located away from drains and watercourses. Fuel storage areas shall be bunded to provide adequate retention capacity in the event of a leak or spillage occurring;
- Refuelling of construction vehicles to be on impermeable surfaces and located away from nearby drains and watercourses; and
- Spill kits to be provided near all works areas on the North Plaza, Suir Island and Raheen Road.

It should be noted that the above is a non-exhaustive list. The Outline Construction Environmental Management Plan (OCEMP) (RPT-20_071-044) identifies risks and proposes mitigation measures for management of construction works and recommends best-practice guidelines and methods to be implemented. The OCEMP provides the environmental management framework for the appointed Contractors and Sub Contractors as they incorporate the mitigating principles to ensure that the work is carried out with minimal impact to the environment. The construction management team and Contractor’s staff must comply with the requirements and constraints set forth in the OCEMP and/or as required by Conditions/Restrictions in statutory Approval.

Specific Mitigation Measures – Concrete Works

The construction of the proposed bridge structures requires the pouring of concrete for permanent structures (piles, piers and abutments) located in the direct vicinity of the Suir River. The operation and management of these activities be carefully controlled to avoid spillage which will adversely affect the chemical water composition and aquatic habitats of species. As the use of concrete cannot be avoided the following control measures will be employed:

- Quick-setting or rapid hardener add-mixtures shall be used to promote early setting of concrete to ensure cementitious compounds are not absorbed by surface or groundwater;
- Where concrete works are required in or near water sources, the used of biodegradable products shall be used;
- Any plant operating close to water sources will require special consideration and monitoring when on site;
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW);
- No cleaning or hosing of any concrete surfaces, plant or equipment shall be permitted near surface water sources or drains. Designated impermeable areas to be prepared with sufficient settlement capacity and accidental spillage containment volume;
- On-site concrete batching shall not be allowed near the site.

7.11.2 Erosion and Sediment Transport

Construction of structures in or the river floodplain, which would require temporary works such as localised sheet piling and excavation works must be phased to minimise the reduction of flow area. The reduction of flow area increases scour potential of the river by increasing the flow velocities. Although the hydraulic modelling accounted for the worst-case-scenario, it is proposed that the works will be phased to negate or minimise any increase in flow velocities arising from restricting the river flow area.

7.11.3 Flooding

The volumes displaced by the proposed bridge piers, abutments and cofferdams during construction phase is extremely small relative to the volumes of the receiving waterbodies and will result in an *imperceptible, negative and permanent* impact.

The existing flood defence wall located along Raheen Road will have to be modified by cutting a 5m wide gap into the wall to allow for the integration of the bridge abutment and landing area. River water levels and weather forecasts shall be monitored for potential flood events during construction and temporary flood defences shall be provided during construction where the existing flood defence wall will be altered.

7.11.4 Operation Phase

All potential impacts have been identified as *Imperceptible* to *Not significant* in the operational phase and as such no *Long-term* mitigations measures are proposed.

7.12 Residual Impacts

The residual hydrological impacts associated with the Suir Island Infrastructure Links can be grouped as follows:

- Construction Phase;
- Flood Risk; and
- Erosion and Sediment Transport.

7.12.1 Construction Phase

Measures to mitigate any adverse effects associated with the proposed construction works are outlined in the Outline Construction Environmental Management Plan (OCEMP) included in **Appendix 7.1** of the EIAR. There will be *no significant residual* impact arising from the construction works.

7.12.2 Flood Risk

Residual impacts on flood risk are not expected from the proposed design. The design makes provision to minimise the restriction of flow area and available storage around the support piers and abutments. The proposed mitigation measures will negate potential risk of flooding during construction.

7.12.3 Erosion and Sediment Transport

The effect of the proposed bridge on river morphology and erosion will be minimal and concentrated in a localised area. The effective change to the scour patterns and sediment transport will be insignificant in comparison to the existing bridges and weirs located in the vicinity of the proposed pedestrian bridges. The mitigation measures will minimise potential risk to residual changes to river morphology.

7.13 Cumulative Impacts Of The Proposed Development

The cumulative impacts of the proposed development with any/all relevant other planned or permitted developments are discussed below. Refer to EIAR Chapter 1 Introduction, **Section 1.15** for a list of other developments taken into consideration.

7.13.1 Construction Phase

Contractors for the proposed development will be contractually required to operate in compliance with the CEMP which includes the mitigation measures outlined in this EIA report. Other developments will also have to incorporate measures to protect water quality in compliance with legislative standards for receiving water quality (European Communities Environmental Objectives (Surface Water) Regulations (S.I. 272 of 2009 and S.I. 77 of 2019). As a result, there will be minimal cumulative potential for change in the natural hydrological regime. The cumulative impact is considered to be *neutral* and *imperceptible*.

7.13.2 Operational Phase

All developments are required to manage discharges in accordance with S.I 272/2009 and 77/2019 amendments. As such there will be no cumulative impact to surface water quality and therefore there will be no cumulative impact on the Surface Waterbody Status. The operation of the proposed development is concluded to have a *long-term*, *imperceptible significance* with a *neutral* impact on surface water quality.

7.13.3 Water Framework Directive

In terms of the construction and operation phases, this assessment has considered the current water status of all relevant water bodies (**Section 7.4** above), and potential impacts have been considered (**Section 7.8** above) With mitigation measures (**Section 7.11**) in place, it is concluded there will be no degradation of the current water body (chemically, ecological and quantity) or any impact on its potential to meet the requirements and/or objectives in the second RBMP 2018-2021 (River Basin Management Plan) and draft third RBMP 2022-2027.

There are appropriately designed mitigation and design measures which will be implemented during the construction phase to protect the hydrological environment. There is a potential of accidental discharges during the construction phase, however these are temporary short-lived events that will not impact on the water status of waterbodies long-term and as such will not impact on trends in water quality and over all status assessment.

The final CEMP which the works Contractor will develop will implement strict mitigation measures to ensure the protection of the hydrological environment during construction which will ensure that there will be no negative impact on the quantitative or qualitative or morphology of the nearby watercourses.

7.14 Difficulties Encountered

There were no difficulties associated with this assessment.

7.15 References

- EPA (Environmental Protection Agency) Guidelines on the Information to be contained in Environmental Impact Assessment Reports, May 2022;
- Environmental Protection Agency (EPA) – Surface Water Quality, Water Features and Regions and Monitoring Stations;
- EPA – Catchments Data;
- Floodmaps.ie – Flood Mapping;
- NRA (TII) Environmental Impact Assessment of National Road Schemes – A Practical Guide, November 2008;
- NRA (TII) Guidelines for Assessment of Ecological Impacts of National Roads Schemes, Revision 2, June 2009;
- NRA (TII) Guidelines for the crossing of watercourses during the construction of National Road Schemes, (2008);
- NRA (TII) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, (2009);
- OPW The National CFRAM Programme Flood Risk Management Plan for River Basin Suir (16), (2018);
- OPW The National Preliminary Flood Risk Assessment (PFRA), Designation of Areas for Further Assessment, March 2012;
- OPW The National Preliminary Flood Risk Assessment (PFRA), Overview Report, March 2012;
- OPW The Planning System and Flood Risk Management, Guidelines for Planning Authorities, November 2009;

Appendix 7.1: Outline Construction Environmental Management Plan

Clifton Scannell Emerson Associates

Outline Construction Environmental Management Plan
Suir Island Infrastructure Links

Comhairle Contae Thiobraid Árann
Tipperary County Council

Client: Tipperary County Council

Date: September 2023

Job Number: 20_071

Civil Engineering | Structural Engineering | Transport Engineering | Environmental Engineering | Project Management | Health and Safety

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Document Control Sheet

Project Name:	Suir Island Infrastructure Links
Project Number:	20_071
Report Title:	Outline Construction Environmental Management Plan
Filename:	RPT-20_071-044

Issue No.	Issue Status	Date	Prepared by	Checked by
0	Final	22.09.2023	HB	LP

Table of Contents

1 INTRODUCTION

1.1 Overview

This document sets out the Outline Construction Environmental Management Plan (OCEMP) for the construction of the Suir Island Infrastructure Links proposed development ("the Project") on behalf of Tipperary County Council.

This OCEMP applies to all works associated with the construction of the proposed civil works, bridge construction and landscaping including the pre-construction site clearance and reinstatement works.

As a contractor has not yet been appointed, the Construction Environmental Management Plan (CEMP) has not been formally adopted and further development and commitment to the OCEMP will be undertaken following selection of Contractors and prior to the commencement of site works.

The OCEMP provides the environmental management framework for the appointed Contractors and Sub Contractors as they incorporate the mitigating principles to ensure that the work is carried out with minimal impact to the environment. The construction management team and Contractor's staff must comply with the requirements and constraints set forth in the OCEMP in developing their CEMP(s). The key environmental constraints associated with the construction of the project, the appropriate mitigation and monitoring controls, are identified in the OCEMP and its supporting documentation.

The implementation of the OCEMP will ensure that the construction phase of the project is carried out in accordance with the commitments made by Tipperary County Council in the planning application process for the development, the Environmental Impact Assessment Report (EIAR) and as required under the conditions of the planning approval.

Following construction commencement, the CEMP is considered to be a living document that will be updated according to changing circumstances of the project and to reflect current construction activities. The CEMP will be reviewed on an ongoing basis during the construction process and will include information on the review procedures.

1.2 Document Structure

The OCEMP has been structured as follows:

- Section 1 outlines the purpose of the OCEMP and highlights the minimum requirements of the CEMP to be compiled by the appointed contractor;
- Section 2 describes the proposed development;
- Section 3 sets out the framework and mechanisms through which environmental requirements would be managed;
- Section 4 outlines the procedures to be employed during construction to manage environmental aspects.
- Section 5 describe the general requirements to be implemented to minimise likely signification negative effects, as far as feasible, during the construction of the proposed development.

1.3 Purpose of OCEMP

This OCEMP identifies the minimum requirements with regard to the appropriate mitigation, monitoring, inspection and reporting mechanisms that need to be implemented throughout construction. Compliance with this Outline CEMP does not absolve the contractor or its sub-contractors from compliance with all legislation and by-laws relating to their construction activities.

This Outline CEMP has been produced as part of the application for planning consent to ensure compliance with legislative requirements and the EIAR that has been prepared for the proposed development.

The purpose of the OCEMP is to provide a framework for the appointed Contractor to:

- Describe the programme for environmental management during construction;
- Implement those monitoring and mitigation measures;
- Outline the principles and minimum standards required of the contractor during the development of the detailed CEMP (and associated Method Statements) and throughout construction;
- Identify the relevant roles and responsibilities for developing, implementing, maintaining and monitoring environmental management; and
- Outline the procedures for communicating and reporting on environmental aspects of the proposed development throughout construction.

It is intended that this OCEMP be utilised as a baseline for the detailed CEMP to be compiled by the appointed contractor and be expanded upon prior to the commencement of any construction activities on site.

1.4 Requirements of the CEMP

The appointed contractor shall be required to comply with all the performance requirements set out in tender documentation included the statutory consent approvals which may be granted by An Bord Pleanála, Office of Public Works, Tipperary County Council, Environmental Protection Agency (EPA), Inland Fisheries Ireland (IFI) and any other statutory stakeholders.

The contractor is required to develop a detailed CEMP(s) that:

- Is in accordance with the mitigation measures specified in the EIAR, NIS and this OCEMP;
- Is in accordance with any conditions that may be prescribed as part of the consent(s) for the proposed development;
- Aligns with design and construction details described in the EIAR and NIS which ensure these is no material change in terms of significant effects on the environment; and
- Where practicable the contractor should seek to identify opportunities for further reducing significant negative environmental impacts by the implementation of best practices.

Further, the contractor is required to develop the following plans, and any others considered relevant, and incorporate accordingly into the detailed CEMP(s);

- Heritage Management Strategy;
- Construction Compound Management Plan;
- Construction Traffic Management Plan;
- Noise and Vibration Management Plan;
- Water Quality Management Plan;
- Dust Management Plan;
- Construction and Demolition Waste Management Plan;
- Invasive Species Management Plan;
- Protected Species Management Plan; and
- Emergency Incident Response Plan.

2 DESCRIPTION OF THE DEVELOPMENT

2.1 Project Description

The proposed development will consist of:

- Two pedestrian bridges, the first bridge linking the proposed North Plaza on The Quay/Quay St/Sarsfield St Junction to Suir Island, and the second bridge connecting Suir Island to Raheen Road.
- The pedestrian bridges will be 4-metre-wide consisting of a double curvature alignment, which allow users to discover Suir Island 'from up high' by walking seamlessly between the trees while linking the project elements (North Plaza, the berm embankment, and the south riverbank) along one sinuous route. The first bridge follows the geometry of Sarsfield Street and arrives on the island following the line of the berm embankment, which then links onto the second bridge facilitating a link to Denis Burke Park on Raheen Road, creating a direct connection for pedestrians/cyclists between the park and the Town Centre.
- Provision of a new public open space called the North Plaza which will be aligned with Sarsfield Street. The steps and ramp will be visible from O'Connell Street creating a new landmark in the town of Clonmel and will encourage pedestrian movement towards the River Suir. The bicycle access ramp is designed to be as transparent as possible so as not to block the view of Suir Island from Sarsfield Street.
- Modification of traffic direction and carriageway width around the North Plaza and The Quay and Quay St.
- Provision of a bus stop on the western side of the North Plaza located on Quay Street with five benches providing comfortable facilities for public transport users.
- Upgrading of the existing 2-metre-wide sidewalk along Quay Street into a 4-metre-wide shared pedestrian/cycle path which will provide unencumbered access to the proposed plaza area underneath the elevated access ramp.
- Provision of a sloping landscaped terrace with public seating, located inside the hairpin-shaped access ramp leading up to the northern bridge crossing.
- Provision of three benches and a 9-metre-long stepped promenade seating area integrated into the circular-shaped plaza.
- Planting of various native tree species around the North Plaza to integrate the proposed development with the existing scenery of Suir Island and complement the visual experience of users.
- Provision of a pedestrian path or promenade along the existing berm embankment across Suir Island linking the two pedestrian bridges, to facilitate access between Denis Burke Park on Raheen Road and the proposed North Plaza on The Quay.
- Construction of a pedestrian/bicycle ramp from the link promenade onto Suir Island Carpark. The ramp is fully integrated into the landscape by using the existing slope of the berm.
- Construction of three sets of steps connecting the link promenade to Suir Island carpark and the eastern end of Suir Island.
- Provision of a mini public space within Suir Island Carpark at the entrance to the proposed Suir Island Gardens.
- Provision of a south arrival point for the second bridge connecting Suir Island to the Raheen Road. The South Arrival Point will consist of one access ramp to the east and one set of steps to the west, integrated with the bridge landing level and running parallel to the footpath. These elements will be located outside the existing flood barrier.
- Road improvements for the safety of pedestrians/cyclists at the South Arrival Point, including the footpaths being widened and the road narrowed to accommodate 3.0-metre-wide lanes.

Removal of three carparking spaces from the southern edge of the road to allow for wider footpaths.

- Installation of two uncontrolled pedestrian crossings positioned at either ends of the proposed access ramp and flight of steps to provide traffic calming at the South Arrival Point. This bridge arrival point will be located close to the school entrance of Raheen College, providing safe and convenient access for the schoolchildren.
- Access ramps and steps are located behind the flood barriers to allow access even during flood events.
- Construction of a new foul pumping station to be located within Suir Island car park which will facilitate future Irish Water connections. Wastewater will be pumped 0.1km approx. via rising main along the proposed bridge linking Suir Island to the proposed North Plaza where it will connect into the existing public network along The Quay.
- Ancillary site development works to include, but not limited to, surface water drainage, lighting and associated electrical works, hard and soft landscaping, road works to include surfacing and line marking, landscaping and installation of street furniture.
- All associated site works.

2.2 Construction Stage

It is anticipated that the construction of the proposed development will be progressed as a single construction contract with the construction phase lasting approximately 18 months. The construction start date is proposed for spring or early summer when the Suir River is not in spate and flood risk is reduced when working in the floodplain.

2.3 Construction Procurement

It is proposed that the construction of the development will be tendered under a Public Works Contract for Civil Engineering Works Designed by the Employer.

3 ENVIRONMENTAL MANAGEMENT FRAMEWORK

3.1 Overview

The CEMP will be developed by the contractor to meet the requirements of ISO 14001 and all site works will be undertaken in compliance with the CEMP. The CEMP shall include details of the topics listed below, further information on which is given in the following section.

- Environmental Policy;
- Environmental Aspects Register;
- Project Organisation and Responsibilities;
- Project Communication and Co-ordination;
- Training;
- Operational Control;
- Checking and Corrective Action;
- Environmental Control Measures;
- Complaints Procedure.

The CEMP details all the environmental aspects and impacts associated with this contract such as waste management, pollution prevention and protection of flora and fauna with particular emphasis on the Special Area of Conservation (SAC) and Water Quality in watercourses.

The Qualifying Interests of the Lower-River Suir (National Park &Wildlife Services) are:

- Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]
- Mediterranean salt meadows (Juncetalia maritimi) [1410]
- Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]
- Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]
- Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]
- Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]
- Taxus baccata woods of the British Isles [91J0]
- Margaritifera margaritifera (Freshwater Pearl Mussel) [1029]
- Austropotamobius pallipes (White-clawed Crayfish) [1092]
- Petromyzon marinus (Sea Lamprey) [1095]
- Lampetra planeri (Brook Lamprey) [1096]
- Lampetra fluviatilis (River Lamprey) [1099]
- Alosa fallax fallax (Twaite Shad) [1103]
- Salmo salar (Salmon) [1106]
- Lutra lutra (Otter) [1355]

3.2 Environmental Policy

The contractor will complete an Environmental Policy with consideration for impacts on the natural and built environment. All project personnel will be accountable for the environmental performance of the project and will be made aware of the Environmental Policy at induction. The environmental policy will consider and make commitments with regard to the protection of Natura 2000 site emissions to the atmosphere, maintenance of water quality, resource usage energy consumption and waste management.

3.3 Environmental Aspect Register

Once appointed, the Contractor will prepare a register of all sensitive environmental features which have the potential to be affected by the construction works, together with details of commitments and agreements made within the Environmental Impact Statement, the Contract Documentation, Planning conditions imposed by the local authority, and conditions identified by Statutory Authorities with regards mitigation of potential impacts.

The Environmental Aspects Register provides the relevant information for the preparation of construction method statements and will be regularly updated during the works. A non-exhausted list of sensitive environmental features/receptors is listed below:

- Identification off all waterways for the protection against ingress of suspended solids or any pollutant;
- Air emissions;
- Noise emissions;
- Light emissions;
- Waste generation;
- Use hazardous materials;
- Energy usage;
- Water usage;
- Discharge of waste water;
- Traffic generation;
- Terrestrial ecology;
- Aquatic ecology;
- Visual impacts;
- Hydrogeology;
- Archaeology and Cultural Heritage.

3.4 Project Organisation and Responsibilities

3.4.1 Employer

Tipperary County Council will be the Employer responsible for ensuring that the competent parties are appointed to undertake construction and that sufficient resources are made available to facilitate the appropriate management of risks to the environment.

3.4.2 Employers Representative

The Employers Representative (ER) appointed by Tipperary County Council will be responsible for the monitoring compliance with the CEMP. The ER may be required to appoint a temporary or permanent specialist(s) with appropriate experience as required to implement on site procedures and monitoring construction on behalf of Tipperary County Council i.e. competent experts in biodiversity, architecture, archaeology and heritage, noise, vibration, dust, waste, land, soils, contamination and/or water.

3.4.3 Employer’s Ecological Clerk of Works

The Employer’s Ecological Clerk of Works (ECoW) appointed by Tipperary County Council will be responsible for monitoring compliance with the CEMP and other relevant regulations, and conduct inspections and audits as highlighted in this document. The Employer’s ECoW will liaise with TCC and other relevant stakeholders to obtain the necessary approvals of Construction Method Statements and the Construction Environmental Management Plans which will be prepared by the appointed contractor. Further details on the ECoW responsibilities are highlighted in **Appendix A** of this report.

3.4.4 Project Manager

The overall responsibility lies with the Project Manager whose responsibility it will be to approve key personnel required for employment on the project. The Project Manager shall liaise with the Site Environmental Manager (SEM) throughout the project construction phase.

The Project Manager will lead the operations in/on the site and will be responsible for the management and control of the activities and will have overall responsibility for the implementation of the CEMP.

The Project Managers main duties and responsibilities in relation to the CEMP include liaising with the Project Team in assigning duties and responsibilities in relation to the CEMP to individual members of the main contractor's project staff.

3.4.5 Site Environmental Manager

The main duties and responsibilities of the SEM include and is not limited to the following:

- Liaise with the Project Manager during the finalisation of the CEMP to assign individual duties and responsibilities bearing in mind the overall organisational structure, the nature of the Environmental Commitments and requirements and the proposed development;
- Ensuring that the CEMP is finalised, implemented and continuously updated;
- Liaise with Tipperary County Council Environmental Manager and the ER on all Method Statements, any alternations to live documents and any other works to ensure protection of environmental receptors identified in the EIAR;
- Being familiar with the information in the pre-construction surveys, construction requirements, planning approval conditions and all relevant method statements;
- Being familiar with the contents, environmental commitments and requirements continued within the reference documentation listed in this OCEMP;
- Being familiar with the baseline data collated during the compilation of the EIAR;
- Assisting Management in liaising with the ER and Tipperary County Council and the provision of information on environmental management during the construction of the Project;
- Assigning duties and responsibilities in relation to the CEMP, to individual members of the main contractor's project staff;
- Overseeing, ensuring coordination and playing a lead role in third-party consultations required statutorily, contractually and in order to fulfil best practice requirements;
- Liaising with the ER and Tipperary County Council in the approving of site-specific construction method statements;
- Bring any legal constraints that may occur during certain tasks to the attention of the relevant stakeholders;
- Hold copies of all permits and licenses provided by waste contractors;
- Ensuring that any operations or activities that require certificates of registration, waste collection permits, waste permits, waste licences, etc have appropriate authorization;
- Gathering and holding documentation with respect to waste disposal;
- Keeping up to date with changes in environmental best-practices, legislation and advising staff of such changes and incorporating them into the CEMP;
- Liaising with contactors and consultants prior to works;
- Procuring the services of specialist environmental consultants as required;
- Ensuring that all specialist environmental consultants are legally accredited and proven to be competent;
- Coordinating all the activities of the specialist environmental contractors;
- Ensuring that Environmental Induction Training is carried out on all personnel on site and ensuring that tool box talks include aspects of Environmental Awareness and Training;
- Responsible for notifying the relevant statutory authority when environmental incidents occur and producing the relevant reports as required;
- Ensuring that all relevant works have (and are being carried out in accordance with) the required permits, licenses, certificates and planning permissions;
- Liaising with the designated licence holders and specific agent defined in the licence with respect to licences granted pursuant to the European Commission (EC) (Natural Habitats) Regulations 1997;
- Carrying out regular documented inspections and audits of the site to ensure that work is being carried out in accordance with the environmental control measures and relevant site-specific method statements;
- Preparation of the Emergency Incident Response Plan;

- Responsible for reviewing all environmental monitoring data and ensuring that they all comply with stated guidelines and requirements; and
- Liaising with management in preparing and inspection of site-specific method statements for activities where there is a risk of pollution or adverse effects on the environment.

3.4.6 Site Manager

A Site Manager will be appointed to oversee the day-to-day management of working areas within the site and ensure effective, safe, planned construction activities are delivered on an ongoing basis to the highest standards practically possible. The Site Manager will be a suitably qualified, competent and experienced professional that will oversee site logistics, communicate regularly with site staff, accommodate project-specific inductions for staff on site and ensure that all work is complaint with the relevant design standards and Health and Safety legislation.

3.4.7 Environmental Specialist Appointed by the Contractor

To fulfil its obligations under the CEMP and to support its Site Environmental Manager, the contractor will be responsible for engaging suitably qualified and experienced professionals including where necessary the following (i.e. depending on the scope of the contract) competent experts:

- Archaeologist;
- Ecologist;
- Aquatic Ecologist/Geohydrologist;
- Noise and Vibration Specialist;
- Air Quality and Dust Specialist;
- Land, Soils, and Contamination Specialist; and
- Water Specialist

3.5 Project Communication and Co-ordination Procedures

3.5.1 Community and Stakeholder Engagement

The contractor will take all practical steps to engage with stakeholders in the local community, focusing on those who may be affected by the construction works including residents, businesses, community resources and specific vulnerable groups.

Communication with the local community, Tipperary County Council and other relevant stakeholders shall be undertaken at an appropriate level and frequency throughout construction. Tipperary County Council will establish a Communications Management Plan that will specify obligations in relation to community and stakeholder engagement that the contractor must adhere to. Where communications are related to environmental issues the Site Environmental Manager will be informed and engaged with, as appropriate.

3.5.2 Regular Consultation and Public Communications

The Communications Management Plan will also specify obligations in relation to regular consultation and public communications activities required during the construction of the proposed development. The contractor will facilitate regular consultation in accordance with the specifications and cooperate with this plan.

Where communications are related to environmental issues the Site Environmental Manager would be informed and engaged with, as appropriate. Details of the available communication channels/points of contact for members of the public to contact the project team during construction will be established in advance of the commencement of construction and displayed around working areas.

3.5.3 Advance Notice of Works

The contractor will ensure that local residents, businesses, occupants, general users of the area and stakeholders are informed in advance of construction activities that may affect them. Relevant obligations and procedures in relation to advance notice of works will be identified in the detailed CEMP(s) and in the Communications Management Plan.

All notifications will detail the nature, estimated duration and working hours. All notifications will include a project-specific contact number to which any enquires can be directed. The contractor will be responsible for preparing and issuing the notifications subject to the relevant approval and consents.

3.5.4 Contacts

An emergency contact list will be established and made available to all construction staff employed. The contact list shall be displayed prominently on site as well as at suitable locations where construction activity is being carried out around working areas. The contact list will include key environmental representatives that may need to be contacted in the event of an incident.

3.5.5 Enquiries and Complaints

The contractor shall establish a process for handling all enquires including complaints. All enquires will be recorded and a log would be maintained to include details of the response and actions taken. This will be available upon request for inspection to Tipperary County Council. All enquiries, whether a query or a complaint, will be dealt with in a timely manner.

The Site Environmental Manager will be immediately informed of any environmental related issues that have been raised. Where appropriate, the Site Environmental Manager would be responsible for informing Tipperary County Council, relevant stakeholders and statutory bodies.

4 ENVIRONMENTAL MANAGEMENT PROCEDURES

4.1 Training, Awareness and Competence

The contractor (and subcontractors) would be selected with due consideration of relevant qualifications and experience. The contractor will be required to employ construction staff with appropriate skills, qualifications and experience appropriate to the needs of the works to be carried out during construction.

All employees and subcontractors involved on site will be given a comprehensive induction prior to commencement of the works. This environmental training can be run concurrently with safety awareness training. Training will include:

- Overview of the Environmental Policy and Environmental Management Plan, goals and objectives;
- Awareness in relation to risk, consequence and methods of avoiding environmental risks as identified within the Register of Aspects and with the planning conditions;
- Awareness of roles and individual environmental responsibilities and environmental constrains to specific jobs;
- Location of and sensitivity of Special Area of Conservations, Special Protection Areas, protected monuments, structures etc.
- Location of habitats and species to be protected during construction, how activities may affect them and methods necessary to avoid impacts.

A record will be kept of a signed register on the project files of all attendees of the environmental induction. Toolbox talks based on specific activities being carried out will be given to personnel by the nominated project representative. These will be based on specific activities being carried out and will include environmental issues particular to the Project, including the impact on the environment and ecology:

- Oil/Diesel spill prevention and safe refuelling practice;
- Storage of materials including oil/diesels and cement;
- Emergency response processes used to deal with spills;
- Minimising disturbance to wildlife;
- Emergency response to include water pollution hotline to the EPA and Tipperary County Council for regulator response. Identification of registered / accredited spill clean-up company for oil etc.; and
- Consideration of importance of containment of vehicle washing, containments of concrete /cement / grout washout etc, bank protection using hessian to prevent excessive scour and mobilisation of suspended solids, maintenance of vegetation corridors etc.

4.2 Meetings

Tipperary County Council and/or the Employer's Representative will arrange regular meetings to discuss environmental matters and ensure effective coordination to be attended by:

- Tipperary County Council;
- Employers Representative;
- Contractor;
- Site Environmental Manager; and
- Environmental Specialists – engaged by either the Client and/or Contractor.

4.3 Monitoring, Inspections and Audits

For the duration of the contract, the environmental performance of the contractor will be monitored through site inspections and audits. The programme for monitoring, inspections and audits shall be specified in the contract and it is likely to be a combination of internal inspections and independent external audits that may be either random or routine.

Records of all inspections carried out should be recorded on standard forms and all actions should be closed out in a reasonable time. The detailed CEMP(s) would include further details of inspection procedures.

4.3.1 Monitoring

Mitigation and monitoring will be carried out in accordance with the requirements of the EIAR and NIS so that construction activities are undertaken in a manner that does not give rise to significant negative effects. Suitable monitoring programmes will need to be developed, implemented, documented, and assessed (with potential follow up) in accordance with the specification outlined in the detailed CEMP(s).

The results of all environmental monitoring activities would be reviewed by the Environmental Manager on an ongoing basis to enable trends or exceedance of criteria to be identified and corrective actions to be implemented, as necessary. The contractor will be required to inform the Employer's Representative of any continuous exceedances of criteria.

4.3.2 Inspections

Routine inspections of construction activities will be carried out by the Environmental Manager on a daily basis to ensure all necessary environmental measures relevant to the construction activities are being effectively implemented by construction staff, ensuring legal and contractual conformity. More detailed inspections would be undertaken by the Environmental Manager on a weekly basis.

The weekly inspections would be appropriately documented by the Environmental Manager and copies of these records and any action required to be undertaken should be made available to the Employers Representative.

Each month one of the weekly inspections will include a review of environmental documentation and records. The monthly inspection will be recorded on a standard form and reported to the Employers Representative within five days of the inspection taking place. This standard form will address the following as a minimum:

- Summary of compliance/non-compliance with the CEMP;
- Results of the monitoring programme;
- Summary of key findings;
- Summary of environmental complaints and queries received; and
- Record of environmental training undertaken by staff.

4.3.3 Audits

Tipperary County Council will arrange for independent environmental audits to be carried out by a third-party during construction. External audits provide the opportunity for an independent auditor to advise on compliance with applicable environmental regulatory requirements, the efficacy of the environmental management approaches used, and recommendations for reducing identified environmental risks (if considered appropriate).

Further, regulatory and statutory bodies may undertake site visits to monitor compliance with legislative and regulatory requirements. These site visits may occur randomly throughout the construction period. The contractor will facilitate these visits and the Environmental Manager will be available to provide information as required and deal with any issues that may arise during, or as a result of, these visits.

The contractor will be required to prepare standard forms for reporting and audit items shall include but not be limited to the following activities:

- Review of environmental documentation to establish if relevant requirements are being met and if continual improvement is occurring;
- Site inspection and interviews with on-site personnel; and
- Reporting with recommendations.

For any environmental nonconformities found, the auditor will prepare a Corrective Actions Report to describe and record the findings of the nonconformance (Refer to **Section 4.4.2**). The verification of previous Corrective Actions Reports should be also recorded.

Upon completion of an audit, the auditor will review all Corrective Actions Reports and prepares and Audit Report to summarise the following:

- Corrective action requests raised;
- Previous corrective actions requests and close-out; and
- Observations made during the audit.

The Environmental Manager will be entitled to participate in all audits. Notwithstanding this, the Employers Representative shall produce and provide the

contractor with a copy of each audit report within five working days of the audit. Each audit report will detail the findings from the auditor, specify nonconformances identified and outline the proposed corrective action.

4.4 Incident Response and Corrective Actions

4.4.1 Overview

Corrective actions are measures to be implemented to rectify any nonconformances (i.e. exceedance of criteria or targets) identified during monitoring, inspections and/or audits.

In the first instance, an investigation should be undertaken by the Environmental Manager to identify the cause of any non-conformances. Appropriate remedial measures shall be identified and implemented as soon as practicable to prevent further exceedances. If necessary, the appropriate statutory authority and stakeholders will be notified.

Where new or amended measures are proposed, the relevant CEMP(s) will be updated accordingly by the Environmental Manager and the Employer’s Representative should be informed at the earliest opportunity.

4.4.2 Corrective Action Reports

A Corrective Actions Report is prepared on foot of any non-conformances identified during environmental monitoring, inspections and/or audits on site. The Corrective Actions Report will describe in detail the cause and effect of a non-conformance on site and describe the recommended corrective action that is required to remedy it.

An appropriate timeline for closing out the corrective actions will be identified by the contractor in their detailed CEMP(s) as well as arrangements for the Environmental Manager verifying the Corrective Actions Report and informing appropriate authorities and stakeholders in a timely manner.

4.4.3 Emergency Incidents

Emergency incidents are those occurrences that give rise to significant negative environmental effects including but not limited to the following:

- Any malfunctions of any mitigation measure and/or environmental protection system;
- Any emission that does not comply with the contract requirements and relevant licences;
- Any circumstance with the potential for environmental pollution; or
- Any emergency that may give rise to environmental effects.

4.4.4 Accidental Spill Control Measures

Every effort will be made to prevent pollution incidents associated with spills during the construction of the proposed development. The risk of oil/fuel spillages will exist on the site and any such incidents will require an emergency response procedure. The following steps provide the procedure to be followed in the event of an oil/fuel spill occurring on site:

- Identify and stop the source of the spill and alert people working in the vicinity;
- Notify the Environmental Manager immediately fiving information on the location, type, extent of the spill;
- If applicable, eliminate any sources of ignition in the vicinity of the incident;
- Contain the spill using control materials, track mats or other material as required. Do not spread or flush away the spill;
- If possible, cover or bund off any vulnerable areas where appropriate such as drains, watercourses and or/or sensitive habitats;
- Contain any used spill control material and dispose of used materials appropriately using a fully licensed waste contractor with the appropriate permits so that further contamination is limited;
- The Environmental Manager shall inspect the site as soon as practicable and ensure the necessary measures are in place to contain and clean up the spill and prevent further contamination from occurring; and
- The Environmental Manager will notify the appropriate stakeholders of the incident.

4.4.5 Emergency Incident Response Plan

A set of standardised emergency response procedures will govern the management of emergency incidents. The contractor will be required to detail emergency incident response procedures in the detailed CEMP(s) and to develop an Emergency Incident Response Plan.

The Emergency Incident Response Plan will contain emergency phone numbers and the method of notifying local authorities, statutory authorities and stakeholders. Contact numbers for key personnel will also be included therein. Contractors will be required to adhere to and implement these procedures and ensure that all staff and personnel on site are familiar with the emergency arrangements.

The contractor will consult with the relevant statutory authorities, stakeholders and relevant parties such as the Health and Safety Authority, the Fire Authority, the Ambulance Service, the EPA, utilities companies and Tipperary County Council when preparing and developing response measures. Further, if any sensitive receptor is impacted, the appropriate environmental specialists will be informed and consulted with accordingly.

Any response measures will be incorporated into an updated Emergency Incident Response Plan that should be disseminated accordingly to construction staff, Tipperary County Council and the Employer's Representative.

4.4.6 Emergency Access

The contractor will be required to maintain emergency access routes throughout construction and identify site access points for each working area. This should be developed in partnership with the emergency services and documented as part of the detailed CEMP(s) and Emergency Incident Response Plan.

4.4.7 Extreme Weather Events

The contractor will consider the impacts of extreme weather events and related conditions during construction. The contractor will use a short to medium range weather forecasting service from Met Eireann or other approved meteorological data and weather forecast provider to inform short to medium term programme management, environmental control and mitigation measures.

The detailed CEMP(s) should consider all measures deemed necessary and appropriate to manage extreme weather events and should specifically cover training of personnel and prevention and monitoring arrangements for staff. As appropriate, method statements should also consider extreme weather events where risks have been identified, e.g. flood risks in the River Suir.

4.4.8 Unexpected Discoveries

The contractor is obliged to put in place appropriate procedures to be employed in the event of encountering unexpected archaeological or cultural heritage assets or subsurface contamination during intrusive ground works.

The contractor will be required to develop appropriate procedures as part of their detail CEMP(s) and the Environmental Manager will ensure that specialists (e.g. archaeologist) are facilitated to ensure management in accordance with industry best practice and effective compliance with the relevant legislation. All unexpected discoveries will be reported to the appropriate authorities and documented in an appropriate manner.

4.5 Reporting

4.5.1 Environmental Compliance Report

The contractor will be required to submit a monthly report to the Employer's Representative for review and approval. The report shall address the following as a minimum:

- Summary of compliance with the CEMP including identification of any non-conformances;
- Interpretation of the results of ongoing monitoring;
- Detailed description of any issues and/or non-compliances identified during inspection and/or audits;
- Record of incidents and corrective actions
- Synopsis of environmental complains received/queries raised by stakeholders; and
- Records of environmental training and/or inductions.

4.5.2 Incident Investigation Reports

The contractor will inform the Employer's Representative of all emergency incidents immediately and prepare an initial report within 24 hours setting out the details of the incident and cause(s) if known. The contractor will be required to complete the Environmental Incident Report and any further documentation requested by the Employer's Representative in relation to the incident within 7 days of the incident occurring. The Contractor will respond to all comments made by the ER on any incident.

The Environmental Incident Report will contain details of the incident including the location, known and suspected causes and weather conditions. It will define the scale and effects (short, medium, long term, temporary/permanent) as well as required corrective actions and mitigation/ remediation/compensation measures (as appropriate).

4.6 Environmental Records

The Contractor shall maintain records of all environmental documentation including monitoring, test results, method statements and plans. All records will be kept up to date and be made available for audits, inspections and periodical reporting. The Contractor will maintain the following environmental records (as a minimum) that will be made available for inspection to the Employer's Representative and the relevant authorities, if required:

- Management Plans;
- Records of environmental incidents;
- Monthly environmental reports;
- Records of environmental training;
- Register of environmental complaints;
- Corrective Action Reports;
- Environmental inspections and audit reports;
- All monitoring data;
- Waste and chemical inventories; and
- Health and Safety records.

5 General Requirements

5.1 Overview

It is the responsibility of the contractor to ensure compliance and to avoid and/or reduce significant adverse effects that have been identified where practicable. Where the contractor diverts from the methodologies and working areas outlined herein and/or defined in the granted planning consent and associated conditions that may be granted, it would be the responsibility of the contractor to obtain the relevant licenses, permits and consents for such changes.

5.2 Good Housekeeping

The Contractor will employ a "good housekeeping" policy at all times. This will include, but not necessarily be limited to, the following requirements:

- General maintenance of working areas and cleanliness of welfare facilities and storage areas;
- Provision of site layout map showing key areas such as first aid posts, material storage, spill kits, material and waste storage, welfare facilities etc;
- Maintain all plant, material and equipment required to complete the construction work in good order, clean, and tidy;
- Keep construction compounds, access routes and designated parking areas free and clear of excess dirt, rubbish piles, scrap wood, etc. at all times;
- Details of site managers, contact numbers (including out of hours) and public information signs (including warning signs) will be provided at the boundaries of the working areas;
- Provision of adequate welfare facilities for site personnel;
- Installation of appropriate security, lighting, fencing and hoarding at each working area;
- Effective prevention of oil, grease or other objectionable matter being discharged from any working area;
- Provision of appropriate waste management at each working area and regular collections to be arranged;
- Excavated material generated during construction will be reused on site as far as practicable and surplus materials/soil shall be recovered or disposed of to a suitably authorised waste facility site;
- Effective prevention of infestation from pests or vermin including arrangements for regular disposal of food and material attractive to pests will be implemented. If infestation occurs the contractor will take appropriate action to eliminate and prevent further occurrence;
- Maintenance of wheel washing facilities and other contaminant measures as required in each working area;
- No discharge of site runoff or water discharge without agreement of the relevant authorities;
- Open fires will be prohibited at all times;
- The use of less intrusive noise alarms which meet the safety requirements, such as broadband reversing warnings, or proximity sensors to reduce the requirement for traditional reversing alarms;
- Maintenance of public rights of way, diversions and entry/ exit areas around working areas for pedestrians and cyclists where practicable and to achieve inclusive access;
- All loading and unloading of vehicles will take place off the public highway wherever this is practicable; and
- Material handling and/or stockpiling of materials, where permitted, will be appropriately located to minimise exposure to wind. Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.

5.3 Working Hours

5.3.1 Core Working Hours

The timing of construction activities, core working hours and the rate of progress of construction works are a balance between efficiency of construction and minimising nuisance and significant effects. The core construction working hours for the proposed development will be:

- 7am – 7pm: Monday to Friday;
- 8am – 2pm: Saturday (Approval required by Tipperary County Council)

The contractor may require a period of up to one hour before and one hour after core working hours for start-up and shut down activities in working areas. Activities permitted may include deliveries and unloading of materials, movement of staff to their place of work, maintenance and general preparation works. The use of plant or machinery likely to cause disturbance, other than for piling, will not be permitted outside of the core working hours.

The permitted working hours for piling in the SAC as set out by the National Parks and Wildlife Services (NPWS) and Inland Fisheries Ireland (IFI) is as below:

- Mondays to Fridays: 08:00am to 18:00pm
- Saturdays, Sunday and Bank Holidays: Not permitted

5.3.2 Additional Working Hours

It may be necessary in exceptional circumstances to undertake certain activities outside of the construction core working hours. Any construction outside of the construction core working hours will be agreed by the contractor in advance with Tipperary County Council and scheduling of such works shall have regard to nearby sensitive receptors.

In the case of work required in an emergency or which if not completed would be unsafe or harmful to workers, the public or local environment, Tipperary County Council will be informed as soon as reasonably practicable of the reasons and likely duration and timing (outside of the core working hours).

5.4 Security

Security will be the responsibility of the contractor who will provide adequate security to prevent unauthorised entry to or exit from any working areas. The following measures may be used to prevent unauthorised access:

- Install CCTV and alarm systems where required;
- CCTV and security systems will be site and directed so that they do not intrude into occupied residential properties;
- Provide adequate security guards and patrols;
- When there is no site activity, close and lock site gates and set appropriate site security provisions in motion;
- Consult with neighbouring properties and local crime prevention officers including Tipperary County Council and An Garda Síochána on site security matters as required; and
- Prevent access to restricted areas and neighbouring properties by securing equipment on site such as scaffolding and ladders.

5.5 Hoarding and Fencing

A site boundary in the form of hoarding or fencing will be established around each of the working areas before any significant construction activity commences in that working area. The hoarding/fencing shall be 2.4m high to provide a secure boundary to what can be a dangerous environment for those that have not received the proper training and are unfamiliar with construction operations.

The erection of hoarding would be of a similar nature to what is carried out on most construction sites. Mounting posts would be erected by using a mini-digger and the posts would be set in concrete. The size and nature of the posts and hoarding would depend on the requirements for any acoustic mitigation as well as preferences that the contractor may have. Where practicable, hoarding and fencing would be retained and re-configured and re-used between working areas as the construction activities progress.

The following measures will be applied in relation to hoarding and fencing:

- Maintenance of adequate fencing and hoardings to an acceptable condition to prevent unwanted access to working areas and provide noise attenuation, screening, and site security where required;
- Appropriate sight lines/visibility splays will be maintained around working areas to ensure safety of both vehicles and pedestrians is preserved;
- Use of different types of fencing and hoarding (e.g. mesh fence of solid hoarding including hoardings used for noise control);
- Temporary fences may be used in certain areas, such as for short term occupation of working areas;
- Display information boards with out of hours contact details, telephone helpline number (for comments/complaints) and information on the works;
- Erect notices on site boundaries to warn of hazards on site such as deep excavations, construction access, etc.;
- Ensure suitable measures for tree protection are implemented as required;
- Keep hoarding and fencing free of graffiti or posters;
- Retain existing walls, fences, hedges and earth banks as far as reasonably practicable; and
- Appropriate positioning of the fencing or hoarding to minimise the noise transmitted to nearby receptors or from plant, equipment and vehicles entering or leaving the working area.

5.6 Services and Facilities

5.6.1 Services and Utilities

Site services shall be installed as part of the enabling works in parallel with the rearrangement and diversion of existing utilities. Working areas will be powered by mains supplies or diesel generators where an electrical supply is not available.

The contractor will be responsible for undertaking their own surveys to establish full extent of underground services prior to the commencement of construction to support any surveys already undertaken as part of early design work and statutory consent applications.

5.6.2 Welfare Facilities

Welfare facilities will be provided, as appropriate, for construction staff and site personnel such as locker rooms, toilets, showers etc. The location of these will be agreed with Tipperary County Council and identified as part of the detailed CEMP(s).

5.7 Reinstatement of Working Areas on Completion

The contractor will reinstate all working areas and access routes as work proceeds during construction. All plant, equipment, materials, temporary infrastructure and vehicles will be removed at the earliest opportunity and the surface of the ground restored as near as practicable to its original condition. Pre-condition and post-condition surveys shall be carried out by the Contractor to ensure reinstatement conditions and requirements are agreed upon with the Engineers Representative and Tipperary County Council.

5.8 Dewatering of Works Areas

The Contractor shall be required to follow the following dewatering methodology as summarised below:

- For The North Plaza, Suir Island Car Park and Raheen Road, dewatering of any excavation works shall make use of Aska Sykes Ltd Dirt-Box and Dirt-Bags systems (or similar approved) to filter water prior to discharging into the existing surface water systems;
- For Suir Island, Denis Burke Park and any works near the Suir River riverbanks, dewatering of any excavation works shall make use of Aska Sykes Ltd Dirt-Box and Dirt-Bags systems, installed in parallel or in series depending on flow and quality requirements;
    - Water shall be discharged overland at a suitably vegetated location subject to the agreement with the ECoW;
    - All excavations shall contain suitable sumps for the removal of water; and
    - Pump shall be fitted with suitable screens and/or sifts to reduce the intake of silt.

Indicative layouts and details of the dewatering methodology is shown in Figure 5-1 below and shown on Drawing 20_071-CSE-00-XX-DR-C-1410.

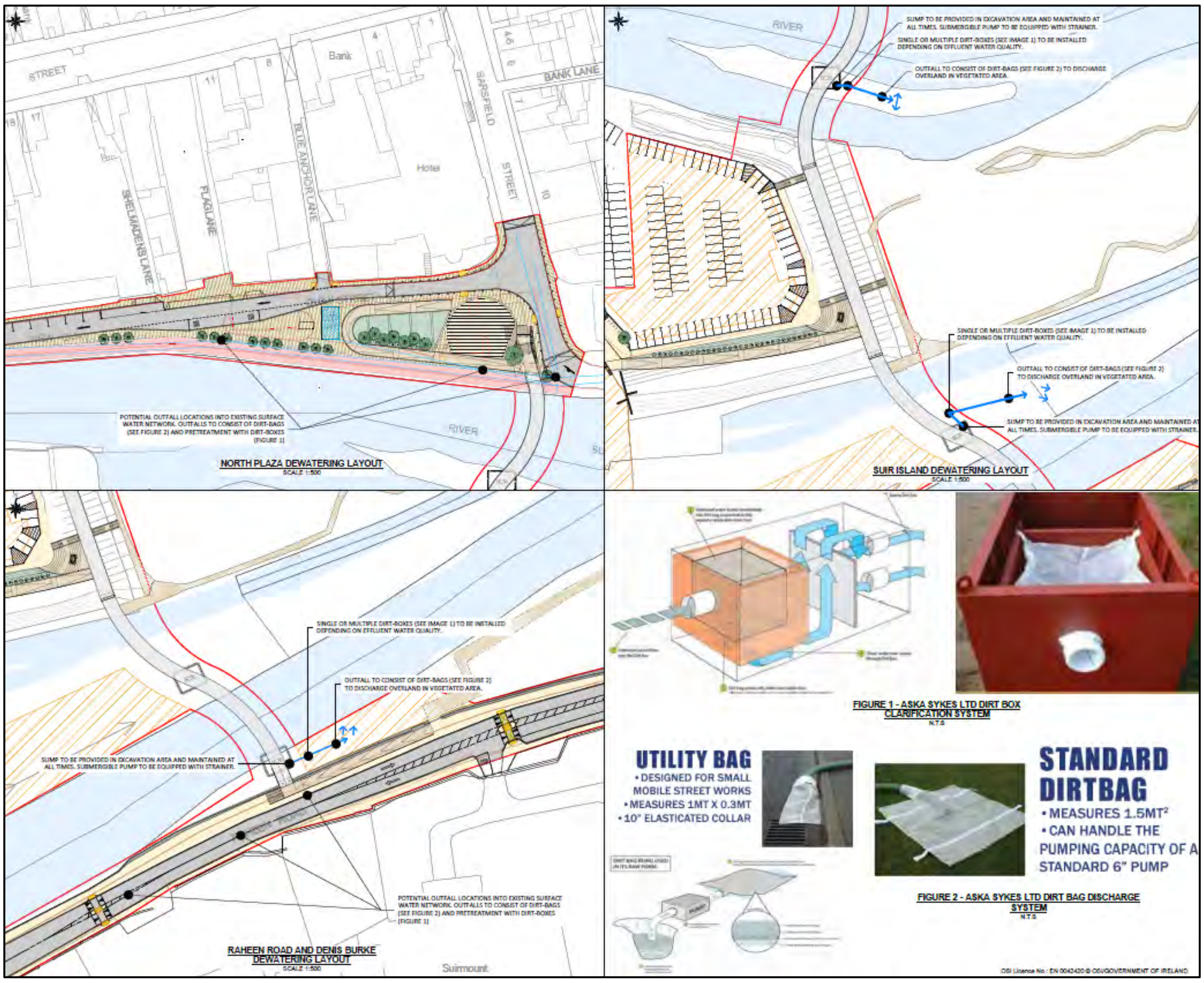


Figure 5-1: Dewatering of excavations

5.9 Health & Safety

The contractor shall be required to ensure all relevant health and safety, fire safety and security requirements are in place prior to the commencement of construction and in accordance with relevant legislative requirements in addition to the specifications of Tipperary County Council.

Relevant Irish and EU health and safety legislation shall be complied with at all times by all construction staff and personnel during construction. Further, contractors shall also have to ensure that all aspects of their works comply with good industry practice and all necessary consents, licences and authorisations that have been put in place for the proposed development.

6 Environmental Management

This section describes the specific environmental requirements identified as part of the specific design and Suir Island Environmental Impact Assessment (EIAR) Chapters, Screening for Appropriate Assessment (AA) and Natura Impact Statement (NIS) that will need to be adhered to by the contractor.

It should be noted that **Sections 6.1 - 6.12** provides a summary of minimum requirements that should be built upon by the contractor when developing the detailed CEMP(s). It is intended that the measures set out herein will be discussed in more detail with relevant stakeholders as required in order to support the identification of any additional measures to be taken account of during construction.

6.1 Traffic and Transportation

The contractor is required to implement the following minimum measures in relation to traffic and transportation during construction:

- All trucks entering and exiting the site will be covered with tarpaulin;
- Adequate parking will be provided near the contractor's compounds to avoid queuing at the site entrances and prevent disruption to neighbouring businesses/roads. Construction vehicles will not be allowed to park on the public road either outside the site or on any of the approach roads leading to the site;
- All trucks entering the site will be restricted to suitable speed limits and will be directed to the relevant area by the Site Manager;
- Trucks required to wait on site will switch off engines to avoid unnecessary fuel usage and noise;
- All trucks exiting the site will be required to pass through a wheel wash. A lance will be provided to clean down the bodies and sides of the truck prior to leaving site;
- Roads outside the site will be visually inspected on a daily basis and power swept and washed as and when required;
- All site staff including truck drivers will be required to abide by the normal rules of the road;
- The contractor shall prepare a Detailed Construction Traffic Management Plan (CTMP) covering all construction stages that takes into account other potential construction works in the area. The CTMP will demonstrate how pedestrians, cyclists and motorised vehicles are prevented from passing through the sites and that measures are in place which ensure traffic is not disrupted;
- The CTMP will include a detailed consultation plan to deal with third party queries from both residents and commercial operators. The CTMP will require agreement with both Tipperary County Council and An Garda Síochána prior to the commencement of construction.
- The contractor will appoint a single point of contact to facilitate the communication of the various traffic management plans and the preparation of a project specific website to aid communications would also be beneficial.
- As part of the CTMP a Mobility Management Plan will be prepared to ensure access to the site by sustainable travel modes is encouraged. The following measures will need to be considered within the Mobility Management Plan:
- The provision of facilities for construction staff;
- The provision of cycle and parking for construction staff;
- The promoting of car sharing among staff, including van pooling to travel between different work sections;

6.2 Air Quality and Climate

The contractor is required to implement the following measures in relation to air quality and climate during construction:

- Implementation of 'standard mitigation' measures as stated in the Transport Infrastructure Ireland (TII), (formerly the National Roads Authority (NRA) (2011)), Good Practice Guidance for the Treatment of Air Quality during the Planning and Construction of National Road Schemes:
- Spraying of exposed earthwork activities and site haul roads during dry weather;

- Provision of wheel washes at exit points;
- Covering of stockpiles;
- Control of vehicle speeds, speed restrictions and vehicle access; and
- Sweeping of hardstand surfaces.
- Erection of the hoarding will be provided around the working areas to minimise the dispersion of dust from working areas as per **Section 5.5** of this OCEMP;
- Generators will be located away from sensitive receptors in so far as practicable;
- Stockpiles will be located as far as possible from sensitive receptors, floodplains and covered/dampened during dry weather conditions;
- Employee awareness shall be promoted by actively training staff on management of operations and dust suppression;
- Where asbestos is uncovered on site, a competent contractor shall remove the ACM from site and disposed of in accordance with relevant procedures and legislations.

6.3 Odour

No mitigation measures are required during the construction of the proposed development with regards to odour.

6.4 Noise and Vibration

The Noise and Vibration Management Plan (NVMP) will outline how the appointed Contractor(s) will comply with the noise criteria set out in this section and will deal specifically with construction activities in a strategic manner to remove or reduce significant noise and vibration impacts associated with the construction of the proposed development. The NVMP will detail the provision and installation of localised acoustic screens, the best practice noise measures that the appointed Contractor(s) will be required to adhere to for construction activities and the noise and vibration monitoring programme that the appointed Contractor(s) will be required to undertake during the construction works.

In addition, the appointed Contractor will prepare detailed method statements addressing the likely ground-borne noise and vibration levels that will be generated as a result of the construction activities once the specific details of the proposed plant items and construction methodologies are known.

The contractor is required to implement the following measures in relation to noise and vibration during construction:

- The contractor will take specific noise reduction measures and comply with the recommendations of the standards and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001 and 2016 so as to acknowledge the EC (Noise Emission by Equipment for Use Outdoors) (Amendment) Regulations 2006;
- A site representative shall be appointed to be responsible for matters relating to noise and vibration;
- Unnecessary revving of engines should be avoided and equipment should be switched off when not required;
- Generators will be located away from sensitive receivers and will be enclosed;
- Careful selection of equipment, construction methods and programming with the objective of reducing noise and vibration where possible. Only equipment, including road vehicles, conforming to relevant national or international standards, directives and recommendations on noise and vibration emissions, will be used;
- Selecting electrically powered plant that is quieter than diesel or petrol-driven plant, if interchangeable;
- Fitting suitable anti-vibration mountings where practicable, to rotating and/or impacting equipment;
- Locating plant, as far as is reasonably practicable, away from receptors or as close as possible to noise barriers or hoardings where these are located between the source and receptor;
- Regular and effective maintenance by trained personnel shall be carried out to reduce noise and/or vibration from plant and machinery;

- Ensuring that all plant is maintained regularly to comply with relevant national or international standards and operation of plant and equipment that minimises noise emissions;
- Ensuring that plant is shut down when not in use;
- Ensuring that air lines are maintained and checked regularly to prevent leaks;
- Designing all audible warning systems and alarms to minimise noise. Nonaudible warning systems can be used in preference, i.e. cab-mounted CCTV or the use of banksmen. If required, ensure that audible warning systems are switched to the minimum setting required by the Health and Safety Authority and where practicable use 'white noise' reversing alarms in place of the usual 'siren' style reversing alert;
- A c. 2.4m hoarding shall be provided around construction works;
- Handling all materials, particularly steelwork, in a manner that minimises noise. For example, storing materials as far as possible away from sensitive receptors and using resilient mats around steel handling areas;
- During construction, regular inspections will be undertaken to ensure that the noise and vibration minimising methods, plant and mitigation identified in the specimen design stage are adopted on site and are working effectively. If applicable, it is proposed that construction method inspections be integrated into any health and safety or quality surveillance regime;
- A Communications Management Plan shall be prepared to provide for effective community liaison to help ensure the smooth running of construction activities and to address any issues that may arise;
- Noise monitoring should be undertaken at the start of each new activity to determine the compliance with limit values. This may involve monitoring on a daily basis initially (for the first three weeks), but subject to satisfactory results, this could be relaxed to once a week/twice-weekly depending upon the site activities. The frequency will be increased again if particularly noisy activities (piling) are undertaken;
- Continuous noise and vibration monitoring will take place at three of the nearest sensitive receptors Environmental noise monitoring will be undertaken only by suitably-trained and experienced staff;

6.5 Biodiversity

All mitigation measures outlined in the Suir Island Environmental Impact Assessment (EIAR) Chapters, Screening for Appropriate Assessment (AA) and Natura Impact Statement (NIS) that pertain to the construction stage of the proposed development will be implemented by the Contractor.

These measures are outlined under the following broad category headings.

6.5.1 Implementation of Best Practice Guidelines

All construction works, relating to the activities and construction works outlined in **Section 2.1** above, will be undertaken in accordance with the following:

- Inland Fisheries Ireland's Requirements for the Protection of Fisheries Habitat during Construction and Development Works.
- CIRIA (Construction Industry Research and Information Association) Guidance Documents
- Control of water pollution from construction sites (C532)
- Control of water pollution from linear construction projects: Technical Guidance (C648)
- Control of water pollution from linear construction projects: Site Guide (C649)
- Environmental Good Practice on Site (C692)
- NRA Guidance Documents
- Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes
- Guidelines for the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads
- Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, during and Post Construction of National Road Schemes.
- All work completed should be in compliance with the Wildlife Acts, 1976 – 2012;
- Guidance for the Treatment of Otters during the construction of national road schemes.

- Guidance for the Treatment of Badgers during the construction of national road schemes.

An Ecological Clerk of Works (ECoW) will be appointed to oversee the construction phase. The roles and responsibilities of the ECoW are outlined in **Appendix A**.

6.5.2 Measures to Minimise Construction Phase Impacts to Habitats

- The construction corridor will be marked out prior to the commencement of construction.
- All construction work will be confined strictly to the construction corridor. Any construction works required outside the construction corridor will require prior approval from the Employer.
- Excavation and infilling will be carried out in small progressive stages;
- Any topsoil that is of use for landscaping will be stored on the site. Where this is required during the construction phase, it will be stored suitably far away from the River Suir and other surface water features and covered to avoid excessive sediment run-off or wind blow;
- Given the proposed construction methodology the construction phase of the project is not anticipated to result in significant levels of silt laden run off, . Nevertheless, the site will be regularly monitored by construction staff for signs of run-off such as silt in surrounding vegetation and measures will be put in place to prevent this where necessary;
- Excavations will be carried out using a suitably sized excavator;
- Any excavated soil that is not re-used will be disposed of to a Tipperary County Council approved waste disposal facility;
- In all circumstances, excavation depths and volumes will be minimised to the depths in accordance with the design of the cable trenches and excavated material will be re-used where possible.

6.5.3 Measures to Protect Water Quality and Surface Water Bodies

To prevent the ingress of any surface water or dust emissions to watercourses during the construction phase, temporary silt trap and impermeable barrier will be placed along the edge of the works.

Suitable prevention measures should be put in place at all times to prevent the release of sediment to the River Suir and other drainage channels associated with construction areas and migration to adjacent watercourses.

Excavated material will not be stored immediately adjacent to locations in close proximity to watercourses and the River Suir floodplain. No construction activities should be undertaken at watercourses in wet weather conditions.

Any refuelling or lubrication of machinery will only be undertaken at construction compounds on the North Plaza and Raheen Road. Refuelling in Raheen Road and Denis Burke Park will not be permitted.

A method statement for dewatering of excavations will be prepared by the appointed contractor in liaison with the ECoW.

6.5.4 Non-native and Undesirable Species

- The appointed contractor shall prepare a Non-Native and Undesirable Species Removal Plan in accordance with TII Publication “The Management of Invasive Alien Plant species on National Roads – Technical Guidance – GE-ENV-01105 (Dec. 2020) in liaison with the ECoW.
- Any vegetation clearance or construction works to be undertaken in the vicinity of areas identified as supporting non-native species will be undertaken in accordance with the Transport Infrastructure Ireland (TII) (formerly the National Roads Authority (NRA)) guidance measures for the control and management of noxious weeds and non-native invasive species (see NRA, 2010). Sites of known infestation shall be clearly marked prior to works and avoided during construction. The importance of preventing the spread of these species will form part of a tool box talk to all personnel prior to construction commencing.
- In the event that additional topsoil and quarried stone is required on the site, it will be sourced from a stock that has been screened for the presence of any invasive species and where it is confirmed that none are present.

- Sites of known infestation shall be clearly marked prior to works and avoided during construction. The importance of preventing the spread of these species will form part of a tool box talk to all personnel prior to construction stage.
- All contractors should incorporate strict biosecurity protocols into their Construction Environmental Management Plans. This should include the thorough cleaning and disinfection of all machinery prior to arrival and departure from the site, to prevent the spread of invasive species.
- In the event that additional topsoil and quarried stone is required on the site, it will be sourced from a stock that has been screened for the presence of any invasive species and where it is confirmed that none are present.

Non-native invasive plant species are known to occur to the west and outside the boundary of the project site. These species include Japanese Knotweed and Giant Hogweed both of which are categorised as high-impact invasive species. Winter heliotrope, ranked as a low-impact invasive species and traveller's joy and Himalayan honeysuckle, both of which are ranked as medium-invasive species are present on the island and within the footprint of the garden. Tipperary County Council have implemented a non-native invasive plant species eradication programme and treatment of these stands was recorded during 2021 and will continue throughout the 2022 growing season.

6.5.5 Margaritifera margaritifera (Freshwater Pearl Mussel)

The freshwater pearl mussel populations for which the Lower River Suir SAC is designated is restricted to the Clodiagh River sub-catchment which is a separate sub-catchment to the sub-catchment in which Suir Island is located. As such there will be no potential for the project to result in impacts to habitat conditions occurring within the Clodiagh River catchment. However, it is noted that an attribute of the freshwater pearl mussel conservation objectives is the maintenance of suitable host fish densities within the Clodiagh sub-catchment. Salmonids represent the host fish upon which the larvae of freshwater pearl mussel rely. The salmonid population of the Clodiagh River is fed by migratory salmonids that use the main channel of the River Suir to access spawning habitat within the Clodiagh sub-catchment. Given the potential for the project to perturb water quality within the main channel of the River Suir this in turn could result in potential disturbance to migratory host salmonids using the river to access the Clodiagh sub-catchment. In light of this host fish attribute, it is considered that the freshwater pearl mussel population of the Clodiagh River occur within the zone of influence of the project. The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of Freshwater Pearl Mussels in liaison with the project ECoW.

6.5.6 Austropotamobius pallipes (White-clawed Crayfish)

White-clawed crayfish are known to occur along the River Suir surrounding Suir Island. There are records for the presence of this species upstream at Marlfield and downstream of Suir Island at Thomas Bridge. Given the presence of populations of white-clawed crayfish along the main channel of the River Suir and the potential risks posed by the project to water quality and the freshwater habitat upon which this species relies, it is considered to occur within the zone of influence of the project. The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of White-clawed Crayfish in liaison with the project ECoW.

The measures outlined in Section 6.5.5 above and Section 6.7 below that aim to protect water quality will be implemented in full. The successful implementation of these measures will ensure significant effects to water quality and this species are avoided during the construction phase.

6.5.7 Petromyzon marinus (Sea Lamprey)

Sea lamprey are known to occur along the River Suir surrounding Suir Island. Given the presence of populations of sea lamprey along the main channel of the River Suir and the potential risks posed by the project to water quality and the freshwater habitat upon which this species relies, it is considered to occur within the zone of influence of the project. The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of Sea Lamprey in liaison with the project ECoW.

6.5.8 Lampetra planeri (Brook Lamprey)

Brook lamprey are known to occur along the River Suir surrounding Suir Island. Given the presence of populations of brook lamprey along the main channel of the River Suir and the potential risks posed by the project to water quality and the freshwater habitat upon which this species relies, it is considered to occur within the zone of influence of the project. The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of Brooke Lamprey in liaison with the project ECoW.

6.5.9 Lampetra fluviatilis (River Lamprey)

River lamprey are known to occur along the River Suir surrounding Suir Island. Given the presence of populations of river lamprey along the main channel of the River Suir and the potential risks posed by the project to water quality and the freshwater habitat upon which this species relies, it is considered to occur within the zone of influence of the project. The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of River Lamprey in liaison with the project ECoW.

6.5.10 Alosa fallax fallax (Twaite Shad)

Twaite shad is a anadromous species, spending most of its life in salt water and migrates to freshwater to spawn. The spawning grounds of twaite shad along the River Suir are located approximately 1km upstream of the old bridge in Carrick-on-Suir, approximately 20km downstream of the project site. Notwithstanding this distance, given the presence of a hydrological pathway connecting the project site to the spawning grounds of twaite shad and the potential risk posed by the project to water quality and the freshwater habitat of the River Suir this species is considered to occur within the zone of influence of the project. The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of Twaite Shad in liaison with the project ECoW.

6.5.11 Salmo salar (Salmon)

Atlantic salmon are known to occur along the River Suir surrounding Suir Island. Given the presence of populations of Atlantic salmon along the main channel of the River Suir and the potential risks posed by the project to water quality and the freshwater habitat upon which this species relies, it is considered to occur within the zone of influence of the project. The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of Salmon in liaison with the project ECoW.

6.5.12 Lutra lutra (Otter)

Otter is known to occur along the River Suir surrounding Suir Island. Given the presence of otter population along the main channel of the River Suir and the potential risks posed by the project to water quality and the freshwater habitat upon which this species relies, it is considered to occur within the zone of influence of the project. Furthermore, it is considered that the potential for the operation phase of the project to result in disturbance to otters also requires examination as part of a Natura Impact Statement of the project.

Where it is established on foot of pre-construction surveys that a derogation licence is required in respect of an otter breeding place or resting place the application for a derogation licence will be required to satisfy the requirements for the issuing of such a licence as set out in the NPWS guidance document “Guidance on the Strict Protection of Certain Animal and Plant Species under the Habitats Directive in Ireland” NPWS, Guidance Series 1 (2021).

In the event that exclusions of an otter holt are required, they will be undertaken in accordance with the TII/NRA Guidelines (NRA, 2008). These methods will be set out as a method statement that will be provided as a supporting document for any derogation licence application.

It is noted that otters can breed at any time of the year, therefore in the event that otter holts are identified, it will be a requirement of the pre-construction surveys to establish the breeding status of such holts. The breeding status of a holt can be established by undertaking repeated monitoring of the holt over a number of consecutive days. Methods to monitor otter traffic at the holt will include camera traps and the placement of sand at entrances to record footprints. In the event that the holt is identified as inactive the entrance should be blocked to prevent the reoccupation of the holt by otters. The holt should be left blocked for another five days and if there are no signs of otter activity at the holt during this time then it should be destroyed immediately under licence. The destruction of any otter holt will be required to be supervised by the licence holder.

The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of Otters in liaison with the project ECoW and relevant TII guideline documents.

6.5.13 Bats

The project site is located in an area of high bat habitat potential for a number of bat species. No roost sites were identified as occurring within the project site. A roost site for pipistrelle species occurs at the Mill buildings to the west of the project site. High levels of foraging activity by Soprano pipistrelle, Common pipistrelle and Leisler's bat were recorded during monitoring sessions. Low levels of foraging activity for all other species was recorded.

The presence of Soprano pipistrelle, Leisler's bat and Common pipistrelle foraging within and surrounding the project site is not unexpected. Common pipistrelle and Soprano pipistrelle are widespread and commonly occurring throughout the country and is “commonly encountered during bat surveys” (NPWS, 2019). Common pipistrelle is also “very general in its habitat preference, foraging in woodland, riparian habitats and parkland, along linear features in farmland, and in towns and cities” (NPWS, 2019). The national population of this species is increasing and no existing pressures or threats to the conservation status of this species at a national level have been identified. Overall the future prospects for this species in terms of range, population and habitat are Good (NPWS, 2019). Leisler's bat is also abundant in Ireland, being identified as one of the most common and widespread species in Ireland. It prefers to forage over parkland, cattle pasture, meadows, tree crowns over and along woodland habitats (Russ, 2012) as well as urban areas (NPWS, 2019). The national population of this species is increasing and the overall the future prospects for this species in terms of range, population and habitat are Good (NPWS, 2019). Existing threats to this species, as identified by the NPWS, include wind energy development. and the deliberate or accidental exclusion of Leisler's bats from roosts in houses.

The woodland habitats on Suir Island provide an important foraging habitat and resource for the Soprano pipistrelle, Common pipistrelle and Leisler's bat that rely on them. They are important in the context of sustaining the roost at the mill buildings to the west of the project site. In light of the above the bat population that relies on Suir Island and the woodland and riparian habitats is considered to be of county importance (Rating C).

The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of Bats in liaison with the project ECoW and relevant TII guideline documents.

6.6 Archaeology, Architecture and Cultural Heritage

The contractor is required to implement the following measures in relation to archaeology, architectural and cultural heritage during construction:

- A site representative shall be appointed to be responsible for matters relating to Archaeology, Architectural and Cultural Heritage;
- The contractor will be required to develop appropriate procedures as part of their detail CEMP(s) and the Environmental Manager will ensure that specialists (e.g. archaeologist) are facilitated to ensure management in accordance with industry best practice and effective compliance with the relevant legislation. All unexpected discoveries will be reported to the appropriate authorities and documented in an appropriate manner.
- The contractor shall monitor excavation for continuously throughout the construction duration;
- A c. 2.4m hoarding shall be provided around protected structures with appropriate signage;
- Site staff shall undergo regular training and be made cognisant of the requirements set out in the CEMP.

6.7 Hydrology and Water Quality

All construction works, relating to the activities and construction sequence outlined in Section 2.1 above, will be undertaken in accordance with the following:

- Inland Fisheries Ireland's Requirements for the Protection of Fisheries Habitat during Construction and Development Works.
- CIRIA (Construction Industry Research and Information Association) Guidance Documents
  - Control of water pollution from construction sites (C532)
  - Control of water pollution from linear construction projects: Technical Guidance (C648)
  - Control of water pollution from linear construction projects: Site Guide (C649)
  - Environmental Good Practice on Site (C692)
  - CIRIA Handbook C650 Environmental good practice on site;
  - CIRIA Handbook C651 Environmental good practice on site checklist;
- TII/NRA Guidance Documents;
- Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes
- Management of any discharges to surface water must meet S.I. No. 272 of 2009 and amendments (2015 and 2019) European Communities Environmental Objectives (Surface Waters) Regulations;

In general, all works will be subject to a specific method statement agreed in advance. The method statement will be specific to each construction area and activity but will incorporate the following points:

- To avoid water laden with silt discharging to the river, toe boards will be required around all sites;
- To avoid excessive silt runoff, site clearance is not to be undertaken during wet conditions, when rainfall of more than 0.5 mm/hour is forecast within the next 24 hours or rainfall of more than 3mm/hour is forecast within the next five days in the catchment
- No long-term soil storing will be allowed within 30 m of the open water bodies or within floodplains where sufficent working areas are available within the site boundaries, which is in line with Inland Fisheris Ireland guidelines. Temporary daily soil stores are allowable to facilitate works, however soil mounds to be removed daily to a safe distance or covered.
- Fuels, lubricants and hydraulic fluids for equipment used, as well as any solvents and oils etc.are to be carefully handled to avoid spillage. Properly secured against unauthorised access or vandalism, and provided with spill containment. All staff to be trained in management of chemicals and spill response.
- As far as reasonably practicable, fuelling and lubrication of equipment is not to be carried out within 100 m to the open water where sufficent working areas are available within the site boundaries. Fueling should only be undertaken in compounds with spill control measures in place. All fuel storage should be within containers with 110 % containment and located on hardstand. This measures are in line with the Inland Fisheris Ireland guidelines.
- Weedkillers not be used

- Any spillage of fuels, lubricants of hydraulic oils is to be immediately contained and the contaminated soil removed from the site and properly disposed off.
- The washing of any plant equipment will be carried out in designated areas to prevent potentially polluting material from contaminating aquifers and soils/subsoils.
- Excavations will be backfilled (daily preferably) as soon as possible to prevent any infiltration of potentially polluting compounds.
- Where feasible pre fabricated concrete should be used. Where necessary to pour concrete, a dry working area will be created for pouring of any concrete. Raw or uncured waste concrete is not to be disposed of within 50m of the river. No washing out of concrete tankers will be allowed on any of the construction areas.
- A Siltbuster/similiar concrete washwater will be used where there is insufficient space on site to achieve the required clearance distances between the works and river chanel.
- All vehicles will be regularly checked for oil leaks and ruptured hose pipes.

6.8 Land and Soils

In addition to the items listed under **Section 6.7** the following measures should apply:

<u>Soil Storage</u>

Temporary storage of soil will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment and the material will be stored away from any open water bodies and floodplains and any adjacent channels. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust. Where temporary storage of soil is required, it will be covered and moved as quickly as possible. No long-term storage within 30m of water bodies will be permitted.

<u>Soil Contamination</u>

Although there is no evidence of historical contamination in the proposed development area, all excavated materials will be visually assessed for signs of possible contamination such as staining or strong odours. Should any unusual staining or odour be noticed, samples of this soil will be analysed for the presence of possible contaminants in order to ensure that historical pollution of the soil has not occurred. Should it be determined that any of the soil excavated is contaminated, this will be disposed of by a licensed waste disposal contractor.

<u>Infill materials</u>

All aggregate or soil imported should be from a reputable source. Certification shall be provided.

6.9 Resource and Waste Management

The contractor is required to implement the following in relation to resource and waste management during construction:

- The contractor is required to prepare, implement and maintain a Construction and Demolition Waste Management Plan throughout construction that addresses the following as a minimum:
- Description of the proposed development;
- Wastes arising including procedures for minimisation/reuse/recycling;
- Estimated cost of waste management;
- Roles including training and responsibilities for construction and demolition waste;
- Procedures for education of workforce and plan dissemination programme;
- Record keeping procedures;
- Waste collectors, recycling and disposal sites including copies of relevant permits or licences; and
- Waste auditing protocols.
- The Contractor will minimise waste disposal as far as is reasonably practicable;

- Waste from the proposed development will be transported by authorised waste collectors in accordance with the Waste Management (Collection Permit) Regulations 2007 to 2016 to take into account the Waste Management (Collection Permit) (Amendment) Regulations 2016.
- Waste from the proposed development will be delivered to authorised waste facilities in accordance with the Waste Management Acts 1996-2011 and the Waste Management (Collection Permit) (Amendment) Regulations 2016;
- Source segregation: Where possible metal, timber, glass and other recyclable material will be segregated during construction works and removed off site to a permitted/licensed facility for recycling. Waste stream colour coding, and photographs of wastes to be placed in each container as required, will be used to facilitate segregation. Where waste generation cannot be avoided this will maximise the quantity and quality of waste delivered for recycling and facilitate its movement up the waste hierarchy away from landfill disposal and reduce its environmental impact;
- Material management: 'Just-in-time' delivery will be used as far as is reasonably practicable to minimise material wastage;
- Supply chain partners: The contractor will engage with the supply chain to supply products and materials that use minimal packaging, and segregate packaging for reuse;
- Waste Auditing: The contractor will record the quantity in tonnes and types of waste and materials leaving site during the construction phase;
- Waste fuels/oils may be generated from equipment used on-site during construction and may be classified as hazardous waste. Such wastes will be stored in a secure, bunded area on-site prior to collection by a contractor who holds the appropriate waste collection permit;
- Possibilities for re-use of clean non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excavation material may not be re-used within the proposed works the contractor will endeavour to send material for recovery or recycling as far as is reasonably practicable;
- The name, address and authorisation details of all facilities and locations to which waste and materials are delivered will be recorded along with the quantity of waste in tonnes delivered to each facility. Records will show material which is recovered and which is disposed of; and
- The contractor(s) will ensure that any off-site interim storage or waste management facilities for excavated material have the appropriate waste licences or waste facility permits in place.

6.10 Population and Human Health

The contractor is required to implement the following measures in relation to population and human health during construction:

- Provide for safe pedestrian access at all times;
- Stagger works wherever possible and remove hoarding as soon as it is no longer needed to mitigate against severance;
- Avoid works that could involve high noise or visual intrusion;
- Provide temporary signalling at all sites;
- Maintain regular proactive consultation with local residents and businesses.

The appointed contractor shall include a site-specific risk and mitigation register for the works specific to the protection of Population and Human Health in liaison with the project ECoW and relevant guideline documents as well as the Suir Island Environmental Impact Assessment (EIAR) Chapters, Screening for Appropriate Assessment (AA) and Natura Impact Statement (NIS).

6.11 Material Assets

The contractor is required to implement the following measures in relation to material assets during construction:

- A Property Protection Scheme will be put in place by Tipperary County Council prior to works commencing on site. This will involve advance condition surveys prior to construction for all properties within the zone of influence of the proposed development. If it is determined that any reported minor cosmetic damage has been caused by construction of the proposed development, suitable remedial works will be undertaken to repair the damage to the properties with the use of the appropriate conservation technique.

- Access to all existing properties will be maintained at all times during the construction of the proposed development.

6.12 Major Accidents and Natural Disasters

The contractor is required to implement the following measures in relation to major accidents and natural disasters during construction:

- The construction methodology for the revetment employed by the contractor, which would involve replacement of the revetment in sections, will work to mitigate the risk of flooding in that it would enable the section under construction to be quickly protected during storm events; and
- A detailed CEMP would be prepared prior to the commencement of any works and implemented during the works. The CEMP will be a live document maintained by the contractor that would work to ensure that potential risks of major accident and/or disaster are identified, avoided and mitigated, as necessary.

Appendix A

ECOLOGICAL CLERK OF WORKS SPECIFICATION

Appendix A - Ecological Clerk of Works (ECoW)

Background

An appropriately qualified Environmental/Ecological Clerk of Works (ECoW) will be employed for the duration of the Civil Works Contract. The ECoW must be a member of the Chartered Institute of Ecology and Environmental Management (CIEEM) or equivalent body. The ecologist performing the ECoW role will attend the site on a weekly basis to check that all works are being completed to the appropriate standards.

As the delivery of the environmental protection measures outlined in this Appendix is highly dependent on the roles and responsibilities of the ECoW some detail is provided here regarding this position.

Term of Appointment

The ECoW will be on site for minimum 1 day per week during the construction works, provision will be made for an initial briefing to all contractors, and a final visit to report on the ecological aspects of construction. Some office time is also required for weekly reporting.

ECoW Tasks

Overview

The provision of an ECoW helps to monitor, control, and direct the ecological and environmental protection aspects of the Ecological Impact Assessment and EIA Screening documentation, Construction Environmental Management Plan and Construction Method Statements (CMS) to ensure that all measures are fully adhered to during construction. It also allows any issues arising to be dealt with in an appropriate manner.

Taking account of the requirements set out in the list of measures outlined above and also in the EcIA and the EIA Screening documentation, the following are deemed to be required services under the ECoW.

a) Construction surveys.
b) Visual inspection of construction safeguards such as temporary construction boundary fencing.
c) Monitoring environmental controls (including briefing of digger drivers).
d) Monitoring of construction activity in the vicinity of badger setts.
e) Monitoring of construction activity in the vicinity of Vertigo habitat
f) Maintaining records of checks and issues.
g) Providing a report detailing the implementation of all ecological and environmental protection measures during the construction phase.
h) Survey the site for sensitive and protected species prior to construction (due diligence survey).

Pollution Prevention Plan

a) Review, agreement and approval of Contractor’s pollution prevention plan prior to commencement of work.
b) Conduct weekly inspection of site pollution prevention measures (silt traps boards, etc.) and visually assess their effectiveness. This will include inspection of water management measures installed by Contractor such as excavation pumping and diversion channels, as well as containment of silt away from watercourses and advice on micro-siting of mitigation measures.

c) Maintain a Pollution Prevention Measures Register of the weekly inspections, to include an inventory of all measures on the site, their effectiveness, as well as any advice provided.
d) Suspension of work where potential risk from pollution is identified, or where construction methods and mitigation measures are not specified in construction method statements and/or plans as agreed at commencement of works.
e) Provide advice and recommendations to the contractors regarding the above.

Waste Management

a) Review, agreement and approval of the Contractor’s Site Waste Management Plan
b) Review of the Contractor’s records for all inspections of fuel, oil or chemical storage areas, including the integrity of storage facilities.

Drainage Management

a) Review, agreement and approval of the Contractor’s Site Drainage Management Plan
b) Inspection of drainage management works.
c) Liaison with Planning / NPWS / IFI.
d) Agreement of monitoring standards to be applied by Contractor’s personnel.
e) Assessment in advance of habitats and species for ground to be affected by drainage management.
f) Review of Contractor’s records for plant inspections, evidence of contamination and checks made after extreme weather conditions.

Water Quality Monitoring

a) Review, agreement and approval of the Contractor’s and independent Site Water Quality Monitoring Plans where undertaken.
b) Inspection of Contractor’s records for water environmental monitoring and comparison of those records with independent records.
c) Presentation of independent water environmental monitoring results at weekly site meetings.

Excavated Materials and Reinstatement

a) Review, agreement and approval of the Contractor’s Spoil Management and Reinstatement Plan.
b) Marking working areas and route corridors, in consultation with the Geo-technical/Civil Designer and/or Archaeologist, as necessary.
c) Granting permission to work outside the temporary construction corridor, in the event that such a requirement arises. No works will be undertaken outside this corridor until permission is received by the ECoW. Where necessary the ECoW will liaise with the Planning Authority and the NPWS prior to deciding on the acceptability of any works outside this corridor.
d) Agreeing proposals temporary storage areas as development proceeds.
e) Agreeing timing of restoration and reinstatement of path surfaces.
f) Monitoring the condition of stored turf.

g) Issuing instruction to cease work if unexpected risks arise, until an agreed alternative solution is identified and risks are avoided or minimised.

Recording

The ECoW will keep a record of the following:

a) notable animal sightings and signs (including birds, in addition to other site ornithological monitoring);
b) The Pollution Prevention Measures Register (as detailed above);
c) The habitats and soil (including peat depth) of ground to be developed via survey at least a week in advance of construction work;
d) record of tasks carried out;
e) written record of all oral advice given

The ECoW will maintain a GIS database of key recordings made during the construction period. ECoW weekly site visit notes will be made available for all personnel on site to consult and incorporates the following:

- Monitoring of requirements listed under the EcIA, EIA Screening, CEMP and CMS
- Pollution Prevention Measures Register

On-Site Communication

The success of ECoW appointment is largely dependent on well-defined lines of communication. In theory, robust construction method statements will incorporate many of the areas of ECoW concern into the daily activities of construction personnel. However, the ECoW will always inform the Civil Contractor and their Designer of areas of particular concern, who will then make a decision as to the subsequent action.

The ECoW will be involved in the delivery of biodiversity-related Toolbox Talks as part of the site induction process Toolbox talks will be given to the work force at regular intervals to highlight the environmental issues that are unique to the proposed development. All staff will know of the circumstances when the ECoW will be contacted, and the relevant phone numbers.

Liaison with Consultees

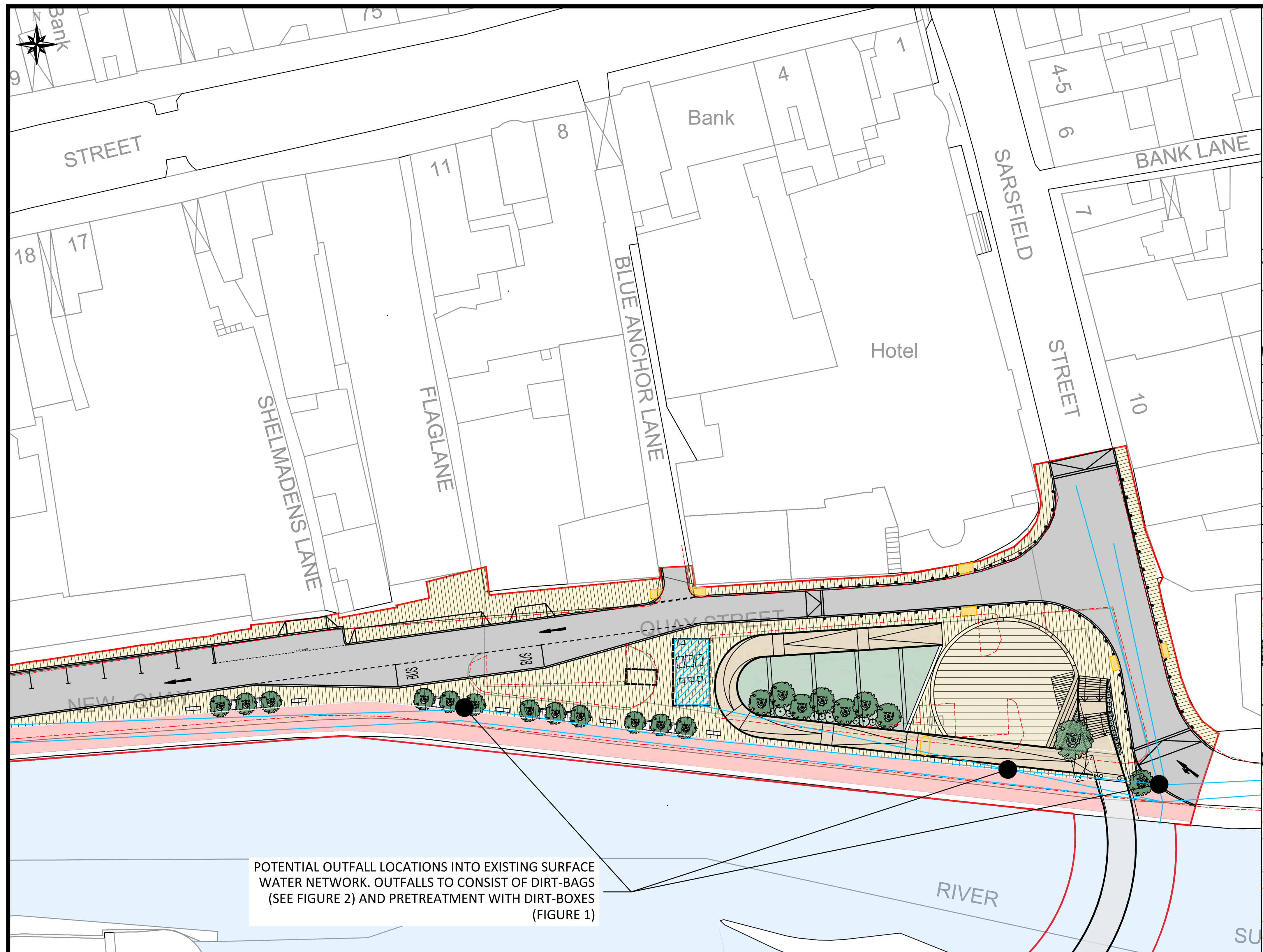
The ECoW will provide a liaison between the Planning Authority, NPWS and the IFI.

Final Report

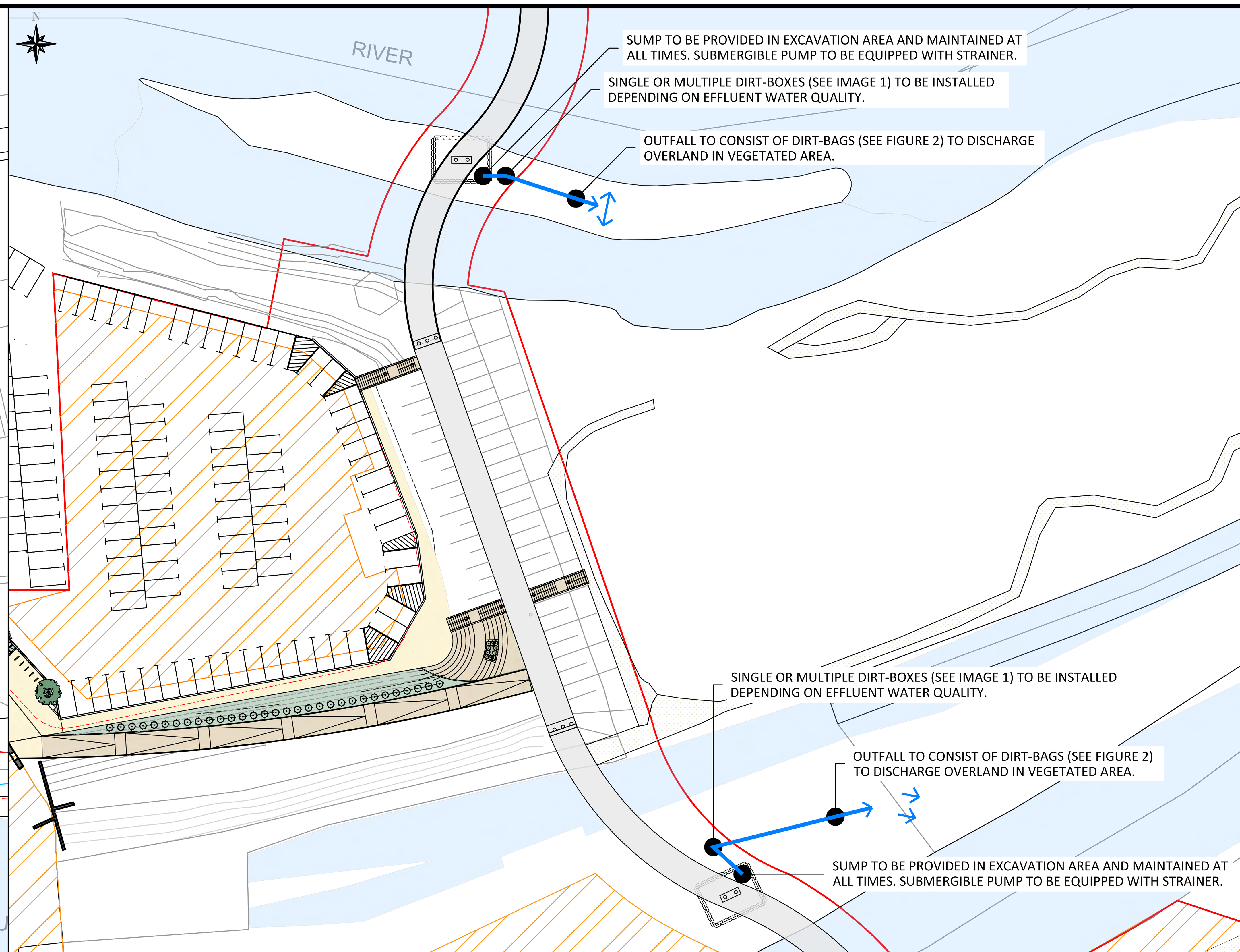
The ECoW will produce a final report documenting the environmental and ecological effects of the construction period. The evidence for effects will be based on findings included in the minutes of weekly meetings, together with other recording information maintained by the ECoW. The report will be made available to the Contractor, the Planning Authority, NPWS, IFI and other external agencies where appropriate.

Appendix B

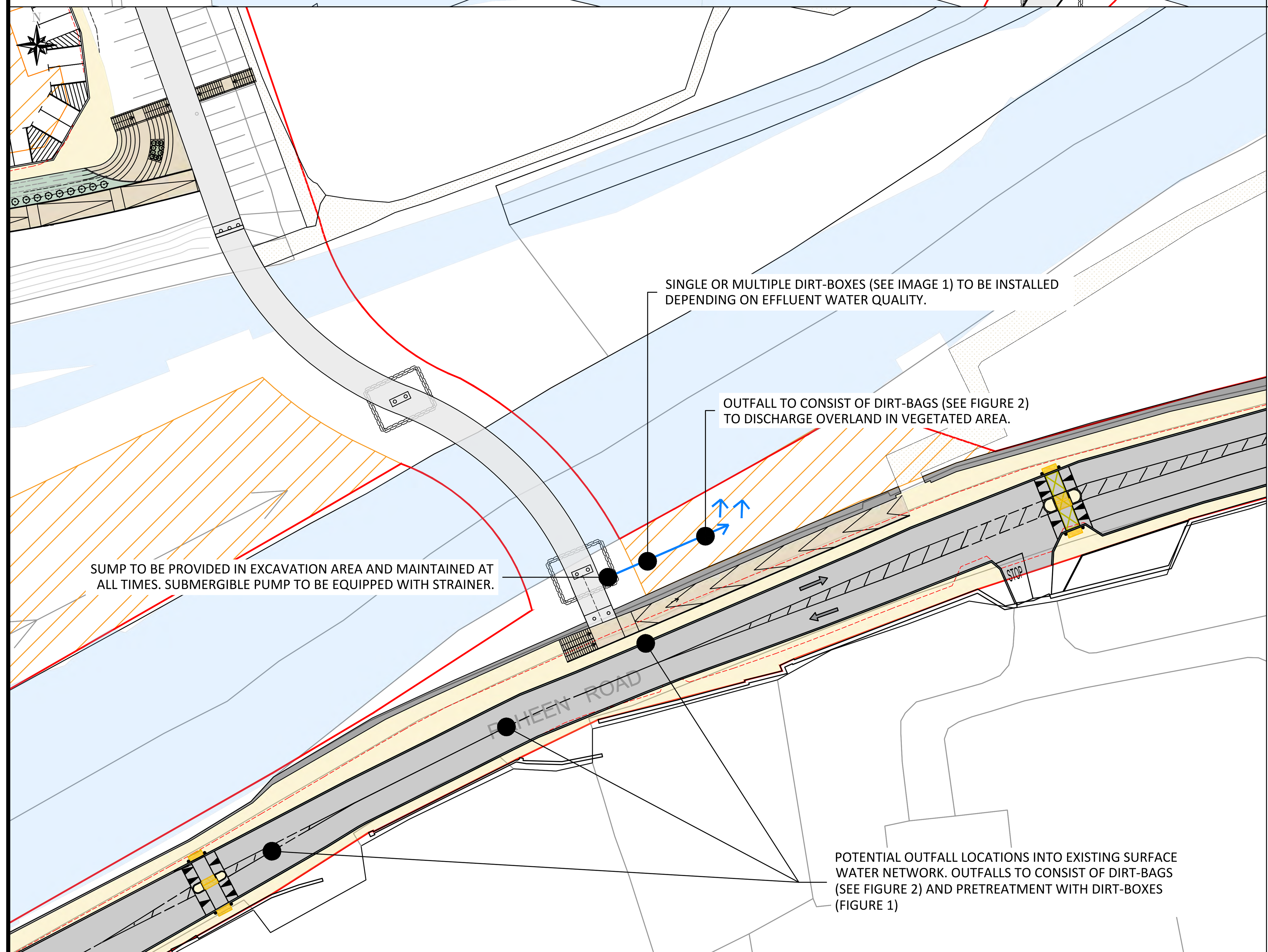
DEWATERING METHODOLOGY DRAWING



NORTH PLAZA DEWATERING LAYOUT
SCALE 1:500



SUIR ISLAND DEWATERING LAYOUT
SCALE 1:500



RAHEEN ROAD AND DENIS BURKE DEWATERING LAYOUT
SCALE 1:500

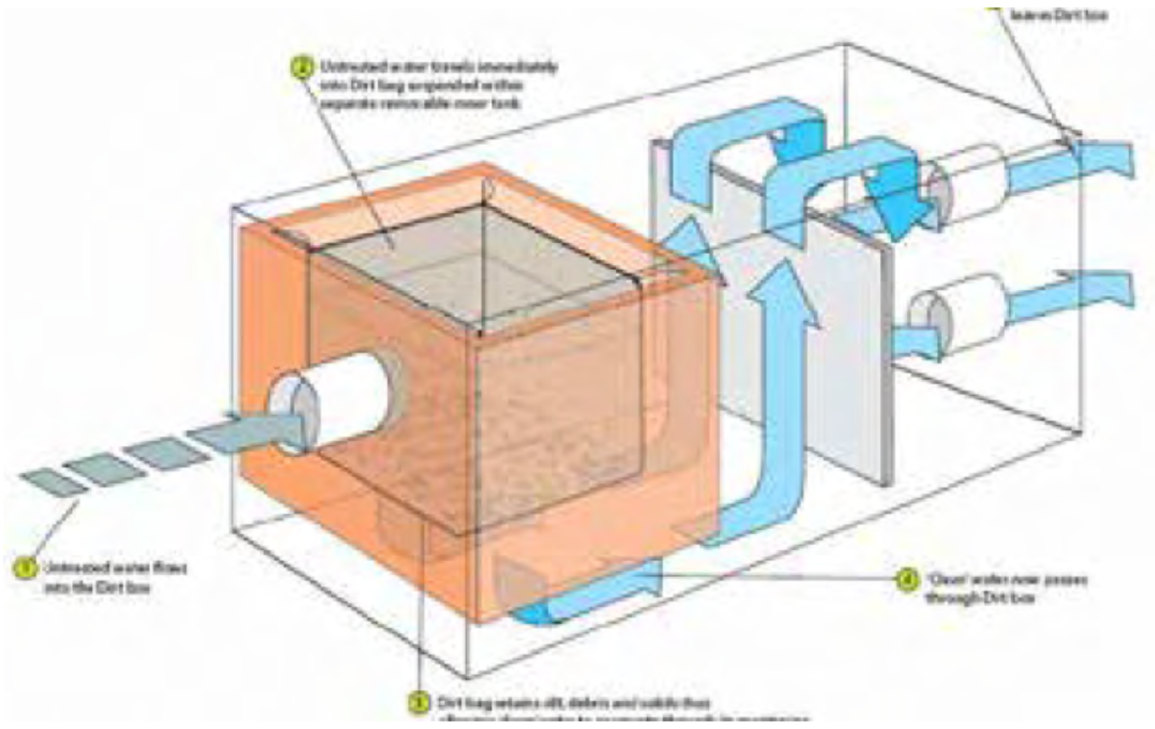


FIGURE 1 - ASKA SYKES LTD DIRT BOX CLARIFICATION SYSTEM
N.T.S

UTILITY BAG
- DESIGNED FOR SMALL MOBILE STREET WORKS
- MEASURES 1MT X 0.3MT
- 10" ELASTICATED COLLAR

STANDARD DIRTBAG
- MEASURES $1.5MT^2$
- CAN HANDLE THE PUMPING CAPACITY OF A STANDARD 6" PUMP

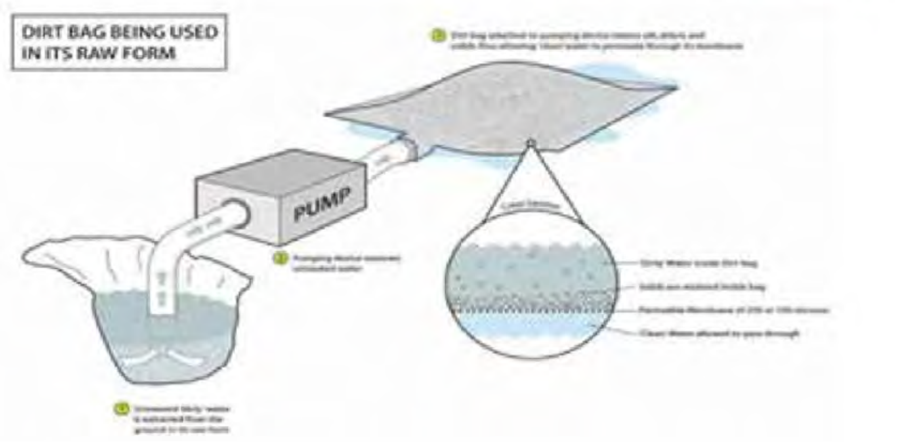


FIGURE 2 - ASKA SYKES LTD DIRT BAG DISCHARGE SYSTEM
N.T.S

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT
Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS
dhbarchitects

ARCHEOLOGISTS
CourtneyDeery
ARCHAEOLOGY & CULTURAL HERITAGE

BRIDGES
MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS
Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS
awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS
Douglas Carroll
Consulting Engineers

DEWATERING METHODOLOGY:
- NORTH PLAZA/RAHEEN ROAD WILL MAKE USE OF DIRT BOX AND BAG SYSTEMS WHICH WILL FILTER WATER PRIOR TO DISCHARGING INTO EXISTING SURFACE WATER NETWORK SYSTEM.
- SUIR ISLAND/DENIS BURKE PARK WILL CONSIST OF DIRT BOX CLARIFICATIONS, INSTALLED SEPARATELY OR IN SERIES WHICH WILL DRAIN TO DIRT BAGS BEFORE DISCHARGING OVERLAND ON VEGETATED AREAS.
- SUMPS TO BE PROVIDED IN ALL EXCAVATIONS AT ALL TIMES.
- EFFLUENT WATER QUALITY VISUAL INSPECTIONS TO BE CARRIED OUT ON CONTINUOUS BASIS AND SAND BAGS TO BE DISPOSED OF AS PER MANUFACTURER RECOMMENDATIONS.
- EFFLUENT WATER QUALITY MONITORING TO BE CONDUCTED ON WEEKLY BASIS.

Rev	Description	Drawn	Checked	Date
P01	FOR INFORMATION	HB	LP	31/08/23

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Client: TIPPERARY COUNTY COUNCIL
Project: SUIR ISLAND INFRASTRUCTURE LINKS
Dwg. Title: CONSTRUCTION DEWATERING LAYOUT

Drawn By	LP	Date	AUG 2023	20_071
Checked By	HB	Scale	1:500 @ A1	CSEA Job No.

Project Code / Originator / Zone/Phase / Level / Type / Role / Dwg. No.
20_071 - CSE - 00 - XX - DR - C - 1410

Status Code: S2 — Suitability Description: FOR INFORMATION
Revision: P01 — Project Status: PRELIMINARY

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Appendix 7.2: Flood Risk Assessment Stage I and II

Clifton Scannell Emerson Associates

Flood Risk Assessment – Stage 1 & 2

Suir Island Infrastructure Links

Comhairle Contae Thiobraid Árann
Tipperary County Council

Client: Tipperary County Council

Date: September 2023

Job Number: 20_071

Civil Engineering | Structural Engineering | Transport Engineering | Environmental Engineering | Project Management | Health and Safety

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Document Control Sheet

Project Name:	Suir Island Infrastructure Links
Project Number:	20_071
Report Title:	Flood Risk Assessment – Stage 1 & 2
Filename:	RPT-20_071-058

Issue No.	Issue Status	Date	Prepared by	Checked by
0	Final	22.09.2023	HB	LP

Table of Contents

List of Figures

List of Tables

1 Introduction

Tipperary County Council (TCC) have commissioned Clifton Scannell Emerson Associates (CSEA) to conduct a Flood Risk Assessment for the proposed Suir Island Infrastructure Links proposed development, situated in Clonmel, County Tipperary. This report provides support for the Planning Application and covers the Stage 1 and 2 Flood Risk Assessments, as set out in the Planning and Development Regulations 2001 (as amended).

1.1 Scope of the Report

This Flood Risk Assessment Report has been prepared in accordance with the Office of Public Works (OPW) guidelines publication, "*The Planning System and Flood Risk Management, Guidelines for Planning Authorities*" published in November 2009. This Guideline was issued by the Minister of the Environment, Heritage and Local Government under Section 28 of the Planning and Development Act 2000.

The scope of this assessment involves the site-specific assessment to identify sources of floods which may affect the proposed development, evaluate the flood risk to the proposed development from the various sources and to justify the viability of the proposed development in terms of flood risk.

This report should be read in conjunction with the Detailed Flood Risk Assessment Report "*Suir Island Hydraulic Modelling Report (RPT-20_071-055)*" contained in Appendix C of the OPW Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010, Report No. RPT-20_071-019.

1.2 Site and Proposed Development Description

The Suir Island Infrastructure Links site is located south of Clonmel Town Centre in County Tipperary, with the development encompassing areas located on The Quays, Suir Island and Raheen Road. Refer to Figure 1-1 for the locality and site extent map and proposed development Drawings 20_071-CSE-00-XX-DR-C-2250 to 2256 included in **Appendix A**.

The proposed development will consist of:

- Two pedestrian bridges, the first bridge linking the proposed North Plaza on The Quay/Quay St/Sarsfield St Junction to Suir Island, and the second bridge connecting Suir Island to Raheen Road.
- The pedestrian bridges will be 4-metre-wide consisting of a double curvature alignment, which allow users to discover Suir Island 'from up high' by walking seamlessly between the trees while linking the project elements (North Plaza, the berm embankment, and the south riverbank) along one sinuous route. The first bridge follows the geometry of Sarsfield Street and arrives on the island following the line of the berm embankment, which then links onto the second bridge facilitating a link to Denis Burke Park on Raheen Road, creating a direct connection for pedestrians/cyclists between the park and the Town Centre.
- Provision of a new public open space called the North Plaza which will be aligned with Sarsfield Street. The steps and ramp will be visible from O'Connell Street creating a new landmark in the town of Clonmel and will encourage pedestrian movement towards the River Suir. The bicycle access ramp is designed to be as transparent as possible so as not to block the view of Suir Island from Sarsfield Street.
- Modification of traffic direction and carriageway width around the North Plaza and The Quay and Quay St.
- Provision of a bus stop on the western side of the North Plaza located on Quay Street with five benches providing comfortable facilities for public transport users.
- Upgrading of the existing 2-metre-wide sidewalk along Quay Street into a 4-metre-wide shared pedestrian/cycle path which will provide unencumbered access to the proposed plaza area underneath the elevated access ramp.

- Provision of a sloping landscaped terrace with public seating, located inside the hairpin-shaped access ramp leading up to the northern bridge crossing.
- Provision of three benches and a 9-metre-long stepped promenade seating area integrated into the circular-shaped plaza.
- Planting of various native tree species around the North Plaza to integrate the proposed development with the existing scenery of Suir Island and complement the visual experience of users.
- Provision of a pedestrian path or promenade along the existing berm embankment across Suir Island linking the two pedestrian bridges, to facilitate access between Denis Burke Park on Raheen Road and the proposed North Plaza on The Quay.
- Construction of a pedestrian/bicycle ramp from the link promenade onto Suir Island Carpark. The ramp is fully integrated into the landscape by using the existing slope of the berm.
- Construction of three sets of steps connecting the link promenade to Suir Island carpark and the eastern end of Suir Island.
- Provision of a mini public space within Suir Island Carpark at the entrance to the proposed Suir Island Gardens.
- Provision of a south arrival point for the second bridge connecting Suir Island to the Raheen Road. The South Arrival Point will consist of one access ramp to the east and one set of steps to the west, integrated with the bridge landing level and running parallel to the footpath. These elements will be located outside the existing flood barrier.
- Road improvements for the safety of pedestrians/cyclists at the South Arrival Point, including the footpaths being widened and the road narrowed to accommodate 3.0-metre-wide lanes. Removal of three carparking spaces from the southern edge of the road to allow for wider footpaths.
- Installation of two uncontrolled pedestrian crossings positioned at either ends of the proposed access ramp and flight of steps to provide traffic calming at the South Arrival Point. This bridge arrival point will be located close to the school entrance of Raheen College, providing safe and convenient access for the schoolchildren.
- Access ramps and steps are located behind the flood barriers to allow access even during flood events.
- Construction of a new foul pumping station to be located within Suir Island car park which will facilitate future Irish Water connections. Wastewater will be pumped 0.1km approx. via rising main along the proposed bridge linking Suir Island to the proposed North Plaza where it will connect into the existing public network along The Quay.
- Ancillary site development works to include, but not limited to, surface water drainage, lighting and associated electrical works, hard and soft landscaping, road works to include surfacing and line marking, landscaping and installation of street furniture.
- All associated site works.

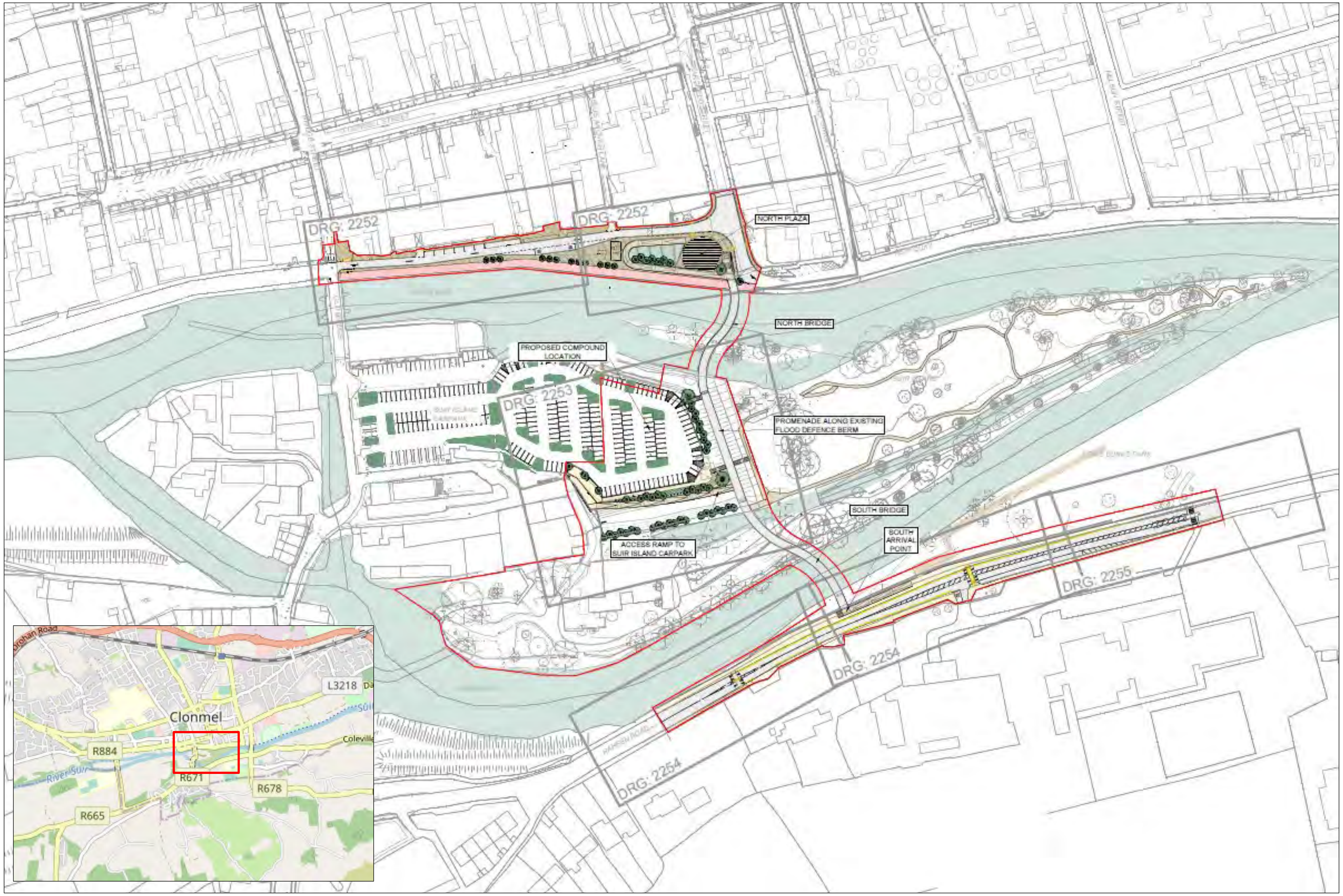


Figure 1-1: Project locality map and layout extent

2 Background Information

2.1 Catchment-based Flood Risk Assessment and Management

The Catchment-based Flood Risk Assessment and Management (CFRAM) program was implemented by the OPW, as required by the 2007 EU "*Directive on the assessment and management of flood risks, 2007/60/EC*". Over 29 Flood Risk Management Plans (FRMPs) have been prepared in coordination with the implementation of the Water Framework Directive (WFD). The FRMPs involved undertaking detailed engineering assessments and producing flood protection measures. The assessments addressed the potential impact of the proposed measures on waterbodies, hydro-morphology and quality status. The Suir River CFRAM is highlighted in more detail in **Section 3.1**.

The following reports are available on the OPW Publications website in relation to the Suir CFRAM study:

1. Hydrology Report (Draft Final Report) dated July 2015. Reference: 1891_RP_ Hydrology Report Draft Final_Rev14;
2. Hydraulics Report (Final Report) dated July 2016. Reference: 1891_REP_160711_Hydraulic_Final; and
3. Flood Risk Management Plan River Basin (16) Suir completed in 2018.

2.2 The Planning System and Flood Risk Management

The purpose of The Planning System and Flood Risk Management Guidelines for Planning Authorities, published by the OPW in 2009, is to introduce comprehensive mechanisms for the incorporation of flood risk identification and the assessment and management of floods into the planning process. These mechanisms are highlighted in **Section 2.2.2**.

2.2.1 Core Objectives and Guidelines

The core objectives of the OPW Guidelines are to:

- Avoid unsuitable developments in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional and local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and
- Ensure the requirements of EU and national law in relation to the natural environment and nature conservation area complied with at all stages of flood risk management.

2.2.2 Flood Risk Assessment Concepts

Understanding flood risk is a key step in managing the impacts of flooding. Flood risk is a combination of the likelihood of flooding and the potential consequences arising. The OPW Guidelines recommend a staged approach to flood risk assessments as highlighted in this section.

The staged approach appraisal and assessment is defined as:

- **Stage 1 Flood Risk Identification** – to identify whether there may be any flooding or surface water management issues related to either the area of regional planning guidelines, development plans and Local Area Plans (LAPs) or a proposed development site that may warrant further investigation at the appropriate lower-level plan or planning application levels;
- **Stage 2 Initial Flood Risk Assessment** – to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to

scope the extent of the risk of flooding which may involve preparing indicative flood zone maps. Where hydraulic models exist the potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures can be assessed. In addition, the requirements of the detailed assessment should be scoped; and

- **Stage 3 Detailed Flood Risk Assessment** – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development or land to be zoned, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures.

Two important components that must be considered in applying the guidelines in a consistent manner are:

- Likelihood of flooding must be expressed as the percentage probability of a flood of a given magnitude or severity occurring or being exceeded in any given year. For example, a 1% probability indicates the severity of a flood that is expected to be exceeded on average once in 100 years, i.e. it has a 1 in 100 (1%) chance of occurring in any one year.
- Consequences of flooding depend on the hazards associated with the flooding (e.g. depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality), and the vulnerability of people, property and the environment potentially affected by a flood (e.g. the age profile of the population, the type of development, presence and reliability of mitigation measures etc).

Source-Pathway-Receptor Model

For carrying out a site-specific Flood Risk Assessment (SSFRA), the OPW Guidelines recommend using the Source-Path-Receptor model to identify where the flood originates from, the floodwaters path, and the areas in which assets and people might be affected by such flooding. Figure 2-1 displays a schematic representation of S-P-R model.

The principal sources are rainfall or higher than normal sea levels. The principal pathways are rivers, drains, sewers, overland flow and river and coastal floodplains and their defence assets. The receptors can include people, their property and the environment. All three elements must be examined as part of the flood risk assessment including the vulnerability and exposure of receptors to determine its potential consequences.

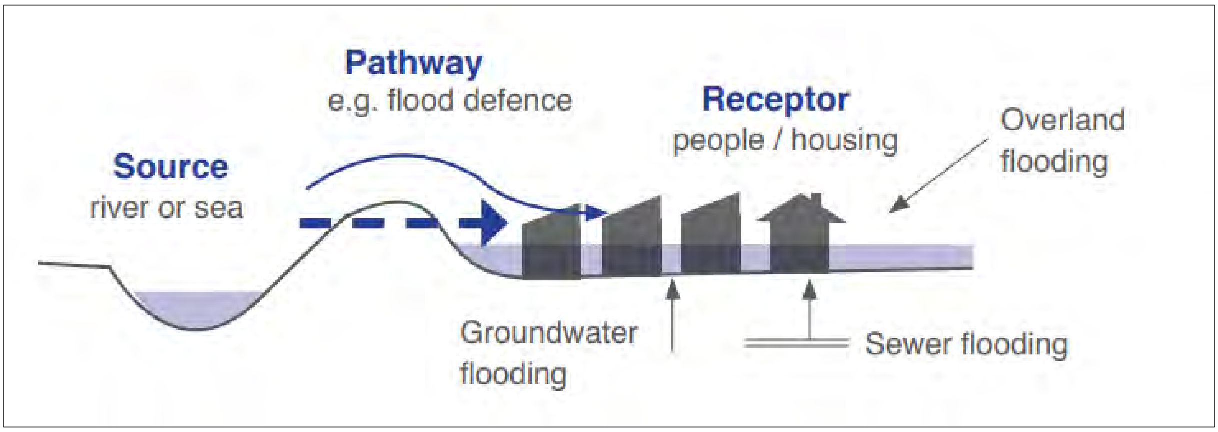


Figure 2-1: Source-Pathway-Receptor Model

Flood Zones

The Flood Zone is the spatial inundation area that falls within a range for the likelihood of flooding. The OPW Guidelines specify three levels of flood zones as shown on Figure 2-2 and summarised below:

- **Flood Zone A** – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);
- **Flood Zone B** – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and
- **Flood Zone C** – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

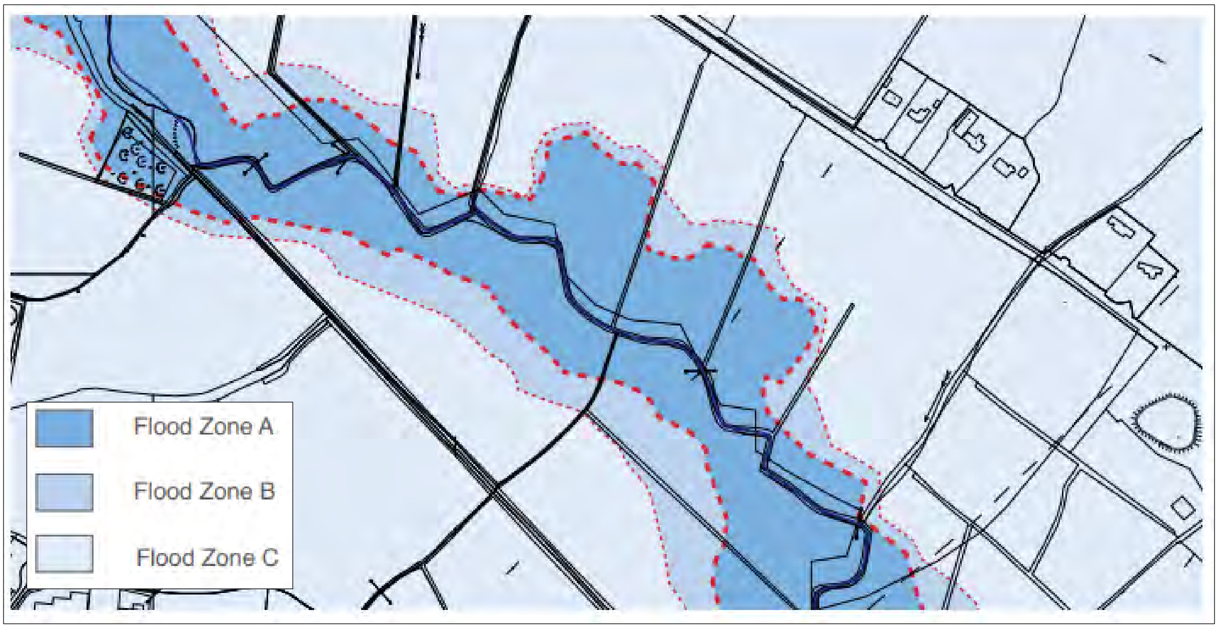


Figure 2-2: Indicative Flood Zones

Climate Change

The OPW states in the *"Climate Change Sectoral Adaptation Plan 2015-2019"* that climate change will significantly increase the flood risk by different mechanisms including:

- Rise in Sea Level;
- Increase in Rainfall/Runoff;
- Increase in wind speed and hence extreme storm surge events.

The OPW specified two main Climate Change Scenarios for the Pilot CFRAMS Studies, which are:

- Mid-Range Future Scenario (MRFS); and
- High-End Future Scenario (HEFS).

The Climate Change Scenario parameters are summarised in Table 2-1.

Table 2-1: Flood Parameters for the Mid-Range Future and High-End Future Scenarios

Parameter	Mid-Range Future Scenario	High-End Future Scenario
Extreme Rainfall Depths	+ 20%	+ 30%
Peak Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm
Land Movement	- 0.5 mm / year[1]	
Urbanisation	No General Allowance – Review on Case-by-Case Basis	
Forestation	- 1/6 Tp[2]	- 1/3 Tp[2] + 10% SPR[3]

Note 1: Applicable to the southern part of the country only (Dublin – Galway and south of this)

Note 2: Reduction in the time to peak (Tp) to allow for potential accelerated runoff that may arise as a result of drainage from afforested land

Note 3: Add 10% to the Standard Percentage Runoff (SPR) rate: This allows for temporary increased runoff rates that may arise following felling of forests

Sequential Approach

A sequential approach to planning is a key tool in ensuring that developments, particularly new developments, are first and foremost directed towards land that is at low risk of flooding. The sequential approach described in Figure 2-3 and Figure 2-4 should be applied to all stages of the planning and development management process.

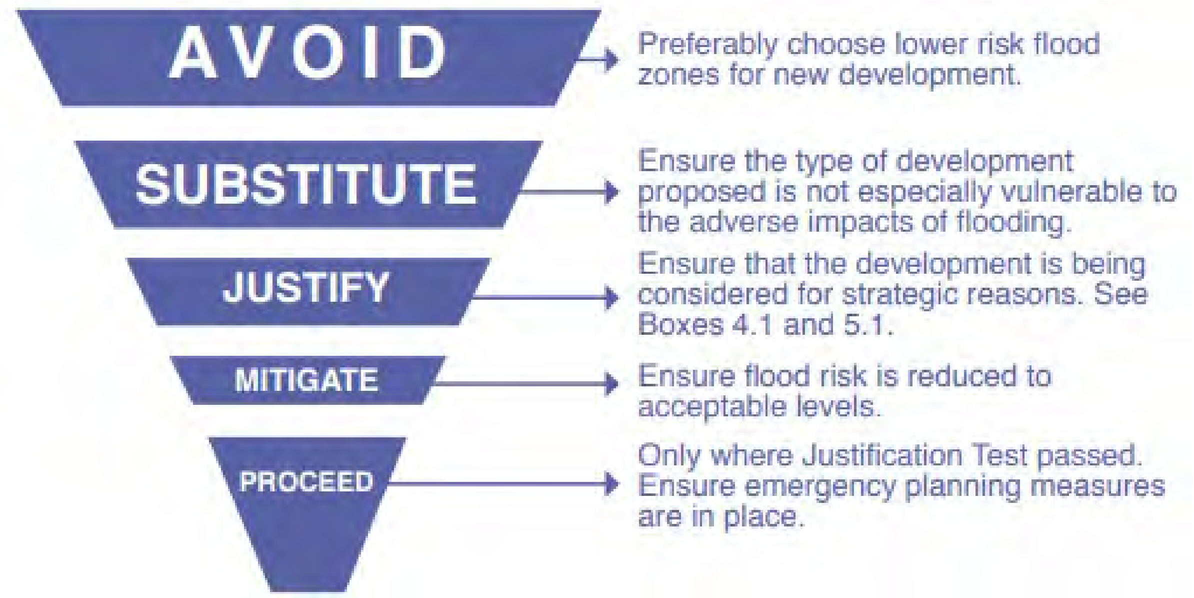


Figure 2-3: Sequential approach principles in flood risk management

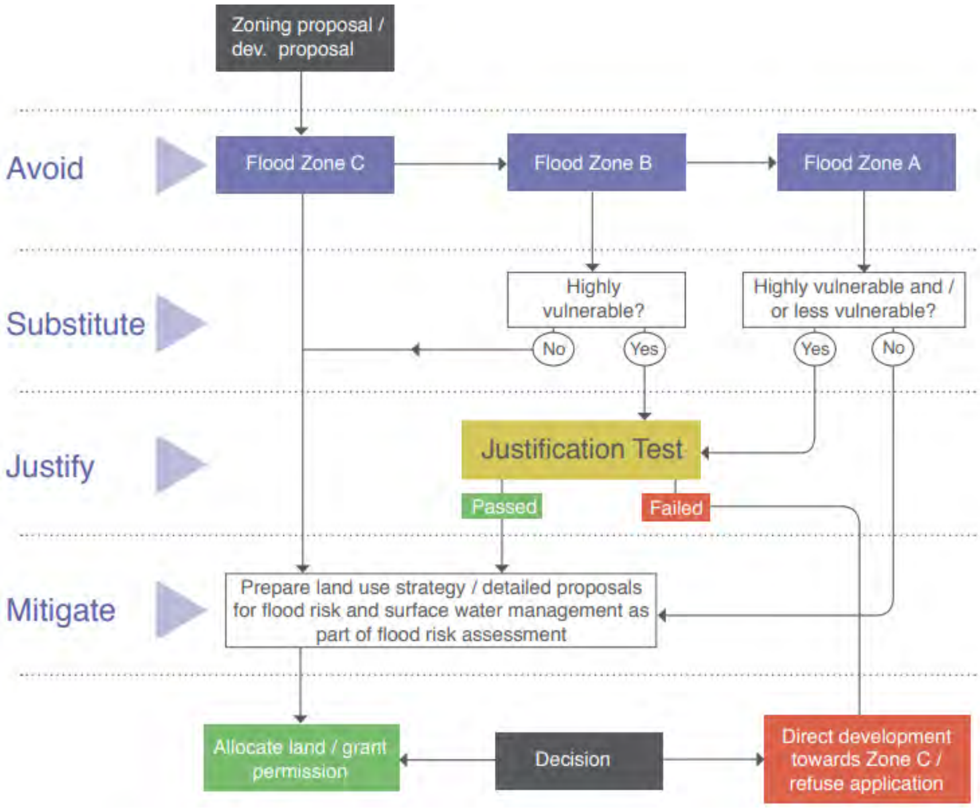


Figure 2-4: Sequential approach mechanism in the planning process

<u>Development Classification</u>

The OPW Guidelines provide three vulnerability categories based on the type of development which are:

- **Highly vulnerable**: This includes essential infrastructure, such as primary transport and utilities distribution, electricity generating power stations and sub-stations
- **Less vulnerable**: This category includes land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans;
- **Water compatible**: Includes water-based flood control and recreational developments and other amenities, open space, outdoor sports and recreation facilities.

Refer to Table 3.1 on page 25 in the OPW guidelines for a more comprehensive list of land use types and developments which can be classified as per the above categories.

Table 2-2 illustrates those types of developments that would be appropriate to each flood zone and those that would be required to meet a Justification Test in accordance with Section 5 (Box 5.1) of the OPW guidelines.

Table 2-2: Matrix of vulnerability versus flood zone

Development Types	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable (incl. essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable	Justification Test	Appropriate	Appropriate
Water-compatible	Appropriate	Appropriate	Appropriate

3 Stage 1 – Flood Risk Identification

This stage of the flood risk assessment is undertaken to review available information on a regional and localised scale to identify whether there may be any flood risk or water management issues related to the proposed development area.

3.1 Suir CFRAM

The South Eastern Catchment Flood Risk Assessment and Management (CFRAM) study commenced in August 2011 and was completed in 2016. The proposed development is located in Unit of Management (UoM) No. 16 shown in Figure 3-1. Clonmel was designated as an Area for Further Assessment (AFA). The detailed assessment was carried out by Mott MacDonald Ireland consultants in 2003, during the design of the Clonmel Flood Relief Scheme.

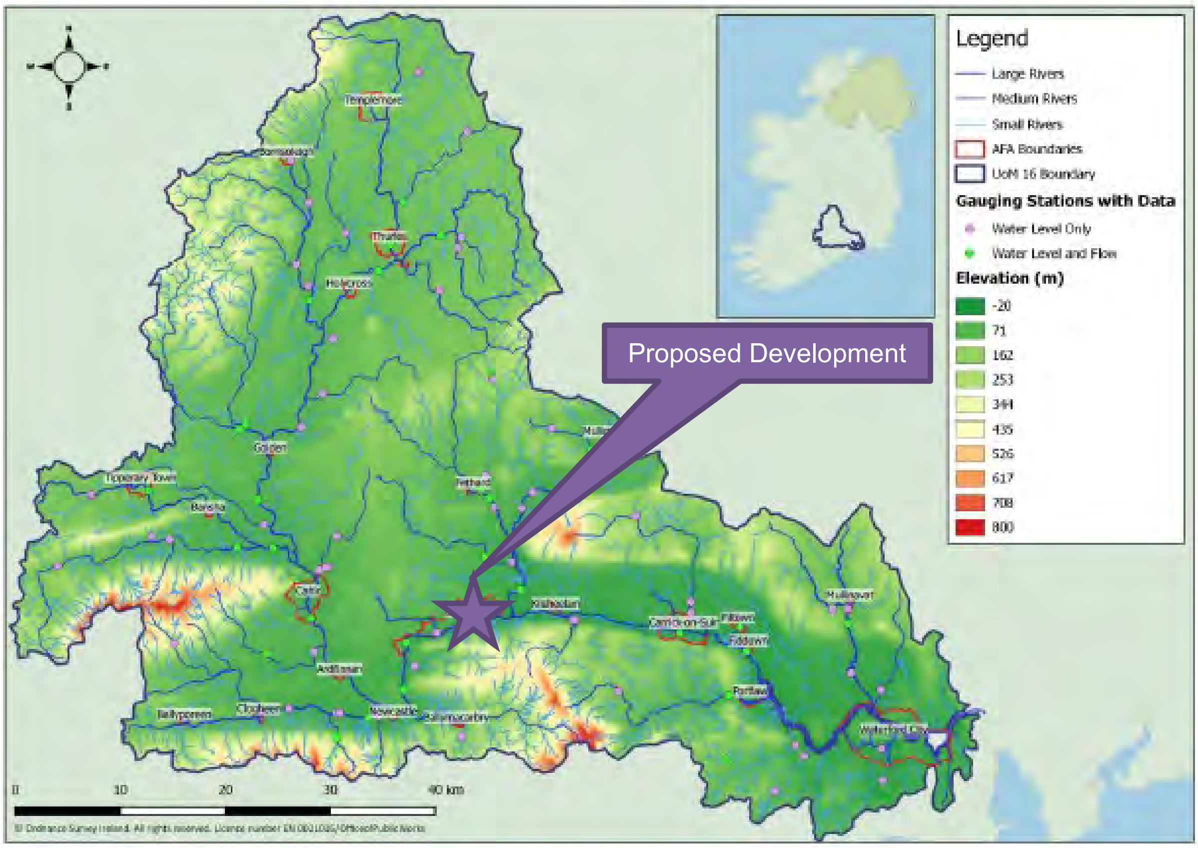


Figure 3-1: Geographical location of the Suir River Basin

Figure 3-2 shows the flood inundation extents extracted from the Suir CFRAM and Clonmel Flood Relief Scheme studies with the Suir Island Infrastructure Links proposed development works areas overlayed. Refer to Drawing No. O16CLN_EXFCD_F0_45 and 46, included in **Appendix B** for the CFRAM Fluvial Flood Extent Maps.

Clifton Scannell Emerson Associates

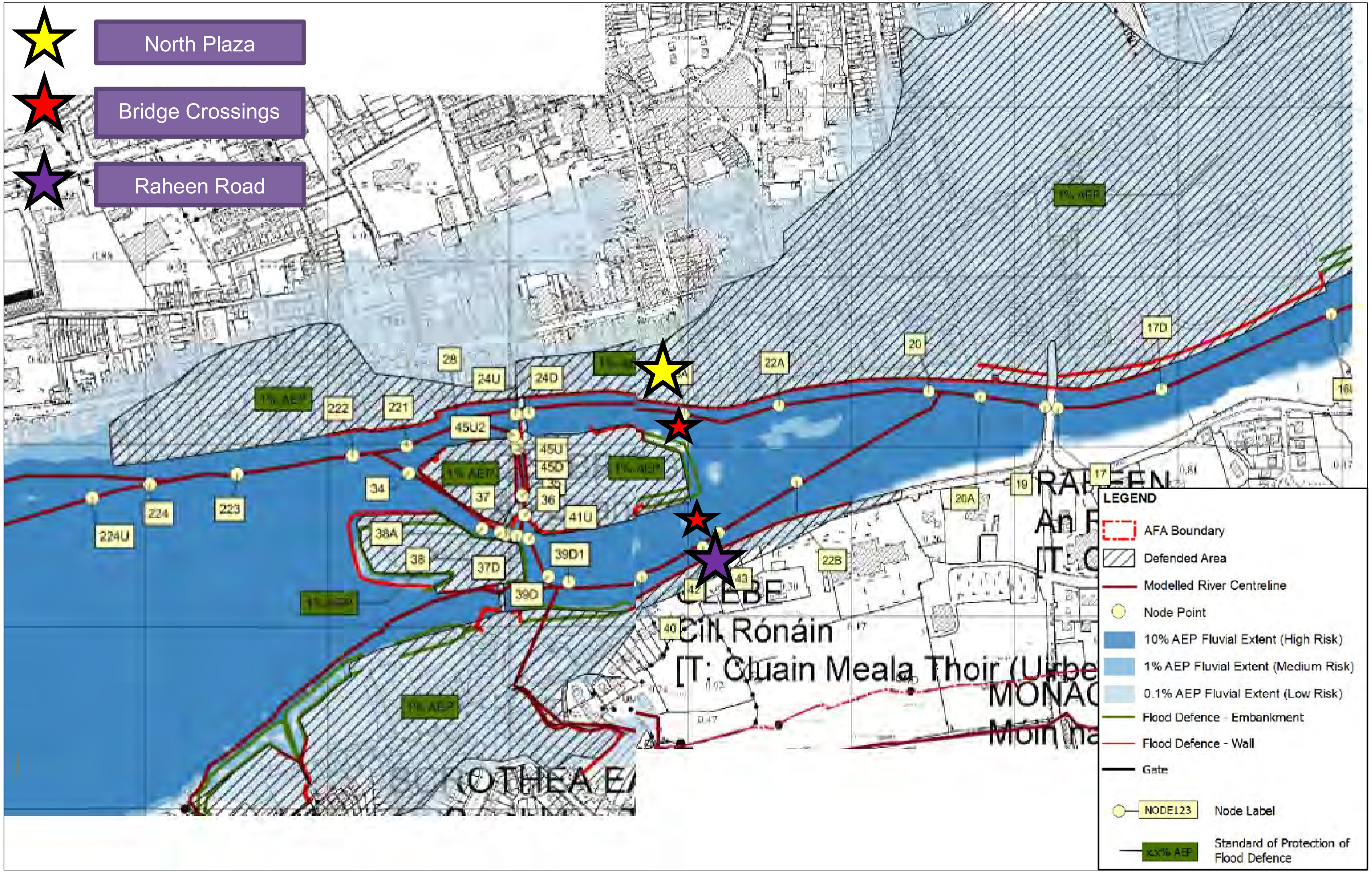


Figure 3-2: Fluvial Flood Extent Map (Suir CFRAM Study)

3.2 Clonmel Flood Relief Scheme

The flood relief scheme in Clonmel was undertaken in two phases, namely, West and North/East Clonmel. Mott MacDonald Pettit undertook the scheme design and HR Wallingford completed the hydraulic modelling.

The defences located along the Quays (Figure 3-3) are so designed to provide protection against a flood with a 1% probability of occurring in any given year and can be further raised at relatively little additional cost should it be necessary for protection against climate change (Mid-Range Future Scenario). The flood defence structures located around the proposed development in Clonmel are shown on Drawing 9986_Clonmel_Flood_Defence_Plan_03 included in **Appendix B**.

The Clonmel Flood Defence Design Report and related Hydraulic Modelling Report was not available for further review at the time of compiling this Stage 1&2 Flood Risk Assessment Report.

Figure 3-3: Flood defence structure installed next to North Plaza

3.3 Historical Flood Records

Historical flood records were obtained from the OPW Flood Maps website as shown in Figure 3-4 below (https://www.floodinfo.ie/map/floodmaps/). It should be noted that these flood events occurred prior to the completion of the Clonmel Flood Relief Scheme works, except for ID-12503, which is situated on a tributary of the Suir River and located upstream of the proposed development.

Historical flood events, as shown in Table 3-1, was extracted from the Suir River Flood Risk Management Plan, which highlights historical flooding in Clonmel with severity classifications. Floods which occurred in 2012 and 2014 are indicated as “protected” following the completion of the Clonmel Flood Relief Scheme.

Figure 3-4: Past Flood Events

Table 3-1: Historical Flood Events in Clonmel

Year	**1960**	**1968**	**1990**	**1995**	**1996**	**2000**	**2004**	**2008**	**2009**	**2012**	**2014**
Clonmel	X	X	X	X	X	X	X	X	X		

Legend	
AEP	**Flood Severity Classification**
< 5%	**Severe**
5-10%	**Significant**
> 10%	**Minor**
Protected	**Scheme in place**

3.4 Climate Change Scenarios

The Suir CFRAM Mid-Range Future and High-End Future Scenario mapping is not available for Clonmel on the OPW Flood Maps website (https://www.floodinfo.ie/map/floodmaps/), as the hydraulic modelling was conducted during the design phase of the Clonmel Flood Relief Scheme as stated in **Section 3.1**.

4 Stage 2 – Initial Flood Risk Assessment

This stage of the flood risk assessment is undertaken to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to scope the extent of the risk.

4.1 Tidal Flood Risk

As shown in Figure 4-1 and highlighted in the Suir CFRAM Hydrology Report, the Suir River is tidally influenced past Carrick-On-Suir. The location of the tidal influence is located circa. 17km downstream of the proposed development with an elevation difference of approximately 14m. Based on the above the Suir Island Infrastructure Links proposed development is deemed not to be at risk from tidal sources.

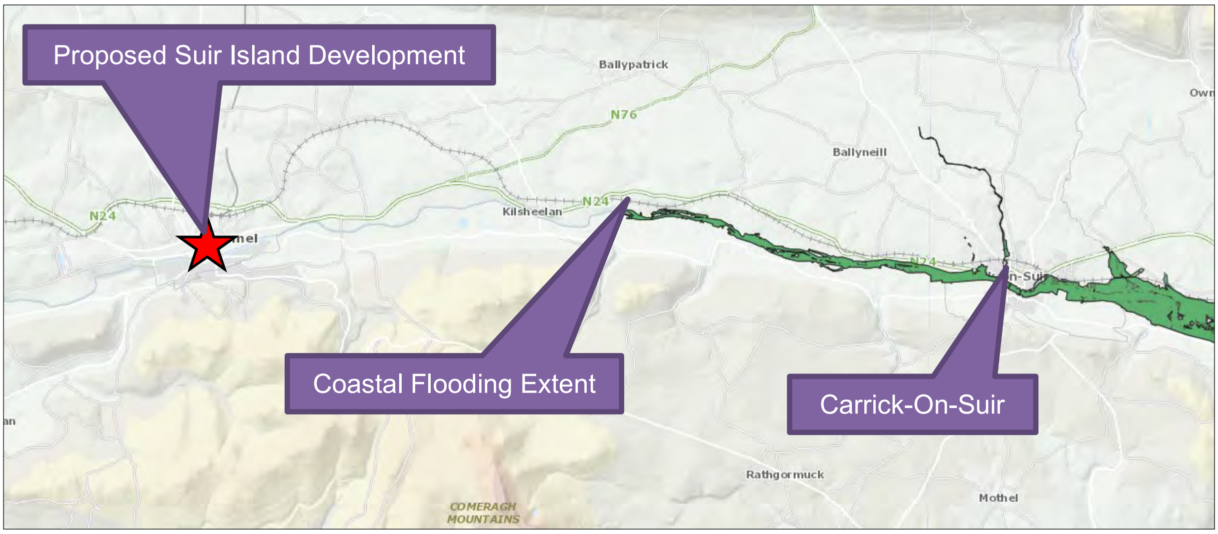


Figure 4-1: Suir CFRAM Coastal Flood Extents (www.floodinfo.ie/map/floodmaps)

4.2 Fluvial Flood Risk

As discussed in **Section 3**, the Suir Island Infrastructure Links proposed development is at risk of fluvial flooding. The Office of Public Works (OPW) guidelines publication, "The Planning System and Flood Risk Management, Guidelines for Planning Authorities" published in November 2009 states that flood protection structures should be ignored when determining the correct flood zone for a proposed development. Thus, the development is considered to be in Flood Zone A, even though the development is defended by structures providing protection for events up to the 1-in-100-year plus 20% climate change events. Refer to **Section 5** for further details.

4.3 Pluvial Flood Risk

The proposed development is not at risk from Pluvial Flooding from existing or proposed surface water drainage systems. The existing surface water drainage systems, located in the North Plaza, Suir Island car park and Raheen road will be upgraded as part of the proposed works to comply with the latest Sustainable Drainage Systems (SuDS) guidelines. Refer to the Engineering Planning Report (RPT-20_071-059) for details regarding the surface water drainage system.

4.4 Groundwater Flood Risk

The OPW Flood Maps website (https://www.floodinfo.ie/map/floodmaps/) and Geological Survey Ireland Spatial Resources website (Geological Survey Ireland (Groundwater Flooding Data Viewer)) was used to assess the risk of groundwater flooding for the proposed development. Based on the above sources, the proposed development was found not to be at risk to groundwater flooding.

4.5 Increasing Flood Risk Downstream

The proposed development poses an imperceptible risk of increasing flood risk either upstream or downstream in the River Suir. The northern bridge crossing will require one support pier, located in the Suir River northern reach and the southern bridge crossing will require two support piers on either side of the southern river reach as indicated in Figures 4-2 and 4-3. The bridge decks are so designed to have sufficient freeboard between the deck soffit levels and/or flood water levels/existing flood defence structures.

In support of the Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010 to construct bridges across the Suir River and existing flood defences, the OPW requested that Hydraulic Modelling be conducted to determine the effect of constructing the bridge piers in Flood Zone A.

The outcomes of the hydraulic modelling conducted to determine if the construction of the bridge support piers in the floodplain would increase flood risk upstream or downstream of the proposed development, found that:

- For the 1% AEP event; flood water levels upstream can potentially be increased by 5mm and 3mm downstream of the northern bridge crossing;
- For the 1% AEP event; flood water levels upstream can potentially be increased by 35mm and 8mm downstream of the southern bridge crossing;

For more information refer to the Suir Island Infrastructure Links Hydraulic Modelling Report No. RPT-20_071-055.

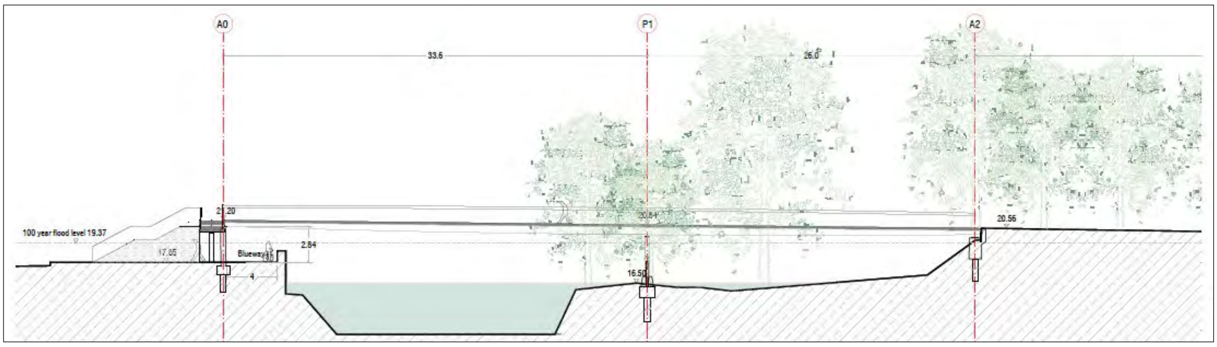


Figure 4-2: Northern Bridge crossing

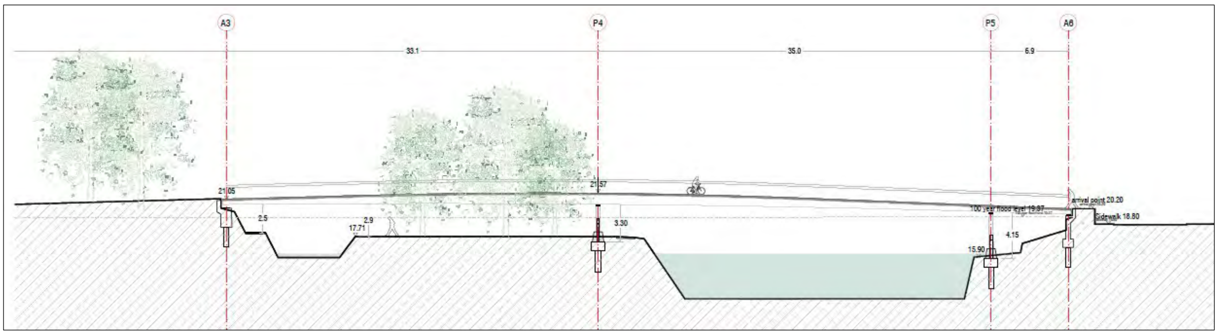


Figure 4-3: Southern Bridge crossing

5 Conclusion

This section of the Flood Risk Assessment summarises the outcomes of the Stage 1 & 2 assessments carried out for the Suir Island Infrastructure Links proposed development as set out in the OPW guidelines.

5.1 *Sequential Approach*

The purpose of the sequential approach to assessing flood risks for planning applications, is to ensure that developments, particularly new developments, are first and foremost directed towards land that is at low risk of flooding. As the purpose of the development is to promote pedestrian access to Suir Island and the surrounding area, the avoidance of areas which are at risk of flooding is unavoidable. Table 5-1 evaluates the different elements of the development in terms of the Flood Zones and Vulnerability as set out in the guidelines sequential approach. As highlighted in **Section 4.2**, the evaluation of flood zones ignores the presence of flood protection structures.

Table 5-1: Proposed development flood zone and vulnerability classification

Development Elements	Flood Zone	Vulnerability Category
North Plaza		
Amenities open space and plaza	**Zone A**	Water compatible
Redevelopment of Quay Steet surfacing/drainage	**Zone A**	Less vulnerable
Access ramps, stairs and walkways, cycle lanes	**Zone A**	Less vulnerable
North Bridge Crossing		
Abutments	**Zone A**	Less vulnerable
Piers (Total 1 No.)	**Zone A**	Less vulnerable
Bridge Deck	**Zone A**	Less vulnerable
Suir Island		
Walkways, access ramps	**Zone A**	Less vulnerable
Amenities open space	**Zone A**	Water compatible
South Bridge Crossing		
Abutments	**Zone A**	Less vulnerable
Piers (Total 2 No.)	**Zone A**	Less vulnerable
Bridge Deck	**Zone A**	Less vulnerable
Raheen Road (south arrival point)		
Access ramps, stairs and walkways, cycle lanes	**Zone A**	Less vulnerable
Resurfacing of Raheen road and surface water drainage	**Zone A**	Less vulnerable

As summarised in the table above, the proposed development elements are proposed to be located in Flood Zone A, even though extensive flood protection infrastructure is available along this section of the River Suir. The development elements can be considered as “Less Vulnerable” to “Water Compatible” as highlighted in Table 3.1 of the OPW guideline document. The next step in the sequential approach is to determine if a detailed Justification Test is required. Refer to **Section 5.2** below.

5.2 *Justification Test*

As per Section 3 of the OPW guidelines, to determine if a detailed Justification Test is required, the development must be classified in terms of its vulnerability to flooding and corresponding Flood Zone, as shown in Table 5-1 above.

The Suir Island Infrastructure Links proposed development is considered to be in Flood Zone A with the development elements consisting of local transport infrastructure, pedestrian infrastructure, amenities open space and recreational facilities, which is categorised as “Less Vulnerable” to “Water Compatible” infrastructure according to the guidelines. Table 5-2 below specifies that for a development located in Flood Zone A and consisting of “Less Vulnerable” elements, a detailed Justification is required to motivate the appropriateness of the development being considered for an area of high flood risk.

Table 5-2: Matrix of vulnerability versus flood zone to illustrate appropriate development

Vulnerability Category	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

The OPW guideline sets out that the following criteria must be satisfied whilst applying the Justification Test (Table 5-3) when considering proposal for developments, which may be vulnerable to flooding:

- The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.
- The proposal has been subject to an appropriate flood risk assessment that demonstrates:
    i. The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
    ii. The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
    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
    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.

Table 5-3: Justification Test Criteria-Assessment

Criteria Ref	OPW Criteria	CSEA Assessment
1	The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.	The scheme aligns with the core strategy/objectives as set out in the Tipperary County Development Plan (2022 – 2028). The proposed development forms part of the local strategy to transform Suir Island into the “Green Heart of Clonmel” as highlighted in the Clonmel & Environ Development Plan 2013 – 2019. Hence, the subject lands of the scheme meet the operative developments plans of Tipperary County Council.

2	The proposal has been subject to an appropriate flood risk assessment that demonstrates:	
2(i)	The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk	• The development will not significantly increase flood risk upstream or downstream of the proposed development as detailed in the Stage 3 Detailed Flood Risk Assessment Report "Suir Island Hydraulic Modelling Report (RPT-20_071-055)" contained in Appendix C of the OPW Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010, Report No. RPT-20_071-019. • The scheme is so designed not to adversely impact on the operation of the Clonmel Flood Defence Scheme infrastructure or significantly increase the flood levels as determined in the OPW Suir CFRAM. • The proposed development is so designed to be located in the defended areas indicated on the Suir CFRAM Study Clonmel Scheme Fluvial Flood Extent Map Drawing O16CLN_EXDCD_F0_45 and 46 included in **Appendix B**. • Refer to criteria 2(ii) below for mitigation measures included in the design to counteract increasing flood risk upstream or downstream of the development.
2(ii)	The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible.	• The proposed development includes measures to minimise flood risk as summarised below: - The proposed North Plaza is located behind the flood defence wall and demountable barrier system providing protection for the 1-in-100-year recurrence interval plus 20% climate change scenario flood event. - The proposed North Bridge abutments are located behind the defence wall mentioned above and on top of the existing flood protection berm located on Suir Island. Only a single narrow support pier will be constructed on Suir Island in the floodplain. The pier width varies from 410mm to 300mm in diameter and the pile cap will not protrude into the floodplain, thus minimising the impact on existing flood water levels. - The proposed upgrading works on Suir Island is contained to the top of the existing flood defence berm or in the defended Suir Island car park. - The existing berm will be upgraded and raised as part of the works, thus decreasing flood risk for Suir Island. - The South Bridge abutments are so designed to integrate into the existing flood defence berm on Suir Island and the existing flood defence wall located along Raheen Road. - The South Bridge consisting of a 75m span will be supported by two narrow support piers constructed in the floodplain on either side of the Slalom Course. - Both the North and South Bridge deck levels are so designed to allow a minimum available freeboard of 300mm between the bridge soffit levels and the 1% Annual Exceedance Probability Flood and can accommodate the 0.1% AEP event without significantly increasing flood risk upstream or downstream of the proposed development.

		- The bridge supporting structures are so designed to be located in the floodplains and no works will be required in the main River Suir and Slalom Course channels, thus not significantly impacting on the river morphology and hydraulic characteristics. - The proposed development includes the provision of upgrading the existing surface water drainage systems on The Quays, Suir Island Car Park and Raheen Road.
2(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	• The development is so designed as to not impact on the operation of the Clonmel Flood Defence Scheme infrastructure (as highlighted in criteria 2(ii) above) and thus the development does not increase residual flood risk. • Provisions for public awareness and early flood warning are provided by TCC to the best practices.
2(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.	As assessed in criteria (1) above, the scheme is compatible with wider plans.

5.3 S-P-R Model

A Source-Pathway-Receptor model has been produced to assess the possible sources of floodwater and their likelihood of impact of the pathways by which flood water reaches receptors and also the risk to the receptors that could be affected by potential flooding, as summarised in Table 5-4.

Table 5-4: Proposed Development S-P-R Model

Flood Type	Source	Path	Receptor	Likelihood	Impact	Risk
Tidal	Suir Estuary	Suir River	People and infrastructure (the proposed development)	Improbable	Moderate	Very Low
Fluvial	Suir River	Suir River	People and infrastructure (the proposed development)	High	High	High
Pluvial	North Plaza Suir Island Raheen Rd	Existing Surface Water Infrastructure	People and infrastructure (the proposed development)	Improbable	Low	Very Low
Groundwater	Rising groundwater levels around site	Open space	People and infrastructure (the proposed development)	Improbable	Low	Very Low

Other sources	Flooding due to human or mechanical errors	Open space	People and infrastructure (the proposed development)	Unlikely	Low	Very Low

5.4 Conclusion

The site-specific Flood Risk Assessment for the proposed Suir Island Infrastructure Links development was carried out in accordance with the Office of Public Works (OPW) guidelines publication, “The Planning System and Flood Risk Management, Guidelines for Planning Authorities”, published in November 2009.

The outcomes of the assessment found the proposed development to be most at risk from Fluvial Flooding occurring in the Suir River. The development is considered to be located in Flood Zone A with the project elements/structures classified as Less Vulnerable to Water-Compatible.

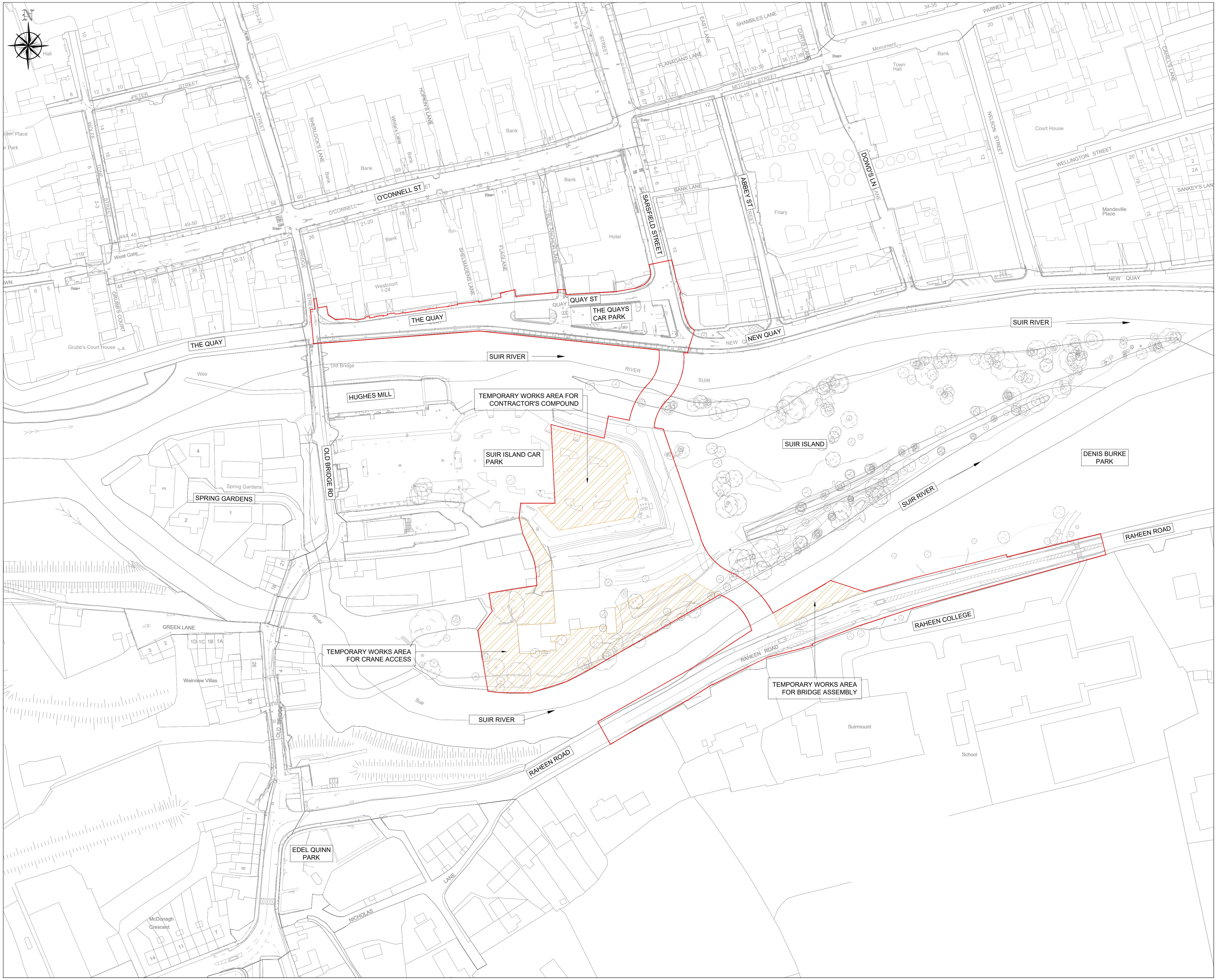
The majority of the development is located within the “Defended Area” as indicated on the Suir CFRAM Study Clonmel Scheme, Fluvial Flood Extent Map Drawing O16CLN_EXDCD_F0_45 and 46 included in **Appendix B**. Only three (3) support piers will be constructed in the floodplain of the River Suir and southern Slalom Course. As per the guideline document, flood defences were ignored when categorising the correct Flood Zone for the proposed development. As stated in **Section 3.2**, the Clonmel Flood Relief Scheme defence structures provide protection against floods with a 1% annual exceedance probability (i.e Flood Zone A) and can be further raised to provide protection against a 20% climate change scenario.

As per **Section 5.2** of this report and the OPW guideline document, further justification is required for developments categorised as “Less Vulnerable” or “Water Compatible” and located in Flood Zone A. Refer to Table 5-3 summarising the outcomes of the Justification Test Criteria-Assessment. Following the outcomes of the assessment and compliance with the Justification Test Criteria, the development is considered appropriate for this flood risk area.

Due to the complex nature of the development and the hydraulic characteristics of the River Suir, hydraulic modelling was undertaken to accurately assess the impact on flood water levels upstream and downstream of the proposed bridge crossings. As noted in **Section 4.5** of this report, the hydraulic modelling outcomes are summarised in the Suir Island Infrastructure Links Hydraulic Modelling Report No. RPT-20_071-055. The outcomes of this detailed flood risk assessment and hydraulic modelling found that there will be an imperceptible increase in flood water levels upstream and downstream of the proposed development for both the northern and southern river reaches.

In conclusion, the proposed development is considered appropriate for the identified flood risk area and poses an imperceptible risk of increasing flood risk either downstream or upstream of the development. An Office of Public Works Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010 has been submitted to the OPW where the detailed analysis and flood water levels relative to the proposed structures are highlighted.

Appendix A – Proposed Development Drawings



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A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

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ARCHEOLOGISTS: CourtneyDeery

BRIDGES: MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS: Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS: awnconsulting

LIGHTING CONSULTANTS: Douglas Carroll Consulting Engineers

LEGEND:

SITE BOUNDARY

TEMPORARY WORKS AREAS

Rev	Description	Drawn	Checked	Date

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: SITE LOCATION MAP

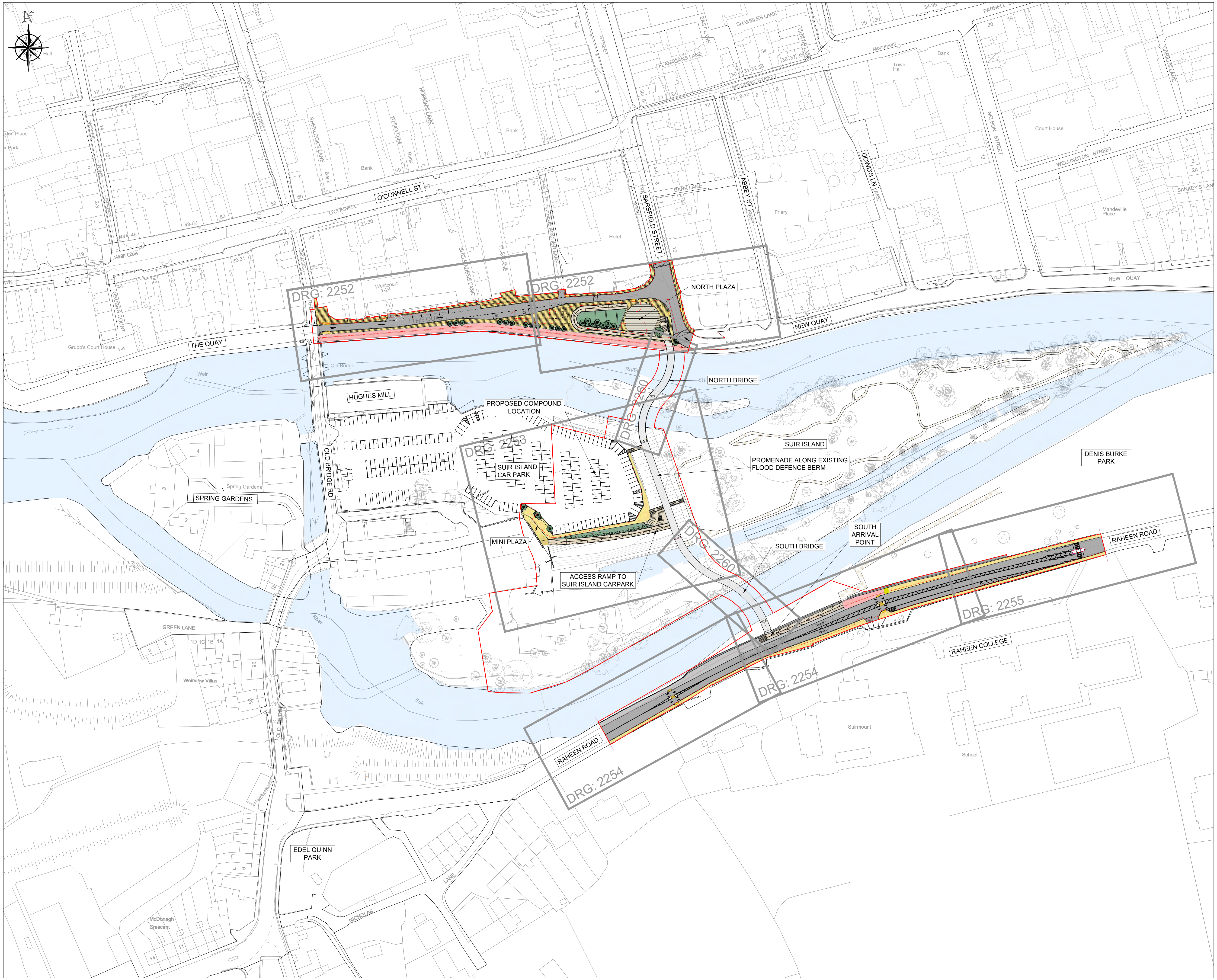
Drawn By: FO
Date: SEPT 2023
Checked By: LP
Scale: 1:1000@ A1
CSEA Job No.: 20_071

Project Code - Originator - Zone/Phase - Level - Type - Role - Dwg. No.

20_071 - CSE - GEN - XX - DR - C - 2001

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 — Project Status: ISSUED FOR PLANNING



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A1

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Consulting Engineers

LEGEND :

- SITE BOUNDARY
- PEDESTRIAN BRIDGES - STEEL STRUCTURE - BUSH - HAMMERED CONCRETE FINISH LAID ON A WATERPROOF SURFACE
- VARIOUS SIZES OF STONE PAVING TO FOOTPATH (LIGHT GREY GRANITE AND / OR SANDSTONE)
- STONE AGGREGATE PAVING TO FOOTPATH (SILVER / SANDSTONE)
- ASPHALT FINISH TO ROAD & SHARED SURFACE
- STONE AGGREGATE FINISH TO THE SHARED SURFACE FOR PEDESTRIANS AND BICYCLES (BEIGE/WHITE/LIGHT GREY)
- EXPOSED STONE AGGREGATE FINISH TO STEPS AND RAMP (BEIGE/WHITE/LIGHT GREY)
- GRASSED AND PLANTED AREAS
- TACTILE SURFACE TO PEDESTRIAN CROSSINGS
- STONE KERBS TO FOOTPATH
- STONE KERBS TO PLANTER BED
- EXISTING PATH LINE
- SELECTED BOLLARD
- PROPOSED PLANTING (SHRUBS / WILDFLOWER)
- PROPOSED TREE: **BIG TREE**-SALIX ALBA / SWEETGUM / RED MAPLE **MEDIUM TREE**-RIVER BIRCH / ALNUS GLUTINOSA / BETULA PUBESCENS CARPINUS BETULUS **SMALL TREE**-CRATAEGUS
- EXISTING TREE

Rev	Description	Drawn	Checked	Date

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 OVERALL PLAN

Drawn By	Date	CSEA Job No.
FO	SEPT 2023	20_071

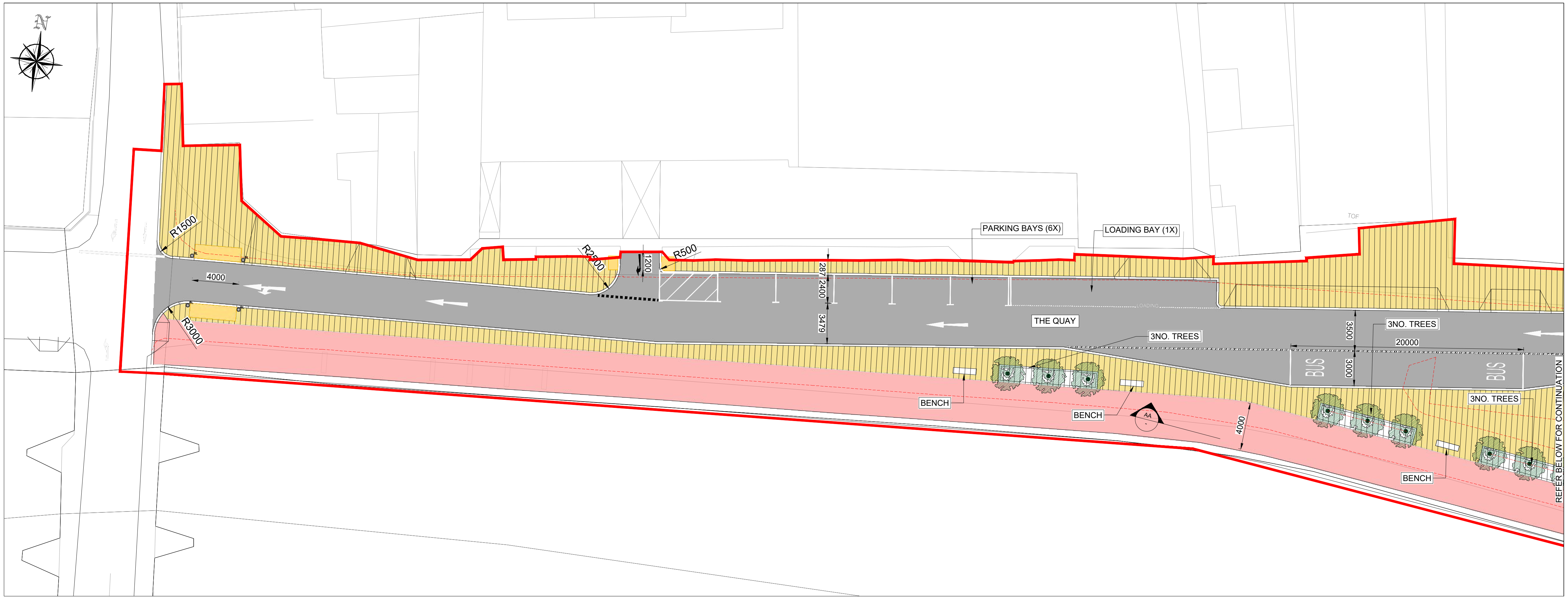
Checked By	Scale
LP	1:1000@ A1

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2251

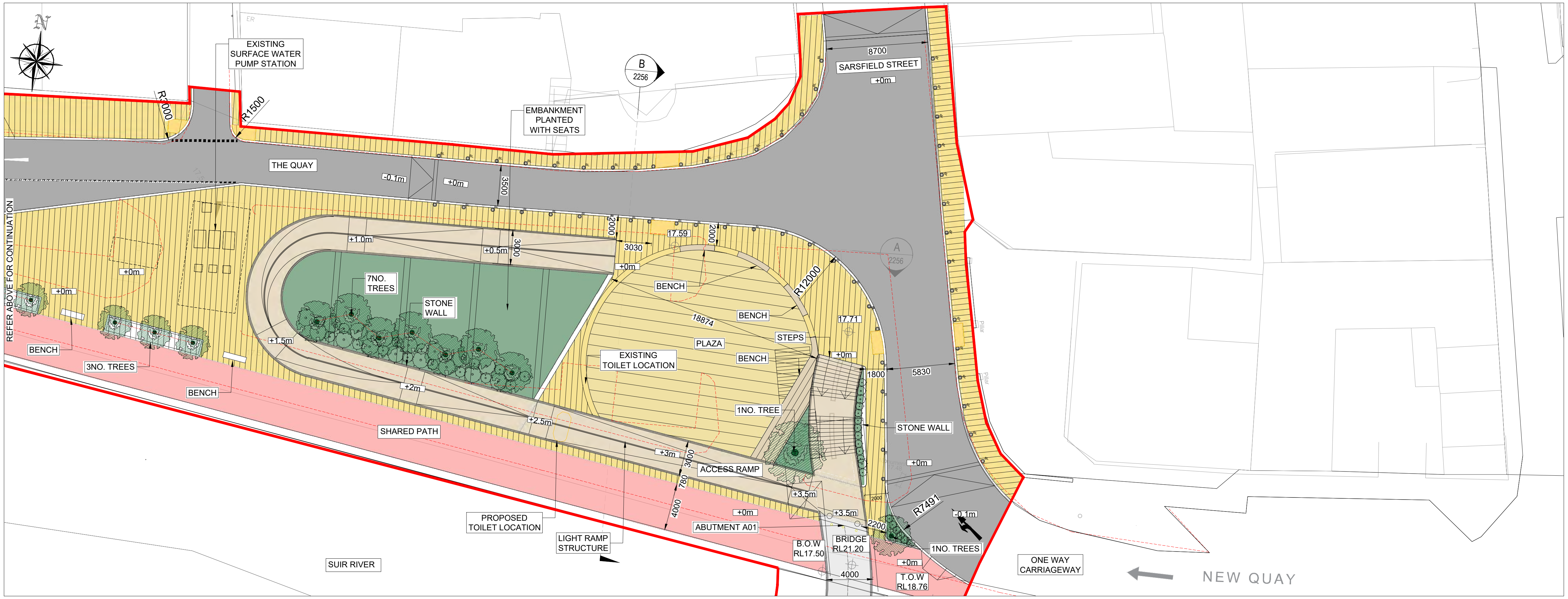
20_071 - CSE - GEN - XX - DR - C - 2251

Status Code: S2
Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01
Project Status: ISSUED FOR PLANNING



PLAN 1
SCALE 1:200



PLAN 2
SCALE 1:200

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LEGEND :

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 NORTH PLAZA PLAN SHEET 01 OF 04

Drawn By	FO	Date	SEPT 2023	20_071
Checked By	LP	Scale	1:200@ A1	CSEA Job No.

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	00	XX	DR	C	2252

20_071 - CSE - 00 - XX - DR - C - 2252

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 — Project Status: ISSUED FOR PLANNING

PLAN 3
SCALE 1:200

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LEGEND :

- SITE BOUNDARY
- PEDESTRIAN BRIDGES - STEEL STRUCTURE - BUSH - HAMMERED CONCRETE FINISH LAID ON A WATERPROOF SURFACE
- VARIOUS SIZES OF STONE PAVING TO FOOTPATH (LIGHT GREY GRANITE AND / OR SANDSTONE)
- STONE AGGREGATE PAVING TO FOOTPATH (SILVER / SANDSTONE)
- ASPHALT FINISH TO ROAD & SHARED SURFACE
- STONE AGGREGATE FINISH TO THE SHARED SURFACE FOR PEDESTRIANS AND BICYCLES (BEIGE/WHITE/LIGHT GREY)
- EXPOSED STONE AGGREGATE FINISH TO STEPS AND RAMP (BEIGE/WHITE/LIGHT GREY)
- GRASSED AND PLANTED AREAS
- TACTILE SURFACE TO PEDESTRIAN CROSSINGS
- STONE KERBS TO FOOTPATH
- STONE KERBS TO PLANTER BED
- EXISTING PATH LINE
- BL SELECTED BOLLARD
- PROPOSED PLANTING (SHRUBS / WILDFLOWER)
- PROPOSED TREE:
  BIG TREE-SALIX ALBA / SWEETGUM / RED MAPLE
  MEDIUM TREE-RIVER BIRCH / ALNUS GLUTINOSA / BETULA PUBESCENS CARPINUS BETULUS **SMALL TREE**-CRATAEGUS
- EXISTING TREE

Rev	Description	Drawn	Checked	Date
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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 CARPARK PLAN SHEET 02 OF 04

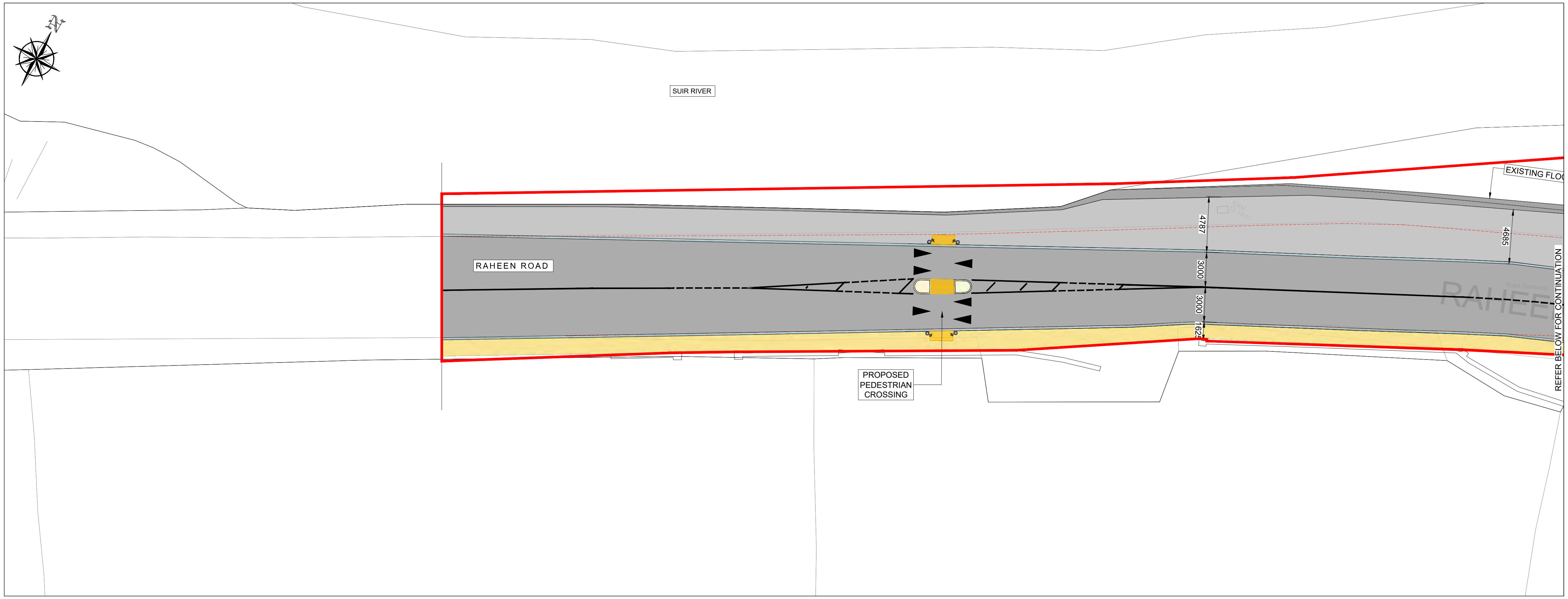
Drawn By: FO
Date: SEPT 2023
Checked By: LP
Scale: 1:200 @ A1
CSEA Job No.: 20_071

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	00	XX	DR	C	2253

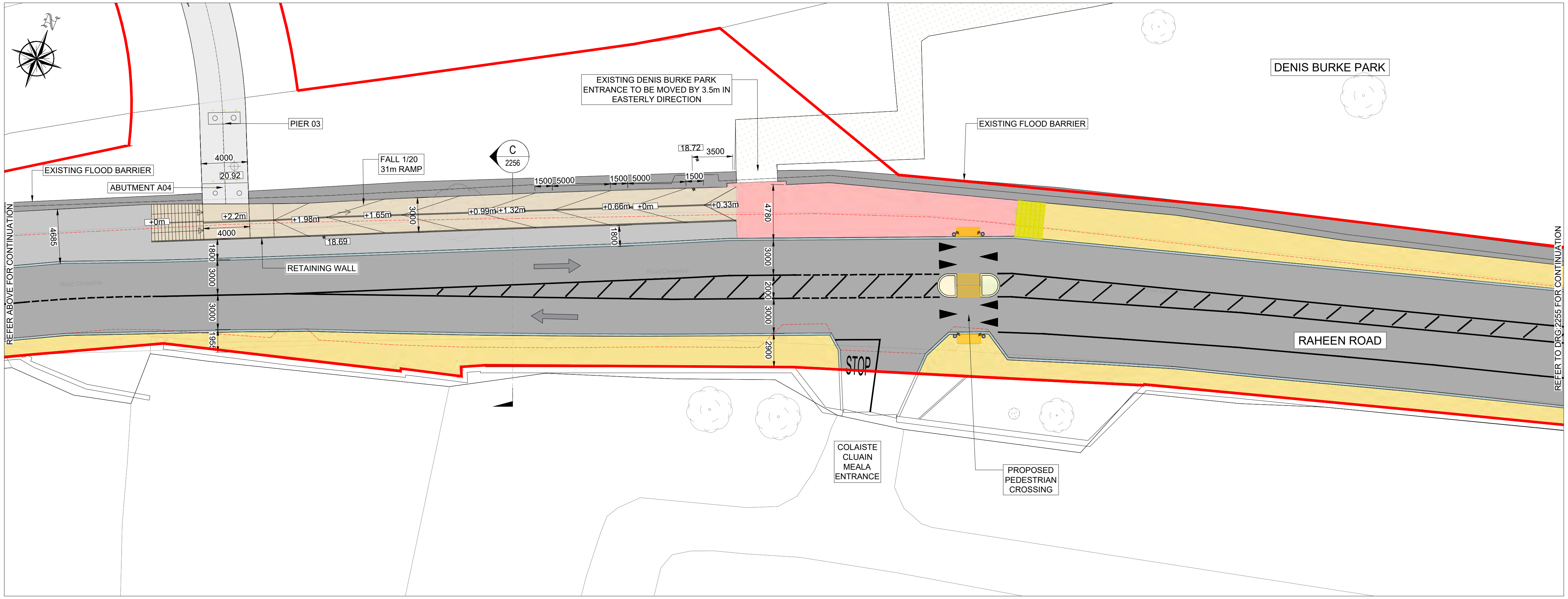
20_071 - CSE - 00 - XX - DR - C - 2253

Status Code: S2
Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01
Project Status: ISSUED FOR PLANNING



PLAN 4
SCALE 1:200



PLAN 5
SCALE 1:200

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT
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Tipperary County Council

ARCHITECTS
dhbarchitects

ARCHEOLOGISTS
CourtneyDeery

BRIDGES
MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS
Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS
awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS
Douglas Carroll
Consulting Engineers

LEGEND :
- SITE BOUNDARY
- PEDESTRIAN BRIDGES - STEEL STRUCTURE - BUSH - HAMMERED CONCRETE FINISH LAID ON A WATERPROOF SURFACE
- VARIOUS SIZES OF STONE PAVING TO FOOTPATH (LIGHT GREY GRANITE AND / OR SANDSTONE)
- STONE AGGREGATE PAVING TO FOOTPATH (SILVER / SANDSTONE)
- ASPHALT FINISH TO ROAD & SHARED SURFACE
- STONE AGGREGATE FINISH TO THE SHARED SURFACE FOR PEDESTRIANS AND BICYCLES (BEIGE/WHITE/LIGHT GREY)
- EXPOSED STONE AGGREGATE FINISH TO STEPS AND RAMP (BEIGE/WHITE/LIGHT GREY)
- GRASSED AND PLANTED AREAS
- TACTILE SURFACE TO PEDESTRIAN CROSSINGS
- STONE KERBS TO FOOTPATH
- STONE KERBS TO PLANTER BED
- EXISTING PATH LINE
- SELECTED BOLLARD
- PROPOSED PLANTING (SHRUBS / WILDFLOWER)
- PROPOSED TREE: **BIG TREE**-SALIX ALBA / SWEETGUM / RED MAPLE **MEDIUM TREE**-RIVER BIRCH / ALNUS GLUTINOSA / BETULA PUBESCENS CARPINUS BETULUS **SMALL TREE**-CRATAEGUS
- EXISTING TREE

Rev	Description	Drawn	Checked	Date
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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL
Project: SUIR ISLAND INFRASTRUCTURE LINKS
Dwg. Title: PREFERRED OPTION 01 SOUTH ARRIVAL PLAN SHEET 03 OF 04

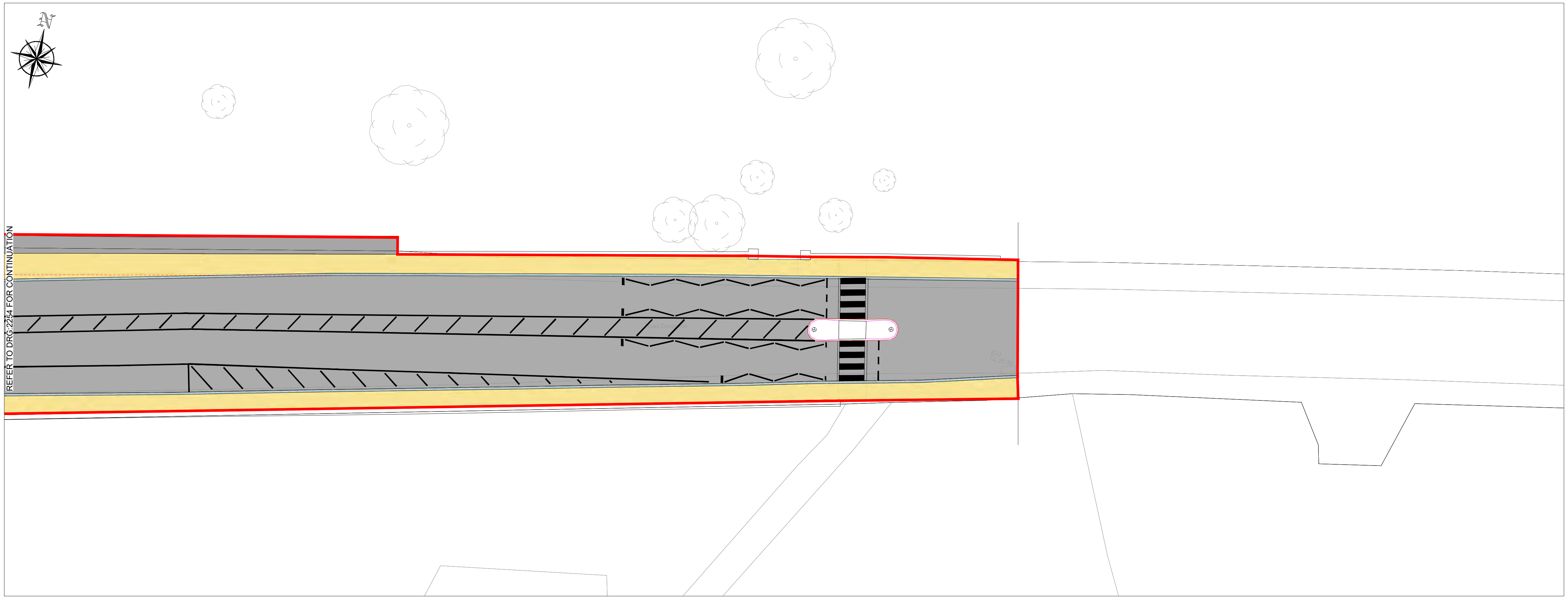
Drawn By	Date	CSEA Job No.
FO	SEPT 2023	20_071
Checked By: LP	Scale: 1:200@ A1	

Project Code	Originator	Zone/Phase	Level	Type	Role	Dwg. No.
20_071	CSE	00	XX	DR	C	2254

20_071 - CSE - 00 - XX - DR - C - 2254

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 — Project Status: ISSUED FOR PLANNING



DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

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dhbarchitects

ARCHEOLOGISTS

CourtneyDeery
ARCHAEOLOGY & CULTURAL HERITAGE

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS

awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

LEGEND :

- SITE BOUNDARY
- PEDESTRIAN BRIDGES - STEEL STRUCTURE - BUSH - HAMMERED CONCRETE FINISH LAID ON A WATERPROOF SURFACE
- VARIOUS SIZES OF STONE PAVING TO FOOTPATH (LIGHT GREY GRANITE AND / OR SANDSTONE)
- STONE AGGREGATE PAVING TO FOOTPATH (SILVER / SANDSTONE)
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- BL SELECTED BOLLARD
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- EXISTING TREE

Rev	Description	Drawn	Checked	Date
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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 SOUTH ARRIVAL PLAN SHEET 04 OF 04

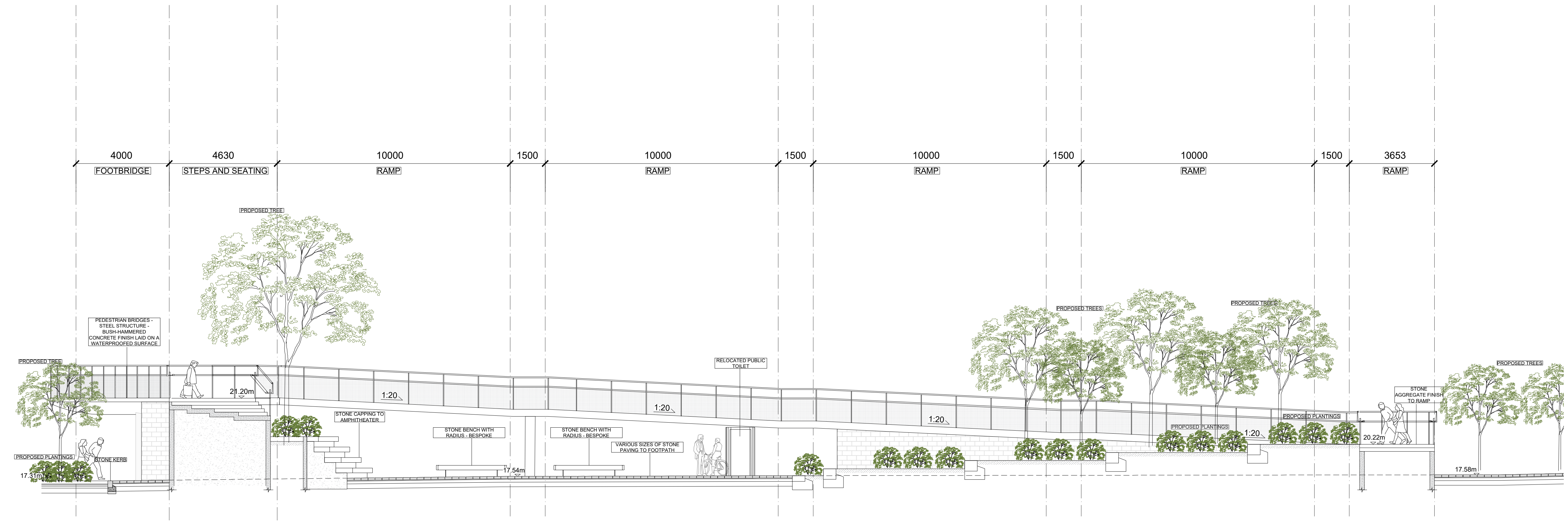
Drawn By	FO	Date	SEPT 2023	CSEA Job No.
Checked By	LP	Scale	1:200@ A1	20_071

Project Code	Originator	Zone/Phase	Level	Type	Role	Dwg. No.
20_071	CSE	00	XX	DR	C	2255

20_071 - CSE - 00 - XX - DR - C - 2255

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

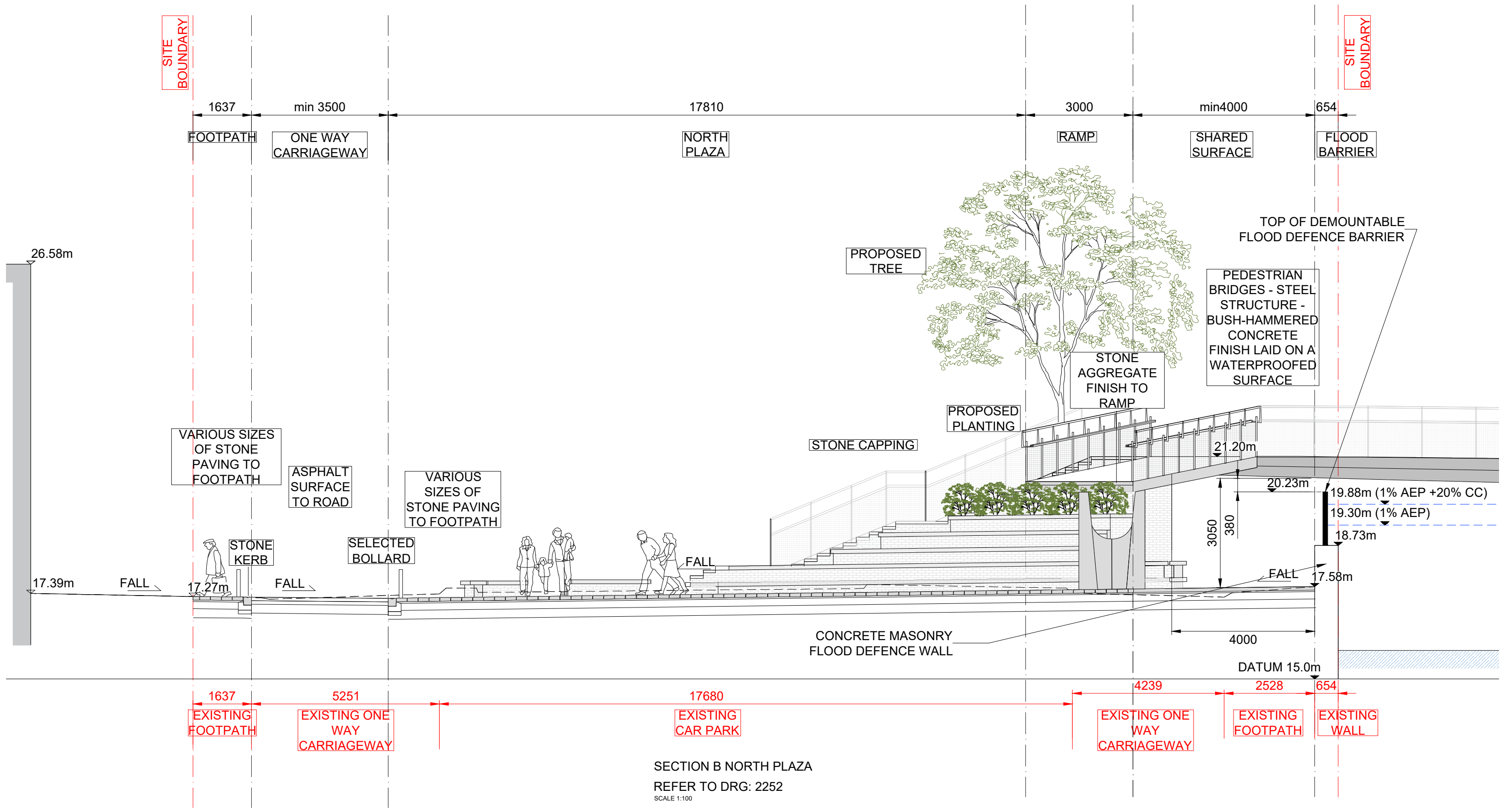
Revision: PL01 — Project Status: ISSUED FOR PLANNING



SECTION A NORTH PLAZA

REFER TO DRG: 2252

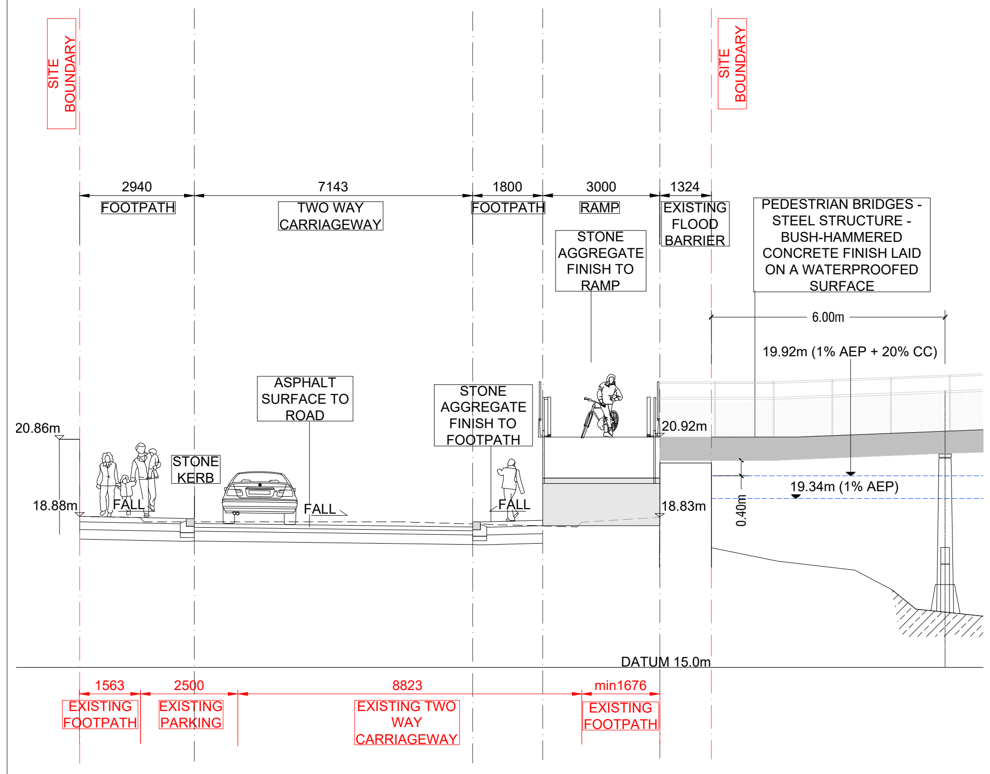
SCALE 1:100



SECTION B NORTH PLAZA

REFER TO DRG: 2252

SCALE 1:100



SECTION C RAHEEN ROAD ARRIVAL POINT

REFER TO DRG: 2255

SCALE 1:100

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

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Tipperary County Council

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ARCHEOLOGISTS

CourtneyDeery

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

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ENVIRONMENTAL CONSULTANTS

awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

Rev	Description	Drawn	Checked	Date
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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 TYPICAL SECTIONS A, B & C

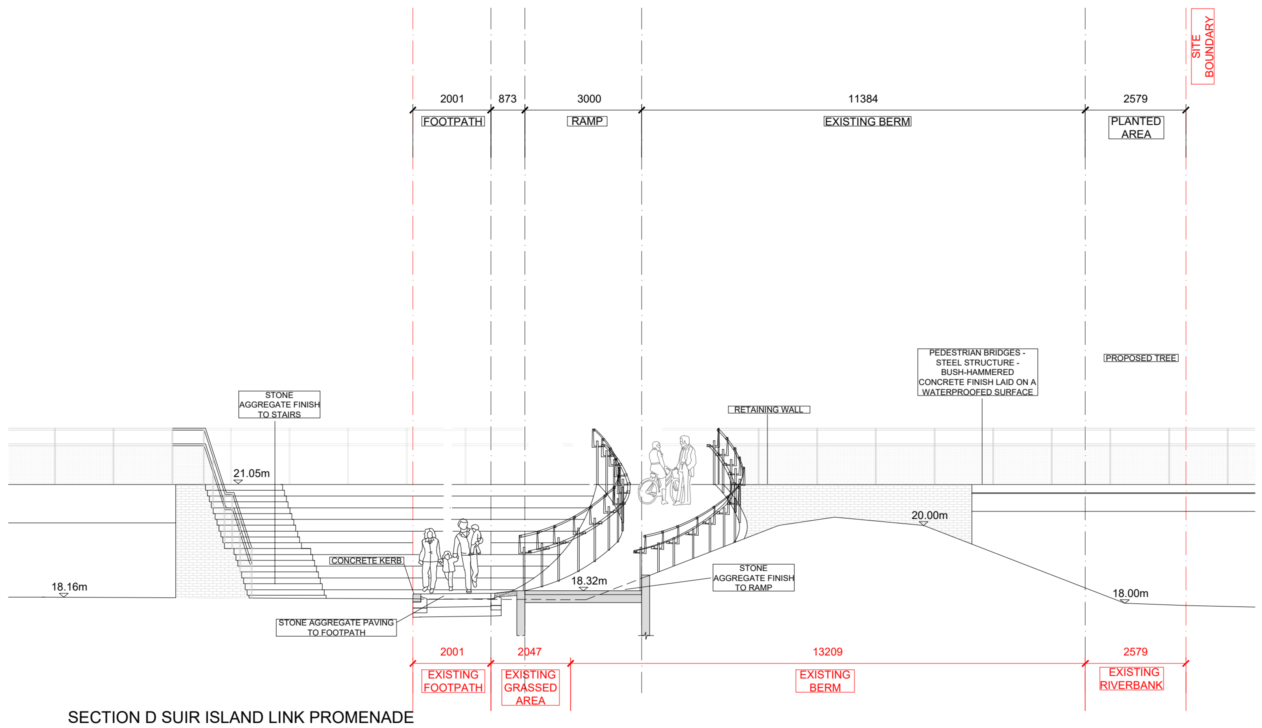
Drawn By	FO	Date	SEPT 2023	20_071
Checked By	LP	Scale	1:100@ A1	CSEA Job No.

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2256

20_071 - CSE - GEN - XX - DR - C - 2256

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

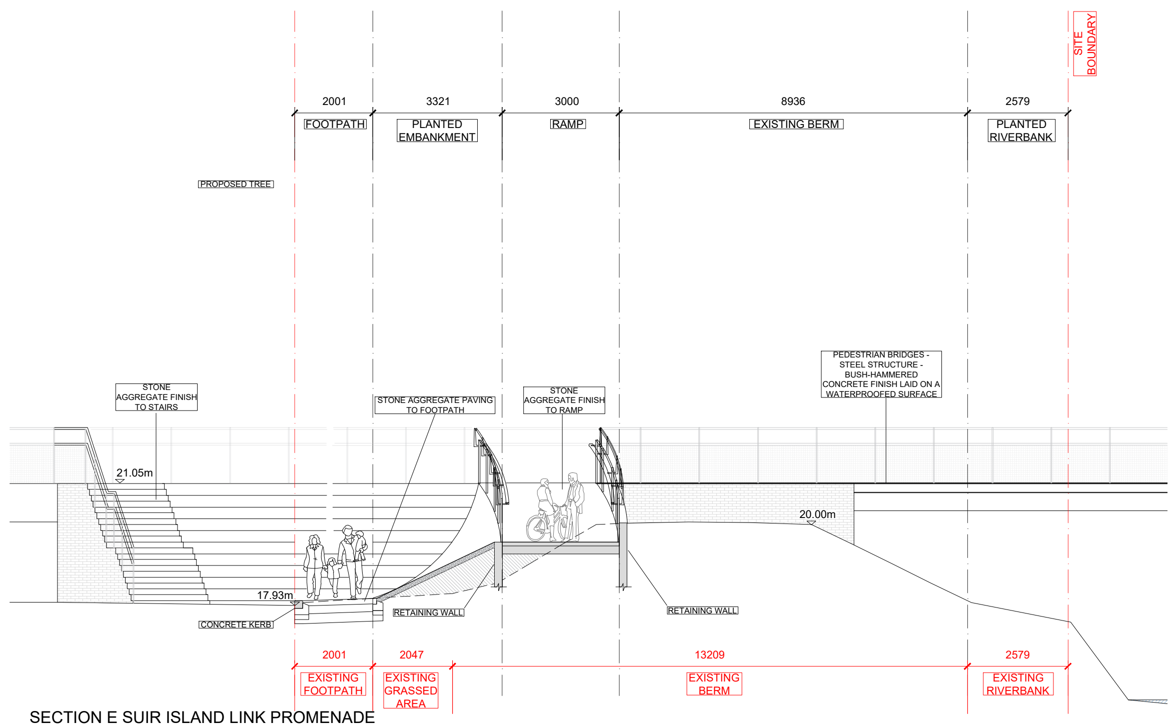
Revision: PL01 — Project Status: ISSUED FOR PLANNING



SECTION D SUIR ISLAND LINK PROMENADE

REFER TO DRG: 2254

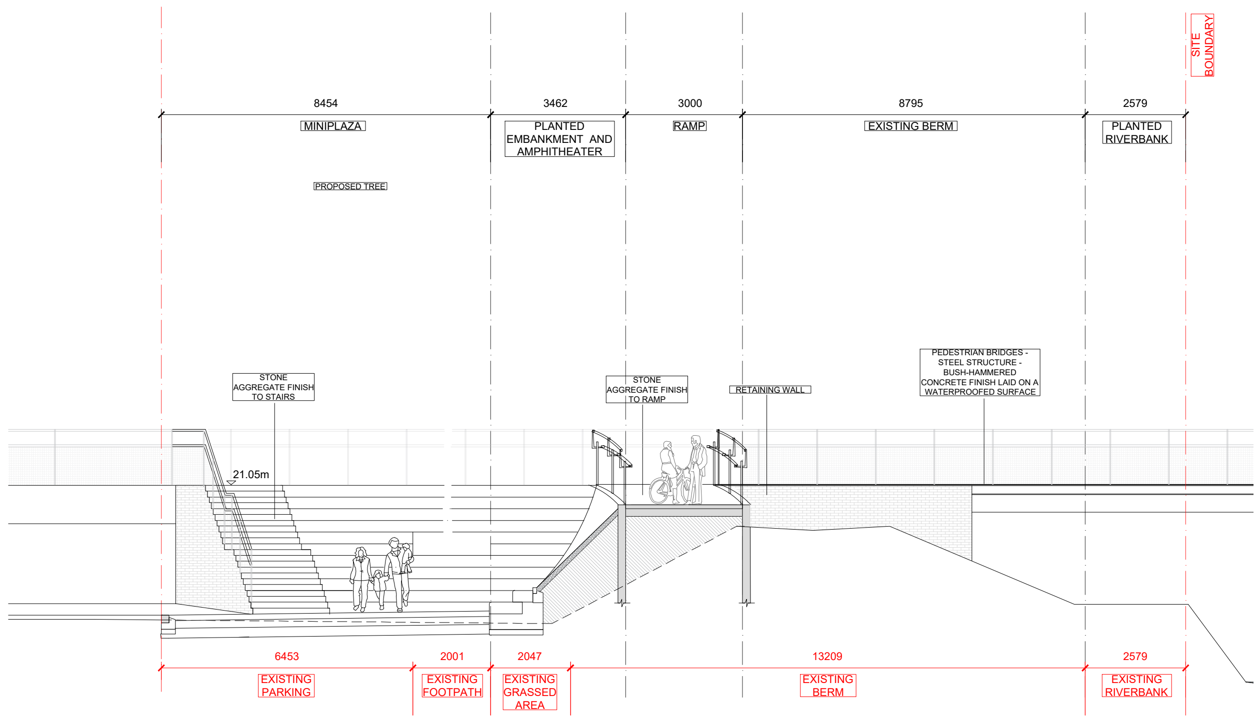
SCALE 1:100



SECTION E SUIR ISLAND LINK PROMENADE

REFER TO DRG: 2254

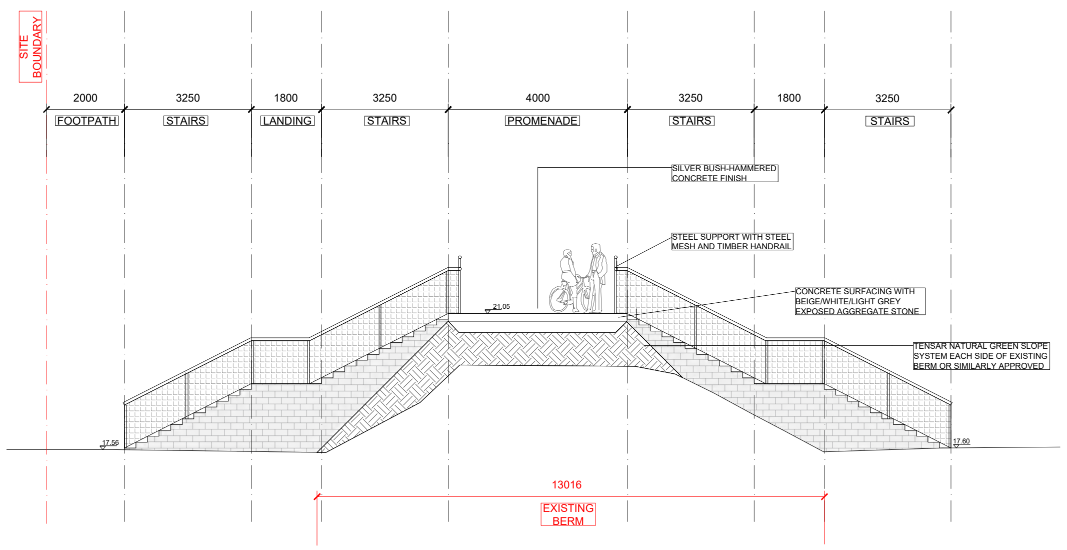
SCALE 1:100



SECTION F SUIR ISLAND LINK PROMENADE

REFER TO DRG: 2254

SCALE 1:100



SECTION G SUIR ISLAND LINK PROMENADE

REFER TO DRG: 2254

SCALE 1:100

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

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dhbarchitects

ARCHEOLOGISTS

CourtneyDeery

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS

awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

Rev	Description	Drawn	Checked	Date

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

Clifton Scannell Emerson Associates

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 TYPICAL SECTIONS D, E, F & G

Drawn By: FO | Date: SEPT 2023 | CSEA Job No.: 20_071

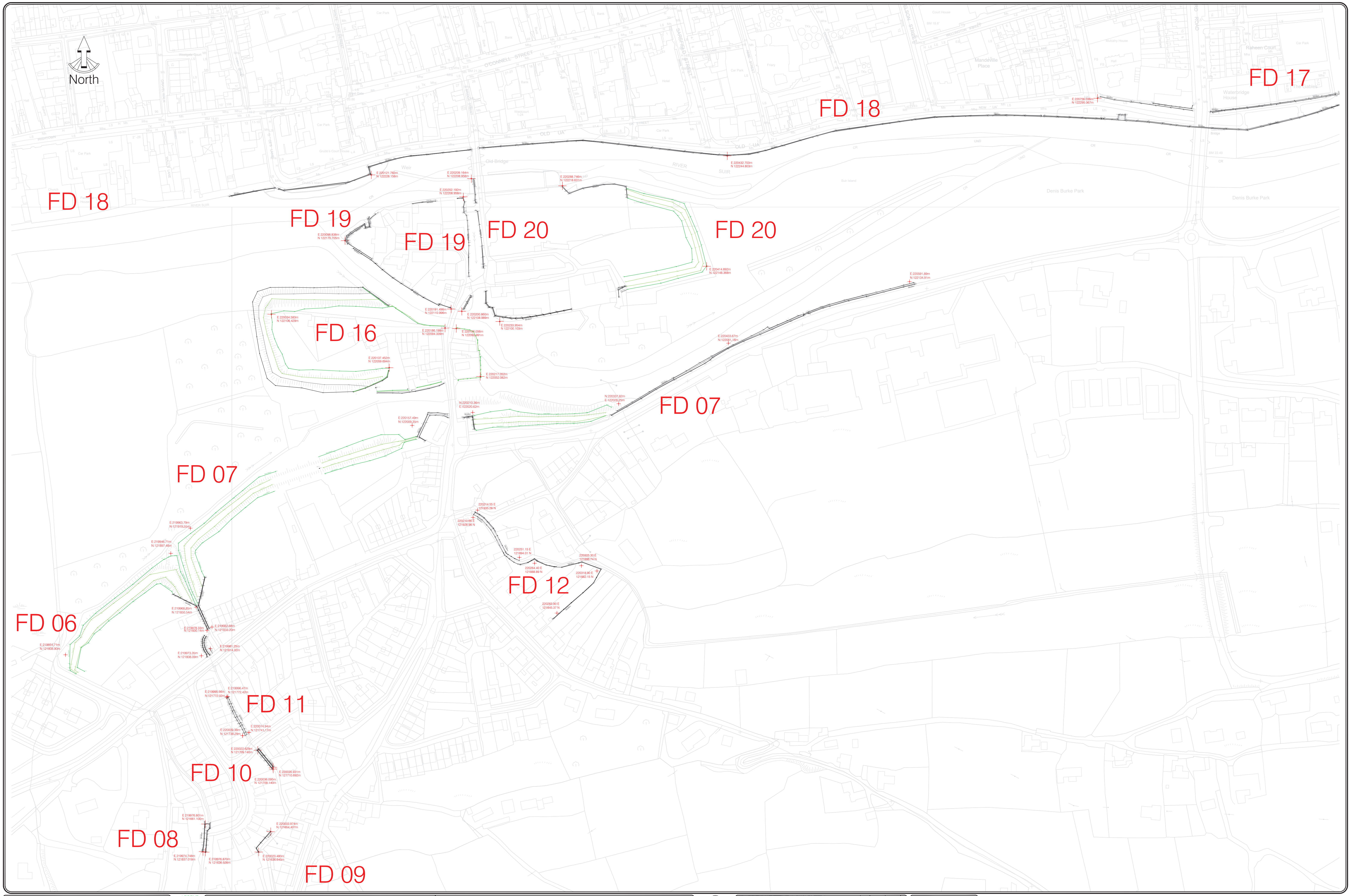
Checked By: LP | Scale: 1:100@ A1

Project Code	Originator	Zone/Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2257

Status Code: S2 | Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 | Project Status: ISSUED FOR PLANNING

Appendix B – Suir CFRAM Fluvial Flood Maps



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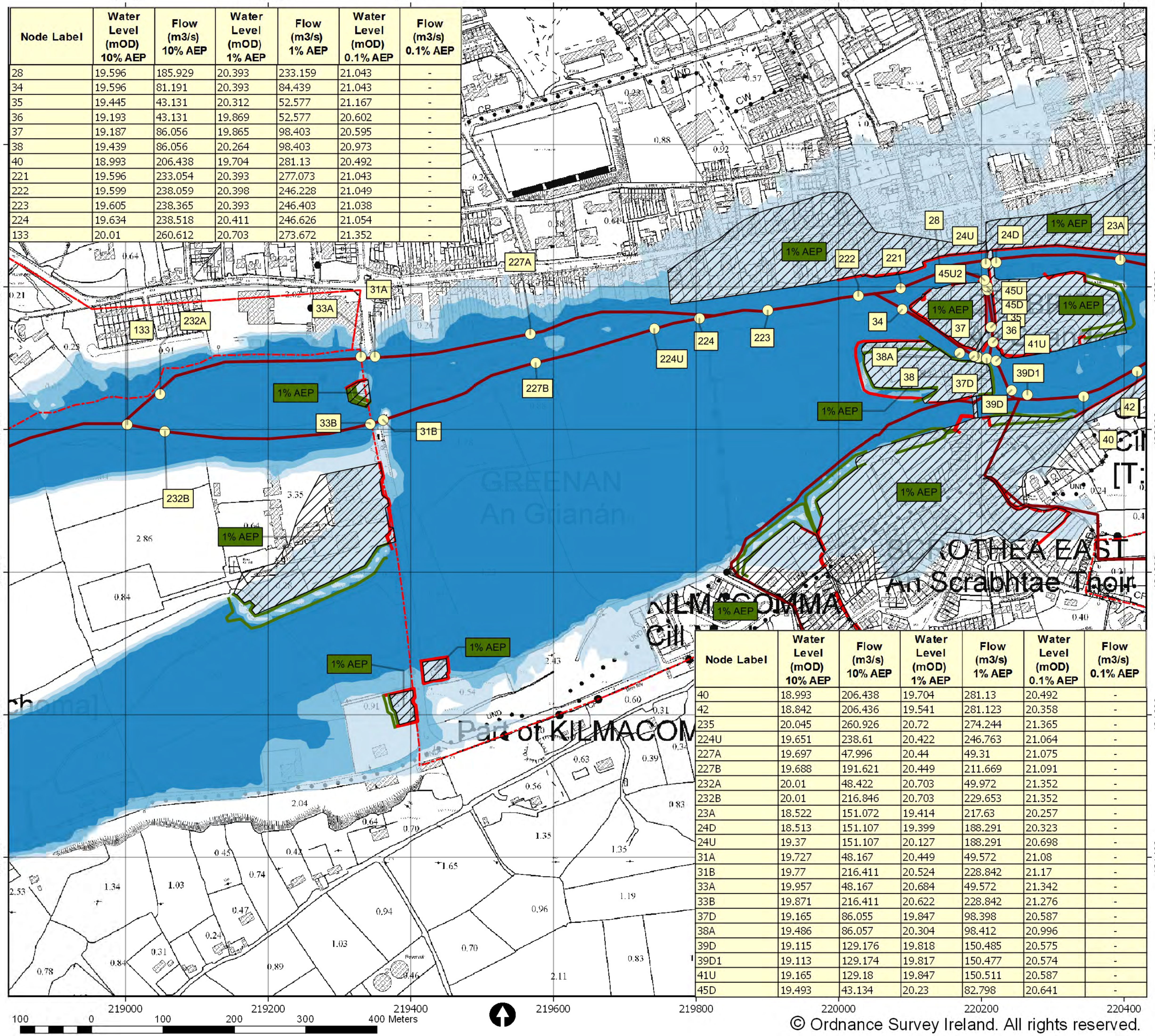
LEGEND

section plan details

- Surveyed Section Lines with References & Section Orientation (at Open channel)
- Surveyed Section Lines with References & Section Orientation (at Structures)
- Surveyed Section Lines with References & Section Orientation (at Additional items)

Client :	OFFICE OF PUBLIC WORKS
Project :	00000009986_SRFT_Minicomp_011_2014
Date : 18.07.14	Scale : 1:1000@A0
Description :	FLOOD DEFENCES PLAN
Drawing Number :	9986_CLONMEL_FLOOD_DEFENCE_PLAN_03



Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
28	19.596	185.929	20.393	233.159	21.043	-
34	19.596	81.191	20.393	84.439	21.043	-
35	19.445	43.131	20.312	52.577	21.167	-
36	19.193	43.131	19.869	52.577	20.602	-
37	19.187	86.056	19.865	98.403	20.595	-
38	19.439	86.056	20.264	98.403	20.973	-
40	18.993	206.438	19.704	281.13	20.492	-
221	19.596	233.054	20.393	277.073	21.043	-
222	19.599	238.059	20.398	246.228	21.049	-
223	19.605	238.365	20.393	246.403	21.038	-
224	19.634	238.518	20.411	246.626	21.054	-
133	20.01	260.612	20.703	273.672	21.352	-

Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
40	18.993	206.438	19.704	281.13	20.492	-
42	18.842	206.436	19.541	281.123	20.358	-
235	20.045	260.926	20.72	274.244	21.365	-
224U	19.651	238.61	20.422	246.763	21.064	-
227A	19.697	47.996	20.44	49.31	21.075	-
227B	19.688	191.621	20.449	211.669	21.091	-
232A	20.01	48.422	20.703	49.972	21.352	-
232B	20.01	216.846	20.703	229.653	21.352	-
23A	18.522	151.072	19.414	217.63	20.257	-
24D	18.513	151.107	19.399	188.291	20.323	-
24U	19.37	151.107	20.127	188.291	20.698	-
31A	19.727	48.167	20.449	49.572	21.08	-
31B	19.77	216.411	20.524	228.842	21.17	-
33A	19.957	48.167	20.684	49.572	21.342	-
33B	19.871	216.411	20.622	228.842	21.276	-
37D	19.165	86.055	19.847	98.398	20.587	-
38A	19.486	86.057	20.304	98.412	20.996	-
39D	19.115	129.176	19.818	150.485	20.575	-
39D1	19.113	129.174	19.817	150.477	20.574	-
41U	19.165	129.18	19.847	150.511	20.587	-
45D	19.493	43.134	20.23	82.798	20.641	-

Location Plan:

LEGEND

- AFA Boundary
- Defended Area
- Modelled River Centreline
- Node Point
- 10% AEP Fluvial Extent (High Risk)
- 1% AEP Fluvial Extent (Medium Risk)
- 0.1% AEP Fluvial Extent (Low Risk)
- Flood Defence - Embankment
- Flood Defence - Wall
- Gate
- NODE123 Node Label
- xx% AEP Standard of Protection of Flood Defence

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
Jonathan Swift Street
Trim
Co. Meath

Project:
SUIR CFRAM STUDY

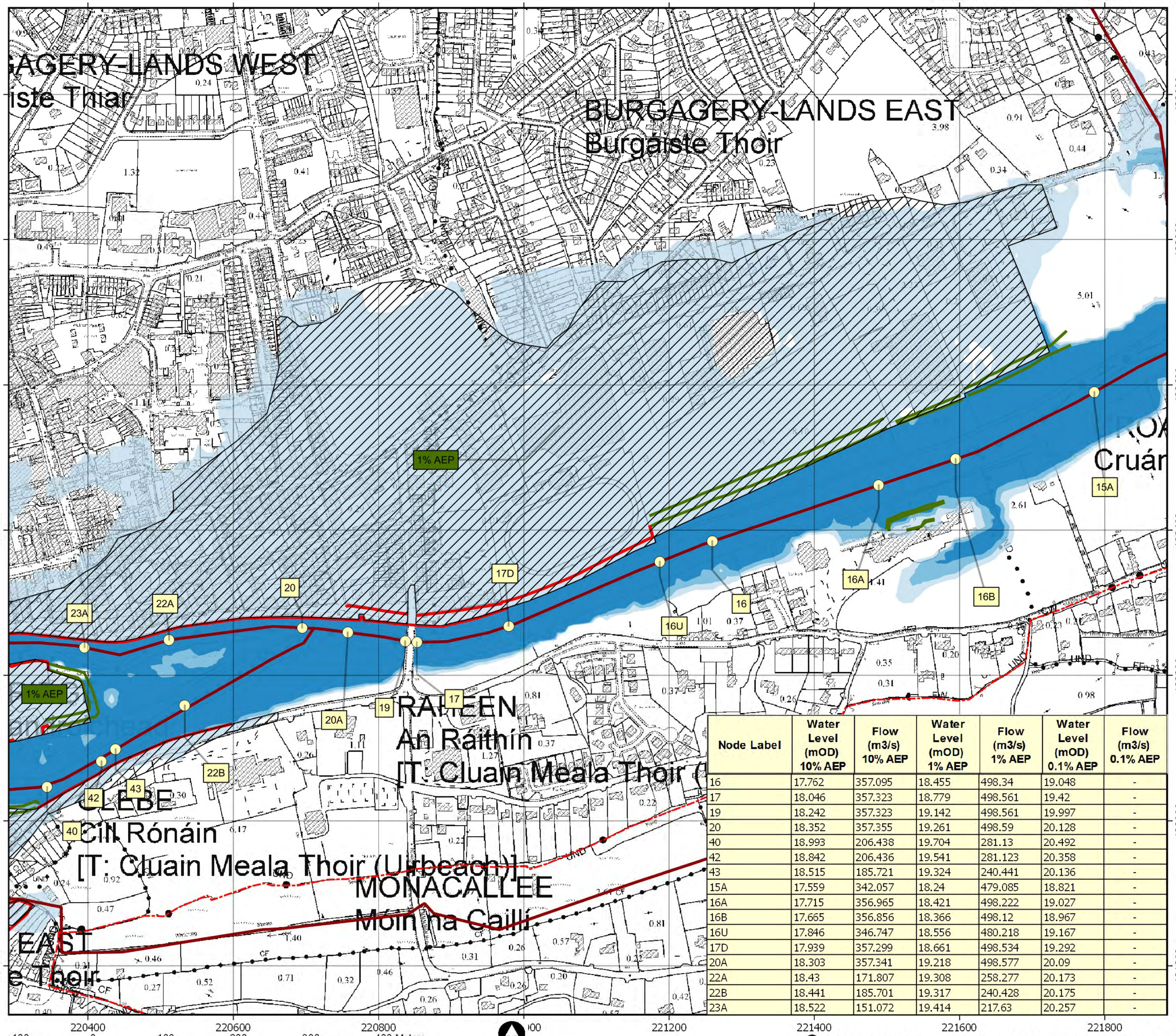
Map:
CLONMEL SCHEME
FLUVIAL FLOOD EXTENT MAP

Map Type:	EXTENT
Source:	FLUVIAL
Map Area:	HPW
Scenario:	CURRENT
Drawn by: NMC	Date: Sep - 2016
Checked by: MC	Date: Sep - 2016
Approved by: GG	Date: Sep - 2016

Map No.:
O16CLN_EXFCD_F0_45

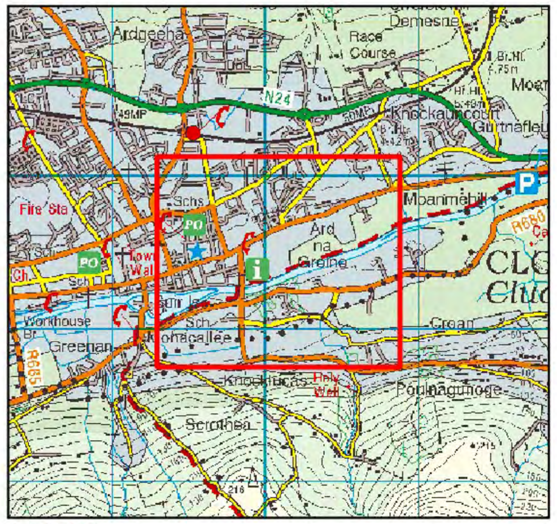
Revision: F0

Map Scale: 1:5,000 Plot Scale: 1:1 @ A3



Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
16	17.762	357.095	18.455	498.34	19.048	-
17	18.046	357.323	18.779	498.561	19.42	-
19	18.242	357.323	19.142	498.561	19.997	-
20	18.352	357.355	19.261	498.59	20.128	-
40	18.993	206.438	19.704	281.13	20.492	-
42	18.842	206.436	19.541	281.123	20.358	-
43	18.515	185.721	19.324	240.441	20.136	-
15A	17.559	342.057	18.24	479.085	18.821	-
16A	17.715	356.965	18.421	498.222	19.027	-
16B	17.665	356.856	18.366	498.12	18.967	-
16U	17.846	346.747	18.556	480.218	19.167	-
17D	17.939	357.299	18.661	498.534	19.292	-
20A	18.303	357.341	19.218	498.577	20.09	-
22A	18.43	171.807	19.308	258.277	20.173	-
22B	18.441	185.701	19.317	240.428	20.175	-
23A	18.522	151.072	19.414	217.63	20.257	-

Location Plan:



LEGEND

- AFA Boundary
- Defended Area
- Modelled River Centreline
- Node Point
- 10% AEP Fluvial Extent (High Risk)
- 1% AEP Fluvial Extent (Medium Risk)
- 0.1% AEP Fluvial Extent (Low Risk)
- Flood Defence - Embankment
- Flood Defence - Wall
- Gate
- NODE123 Node Label
- x.x% AEP Standard of Protection of Flood Defence

IMPORTANT USER NOTE:
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OPW

The Office of Public Works
Jonathan Swift Street
Trim
Co. Meath

Project:
SUIR CFRAM STUDY

Map:
CLONMEL SCHEME
FLUVIAL FLOOD EXTENT MAP

Map Type:	EXTENT		
Source:	FLUVIAL		
Map Area:	HPW		
Scenario:	CURRENT		
Drawn by:	NMC	Date:	Sep - 2016
Checked by:	MC	Date:	Sep - 2016
Approved by:	GG	Date:	Sep - 2016

Map No.:
O16CLN_EXFCD_F0_46

Revision: F0

Map Scale: 1:5,000 Plot Scale: 1:1 @ A3

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Appendix 7.3: Suir Island Hydraulic Modelling Report

Clifton Scannell Emerson Associates

Suir Island Hydraulic Modelling Report

Suir Island Infrastructure Links

Comhairle Contae Thiobraid Árann
Tipperary County Council

Client: Tipperary County Council

Date: August 2022

Job Number: 20_071

CONSULTING ENGINEERS

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Document Control Sheet

Project Name:	Suir Island Infrastructure Links
Project Number:	20_071
Report Title:	Suir Island Hydraulic Modelling Report
Filename:	RPT-20_071-055

Issue No.	Issue Status	Date	Prepared by	Checked by
1st	DRAFT	30/05/2022	HB	LP
2nd	FINAL	29/08/2022	HB	LP

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Commissioning

Tipperary County Council (TCC) appointed Clifton Scannell Emerson Associates (CSEA) to undertake a flood risk assessment study for the proposed Suir Island Infrastructure Links project situated in Clonmel.

Under the EU Flood Directives (2007/60/EC), The Office of Public Works (OPW) and partners undertook a catchment-based Flood Risk Assessment and Management Plan for the Suir Catchment (Suir CFRAM). The main outputs of this study entailed producing predictive flood maps and a Catchment Flood Risk Management Plan (CFRMP) published in 2018.

The Clonmel Flood Defence Scheme was constructed between 2008 to 2012. The Scheme comprises of flood defence walls, demountable barriers, embankments, channel conveyance improvements and pumping stations. The scheme provides protection against a 100-year Recurrence Interval flooding (1% Annual Exceedance Probability (AEP)) event for approximately 500 properties along the Suir River.

This study entails a detailed flood risk assessment to assess the impact of constructing proposed bridge support structures within existing flood zones, as determined by the Suir CFRAM/Clonmel Flood Relief Scheme and to ensure that the efficacy of the existing flood defences is not undermined.

1.2 Purposes and Scope of Study

The purpose of the study is to carry out a detailed flood risk assessment and determine water surface elevations for pre- and post-development scenarios for a range of design flood events including climate change scenarios.

The key processes involved in the study are:

- Review data relevant to flooding in the study area and identify key structures and flood defence assets;
- Complete a bathymetric survey of the river channel and topographical survey of existing structures;
- Complete a hydrological review of the Suir River and comparison to previous studies;
- Develop a combined 1D/2D model for the section of the Suir River to determine hydraulic properties for pre- and post-development scenarios; and
- Compute hydraulic design calculations to determine scour depths on the proposed bridge piers and abutments.

This report serves as an overarching document, summarising the outcomes of the study with more technical detail confined to the appendices. This report concentrates on the findings of the Hydraulic Assessment and discusses the outcomes of the developed model.

2 Description of Study Area

The River Suir rises in the Devil's Bit Mountains, near Moneygall (north of Templemore), and flows in a southerly direction until meeting the Knockmealdown mountain range where the river changes its course northwards. At Knocklofty, the River turns east passing north of the Comeragh Mountains and continues on through Waterford City until it enters the sea at Waterford Harbour.

The study area of the hydraulic model is confined to Clonmel and Suir Island as indicated by the red rectangle in Figure 2-1.

Figure 2-1: Locality map and model study area

2.1 Potential Sources of Flood Risk

The potential sources of flooding in the study area are limited to fluvial flooding as indicated by the Suir Flood Risk Management Plan. The River Suir is tidally influenced to a point 2km upstream of Carrick-on-Suir.

2.2 Water Courses in the Study Area

The study area is limited to the Suir River water course but contains multiple flow separation and joining junctions as highlighted below. This section gives an overview of the nature of the different river reaches included in the hydraulic model. Refer to the Model Check File included in **Appendix C** for more detail on the hydraulics of the channels and how they are represented in the model.

2.2.1 Northern River Reach

The northern or main Suir River reach begins approximately 250m upstream of Little Island and ends 250m downstream of Gashouse Bridge as indicated in Figure 2-2.

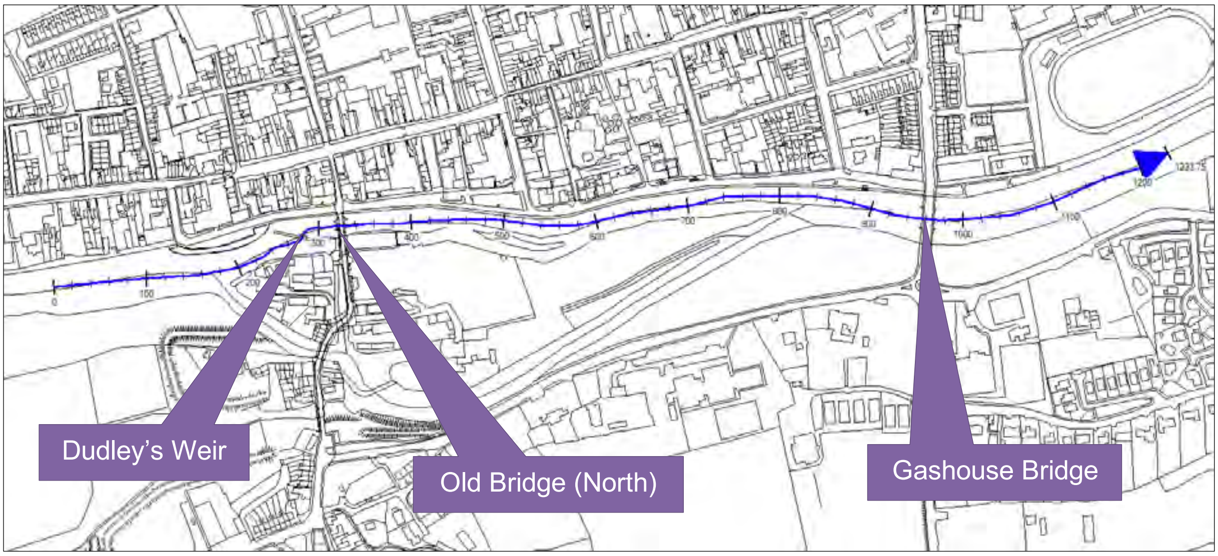


Figure 2-2: Northern river reach extents

The following photographs (Table 2-1) give an indication of the size and nature of this river reach starting from the upstream limit with a reference to the bathymetric survey section identification number and the direction in which the photograph was taken.

Table 2-1: Photographs of Northern river reach

 **01SUIR1208_DN**	 **01SUIR00990_DN**
 **01SUIR00890_DN**	 **01SUIR00286_US**

	
0SUIR00383_DN	**01SUIR00216**

2.2.2 Southern River Reach

The Southern river reach splits from the Northern reach approximately 110m upstream of Dudley's Weir and reconnects with the main river channel approximately 90m upstream of Gashouse Bridge as indicated in Figure 2-3.

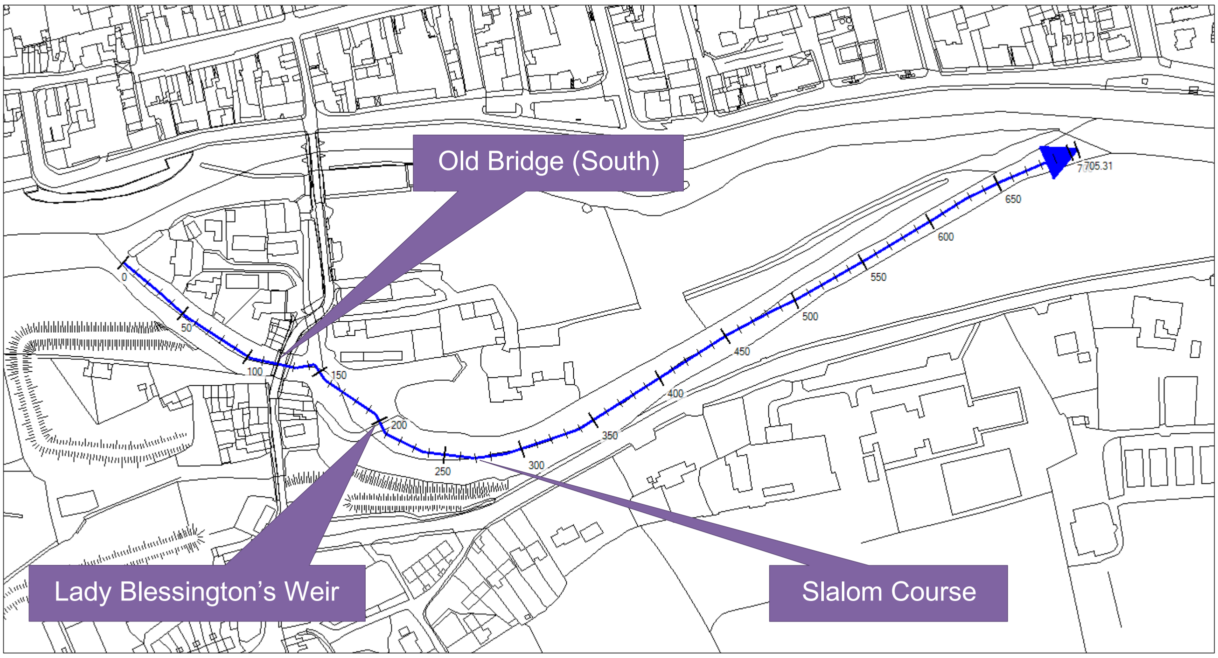


Figure 2-3: Southern river reach extents

The southern river reach is home to the Clonmel Canoe Club or Slalom Course. Upgrades were made to Lady Blessington's Weir to promote fish migration and canoe accessibility in 2016. Multiple gabion groins and features was constructed downstream of the weir for the Slalom Course for a distance of approximately 250m. Details of the course is available in the Clonmel Slalom Course Flood Risk Assessment conducted by Mott MacDonald in March 2016. Table 2-2 contains photographs of the southern river reach.

Table 2-2: Photographs of Southern river reach

 **02SUIR00705_DN**	 **02SUIR00503_UP**
 **02SUIR00499_DN**	 **02SUIR00420_DN**
 **02SUIR00055_DN**	 **02SUIR0005_DN**

2.2.3 Little Island Channel

The Little Island Channel flow separation junction is located 20m upstream of Dudley's Weir and flows between Little Island and Suir Island for a distance of approximately 100m before flowing into the southern reach with the junction located 50m upstream of Lady Blessington's Weir as shown in Figure 2-4. As shown in Table 2-3, the channel contains two bridge crossings and the banks consist of vertical flood protection walls.

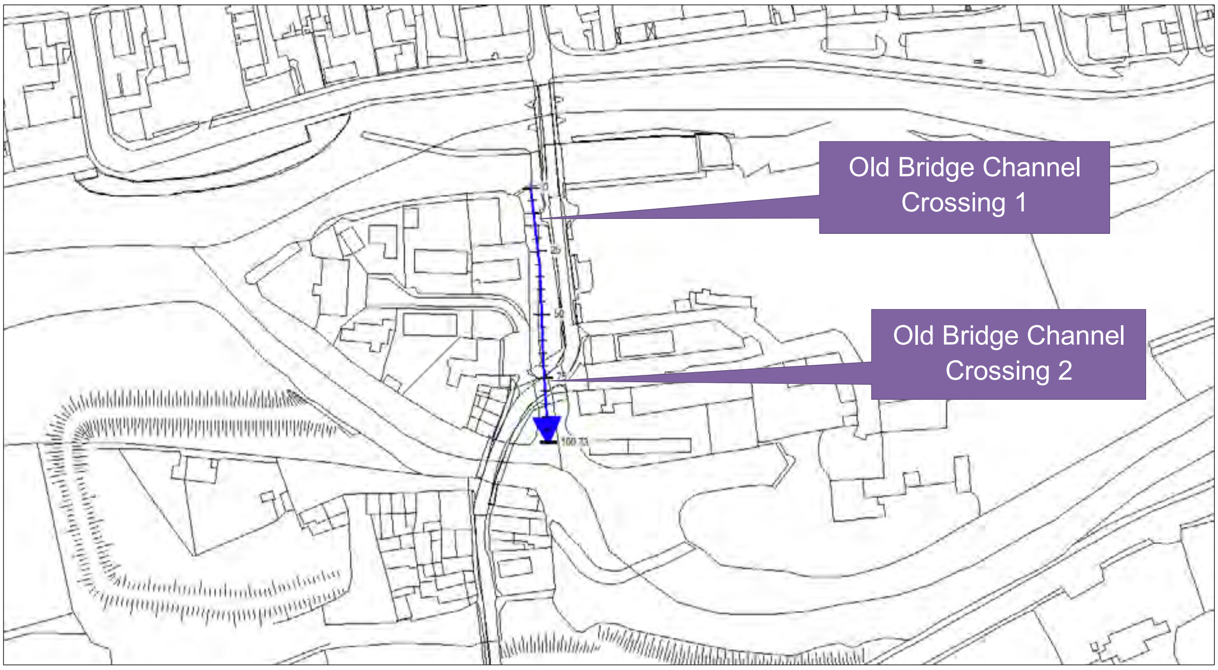


Figure 2-4: Little island channel extents

Table 2-3: Photographs of Little Island Channel

 03SUIR00102_US	 03SUIR00072_UP
 03SUIR00072_DN	 03SUIR00017_DN

3 The Proposed Development

The development proposes the delivery of a pedestrian plaza (North Plaza) at the Sarsfield Street/The Quay/ Quay Street junction. The proposal also includes the provision of a pedestrian path across Suir Island linking Denis Burke Park in Raheen Road to the proposed North Plaza in Sarsfield Street as shown in Figure 3-1.

Two pedestrian bridges will be delivered with the scheme, the first bridge linking the proposed North Plaza to Suir Island (Figure 3-2), and the second bridge connecting Suir Island to Raheen Road (Figure 3-3). The second bridge will facilitate access to Denis Burke Park, creating a direct connection for pedestrians/cyclists between the park and the Town Centre. An access ramp and steps from the proposed path to the Suir Island Car Park will also be provided with the scheme.

Refer to **Appendix E** for additional drawings of the proposed bridges including vertical profiles, pile and foundation details and architectural views.

Figure 3-1: Plan layout of proposed bridge crossings

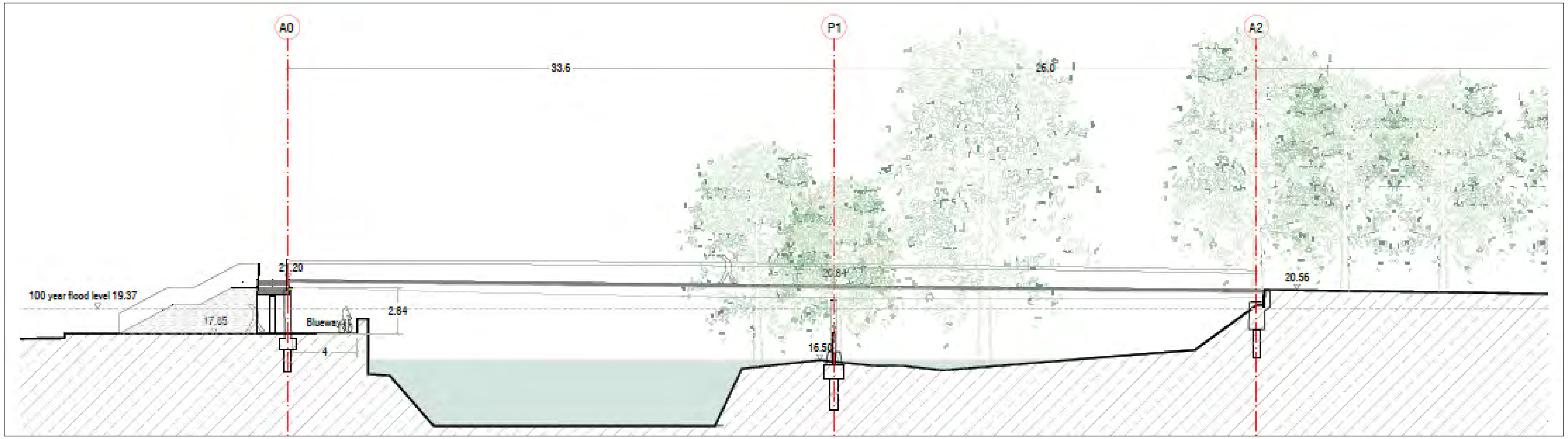


Figure 3-2: Section of proposed Northern Bridge crossing

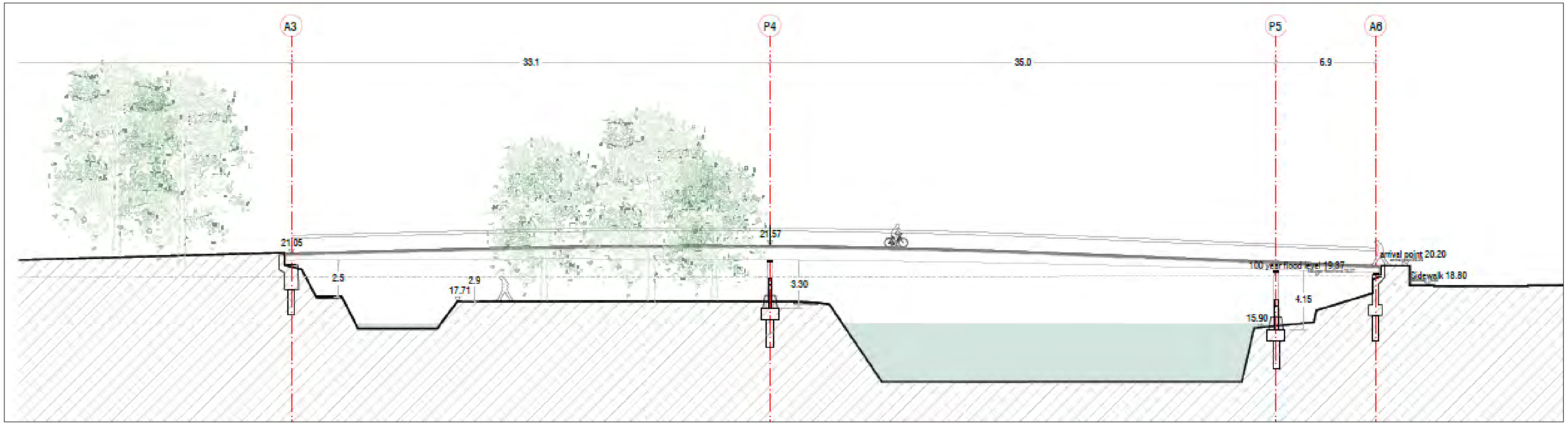


Figure 3-3: Section of proposed Southern Bridge crossing

4 Data Review

This section of the report summarises pertinent data relating to flooding which occurred in Clonmel and the Suir River, and reviews information extracted from previous studies and historical flood records.

4.1 Previous Studies

Suir CFRAM

The following reports were reviewed which were compiled as part of the Suir CFRAM:

- Hydraulics Report (July 2016) – Report No. 1891_REP_160711_Hydraulic_Final
- Hydrology Report, Draft Final Report (July 2015) – Report No. 1891_RP_ Hydrology Report Draft Final_Rev14
- Review of Selected River Gauges Summary Report (November 2010)
- Suir River Fluvial Flood Extents Maps No. O16CLN_EXFCD_F0_45 and 46

Clonmel Flood Relief Scheme

The following drawing was used to confirm elevations of existing flood defence assets not included in the bathymetric or topographic survey scope:

- Flood Defence Plan, Drawing No. 9986_Clonmel_Flood_Defence_Plan_03, surveyed and compiled by Murphy Surveys in July 2014 for the OPW and Mott MacDonald.

The above drawing is included in **Appendix A**. The Clonmel Flood Relief Scheme report were not available for review at the time of compiling this report.

Other Models

The following reports were reviewed which consists of the same ISIS (now Flood Modeller) model utilised to design the Clonmel Flood Relief Scheme.

- Hydraulic Modelling to Assess the Potential Impact on Flood Risk of a Proposed Development at Galloping Fields in Clonmel, Technical Note MCM6217-01, HR Wallingford (January 2009)
- Flood Risk Assessment, Clonmel Slalom Course – Report No. 349466AI_001, Mott McDonald (March 2016)

4.2 Historical Flood Events

National Flood Hazard Maps are available from the OPW, which provides information on historical flood events in the form of reports, photographs and newspaper articles. The information is readily available on the website: https://www.floodinfo.ie/map/floodmaps/. Table 4-1 below summarises flood events that occurred in Clonmel and indicates the severity of the flood based on the AEP.

Table 4-1: Historical Flood Events in Clonmel

	1960	1968	1990	1995	1996	2000	2004	2008	2009	2012	2014
Clonmel	X	X	X	X	X	X	X	X	X		

AEP	**Flood Severity Classification**
< 5%	Severe
5 – 10%	Significant
> 10%	Minor
Protected	Protection Scheme in place

4.3 Hydrometric Gauges

The following hydrometric gauges are located within the hydraulic model domain as shown in Figure 4 1. Flow data is available on the OPW Hydrometric website (https://waterlevel.ie/hydro-data/) which was extracted and reviewed as part of this study.

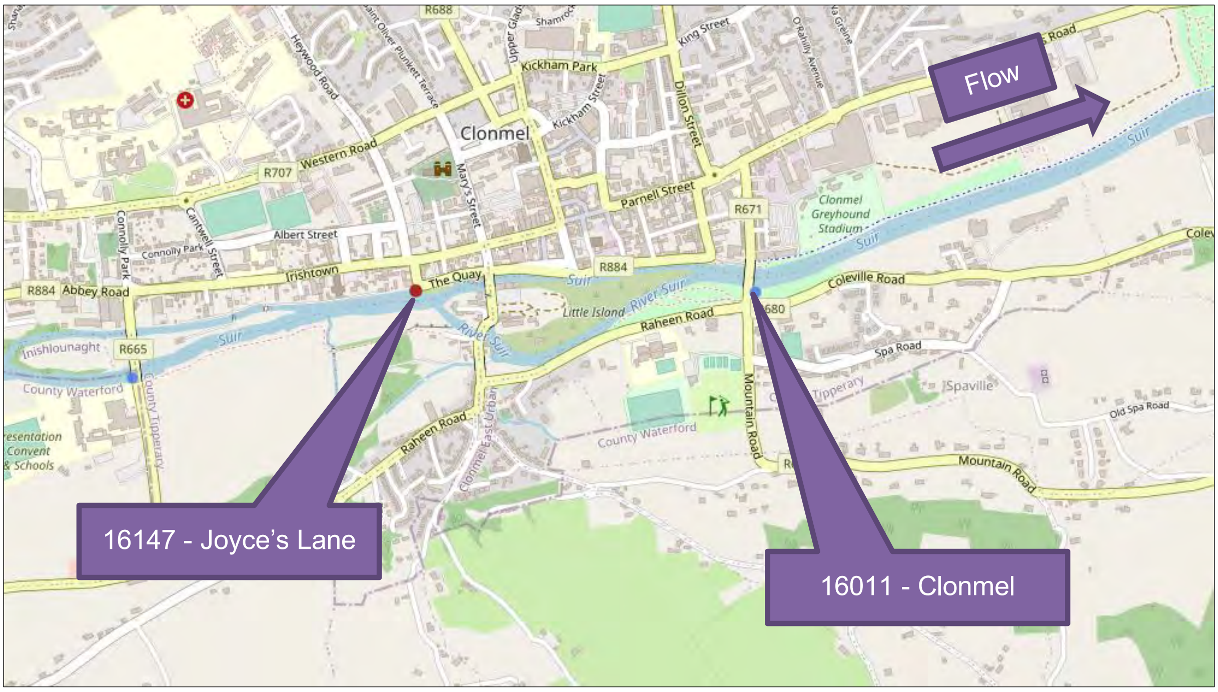


Figure 4-1: Locality plan of relevant hydrometric gauges

4.3.1 Gauge 16011 Clonmel

This gauge is located on the right bank of the Suir River and constructed on the downstream face of Gashouse Bridge. The gauge was constructed in 1940 and upgraded to provide automated readings in 1953 and records flow and water level data. Information relevant to the hydrological review and hydraulic model was extracted from the OPW website and summarised below.

Data records from Gauge 16011 was reviewed as part of the Suir CFRAMs National Gauge Review, which assigned a "A1" rating to the gauge. This indicates that the gauge records are sufficient to extrapolate flows up to 2 times the Q_{med}. The National Gauge Review determined Q_{med} as 247m^3/s and hence 2Q_{med} equal to 494m^3/s.

Table 4-2 summarises historical flood flows and corresponding Return-Periods (RP).

Table 4-2: Historical Flood Flows and Return Periods

Gauge No	Description	22/11/2009	10/01/2008	07/12/2006	29/10/2004	06/11/2000
16011	Flow (m^3/s)	339	266	208	356	356
	RP (years)	38	5	1	68	68

Table 4-3 summarises the Annual Maximum recorded water levels (Poolbeg Datum), Gauge Staff readings and estimated flows for each hydrometric year (1 October – 31 September). As the Clonmel Flood Relief Scheme works was completed in 2012, data preceding the works are deemed not pertinent to the hydraulic model.

Table 4-3: Gauge 16011 Annual Max Readings per Hydrometric Year

Hydrometric Year	Water Level (mOD)	Gauge Staff Reading (m)	Estimated Flow (m^3/s)	Date
2014	19.906	2.958	243.55	14/11/2014
2015	20.951	4.003	385.01	30/12/2015
2016	19.041	2.093	158.29	05/03/2017
2017	19.687	2.739	220.86	15/03/2018
2018	19.6	2.652	212.29	16/12/2018
2019	20.192	3.244	273.78	22/11/2019
2020	20.351	3.403	292.77	24/02/2021

The Annual Maximum (AMAX) flow hydrographs (Figure 4-2) for each **calendar** year were extracted for calibrating the hydraulic model as per **Section 7.4** of this report.

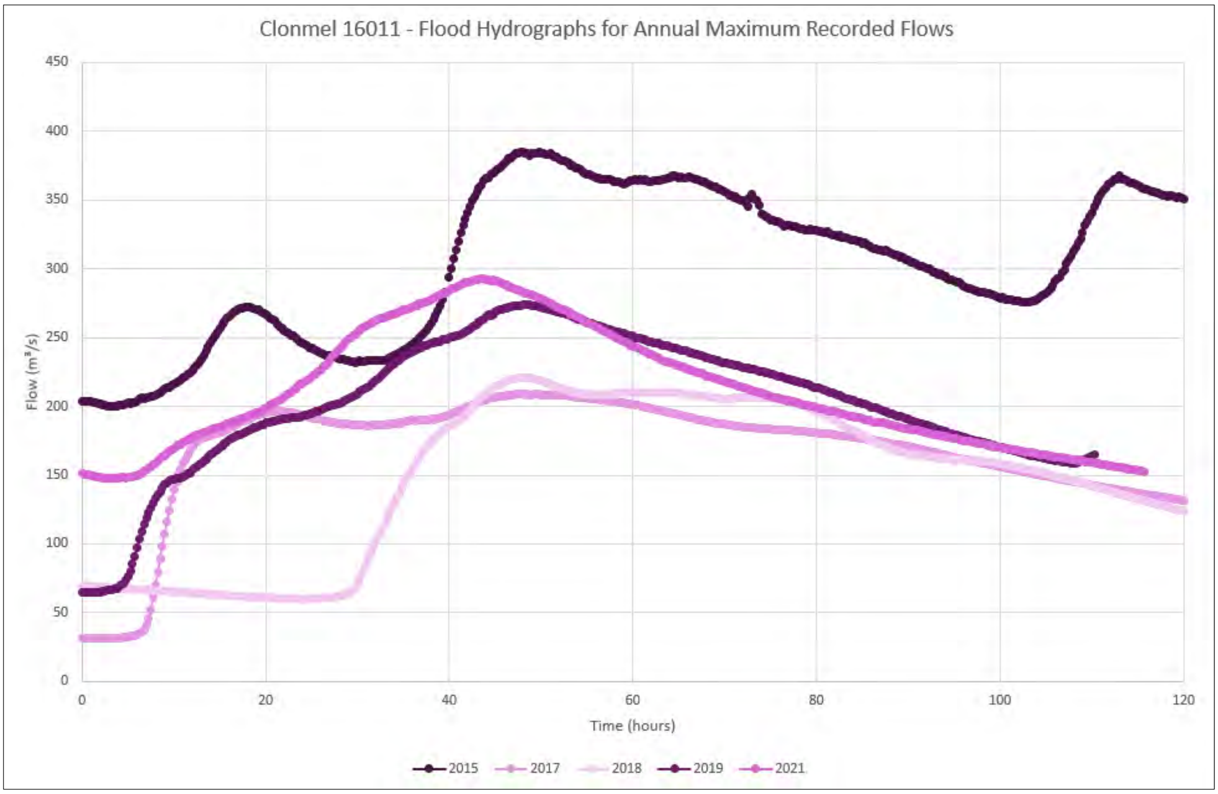


Figure 4-2: Annual maximum flood hydrographs

4.3.2 Gauge 16147 Joyce's Lane

Gauge 16147 Joyce's Lane is situated upstream of Little Island on the left bank of the Suir River, immediately upstream of the first flow separation location. The gauge provides water surface elevations but does not record flow magnitudes.

The relevant Suir CFRAM reports (as per **Section 4.1**) does not reference this gauge and the gauge was not selected for review in the National Gauge Review. Table 4-4 summarises the maximum recorded water levels for each hydrometric year after the completion of the Clonmel Flood Relief Scheme. This gauge is considered unrated and data extracted inserted for information purposes only and not used for calibration purposes.

Table 4-4: Gauge 16147 Annual Max Readings per Hydrometric Year

Hydrometric Year	Water Level (mOD)	S.G. Reading (m)	Date
2014	21.311	1.651	14/11/2014
2015	22.397	2.737	30/12/2015
2016	20.693	1.033	05/03/2017
2017	21.125	1.465	15/03/2018
2018	21.051	1.391	16/12/2018
2019	21.522	1.862	22/11/2019
2020	21.72	2.06	24/02/2021

4.4 Existing Surveys

4.4.1 Topographical

The following existing topographical surveys were reviewed as part of this study for relevant information pertaining to the hydraulic model or existing flood defence structures. Refer to **Appendix A** of this report for Plan Layouts of these surveys.

- Murphy Surveys (September 2017) – Suir Island GPR & Topographical Survey – Drawing No. MSL22204_T_3D_Rev1_0
- Murphy Geospatial (November 2020) – The Gashouse Bridge Clonmel – Drawing No. MGL38728_T_ITM_3D_Rev0
- Land & Aerial Surveys (December 2021) – Suir Island Infrastructure Links – Drawing No. 2021.054 Area 1 to Area 5

4.4.2 LIDAR

LIDAR is an acronym for Light Detecting and Ranging which utilises remote sensing method that uses laser light pulses to measure variable distances to objects to derive 3D information. Ordnance Survey Ireland Lidar was sourced from their online map shop which consisted of 10-meter (resolution) grid spacing. This data is available in XYZ untriangulated format but was not utilised due to the irregularities inherent to working with untriangulated raw survey data sets.

4.4.3 Photogrammetry

Aerial photogrammetry involves the use of aircrafts or drones to derive 3D information through the process of recording, measuring and interpreting overlapping photographs, based on the fundamental principle of triangulation.

The Digital Terrain Model (DTM) for the 2D floodplain consists of 2-meter grid spacing photogrammetry survey sourced from BlueSky Ireland. The survey is dated May 2020 with the following Root-Mean-Square Error (RMSE) of:

- Horizontal = up to ± 1m
- Vertical = up to ± 1.5m

5 Hydrology Review

The purpose of this section is to summarise the extensive hydrological studies that has been conducted for the Suir River as part of the CFRAMs, Clonmel Flood Defence Scheme and compare their findings to this hydrological review assessment based on the Flood Studies Update methodology.

5.1 *Existing Information*

5.1.1 Suir CFRAM Hydrology Report and Gauge Rating Review

The following hydrological information was extracted from the CFRAMs Hydrology Report and National Gauge Review in relation to Clonmel Gauge 16011, situated near the downstream boundary of the hydraulic model. As mentioned in **Section 4.3.2**, no reference is made in the above reports to Gauge 16147 Joyce's Lane situated near the upstream boundary of the model.

The CFRAM Suir Rating Review Summary Report was published by the OPW in August 2009. As per Section 12 of that report, Gauge 16011 was assigned an "A1" rating with a Q_{med} (50% AEP) of 247 m^3/s.

The CFRAM Suir Hydrology Report was published in July 2015 and summarises the Design Flows for Gauge 16011 in Table 7-8 Page 86. These design flows are summarised in Table 5-1.

Table 5-1: Clonmel Gauge 16011 Design Flows

Gauge	50%	20%	10%	5%	2%	1%	0.5%	0.1%
16011	244.47	298.25	330.03	359.37	393.60	420.49	444.94	501.16

5.1.2 Suir CFRAM Hydraulic Report

The CFRAM Hydraulic Report was published by the OPW in July 2016. The Suir River Model 6B (Clonmel) is covered by the Clonmel Flood Relief Scheme which was incorporated into the CFRAM maps but not covered in the reports. The OPW Fluvial Flood Extent Map No. O16CLN_EXFCD_F0_46 included in **Appendix A** summarises water levels and flows at model nodes along the Suir River flowing through Clonmel. Refer to Table 5-2 below for the water levels and flows for Node No 17D which located on the downstream face of Gashouse Bridge i.e. Clonmel Gauge 16011.

Table 5-2: Suir CFRAM Flows at Node 17D

AEP Node	50%	20%	10% AEP (m^3/s)	5%	2%	1% AEP (m^3/s)	0.5%	0.1%
17D			357.299			498.534		-

5.1.3 Clonmel Flood Relief Scheme

The Clonmel Flood Relief Scheme was undertaken by Mott MacDonald Pettit in two phases, namely Clonmel West and Clonmel North/East, commencing in 2005, with construction works completed in 2012. HR Wallingford undertook the Hydraulic Modelling.

The scheme defences are designed to provide protection against a flood with a 1% AEP, with demountable flood barriers that can be further raised at relatively little additional cost and in quick response to floods. As stated in the Suir CFRAM hydraulic modelling report, the Clonmel Flood Relief Scheme was incorporated into the CFRAM mapping and the flood peaks used during the Clonmel study is assumed to be as per Table 5-2.

5.2 Estimation of the Index Flood

The Hydrological Estimation Point (HEP) for this study coincides with Gauge Clonmel 16011, which is an A1 Rated gauged station with 82 years of records, therefore, the index flood does not need to be estimated. The Flood Studies Update website states the Q_{med} flow as 245.32 m^3/s, which compares well with the design flow of the 50% AEP shown in Table 5-1. The FSU Gauge Rating review reported that the mean % difference in FSU Amax Flow series compared to the OPW Amax flow series as -8.2% and reports Q_{med} as 247 m^3/s.

5.3 Flood Frequency Analysis

5.3.1 Single-site Analysis

A single-site analysis consists of estimating design flows directly from the annual maximum records of a gauge without the need to estimate growth factors. This method is best used for gauges with sufficiently long-term records. The Flood Studies Report (NECR, 1975) adopted a criterion where the records length (N) > 0.5 x Return Period (T) and the FEH adopted a more stringent N > 2T (Reed, 1999). As the 82 years of records for the gauge does not meet the above criterion for estimating extreme flood events, the FSU recommends a pooled analysis.

5.3.2 Pooled Analysis

The pooled analysis consists of a statistical analysis of the Annual Maximum (AMAX) data for a number of “pooled” sites to determine the flood frequency curve (i.e. growth factors). The pooled group of gauging stations are based on gauges with good quality data dependable for the estimation of Q_{med} i.e. A1 and A2 rated gauges. The growth factors applied to the Q_{med} for this study are based on the 2-parameter Extreme Value Type-1 (EV1) distribution. Generally, it is better to adopt a 2-parameter distribution than a 3-parameter distribution because the standard error is much smaller in the former. The FSU Technical Research Report – Volume II states that EV1 and Lognormal (LN) distributions are seen to be typically better descriptors of gauged stations in Ireland than the 2-parameter Logistic (LO). The pooled group of stations are listed in the FSU report included in **Appendix B**.

5.3.3 Combined Analysis

The FSU provides the functionality to combine the single-site and pooled grouped analysis by allowing the user to change the weighting of the single-site (green) and pooled (red) analysis as shown in Figure 5-1. The cyan line represents the average between the two methods i.e. weighting of 0.5.

The growth factors and peak flows from the single-site and pooled group are summarised in Table 5-3, which shows a considerable difference in growth factors and design flows between the two methods. Compared to the CFRAM i.e. Clonmel Flood Relief Scheme flows shown in Table 5-2, the single-site analysis provides the more conservative growth factors and flows. Thus, the single-site analysis values were adopted for hydraulic modelling purposes and pooled analysis values not utilised.

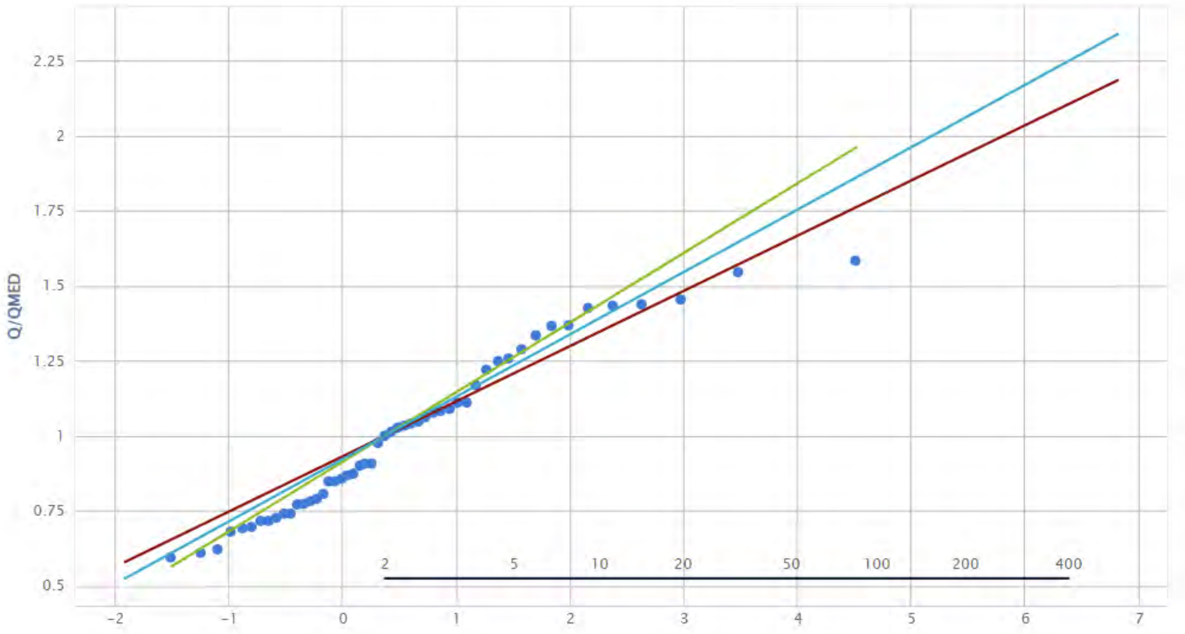


Figure 5-1: Combined analysis graph

Table 5-3: Summary of peak flows and growth factors

Single-site Analysis								
AEP	50%	20%	10%	5%	2%	1%	0.5%	0.1%
Growth Factor	1	1.26	1.44	1.6	1.82	1.98	2.14	2.52
Flows (m^3/s)	245.32	309.84	352.56	393.54	446.58	486.32	525.92	617.65
Pooled Analysis								
AEP	50%	20%	10%	5%	2%	1%	0.5%	0.1%
Flows (m^3/s)	1	1.21	1.35	1.48	1.65	1.78	1.91	2.2
Growth Factor	245.32	296.46	330.32	362.8	404.84	436.35	467.73	540.44

5.4 Flood Hydrograph Analysis

The FSU departed from the rainfall-runoff method for synthesising design hydrographs used in the Flood Studies Report (NERC, 1975), in favour of a parametric approach to derive hydrographs, without the use of design rainfall as input. Instead the method is based on recorded hydrograph data from flow gauging stations in Ireland, using three different shape parameters, n, Tr, and C that describe a design hydrograph shape:

- n = Shape parameter of the Gamma hydrograph that defines the shape of the rising limb and peak of the hydrograph;
- Tr = Recession parameter of the Gamma hydrograph (in hours) and is analogous to the rise time;

- C = Recession parameter for the exponential recession curve (in hours) that defines the shape of the recession limb of the hydrograph beyond the point of inflection on the receding limb.

The reason for using a non-rainfall-based approach was primarily due to the wide availability of flood hydrograph data and the scarcity of high-resolution rainfall data in Ireland. Archer et al.(2000) suggested that the asymmetric profile derived from observed flood hydrographs provides “a more realistic basis for generating a design flood hydrograph than standard FSR methods”. This method does not require the separate assessment of base flow and storm runoff. The method allows the hydrograph to be fitted directly to design flows of any return period.

As shown in Figure 5-2, the design hydrograph shape can be fitted to match historical floods by changing the 3 parameters mentioned above. The shape parameter “n” was accepted as 7.46 which matches the steeper rising limb, relatively short peak duration and slow decline in the receding limb compared to historical hydrographs recorded at Gauge 16011.

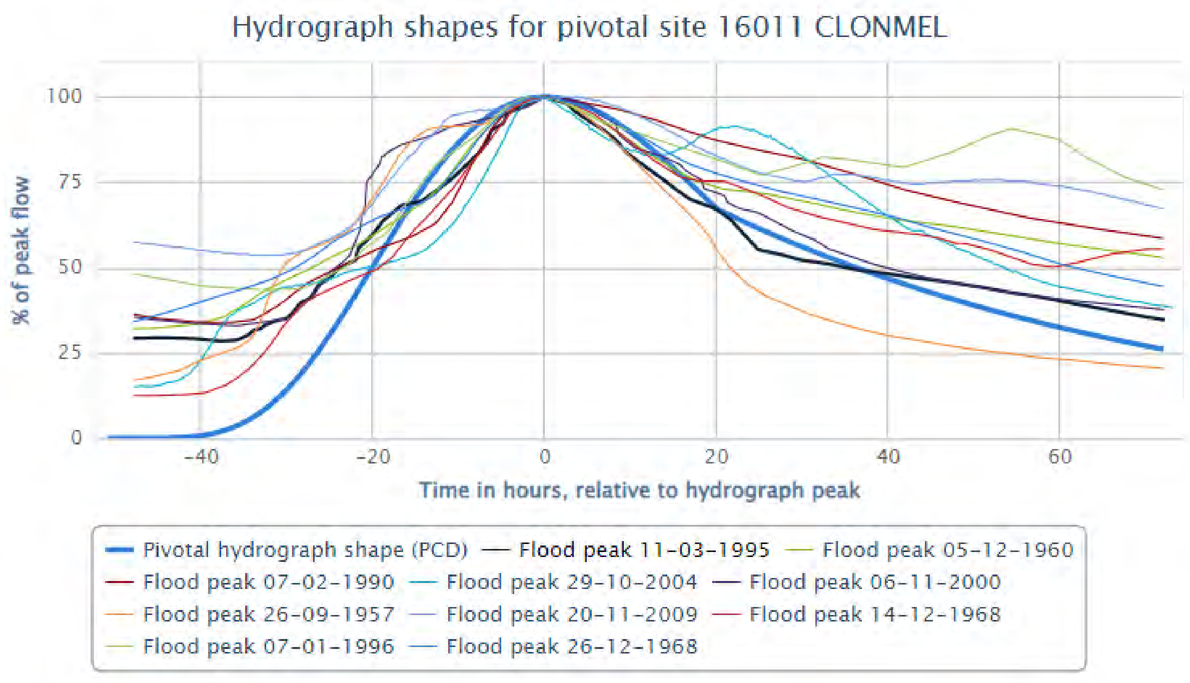


Figure 5-2: Hydrograph width analysis

Figure 5-3 shows the outcome of synthesising the design hydrographs based on the Hydrograph Width Analysis. The FSU website does not provide the hydrograph for the 0.1% AEP event, and the shape of the 1% AEP event was applied in terms of a % to peak method. The FSU report, which summarises the relevant hydrological information is included in **Appendix B** of this report.

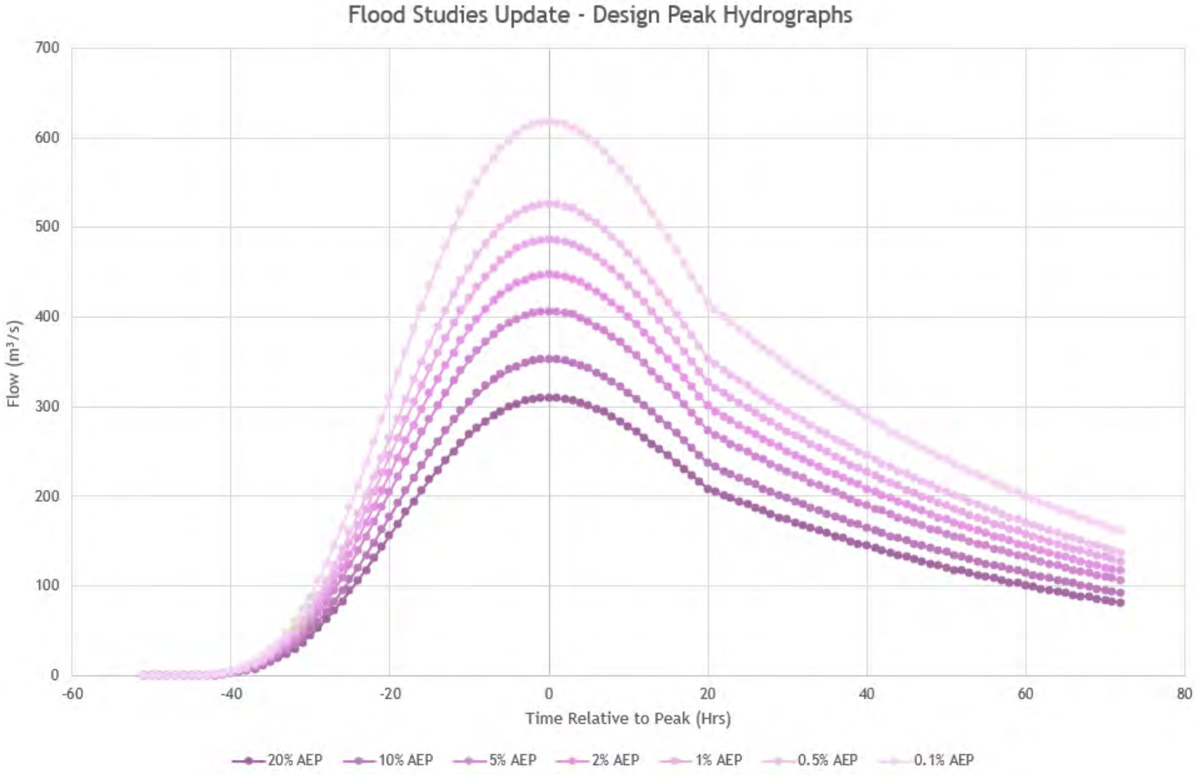


Figure 5-3: Design peak hydrographs

5.5 Surface Water Runoff

Piped and overland surface water flow within the model domain is considered to be included into the gauge readings i.e. recorded Q_{med} which was used to estimate the peak flows and no additional flows were considered for this assessment.

5.6 Tidal and Fluvial Extents

As stated in the Suir CFRAM hydrology report, the Suir River becomes tidal approximately 2km upstream of Carrick-On-Suir and as indicated on the CFRAM Tidal Flood Extent Map No. O16COS_EXCCD_F0_07 available of the www.floodinfo.ie website. Tidal influence or joint fluvial/tidal probabilities were not considered for this study.

5.7 Allowance for Climate Change

The Flood Risk Management Climate Change Sectoral Adaptation Plan prepared by the Office of Public Works in September 2019, states that the Climate Change scenarios must be considered as per the parameters summarised in Table 5-4. The design simulations used in the hydrodynamic modelling is summarised in Table 5-5.

Table 5-4: Climate change allowance parameters

Parameter	Mid-Range Future Scenario	High-End Future Scenario
Extreme Rainfall Depths	+ 20%	+ 30%
Peak Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm
Land Movement	- 0.5 mm / year[1]	
Urbanisation	No General Allowance – Review on Case-by-Case Basis	

Forestation	- 1/6 Tp[2]	- 1/3 Tp[2] + 10% SPR[3]

Note 1: Applicable to the southern part of the country only (Dublin – Galway and south of this)

Note 2: Reduction in the time to peak (Tp) to allow for potential accelerated runoff that may arise as a result of drainage of afforested land

Note 3: Add 10% to the Standard Percentage Runoff (SPR) rate: This allows for temporary increased runoff rates that may arise following felling of forestry.

Table 5-5: Design peaks for present-day and future scenarios

Design Peaks including Climate Change Scenarios								
AEP	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**	**0.5%**	**0.1%**
Flow (m^3/s) (Present-day)	245.32	309.84	352.56	393.54	446.58	486.32	525.92	617.65
Flow (m^3/s) (20% CC - MRFS)	294.38	371.81	423.07	472.25	535.90	583.58	631.10	741.18
Flow (m^3/s) (30% CC - HEFS)	318.92	402.79	458.33	511.60	580.55	632.22	683.70	802.95

5.8 Conclusion

The hydrological review completed in this chapter set out to review and summarise existing information extracted from previous studies conducted for the River Suir. The CFRAM hydrology report design flows for Gauge 16011 Clonmel is summarised in Table 5-1.

The Clonmel Flood Relief Scheme hydraulic modelling was incorporated into the CFRAM hydraulic modelling and mapping as stated in the CFRAM hydraulic modelling report. The flood peaks of Node 17D located on the downstream face of Gashouse Bridge are shown in Table 5-2, which were extracted from the CFRAM Fluvial Extent Maps No. O16CLN_EXFSD_F0_45 and 46 included in **Appendix A.** The Relief scheme report was not available for review at the time of compiling this report. The flows presented in Table 5-1 and 5-2 vary considerably, with the 1% AEP peak of 498 m^3/s being approximately 18.6% higher compared to the CFRAM hydrology report.

Due to the significant variance in flood peak magnitude stated above, the Flood Studies Update methodology for a gauged catchment was used to review the above design flows. A single-site and pooled flood frequency analysis was conducted and the more conservative single-site values were accepted for use in this hydraulic modelling. The peak present-day and Mid-Range Future Scenario (MRFS) flows are summarised in Table 5-5. The hydrographs for the design events were synthesised based on the FSU Hydrograph Width Analysis. The FSU user report is included in **Appendix B**, which highlights the steps followed and summarises pertinent hydrological data and information.

6 Surveys and Data Collection

This section of the report summarises the survey information obtained as part of the study and highlights key structures located within the model domain.

6.1 Bathymetry and topographic

Murphy Geospatial were contracted to conduct a detailed bathymetric survey of the Suir River, which was completed in February 2022. The bathymetric survey consisted of survey sections at regular intervals using a single-beam echosounder and surveying took place over a 3-day period when the river water levels were low and the river could be safely accessed. Table 6-1 below references the survey drawings included in **Appendix A**. Site photographs were taken during the survey, in an upstream and downstream direction at each survey section location, which will be provided to stakeholders in digital format.

Table 6-1: Bathymetric survey drawing references

River Section	Plan Layout Drawing Reference	Section Drawing Reference
North	MGS44342_01SUIR_PLAN_01	MGS44342_01SUIR_LS_01 MGS44342_01SUIR_XS_01 to 06
South	MGS44342_02SUIR_PLAN_01	MGS44342_01SUIR_LS_01 MGS44342_01SUIR_XS_01 to 04
Little Island Channel	MGS44342_03SUIR_PLAN_01	MGS44342_01SUIR_LS_01 MGS44342_01SUIR_XS_01

Various topographical surveys were utilised in developing the model as summarised in **Section 4.4.1**. The information extracted from the surveys included levels on defence assets and the topographical survey of Suir Island.

6.1.1 Flood Defences

The following flood defence structures summarised in Table 6-2 are located within the model domain and were included in the bathymetric/topographic survey extents or modelled as a digital terrain model modification. The structure numbering follows the Clonmel Flood Defence Plan Drawing No. 9986_Clonmel_Flood_Defence_Plan_03 included in **Appendix A** and shown in Figure 6-1.

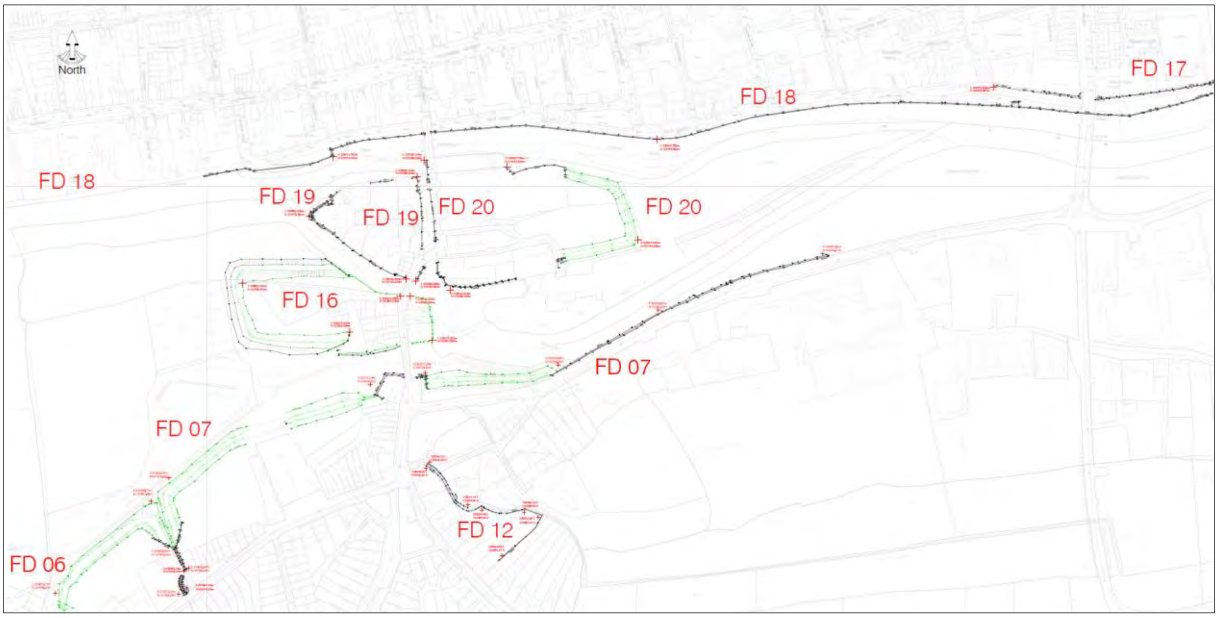


Figure 6-1: Plan layout of flood defence structures

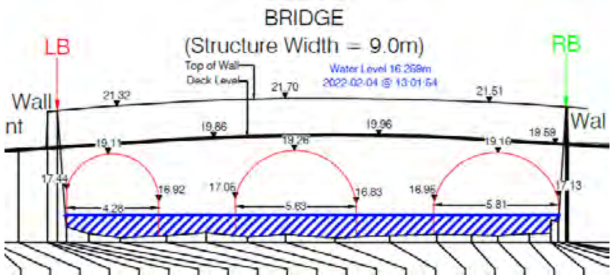
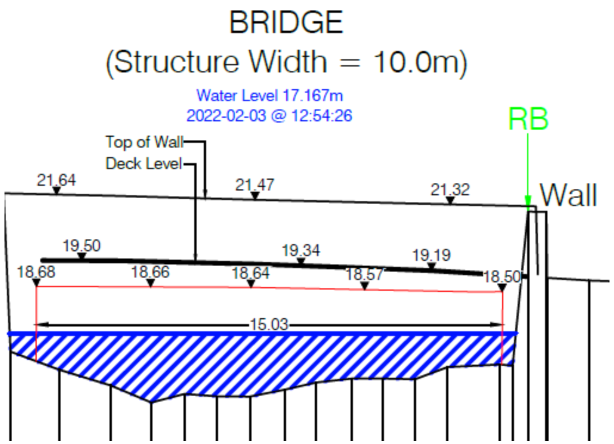
Table 6-2: Summary of flood defence structures

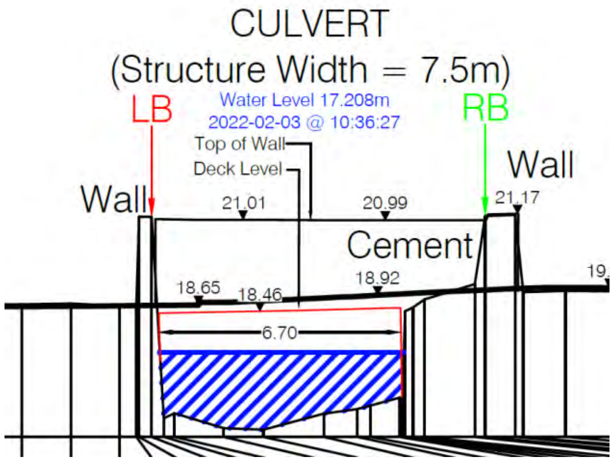
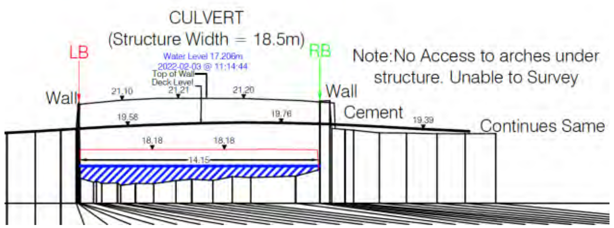
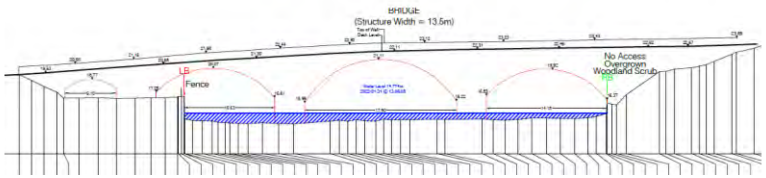
Flood Defence Structure I.D.	Description
FD 06	Earthfill embankment berm modelled as a terrain modification in the 2D DTM.
FD 07	Earthfill embankment berm modelled as a terrain modification in the 2D domain on the LIDAR surface and flood defence walls included in bathymetric survey sections.
FD 16	Earthfill embankment berm modelled as a terrain modification in the 2D DTM. Flood defence walls adjacent to the Suir River were included in the bathymetric survey sections.
FD 17	Defence walls levels updated on bathymetric survey sections as per surveyed levels from Defence Plan Drawing.
FD 18	Flood Defence Walls were included in the bathymetric survey sections of the Suir River. Demountable barrier levels were obtained from Murphy Surveys topographical survey Drawing MSL22204_T_3D_Rev1_0.
FD 19	Little Island flood defences were included in bathymetric survey sections.
FD 20	Suir Island flood defences included in bathymetric survey sections and the topographical survey Land & Aerial Surveys (December 2021) – Suir Island Infrastructure Links – Drawing No. 2021.054 Area 1 to Area 5

6.1.2 Bridges

The following bridges shown in Table 6-3 were surveyed during the Murphy Geospatial Ltd. bathymetric survey.

Table 6-3: Surveyed bridges

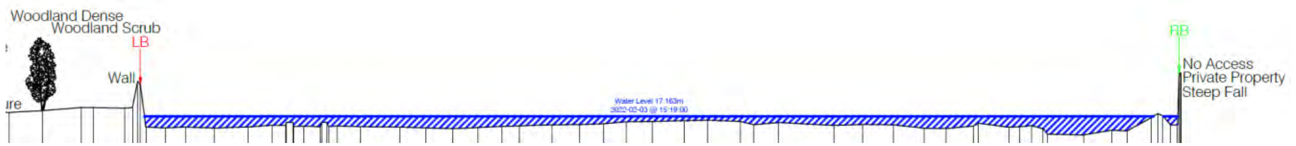
Bridge Name	Survey Section
Old Bridge North, located on the Suir North Reach (Drawing No MGS44342_01SUIR_XS_02)	
Old Bridge South, located on the Suir South Reach (Drawing No MGS44342_02SUIR_XS_01)	

Little Island Bridge 1, located on the Little Island Channel (Drawing No MGS44342_03SUIR_XS_01)	
Little Island Bridge 2, located on the Little Island Channel (Drawing No MGS44342_03SUIR_XS_01)	
Gashouse Bridge, located on the Suir North Reach (Drawing No MGS44342_01SUIR_XS_05)	

6.1.3 Weirs

The following weirs shown in Table 6-4 were surveyed during the Murphy Geospatial Ltd. bathymetric survey.

Table 6-4: Surveyed weirs

Weir Name	Survey Section
Dudley's Weir located on Suir North Reach (Drawing No. MGS44342_01SUIR_XS_02)	
Lady Blessington's Weir located on Suir South Reach (Drawing No. MGS44342_02SUIR_XS_01)	

7 Hydraulic Modelling

The modelling carried out under this study aims to accurately determine the post-development water-levels of the Suir River to ensure that the Clonmel Flood Relief Scheme flood defence structures are not undermined and rendered less effective. The study entails the assessment of a number of flood events ranging from 50% to 0.1% AEP from a pre-development and post-development scenario to determine the effect of construction bridge supports in the existing flood plain.

This chapter gives an overview of the hydraulic modelling development steps, model parameters and uncertainties. For more technical detail and results regarding the hydraulic model, refer to the Model Check File included in **Appendix C**.

7.1 Fluvial Model Development

The model flow schematic diagram is shown in Figure 7-1 and Figure 7-2. The northern river reach is divided into four (4) sections and the southern reach into two (2), with the naming convention starting at 01 from upstream to downstream. The Little Island Channel originates upstream of Dudley's Weir and flows into the southern reach upstream of Lady Blessington's Weir.

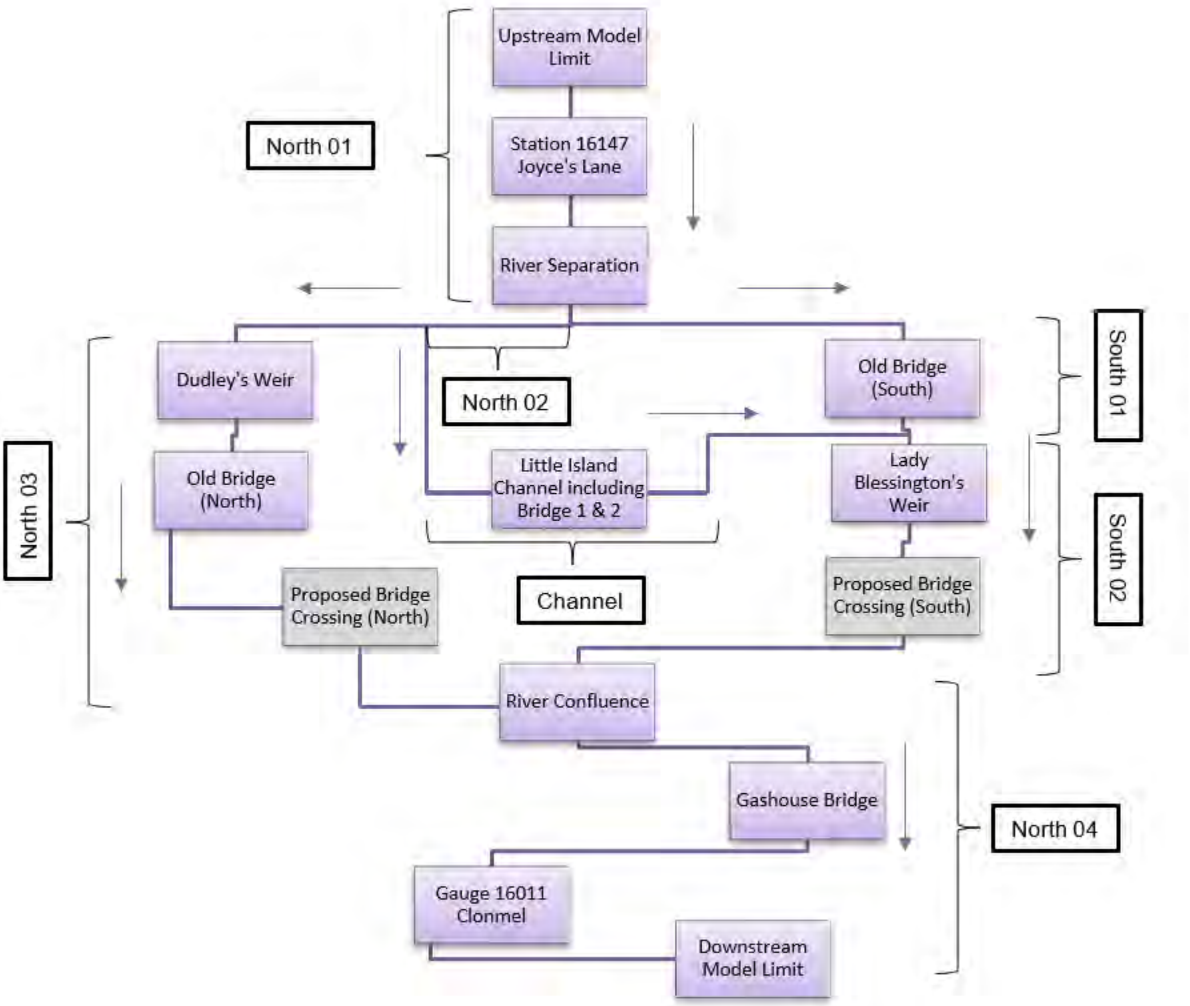


Figure 7-1: Model schematic diagram

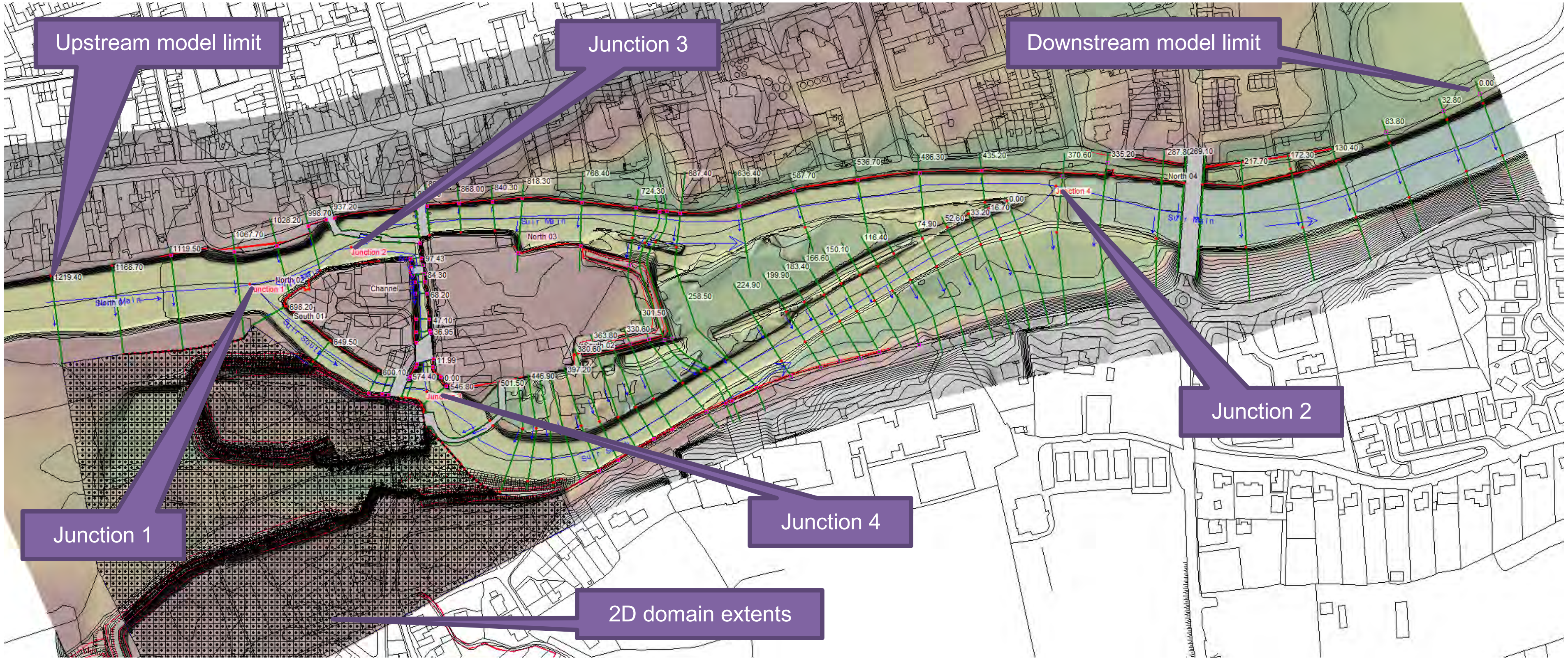


Figure 7-2: Fluvial model schematic

7.2 Key Model Parameters

7.2.1 Active Model Domain

The model domain starts approximately 250m upstream of Little Island and ends the same distance downstream of Gashouse Bridge. Table 7-1 summarises the model parameters for the 1D and 2D domains.

Table 7-1: Model domain parameters

1D Domain			
River Reach	Model Reach	River Length (m)	No. of Sections
Suir North	North 01	151.70	4
	North 02	29.50	2
	North 03	527.60	18
	North 04	370.60	11
Suir South	South 01	128.00	7
	South 02	567.20	29
Little Island Channel	Channel	97.30	11
2D Domain			
Area (ha)	7.8	**Mesh cell spacing (m)**	5x by 5y
Breakline cell spacing	2.5x by 2.5y	**Max cell size (m^2)** **Min cell size (m^2)** **Average cell size (m^2)**	41.51 0.5 18.02

7.2.2 Roughness

The model roughness is based on Chow (1965), USACE (1995) and Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains (USGS Water-Supply Paper 2339, 1989). Multiple roughness coefficients were set for key areas such as the Slalom Course, Suir Island and the existing Millrace. For more information regarding roughness coefficients, refer to the Model Check File in **Appendix C**.

7.2.3 Model Boundary Conditions

The inflow flood hydrographs derived in **Section 5.4** of the hydrological review were applied to the upstream boundary and a Normal Depth river slope to the downstream boundary condition.

7.2.4 DTM Modifications

The flood defences listed in **Section 6.1.1,** located within the 2D model domain, were modelled manually by the built-in functionality of HEC-RAS and RasMapper. This included 3 No flood defence berms and 2 no. flood defence walls/demountable barriers. Breaklines were used to refine the 2D mesh cells on defences to ensure mesh faces are aligned to not bypass the defence topography.

7.3 Model Limitations and Assumptions

All hydraulic models are susceptible to ambiguities due to inaccuracies in the various inputs required to develop a hydraulic model for example; hydrological inputs, topographical information, types of software utilised, software formulae, model parameters and the nature of any assumptions made.

Hydraulic modelling conducted during the Clonmel Flood Relief Scheme which commenced in 2008, utilised survey data, that is subject to change due to natural geomorphologic changes in the river channel and banks. A detailed bathymetric survey was requested in a relatively small area of the Suir River, with the aim to assess the pre- and post-development water levels with a high degree of certainty and mitigate uncertainties regarding topographic information inputs.

The key assumptions and uncertainties are summarised below for information.

7.3.1 Cross Sections

The following assumptions were made in the model with regards to cross sections:

- Due to the inherent difficulties involved with bathymetric surveys across a flowing river, section found to be not perpendicular to the river flow direction were “skewed” to reduce the flow area in the 1D domain;
- Sections, where the coverage fell short of the 1% AEP CFRAM fluvial flood extents were extended with data extracted from the Photogrammetry DTM;
- Due to the curvature of the proposed bridge crossings, custom sections had to be created based on the DTM consisting of the linearly interpolated bathymetric survey river sections and the topographical survey of Suir Island which includes the flood protection berm;
- The flood defences located along the northern river reach which are in the process of being raised by the installation of flood defence pillars and demountable boards were modelled as levees according to levels extracted from surveys listed in **Section 4.4.1**;
- Additional sections were interpolated linearly where lateral structures (1D/2D connections) were added or where HEC-RAS indicated the requirement of additional cross sections;
- Varying Manning’s roughness coefficients were applied to the southern river reach to account for the recent upgrades to the Slalom Course and to Suir Island due to vegetation coverage and the existing Mill Race; and
- Ineffective flow areas were added at locations where flow would not be actively conveyed due to topography, vegetation, changes to flow direction and bridge/weir support structures obstructing flow areas;

7.3.2 Representation of Structures

The following assumptions were made in the model with regards to structures:

- The bridge openings of Gashouse Bridge and Old Bridge North were modelled using as bridge low-cord extracted from the survey sections and not as culverts. This is due to the irregular shape, widths and elevations of the openings. The alternative option would have been to model the openings as culverts, which is based on different formulae and provides less flexibility in terms of modelling varying topography. Refer to **Section 7.5** for a sensitivity analysis completed for this assumption.
- All remaining bridges were modelled with the bridge low-cord functionality as the upstream and downstream widths and bridge soffit levels vary substantially.
- Weirs survey sections consisted of 3 sections namely, upstream, centreline and downstream. The elevations extracted from the centreline section was fitted to model the crest of weirs on the upstream section; and

- Due to the location of junctions, where the river splits into other reaches, an additional cross section was added upstream of Dudley's Weir and downstream of Gashouse Bridge due to the modelling software requirements to have a minimum of two sections upstream/downstream of junctions or reach start/end points; and
- Bridge No. 2 located in the Little Island Channel contains a pier underneath the 13.5m wide bridge deck. Access to this pier for survey purposes was deemed correctly to be unsafe and the dimensions of the pier was estimated based on the photographs taken during the survey.

7.3.3 Boundary Conditions

The following assumption was made in the model regarding the boundary conditions:

- The pre-development model used for calibration (**Section 7.4**) consisted of entering baseline parameters and changing the Normal Depth Slope to fit the calibration curve extracted from Gauge 16011 Clonmel. The Normal Depth is based on various slope measurements taken along the model domain bed slopes over different distances to determine the most representative slope.

7.3.4 Flood Plain and 1D/2D Connections

The following assumptions were made in the model regarding 1D/2D connections:

- 1D/2D connections or Lateral Structures profiles were extracted from the 2D DTM with a discharge coefficient of 0.2 input which represents a lateral structure "constructed" below ground, as per the HEC-RAS hydraulic reference manual guidelines.
- 1D/2D connection were kept to a minimum (2 No.) as this significantly influences model stability. Refer to **Section 9** for a detailed explanation and model limitations.
- The Weir Equation Overflow Computation Method was used to calculate the flow from 1D river sections to 2D floodplains, as this was found to be more stable than using the Normal 2D Equation Domain.

7.3.5 Model Limitations

As indicated in the proposed bridge crossing drawings included in **Appendix A** and shown in Figure 3-1 and 3-2, the abutments will be constructed behind the existing flood defence structures located in the North Plaza, Raheen Road and on top of the existing flood defence berm located on Suir Island. Thus, the post-development increase in water surface elevations will be contributed by the support piers constructed in the existing flood plain. A single pier is required for the North Bridge and 2 No. for the South Bridge. The pier design is narrow and consists of a base width of 410mm which tapers to 300mm at the bridge deck interface. To accurately compute the increase in water surface elevation due to these narrow piers obstructing flow in river channels of 50m and 75m widths, model stability and accuracy had to be preserved.

Factors affecting model stability includes stream junctions, bridges, inline structures such as weirs and lateral structures which act as the connection between 1D river cross sections and 2D floodplain areas. As noted in **Section 6** and **7**, this section of the Suir River contains several stream junctions, bridges, weirs and lateral structures. To preserve the model stability and accuracy, lateral structures i.e. 2D floodplain areas were limited to 2 lateral structures connected to one 2D floodplain.

As the existing flood defence structures provide protection for the 1% AEP event + 20% Climate Change scenario, flood events which would overtop the defence (i.e 0.1% AEP and 0.1% + 20%-30% CC) were not included in this model, as this would require multiple or very long lateral structures to be modelled at the expense of model stability and accuracy.

7.4 Model Calibration

As highlighted in **Section 4.3.1**, the Annual Maximum (AMAX) flows were extracted for Gauge Clonmel 16011, located on the downstream face of Gashouse Bridge. As shown in Figure 4-2, the AMAX event hydrographs vary considerably. The AMAX 2021 event was selected for calibration purposes due to the shape of the hydrograph showing a single peak with a steep rising limb and slower receding limb as described in the CFRAM hydrology report. The 2021 AMAX peak of 292.77 m^3/s is fairly close to the 20% AEP peak of 309.84 m^3/s.

The 2021 AMAX flow hydrograph was extracted from the OPW Hydronet website and introduced as the upstream boundary condition. The hydrograph was extracted from HEC-RAS on the downstream (tailwater (TW)) of Gashouse Bridge for comparison as shown in Figure 7-3. A standard 1% error in water surface elevation is shown for reference. The peak flow comparison is within 0.01% and the rising and receding limbs vary by approximately 0.8%. The hydrograph shape is influenced by various factors such as Manning's roughness, ineffective flow areas and bridge modelling methods.

As noted in **Section 4.3.2**, Gauge 16147 Joyce's Lane is located near the upstream boundary limit of the model. The CFRAM Hydrology and Gauge Rating Review reports makes no mention of this gauge and it is unknown if a Rating has been assigned to this gauge. Thus, the water levels for the 2021 AMAX event have been compared for information purposes only as shown in Figure 7-4, with no alterations made to the model. The peak water surface elevation comparison is within 0.1% tolerance.

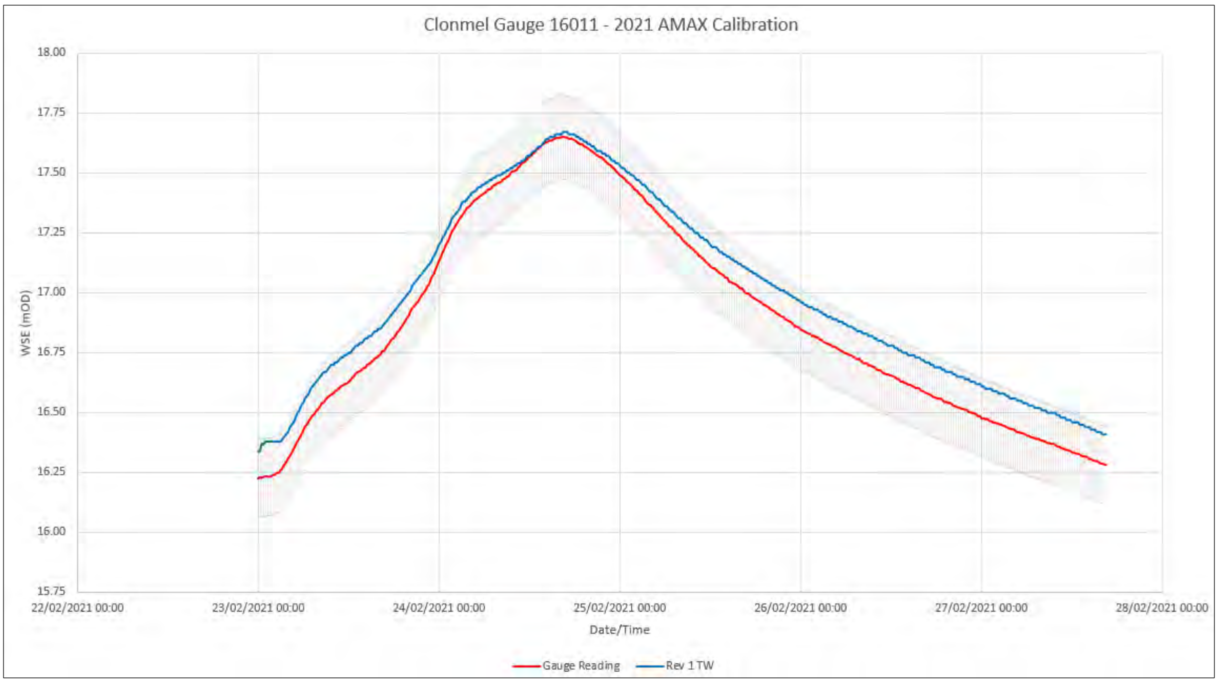


Figure 7-3: Gauge 16011 Clonmel 2021 AMAX calibration

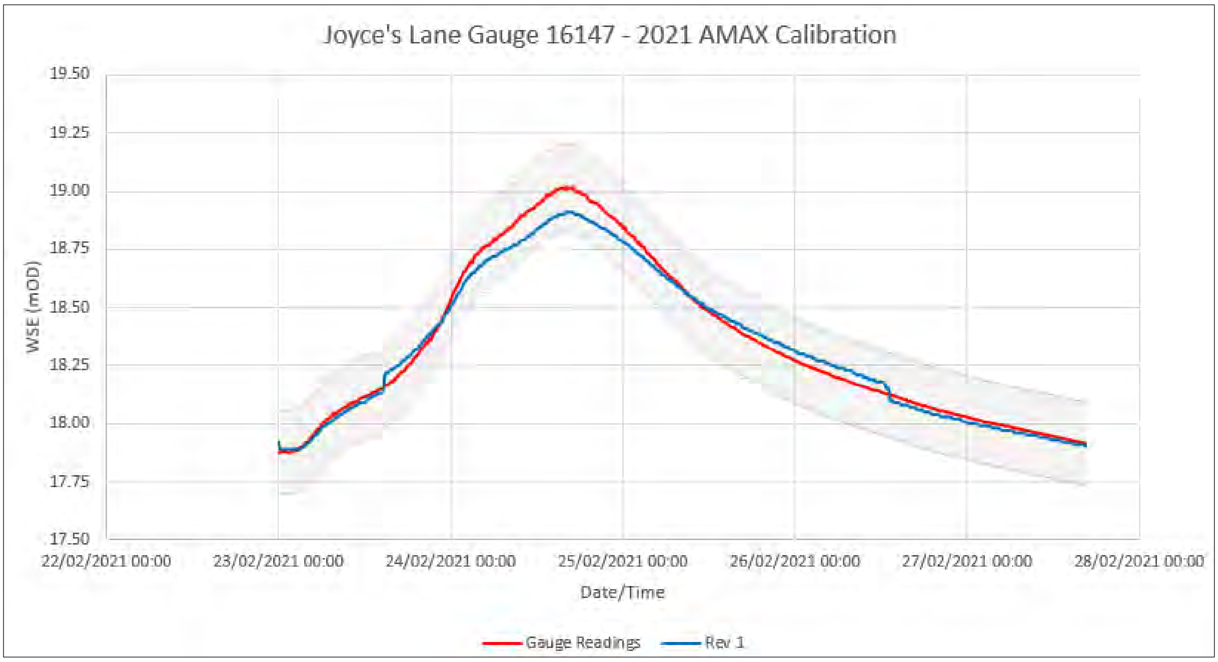


Figure 7-4: Gauge 16147 Joyce's Lane 2021 AMAX comparison

7.5 Sensitivity Analysis

A number of sensitivities were completed on the 1% AEP pre-development and post-development models, which are summarised in Table 7-2. For detailed results, refer to the Model Check File included in **Appendix C**.

Table 7-2: Model sensitivities

Sensitivity Description	Parameter
1. Variation to Manning's Roughness	+20% on all sections and 2D areas
2. Gashouse/Old Bridge North	Openings modelled as low-cord and Con/Span Arch with Span/Rise Ratio of 4:1 and 2:1
3. Variations in Computational Timestep	Timesteps varied from 1 second to 30 second and Advanced Timestep Control (Courant)
4. Variations in Theta Implicit Weighting Factors	Varied from 0.6 or 1.0 , where 0.6 increases numerically accuracy but decreases model stability.
5. Variations in Stability Factors for Lateral and Inline Structures	Varied from 1 to 3, where 1 increases numerical accuracy but decreases model stability
6. 1D Numerical Solution Formulae	Finite Difference (Default) vs Finite Volume (New)
7. Variation in Bridge High Flow Methods	Pressure flow with submerged Inlet and Outlet Discharge Coefficient of 0.8 for bridges located in Little Island Channel and South 01 reach

7.6 Model Design Simulations

Table 7-3 summarises the model simulations to assess the pre- and post-development water levels.

Table 7-3: Summary of Model Simulations

Model	Fluvial AEP	Current	MRFS	Sensitivities
Pre-development 1D/2D	50%	Y	Y	-
	20%	Y	Y	-
	10%	Y	Y	-
	5%	Y	Y	-
	2%	Y	Y	-
	1%	Y	Y	No. 1 to 8
	0.1%	Y	-	-
Post-development 1D/2D	50%	Y	-	-
	20%	Y	-	-
	10%	Y	Y	-
	5%	Y	-	-
	2%	Y	-	-
	1%	Y	Y	No. 4 and No. 7
	0.1%	Y	-	-

8 Model Results

This Chapter of the report summarises the results of the hydraulic modelling and compares the pre- and post-development water surface elevations (WSE) at the cross sections, located upstream and downstream of the proposed bridge crossings. Only a few of the design events are shown below, refer to the Model Results included in **Appendix D** for the results showing all design events and cross sections.

8.1 North Bridge

As per Table 8-1, the model cross sections upstream and downstream of the proposed North Bridge, consisting of 1 No. support pier constructed in the floodplain, resulted in a negligible increase in the water surface elevation ranging from 1mm to 9mm approximately. It should be noted that the water surface elevations are sensitive to the model stability i.e. Volumetric Accounting Errors within HEC-RAS. For reference, the Volume Accounting Errors for each simulation is shown below.

Table 8-1: North Bridge Pre- and Post-Development Water Surface Elevation comparison

River	Reach	XS Station	Pre-Development WSE (mOD)				Post-Development WSE (mOD)				Increase in WSE (m)			
			50% AEP	10% AEP	1% AEP	0.1% AEP	50% AEP	10% AEP	1% AEP	0.1% AEP	50% AEP	10% AEP	1% AEP	0.1% AEP
Suir Main	**North 03**	768.4	17.706	18.491	19.320	20.019	17.706	18.489	19.324	20.060	0.000	-0.002	0.004	0.041
		724.3	17.637	18.441	19.291	19.999	17.637	18.442	19.296	20.044	0.000	0.001	0.005	0.045
		704	17.637	18.447	19.299	20.010	17.638	18.446	19.304	20.052	0.001	-0.001	0.005	0.042
		701	**North Bridge Centreline**											
		698	17.637	18.446	19.300	20.014	17.639	18.445	19.303	20.054	0.002	-0.001	0.003	0.040
		687.4	17.640	18.462	19.330	20.046	17.642	18.460	19.331	20.083	0.002	-0.002	0.001	0.037
		636.4	17.603	18.413	19.288	20.027	17.605	18.414	19.292	20.074	0.002	0.001	0.004	0.047
Overall Volume Accounting Error in 1000 m^3:			**-0.1193**	**-0.0488**	**-0.5520**	**-0.0310**	**-0.1266**	**0.7391**	**-16.944**	**-10.274**	**-0.007**	**0.788**	**-16.392**	**-10.244**
Overall Volume Accounting Error as percentage:			**0.0001**	**0.0000**	**0.0001**	**0.00002**	**0.0001**	**0.0008**	**0.0147**	**0.00721**	**0.000**	**0.001**	**0.015**	**0.007**

8.2 South Bridge

As shown in Table 8-2, the South Bridge crossing containing 2 No. support piers constructed in the floodplain, resulted in a slightly great impact on the upstream water surface elevations of approximately 30mm to 32mm and higher energy head losses resulting in a negligible increase in downstream water levels.

Table 8-2: South Bridge Pre- and Post-Development Water Surface Elevation comparison

River	Reach	XS Station	Pre-Development WSE (mOD)				Post-Development WSE (mOD)				Increase in WSE (m)			
			50% AEP	10% AEP	1% AEP	0.1% AEP	50% AEP	10% AEP	1% AEP	0.1% AEP	50% AEP	10% AEP	1% AEP	0.1% AEP
Suir South	South 02	330.6	17.706	18.482	19.351	20.092	18.527	18.519	19.385	20.163	0.030	0.037	0.034	0.071
		301.5	17.690	18.467	19.335	20.086	18.511	18.503	19.370	20.156	0.030	0.036	0.035	0.070
		281	17.673	18.454	19.323	20.062	18.497	18.490	19.358	20.131	0.032	0.036	0.035	0.069
		278	South Bridge Centreline											
		275	17.645	18.432	19.304	20.043	18.443	18.439	19.312	20.086	0.000	0.007	0.008	0.043
		258.5	17.623	18.430	19.312	20.057	18.441	18.437	19.320	20.101	0.001	0.007	0.008	0.044
		224.9	17.596	18.397	19.278	20.022	18.405	18.403	19.285	20.064	0.001	0.006	0.007	0.042
Overall Volume Accounting Error in 1000 m^3:			Refer to Table 8-1											
Overall Volume Accounting Error as percentage:			Refer to Table 8-1											

8.3 Bridge Scour

Bridge scour depths can be computed in HEC-RAS by using the Hydraulic Design Functionalities. The program automatically populates the parameters from the selected AEP event by extracting information from the computed approach section, section just upstream of the bridge and the internal bridge section.

Contraction scour can be computed either by Laursen's clear-water (Laursen, 1963) or live-bed (Laursen,1960) equations. The two equations (Laursen 1963 and 1960) estimate the combined total scour based on the contraction scour plus pier scour. Only one particle size distribution sample was taken at the base of the pier for South Bridge, which is not representative of the riverbed particle size. The combined total scour comparison is shown below for D50 size of 0.16mm and estimated 1mm for comparison based on the clear-water equation.

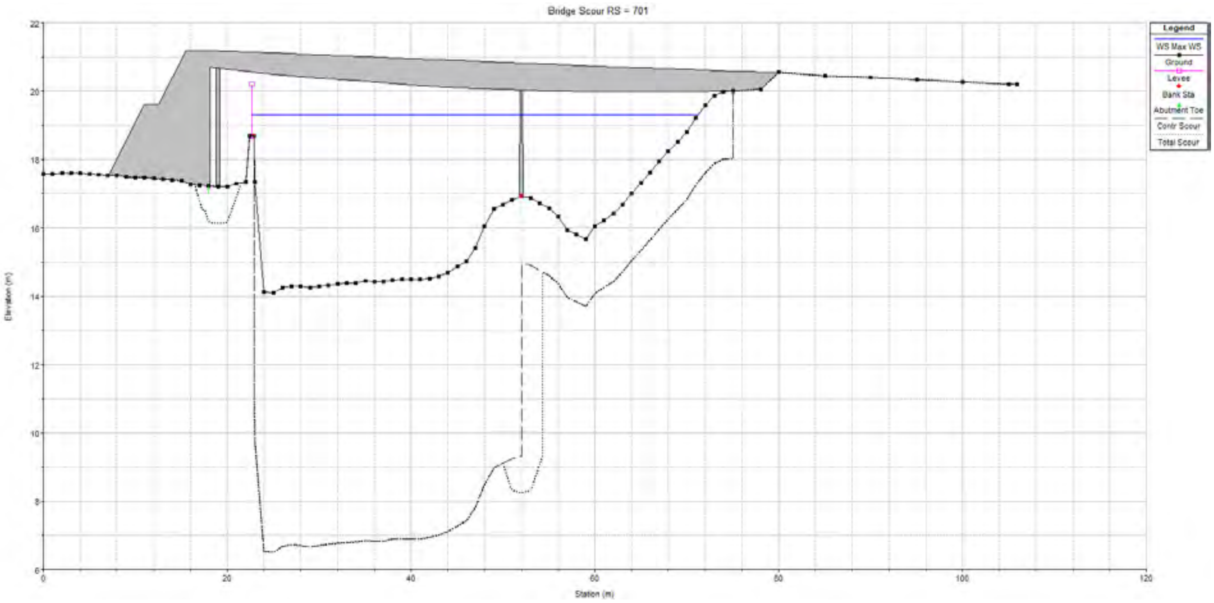


Figure 8-1: North Bridge Total scour for D50 = 0.16mm

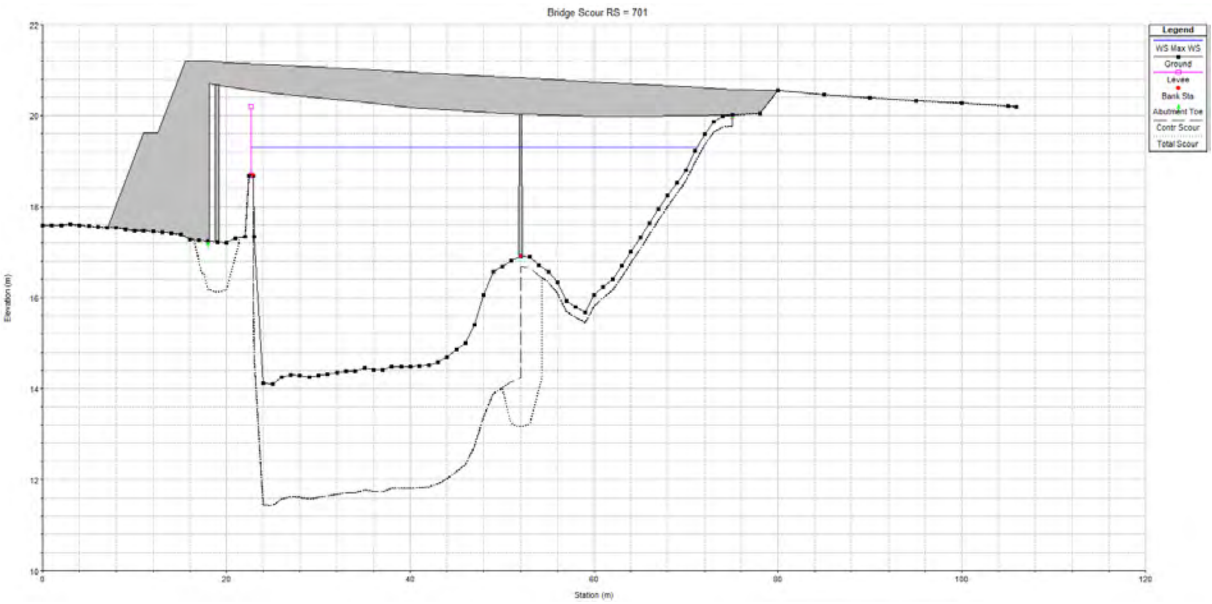
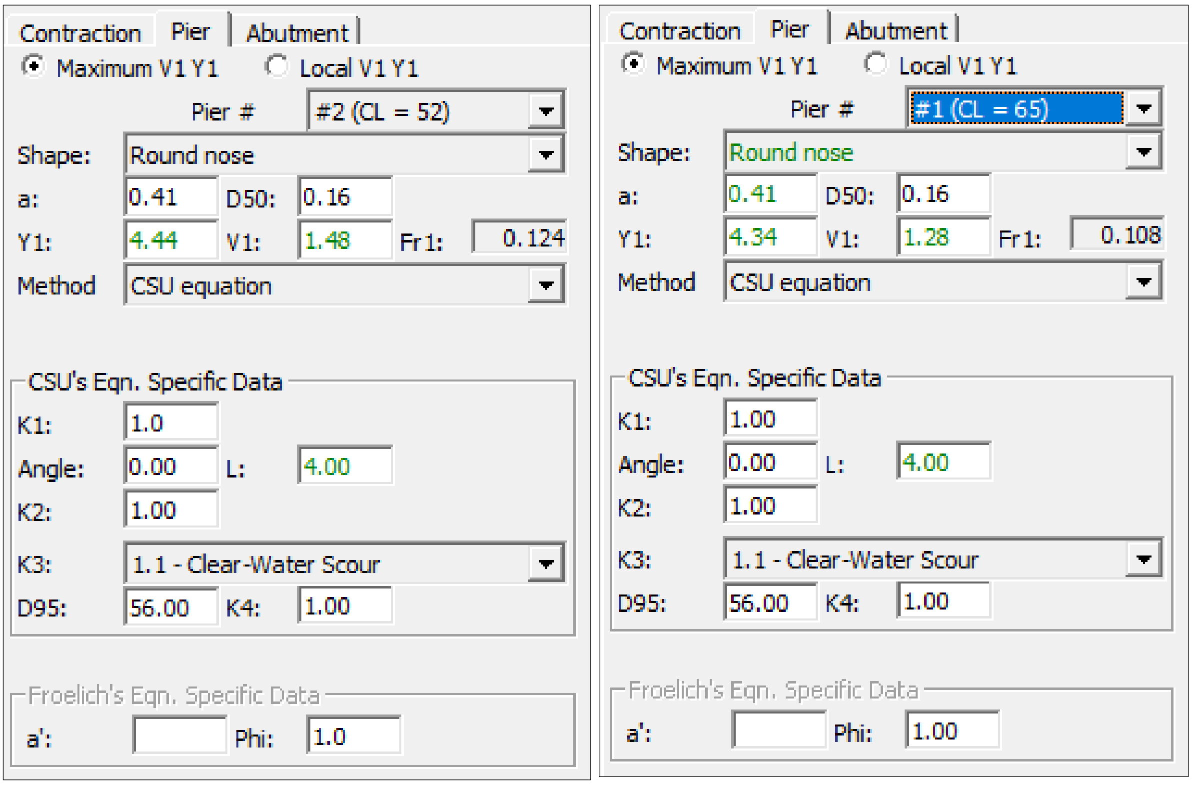


Figure 8-2: North Bridge Total scour for D50 = 1mm

Pier Scour can be computed by either the Colorado State University (CSU) equation (Richardson, et al, 1990) or the Froehlich (1988) equation. Table 8-3 shows the input parameters for the North Bridge (left) and South Bridge (right),used to compute the pier scour depth based on the CSU equation the 1% AEP design event.

Table 8-3: Pier Scour Parameters



<u>Where:</u>

a = Width of pier
Y1 = Depth of water upstream of pier
V1 = Average velocity upstream of pier
Fr1 = Froude number upstream of pier
K1 = Correction factor applied to pier shape
Angle = Angle of attack as flow approaches pier
K2 = Correction factor applied to angle of attack
K3 = Correction factor applied to bed condition
K4 = Correction factor applied to armouring of scour hole only if (D50 > 2mm)
D95 = The median size of the bed material of which 95% is finer

The pier scour depths for the proposed bridge crossings are shown in Figure 8-1 and Figure 8-2 below for the 1% AEP design event with a 0° Angle of Attack (piers orientated in flow direction). Table 8-5 summarises sensitivities to pier scour depth for a single pier in each section by increasing the Angle of Attack. Refer to the Drawing MMA_Suir island_220225_ITM-03-Piles and foundations included in **Appendix E** for design layouts of the piers and foundations.

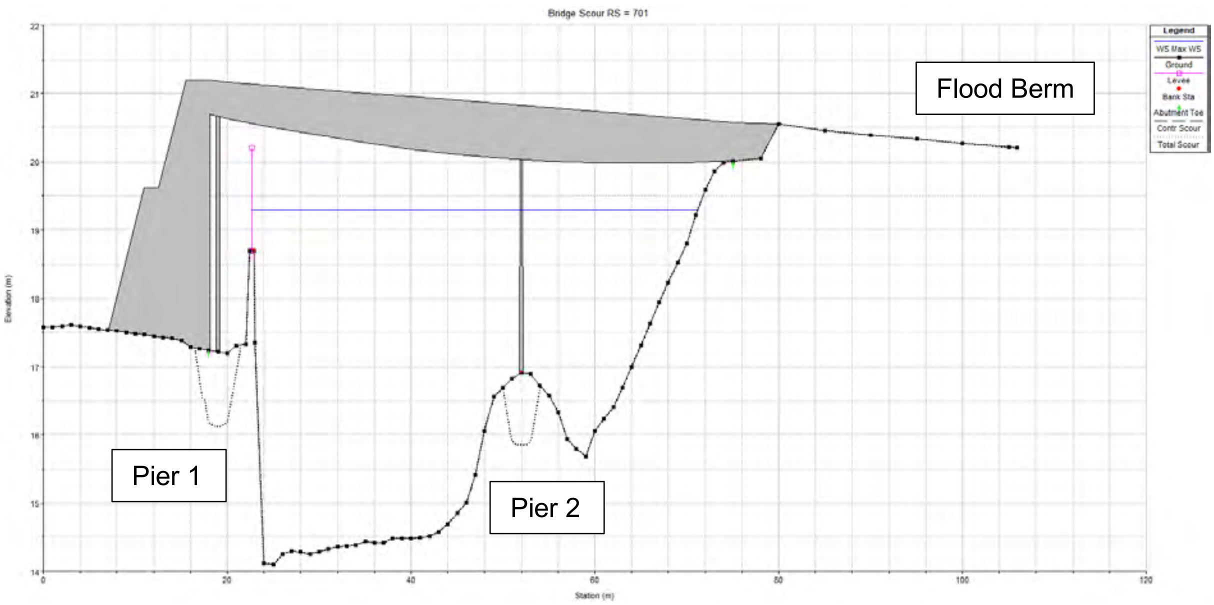


Figure 8-3: North Bridge scour depth (1% AEP, 0° Angle)

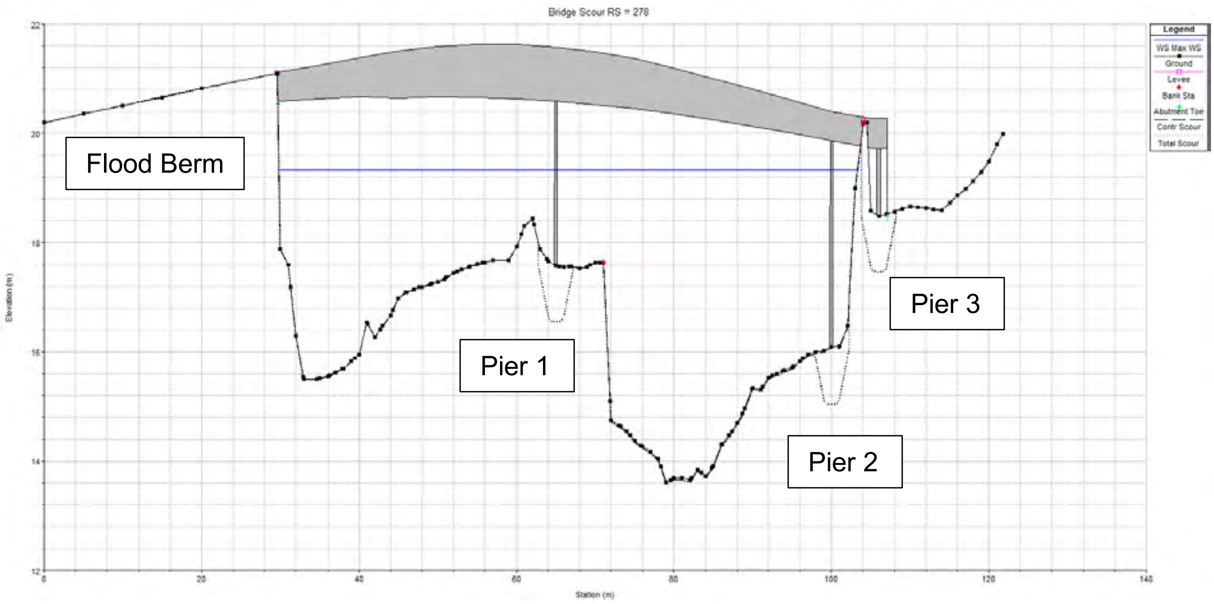


Figure 8-4: South Bridge scour depth (1% AEP, 0° Angle)

Table 8-4: Scour depth sensitivity with increasing Angle of Attack

North Bridge											
Pier No.	**NGL (mOD)**	**0° Angle**		**10° Angle**		**20° Angle**		**30° Angle**		**45° Angle**	
		Elevation (mOD)	**Depth (m)**	**Elevation (mOD)**	**Depth (m)**	**Elevation (mOD)**	**Depth (m)**	**Elevation (mOD)**	**Depth (m)**	**Elevation (mOD)**	**Depth (m)**
Pier 1	17.22	16.13	**1.09**								
Pier 2	16.91	15.85	**1.06**	14.86	**2.05**	14.13	**2.78**	13.53	**3.38**	12.86	**4.05**
South Bridge											
Pier No.	**NGL (mOD)**	**0° Angle**		**10° Angle**		**20° Angle**		**30° Angle**		**45° Angle**	
		Elevation (mOD)	**Depth (m)**	**Elevation (mOD)**	**Depth (m)**	**Elevation (mOD)**	**Depth (m)**	**Elevation (mOD)**	**Depth (m)**	**Elevation (mOD)**	**Depth (m)**
Pier 1	17.57	16.56	**1.01**	15.64	**1.93**	14.96	**2.61**	14.4	**3.17**	13.77	**3.8**
Pier 2	16.06	15.04	**1.02**								
Pier 3	18.48	17.46	**1.02**								

8.4 Bridge Deck Freeboard

As shown in Figure 8-5 and 8-6, the proposed bridge deck elevations have sufficient freeboard between the bridge soffit levels and the 1% AEP event of approximately 0.69m and 0.39m (minimum) for the North and South Bridge crossings, respectively. Compared to the 0.1% AEP event no freeboard would be available but the proposed bridge decks will not be overtopped or significantly increase the water surface elevations.

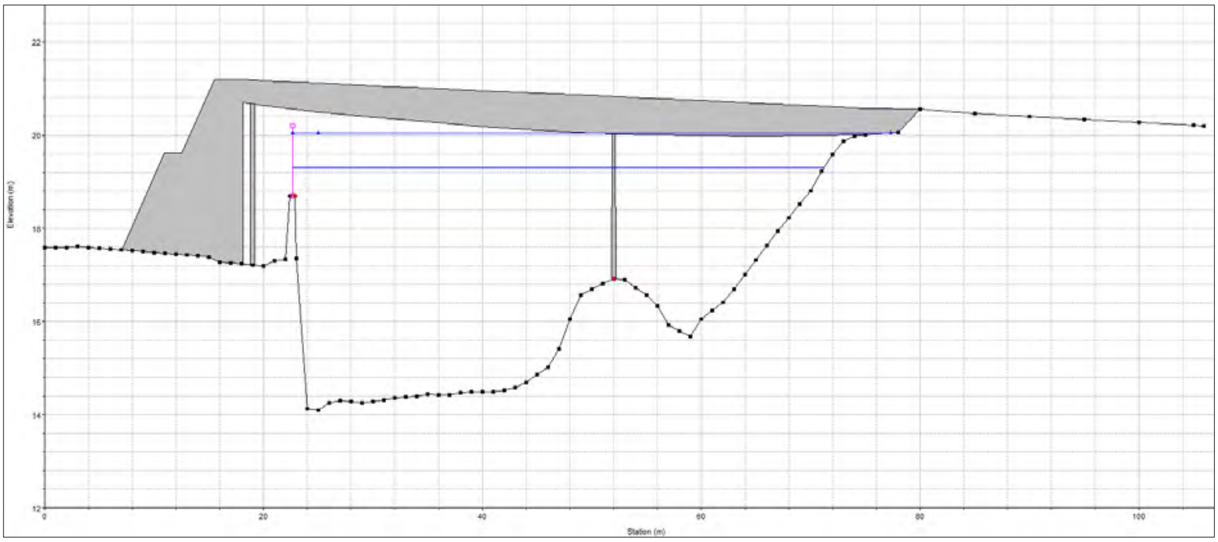


Figure 8-5: North Bridge freeboard to 1% and 0.1% AEP

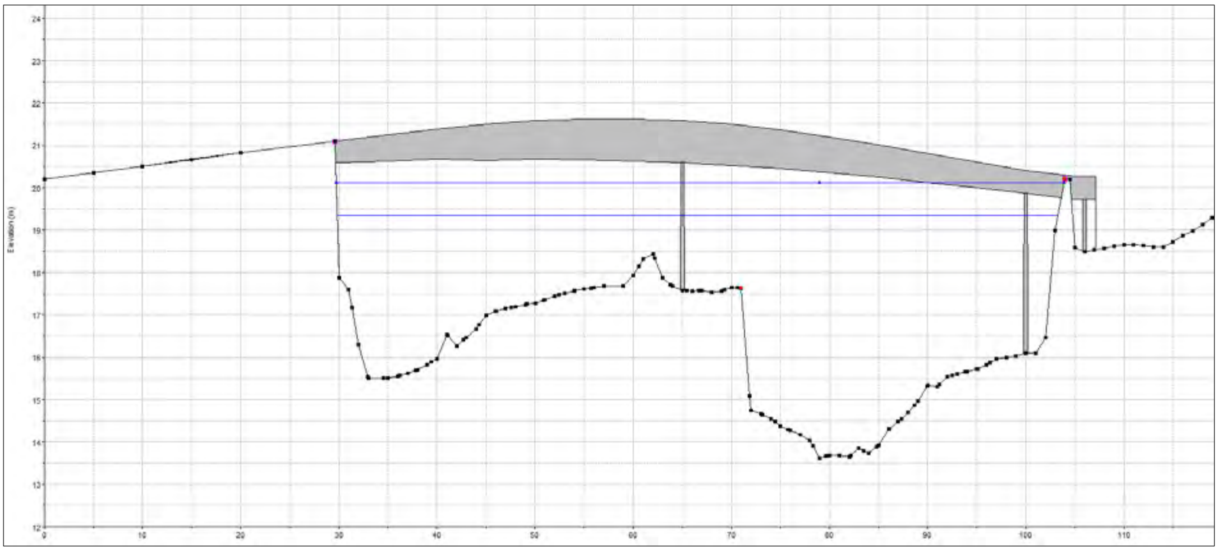


Figure 8-6: South Bridge freeboard to 1% and 0.1% AEP

9 Summary & Conclusions

This report presents the findings from the detailed hydraulic modelling assessment which has been completed for the Suir Island Infrastructure Links proposed development located Clonmel, Co. Tipperary.

The purpose of the detailed hydraulic modelling was to assess the effect on flood water levels from the proposed construction of the two pedestrian bridge crossings. In order to achieve this, a 1D/2D linked hydrodynamic model was constructed in HEC-RAS, built utilising recent bathymetric survey information of the Suir River and topographic survey of inline structures such as bridges, weirs and lateral structures such as flood defence structures. The proposed development drawings and survey information is included in **Appendix A**.

Extensive studies have been completed for the Suir River and in particular for the Town of Clonmel in terms of flood protection. Available information pertaining to hydrology and hydraulic modelling conducted during the Suir CFRAM and Clonmel Flood Relief Scheme was reviewed and summarised in **Section 4**.

The hydrological review followed the Flood Studies Updated methodology and the outcomes compared to previous studies. The Suir CFRAM Hydrology Report and National Gauge Rating Review Report stated flood peak flows for Gauge 16011 Clonmel which is considerably lower than the peak flows shown on the Suir CFRAM fluvial maps and the FSU hydrological review. Refer to **Section 5** for details regarding the hydrological review and **Appendix B** for the FSU report.

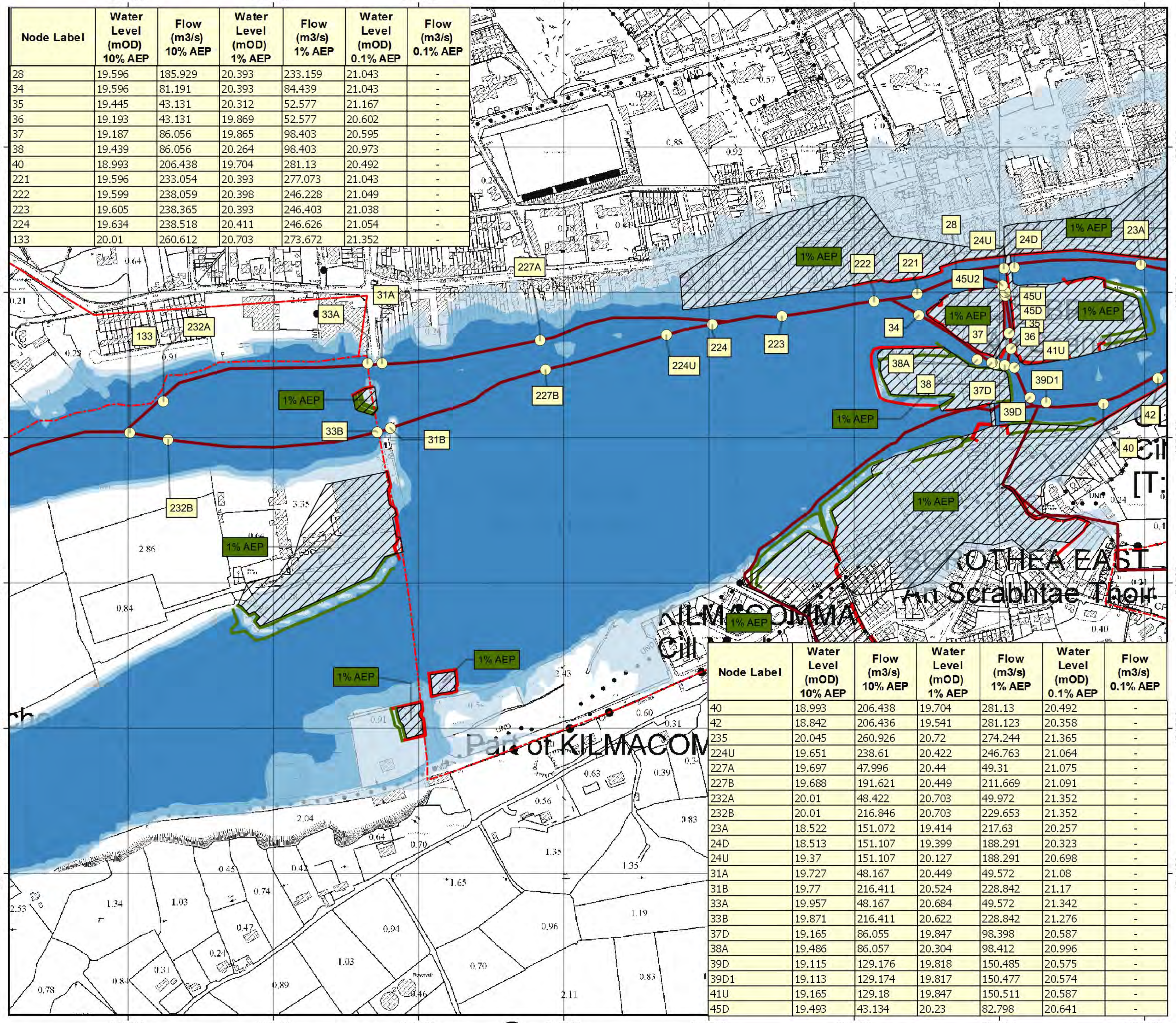
The various sources of information used to build the HEC-RAS model is summarised in **Section 6** and details regarding the model development, parameters, calibration and simulations are summarised in **Section 7**. For more detailed and technical information regarding the model, refer to the Model Check File included in **Appendix C**. Assumptions and model limitations are highlighted in **Section 7.3**.

The model results are summarised in **Section 8**, which compares the pre- and post-development water levels at the proposed bridge crossings. The approximate rise in water surface elevations is summarised in **Table 8-1** and **8-2**. The construction of the proposed bridge support structures and foundations in the existing flood plain will result in an approximate maximum increase in flood water surface elevations of 10mm and 32mm, for the North and South Bridge, respectively. This is considered to be Minor to Negligible and will not undermine the efficacy of the existing flood defence structures completed in the Clonmel Flood Relief Scheme. Bridge scour depths were computed, based on a soil sample taken during the site investigations, which is summarised in **Section 8.3** and **Section 8.4** summarises the minimum available freeboard between the bridge soffit levels and design peaks. Refer to **Appendix D** for the detailed model results.

The findings in this report confirm that the requirements set out in the OPW guidelines “Construction, Replacement and Alteration of Bridges and Culverts – A Guide to Applying for Consent Under Section 50 of the Arterial Drainage Act, 1945” are achieved. The requirements for the design of hydraulically efficient bridges/culverts are summarised below:

- A bridge or culvert must be capable of passing a fluvial flood flow within a 1% annual exceedance probability (AEP) flow without significantly changing the hydraulic characteristics of the watercourse;
- A bridge must be capable of operating under the above design conditions while maintaining a freeboard of at least 300mm;
- If the land potentially affected includes dwelling and infrastructure, it must be demonstrated that those dwellings and/or infrastructure are not adversely affected by the bridge or culvert.

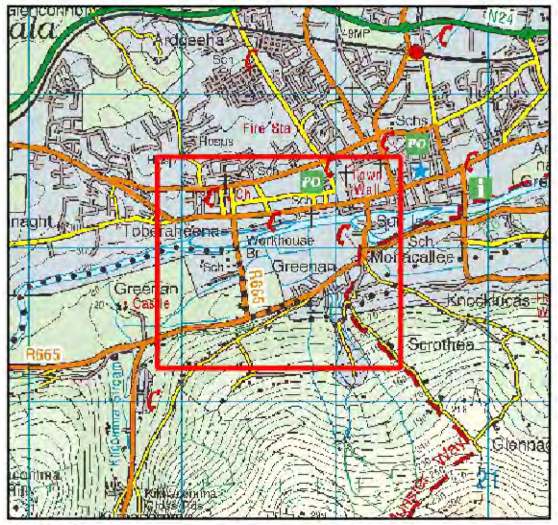
Appendix A – Information



Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
28	19.596	185.929	20.393	233.159	21.043	-
34	19.596	81.191	20.393	84.439	21.043	-
35	19.445	43.131	20.312	52.577	21.167	-
36	19.193	43.131	19.869	52.577	20.602	-
37	19.187	86.056	19.865	98.403	20.595	-
38	19.439	86.056	20.264	98.403	20.973	-
40	18.993	206.438	19.704	281.13	20.492	-
221	19.596	233.054	20.393	277.073	21.043	-
222	19.599	238.059	20.398	246.228	21.049	-
223	19.605	238.365	20.393	246.403	21.038	-
224	19.634	238.518	20.411	246.626	21.054	-
133	20.01	260.612	20.703	273.672	21.352	-

Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
40	18.993	206.438	19.704	281.13	20.492	-
42	18.842	206.436	19.541	281.123	20.358	-
235	20.045	260.926	20.72	274.244	21.365	-
224U	19.651	238.61	20.422	246.763	21.064	-
227A	19.697	47.996	20.44	49.31	21.075	-
227B	19.688	191.621	20.449	211.669	21.091	-
232A	20.01	48.422	20.703	49.972	21.352	-
232B	20.01	216.846	20.703	229.653	21.352	-
23A	18.522	151.072	19.414	217.63	20.257	-
24D	18.513	151.107	19.399	188.291	20.323	-
24U	19.37	151.107	20.127	188.291	20.698	-
31A	19.727	48.167	20.449	49.572	21.08	-
31B	19.77	216.411	20.524	228.842	21.17	-
33A	19.957	48.167	20.684	49.572	21.342	-
33B	19.871	216.411	20.622	228.842	21.276	-
37D	19.165	86.055	19.847	98.398	20.587	-
38A	19.486	86.057	20.304	98.412	20.996	-
39D	19.115	129.176	19.818	150.485	20.575	-
39D1	19.113	129.174	19.817	150.477	20.574	-
41U	19.165	129.18	19.847	150.511	20.587	-
45D	19.493	43.134	20.23	82.798	20.641	-

Location Plan:



LEGEND

- AFA Boundary
- Defended Area
- Modelled River Centreline
- Node Point
- 10% AEP Fluvial Extent (High Risk)
- 1% AEP Fluvial Extent (Medium Risk)
- 0.1% AEP Fluvial Extent (Low Risk)
- Flood Defence - Embankment
- Flood Defence - Wall
- Gate
- NODE123 — Node Label
- XX% AEP — Standard of Protection of Flood Defence

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
Jonathan Swift Street
Trim
Co. Meath

Project:
SUIR CFRAM STUDY

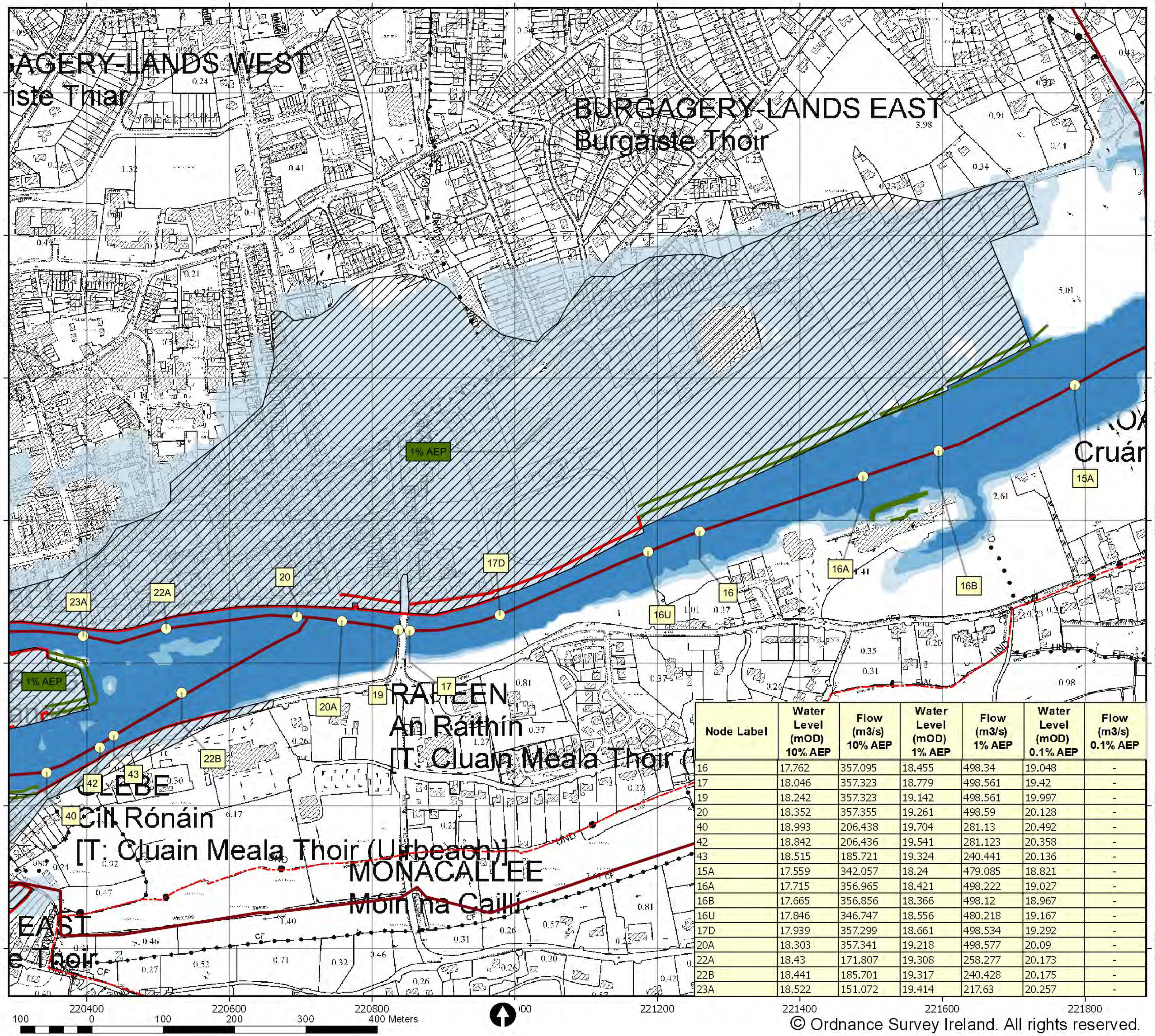
Map:
CLONMEL SCHEME
FLUVIAL FLOOD EXTENT MAP

Map Type:	EXTENT		
Source:	FLUVIAL		
Map Area:	HPW		
Scenario:	CURRENT		
Drawn by:	NMC	Date:	Sep - 2016
Checked by:	MC	Date:	Sep - 2016
Approved by:	GG	Date:	Sep - 2016

Map No.:
O16CLN_EXFCD_F0_45

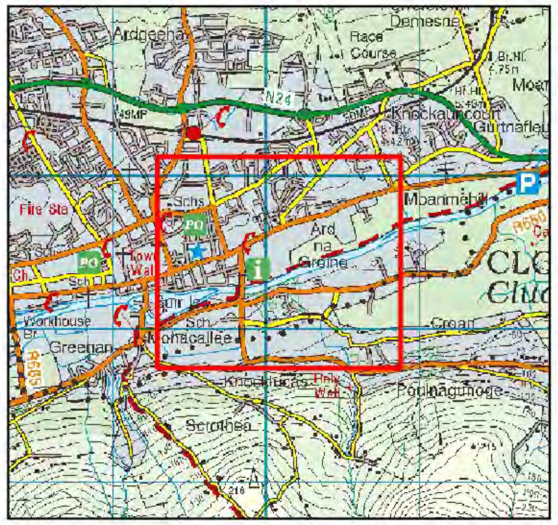
Revision: F0

Map Scale: 1:5,000   Plot Scale: 1:1 @ A3



Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
16	17.762	357.095	18.455	498.34	19.048	-
17	18.046	357.323	18.779	498.561	19.42	-
19	18.242	357.323	19.142	498.561	19.997	-
20	18.352	357.355	19.261	498.59	20.128	-
40	18.993	206.438	19.704	281.13	20.492	-
42	18.842	206.436	19.541	281.123	20.358	-
43	18.515	185.721	19.324	240.441	20.136	-
15A	17.559	342.057	18.24	479.085	18.821	-
16A	17.715	356.965	18.421	498.222	19.027	-
16B	17.665	356.856	18.366	498.12	18.967	-
16U	17.846	346.747	18.556	480.218	19.167	-
17D	17.939	357.299	18.661	498.534	19.292	-
20A	18.303	357.341	19.218	498.577	20.09	-
22A	18.43	171.807	19.308	258.277	20.173	-
22B	18.441	185.701	19.317	240.428	20.175	-
23A	18.522	151.072	19.414	217.63	20.257	-

Location Plan:



LEGEND

- AFA Boundary
- Defended Area
- Modelled River Centreline
- Node Point
- 10% AEP Fluvial Extent (High Risk)
- 1% AEP Fluvial Extent (Medium Risk)
- 0.1% AEP Fluvial Extent (Low Risk)
- Flood Defence - Embankment
- Flood Defence - Wall
- Gate
- NODE123 Node Label
- x% AEP Standard of Protection of Flood Defence

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

OPW
The Office of Public Works
Jonathan Swift Street
Trim
Co. Meath

Project: SUIR CFRAM STUDY

Map: CLONMEL SCHEME FLUVIAL FLOOD EXTENT MAP

Map Type:	EXTENT		
Source:	FLUVIAL		
Map Area:	HPW		
Scenario:	CURRENT		
Drawn by:	NMC	Date:	Sep - 2016
Checked by:	MC	Date:	Sep - 2016
Approved by:	GG	Date:	Sep - 2016
Map No.:	O16CLN_EXFCD_F0_46		
Revision:	F0		
Map Scale: 1:5,000		Plot Scale: 1:1 @ A3	

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LEGEND

section plan details

- Surveyed Section Lines with References & Section Orientation (at Open channel)
- Surveyed Section Lines with References & Section Orientation (at Structures)
- Surveyed Section Lines with References & Section Orientation (at Additional items)

No. 318

THE SURVEY ASSOCIATION

Supply-Line empowered by Achilles

Map Sheet Layout:

Map Sheet : OSI 5429 B,D & 5430 A-D

North

DATUM: - Malin Hd.
GRID SYSTEM: - ING

Site Location

Surveyed by : MSL		Date: July 2014	
Drawn by : RK		Date: July 2014	
Checked by : PF		Date: 18.07.14	

Revisions

No.	Date	Description
0	18.07.14	First Drawing

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Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography
Kildare Cork Belfast London

Mott MacDonald

OPW
The Office of Public Works
Oifig na nOibreacha Poiblí

Client : OFFICE OF PUBLIC WORKS

Project : 00000009986_SRFT_Minicomp_011_2014

Date : 18.07.14 **Scale :** 1:1000@A0

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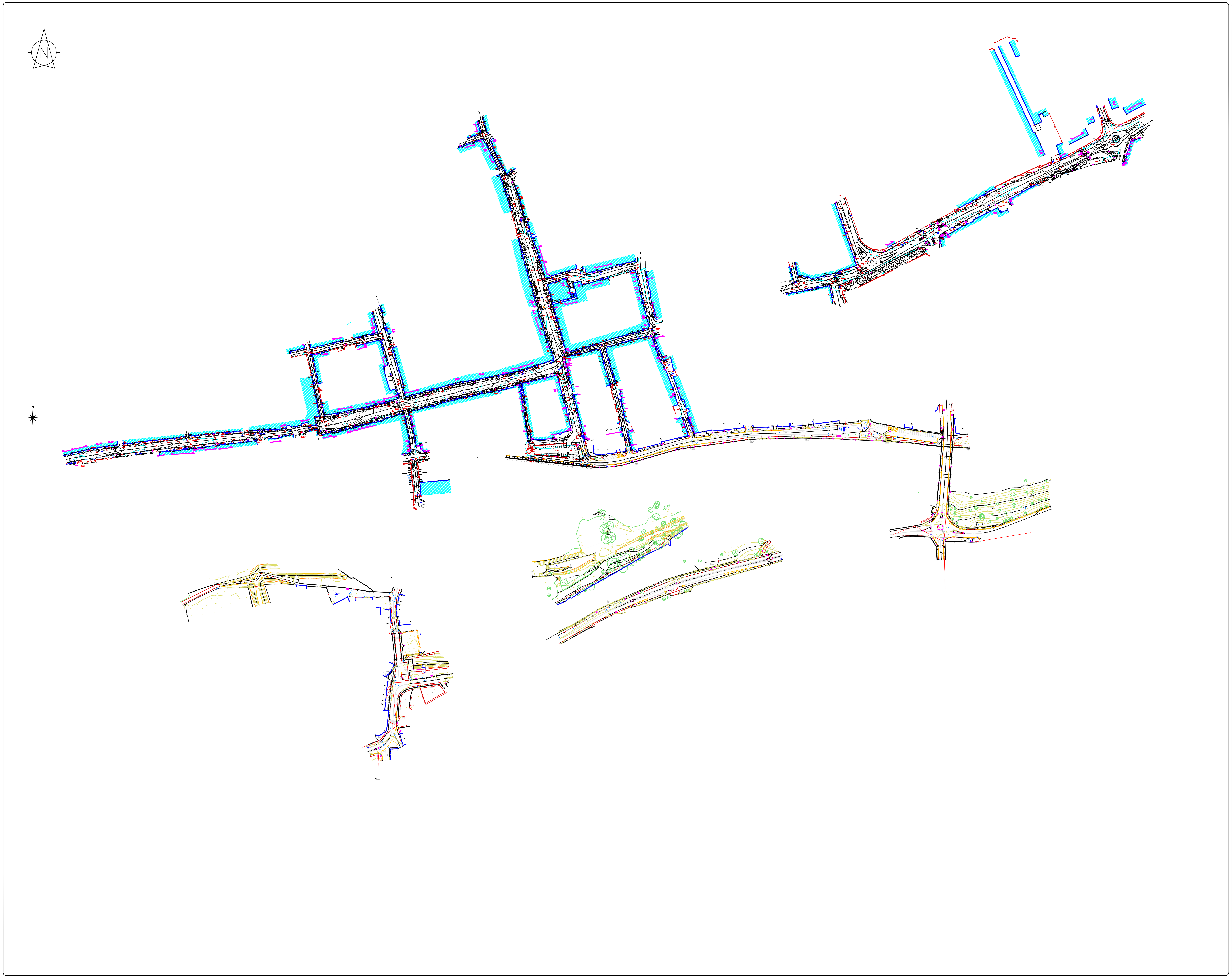
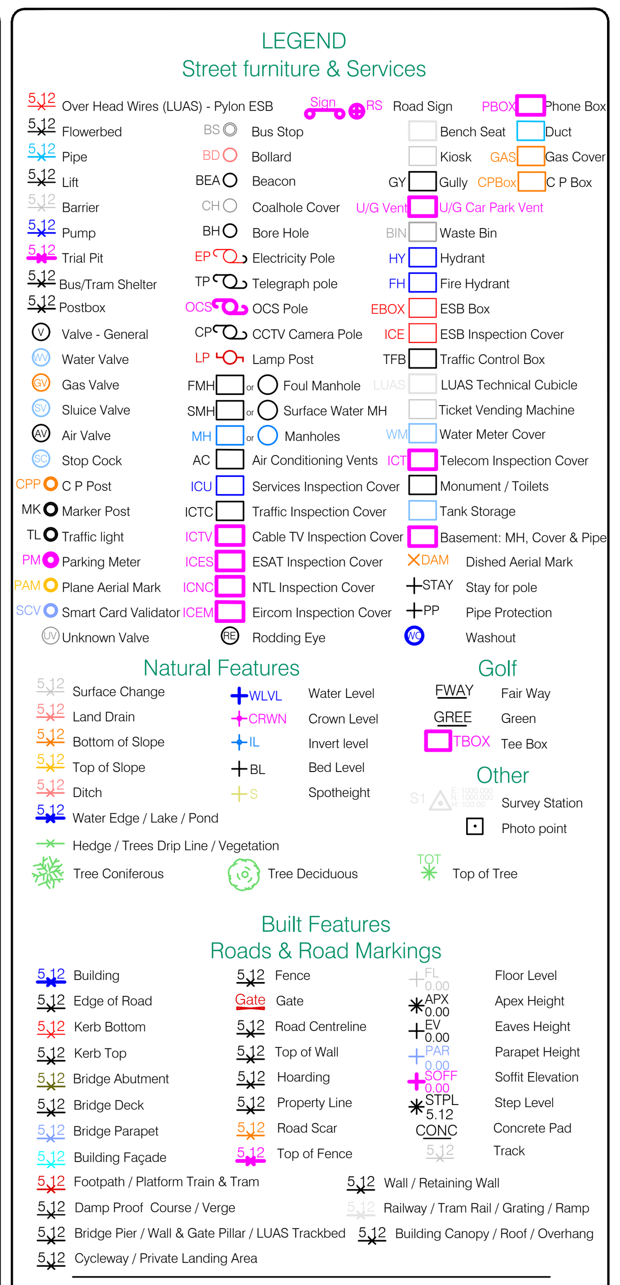
Drawing Number : 9986_CLONMEL_FLOOD_DEFENCE_PLAN_03





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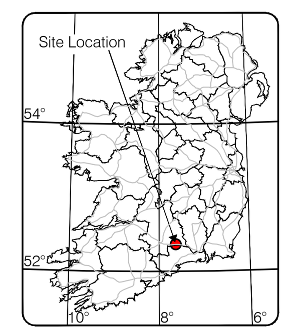
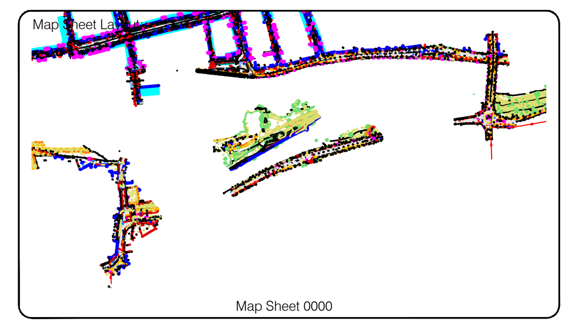
The Company shall not be liable for any inaccuracy of the data provided beyond the specified scale or accuracy, or for any matters resulting from their use for purposes other than that stated in the Contract. No liability shall attach to the Surveyor in respect of any consequential loss or damages suffered by the Client.

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.

North





Map Sheet 0000

Surveyed by : MSL	Date: OCT 2020	Datum : Malin Head
Drawn by : ST	Date: NOV 2020	Grid System:
Checked by : MT	Date: 02.11.20	Irish National Grid ☐ ITM ☒

Revisions

No.	Date	Description
0	01.11.2020	First Drawing

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Email: info@murphygs.ie

Client : Tipperary County Council

Project : The Gas House Bridge Clonmel

Date : 02.11.2020 **Scale :** 1:2000@A1

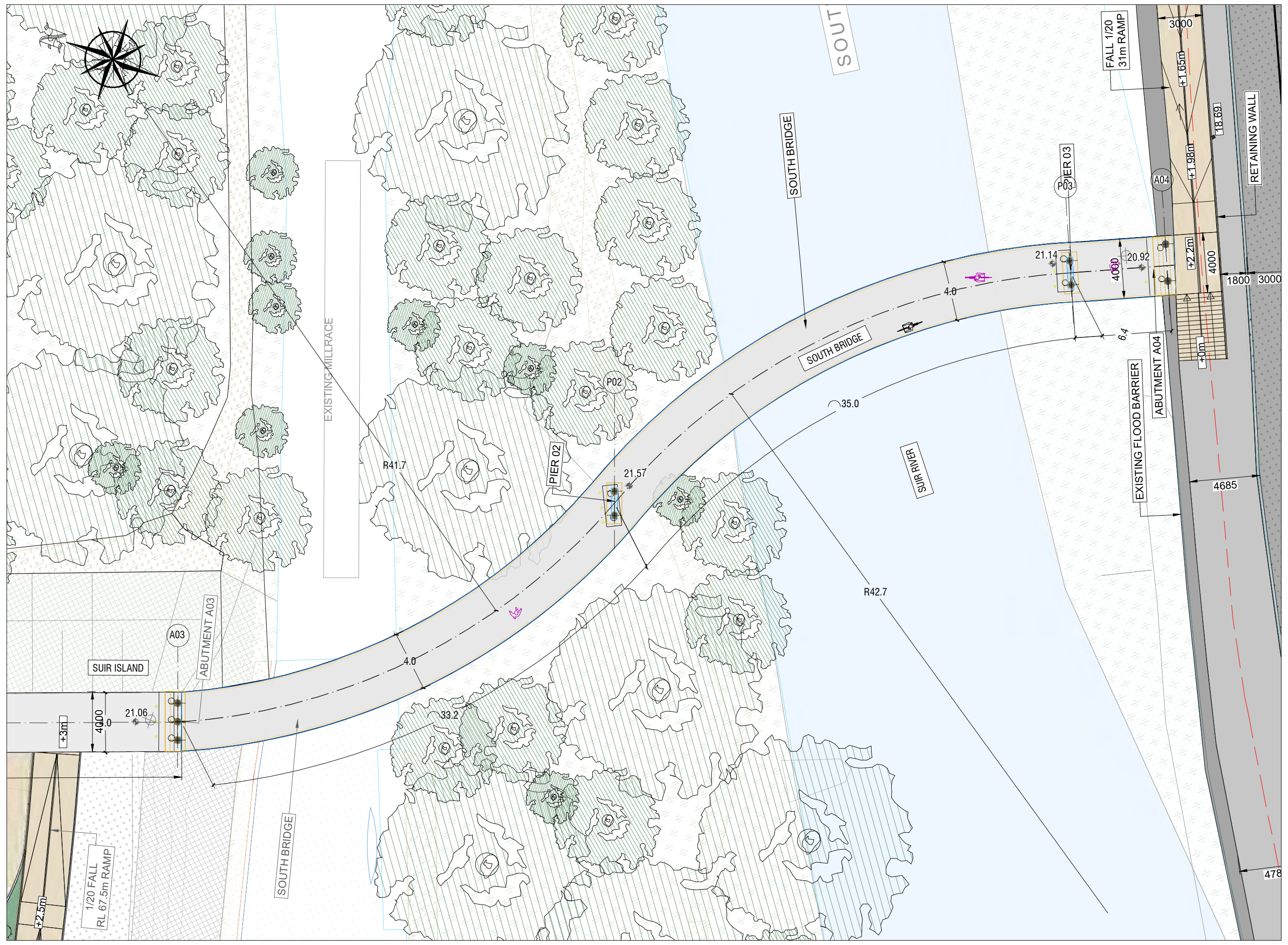
Description : Topographical Survey

Drawing Number : MGL38728_T_ITM_3D_Rev0

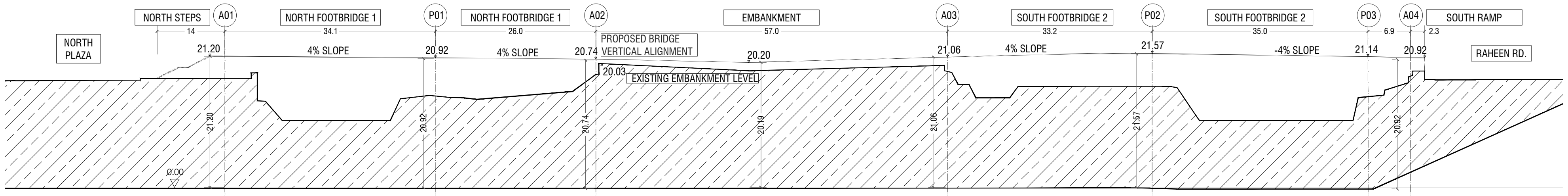
DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

SITE PLAN NORTH BRIDGE 1/250



SITE PLAN SOUTH BRIDGE 1/250



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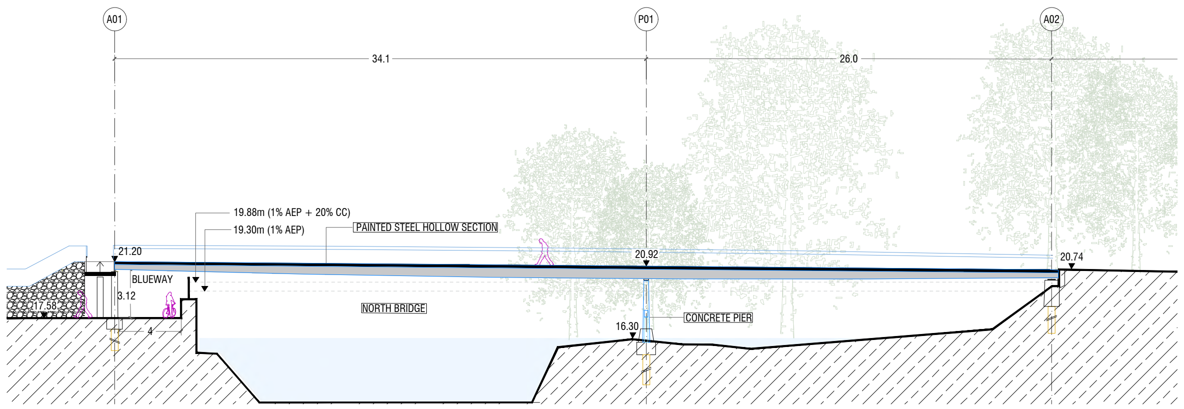
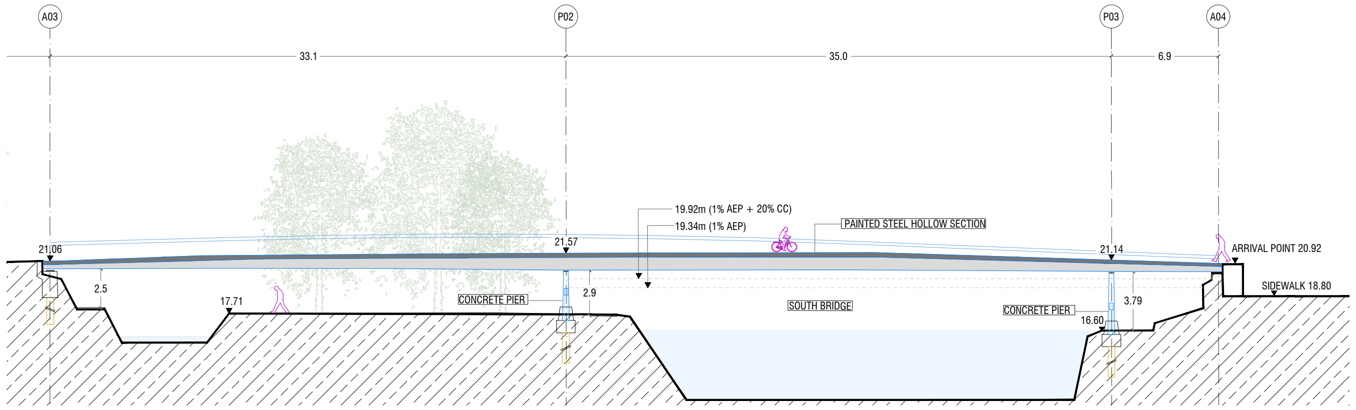


ELEVATION NORTH BRIDGE 1/250



ELEVATION SOUTH BRIDGE 1/250

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS: dhbarchitects

ARCHEOLOGISTS: CourtneyDeery

BRIDGES: MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS: Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS: awnconsulting A Trinity Consultants Company

LIGHTING CONSULTANTS: Douglas Carroll Consulting Engineers

NOTES:

A0X = ABUTMENT FOUNDATION NUMBER X
P0X = PIER FOUNDATION NUMBER X

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23
Rev	Description	Drawn	Checked	Date

Clifton Scannell Emerson Associates

Clifton Scannell Emerson Associates Limited
Consulting Engineers,
3rd Floor The Highline,
Bakers Point, Pottery Road,
Dun Laoghaire, Co. Dublin,
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T. +353 1 288 5006
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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 BRIDGE PLAN & ELEVATIONS

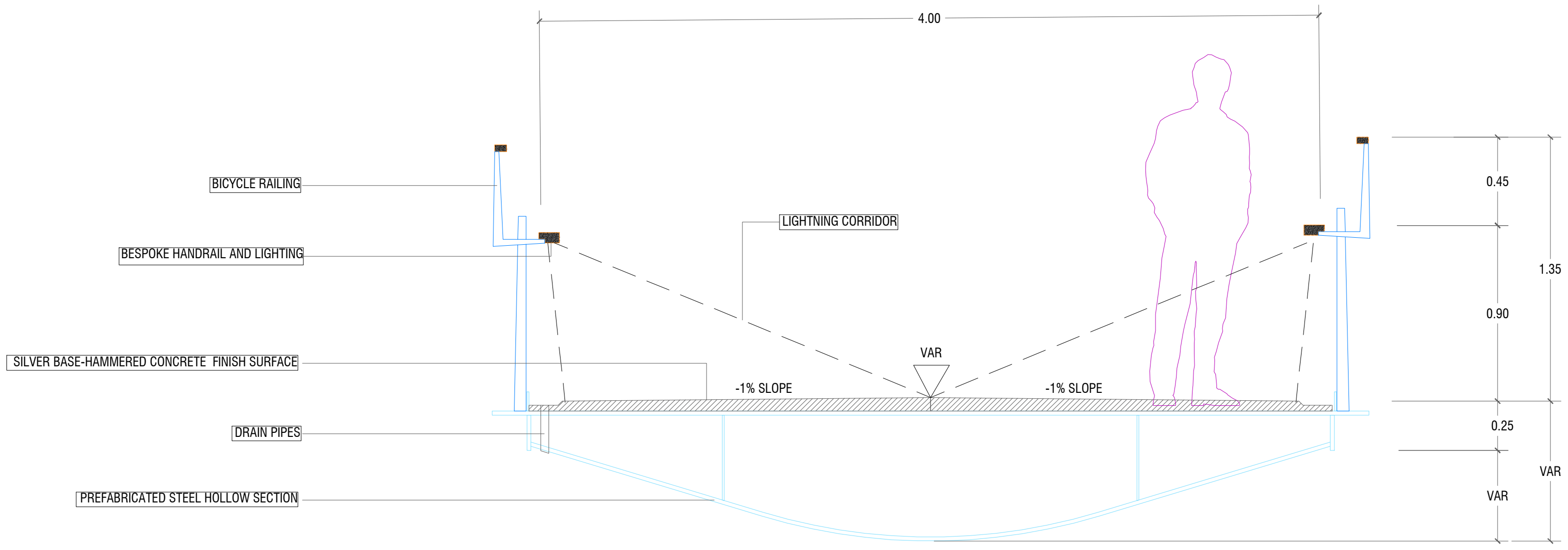
Drawn By: FO	Date: SEPT 2023	20_071
Checked By: LP	Scale: AS INDICATED @ A1	CSEA Job No.

Project Code / Originator / Zone/Phase / Level / Type / Role / Dwg. No.

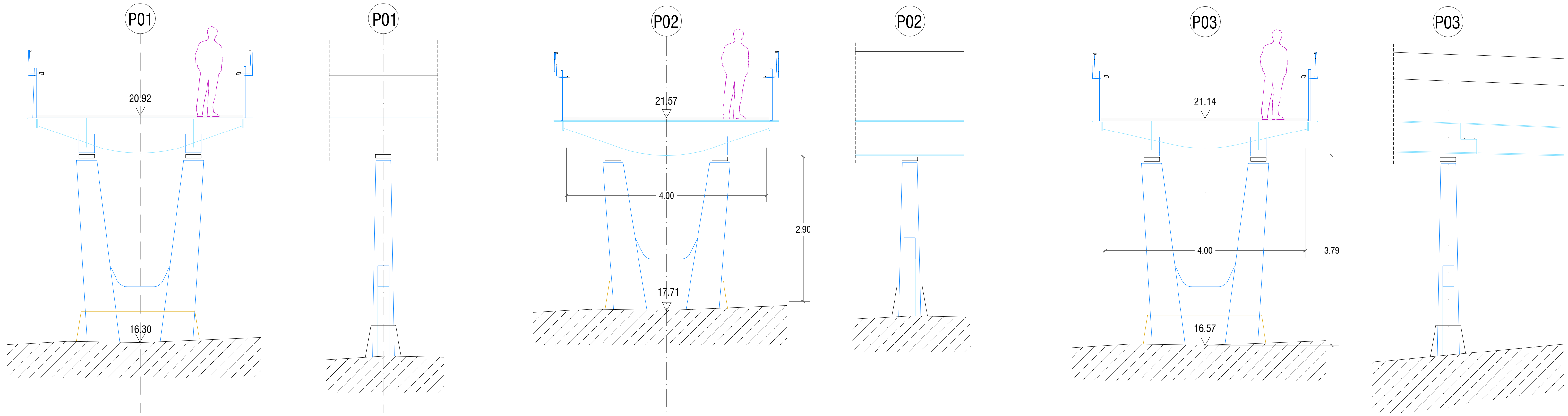
20_071 - CSE - GEN - XX - DR - C - 2260

S2 (Status Code) — SUITABLE FOR INFORMATION (Suitability Description)

PL01 (Revision) — ISSUED FOR PLANNING (Project Status)



TYPICAL BRIDE SUPERSTRUCTURE CROSS SECTION 1/20



TYPICAL SUPPORT PIER CROSS SECTIONS 1/50

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A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS

dhbarchitects

ARCHEOLOGISTS

CourtneyDeery

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS

awnconsulting

LIGHTING CONSULTANTS

Douglas Carroll Consulting Engineers

NOTES:

A0X = ABUTMENT FOUNDATION NUMBER X
P0X = PIER FOUNDATION NUMBER X

Rev	Description	Drawn	Checked	Date

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----	----	----	----	----
----	----	----	----	----
----	----	----	----	----
PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

Clifton Scannell Emerson Associates

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3rd Floor The Highline,
Bakers Point, Pottery Road,
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E. info@csea.ie
W. www.csea.ie

Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 BRIDGE SECTIONS

Drawn By: FO | Date: SEP 2023 | 20_071 CSEA Job No.

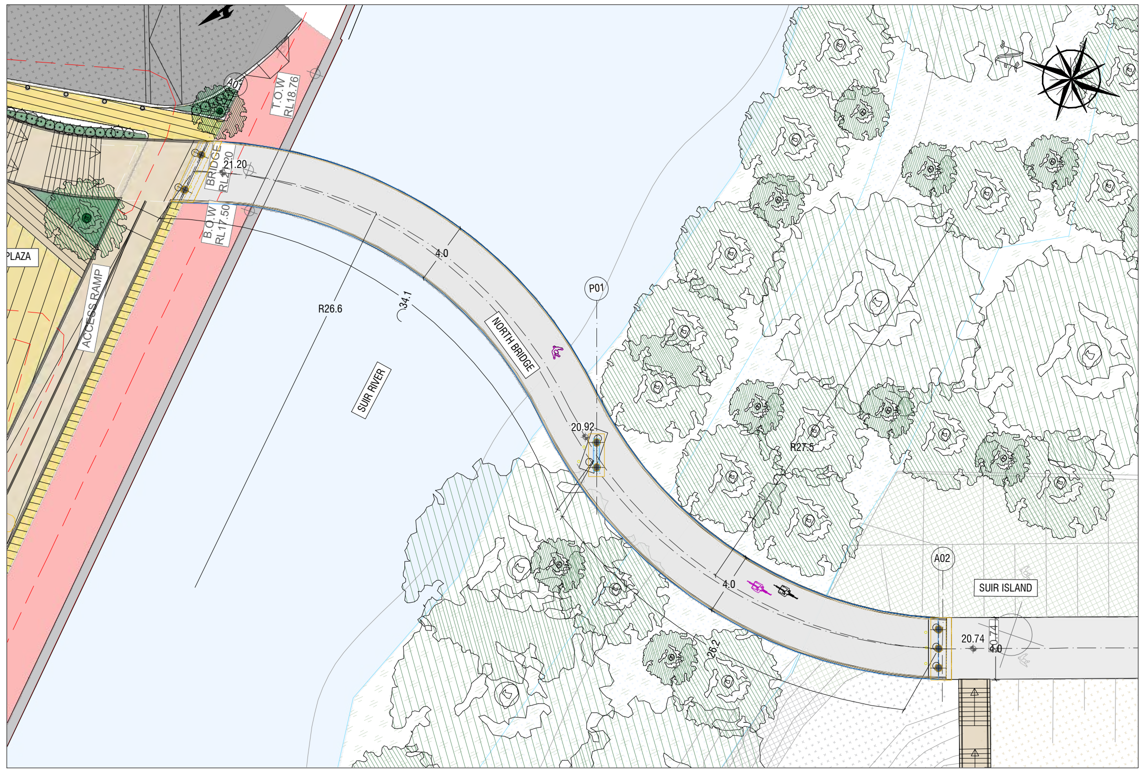
Checked By: LP | Scale: AS INDICATED@ A1

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2261

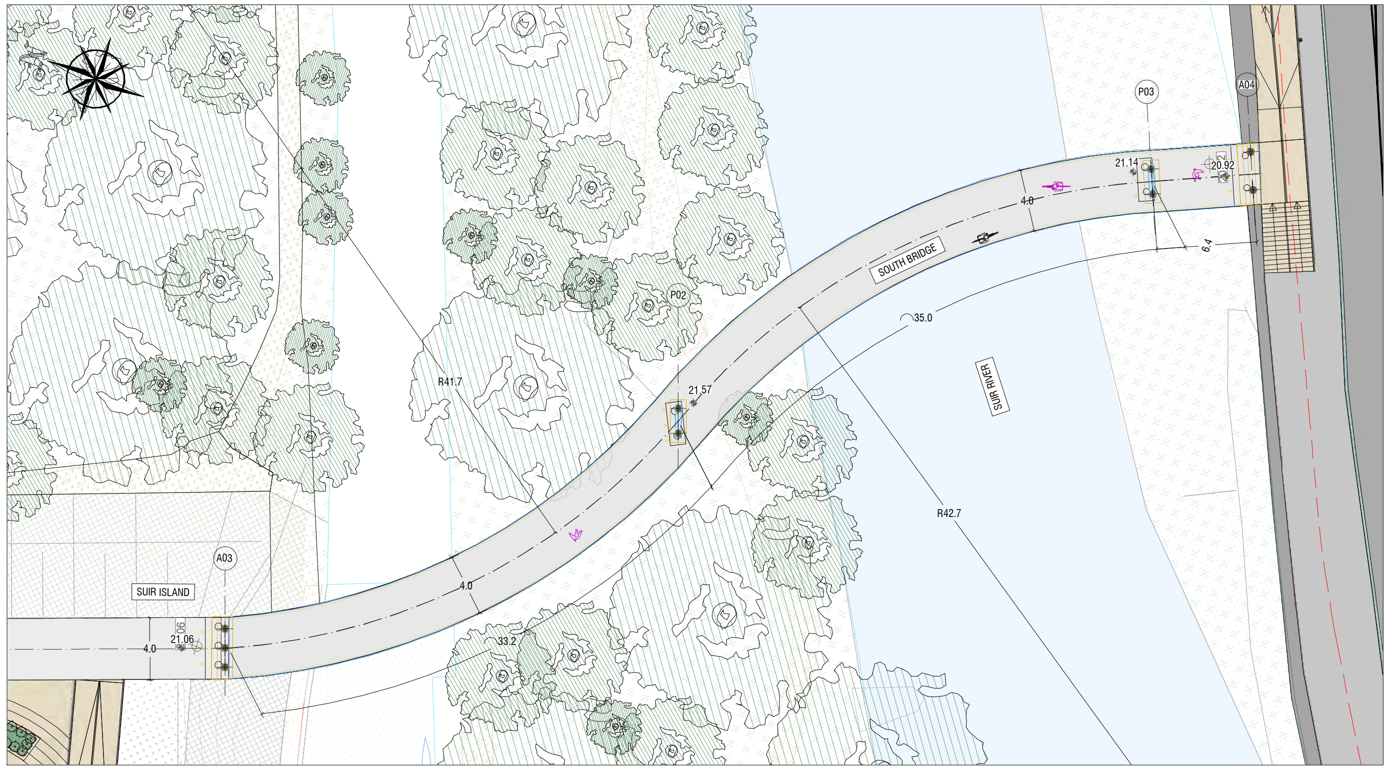
20_071 - CSE - GEN - XX - DR - C - 2261

Status Code: S2 | Suitability Description: SUITABLE FOR INFORMATION

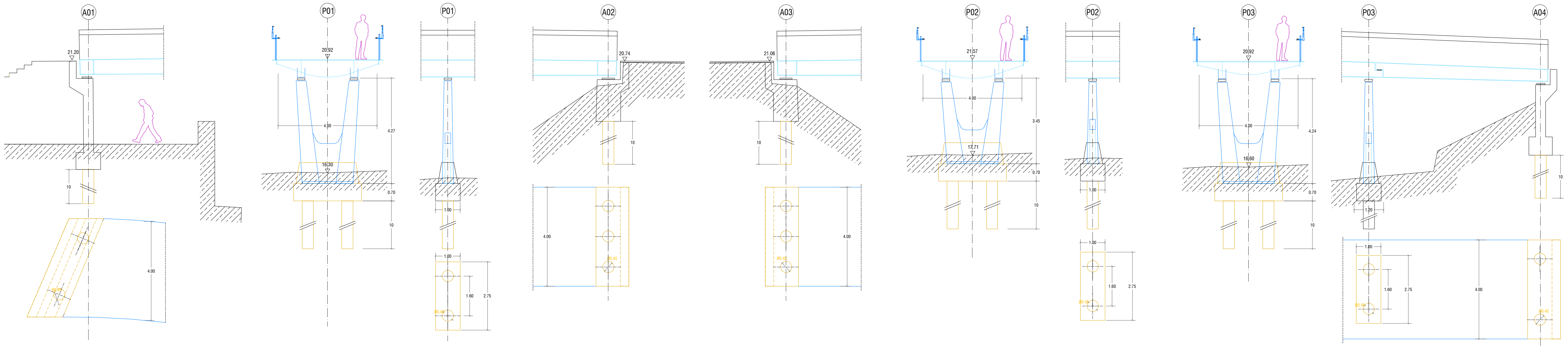
Revision: PL01 | Project Status: ISSUED FOR PLANNING



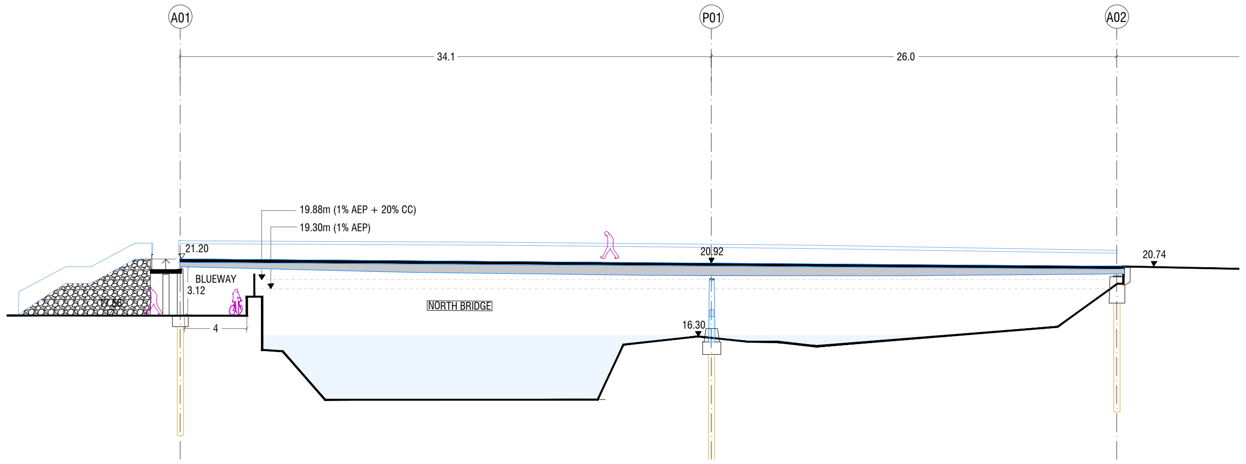
SITE PLAN NORTH BRIDGE 1/250



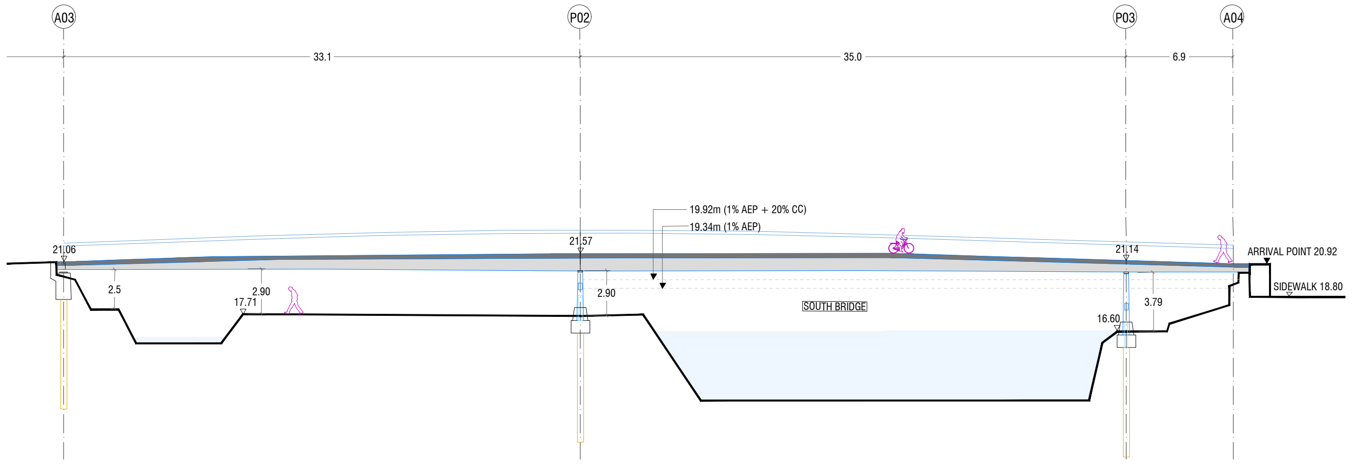
SITE PLAN SOUTH BRIDGE 1/250



FOUNDATIONS PIERS AND ABUTMENTS 1/100 TYPICAL SKETCHES



ELEVATION NORTH BRIDGE 1/250



ELEVATION SOUTH BRIDGE 1/250

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS

dhbarchitects

ARCHEOLOGISTS

CourtneyDeery

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS

awnconsulting

LIGHTING CONSULTANTS

Douglas Carroll

NOTES:

A0X = ABUTMENT FOUNDATION NUMBER X
P0X = PIER FOUNDATION NUMBER X

Rev	Description	Drawn	Checked	Date
----			----	----
----	----	----	----	----
----	----	----	----	----
----	----	----	----	----
----	----	----	----	----
PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

Clifton Scannell Emerson Associates

Clifton Scannell Emerson Associates Limited
Consulting Engineers,
3rd Floor The Highline,
Bakers Point, Pottery Road,
Dun Laoghaire, Co. Dublin,
Ireland, A96 KW29

T. +353 1 288 5006
F. +353 1 283 3466
E. info@csea.ie
W. www.csea.ie

Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 BRIDGE DETAILS

Drawn By: FO | Date: SEPT 2023 | 20_071

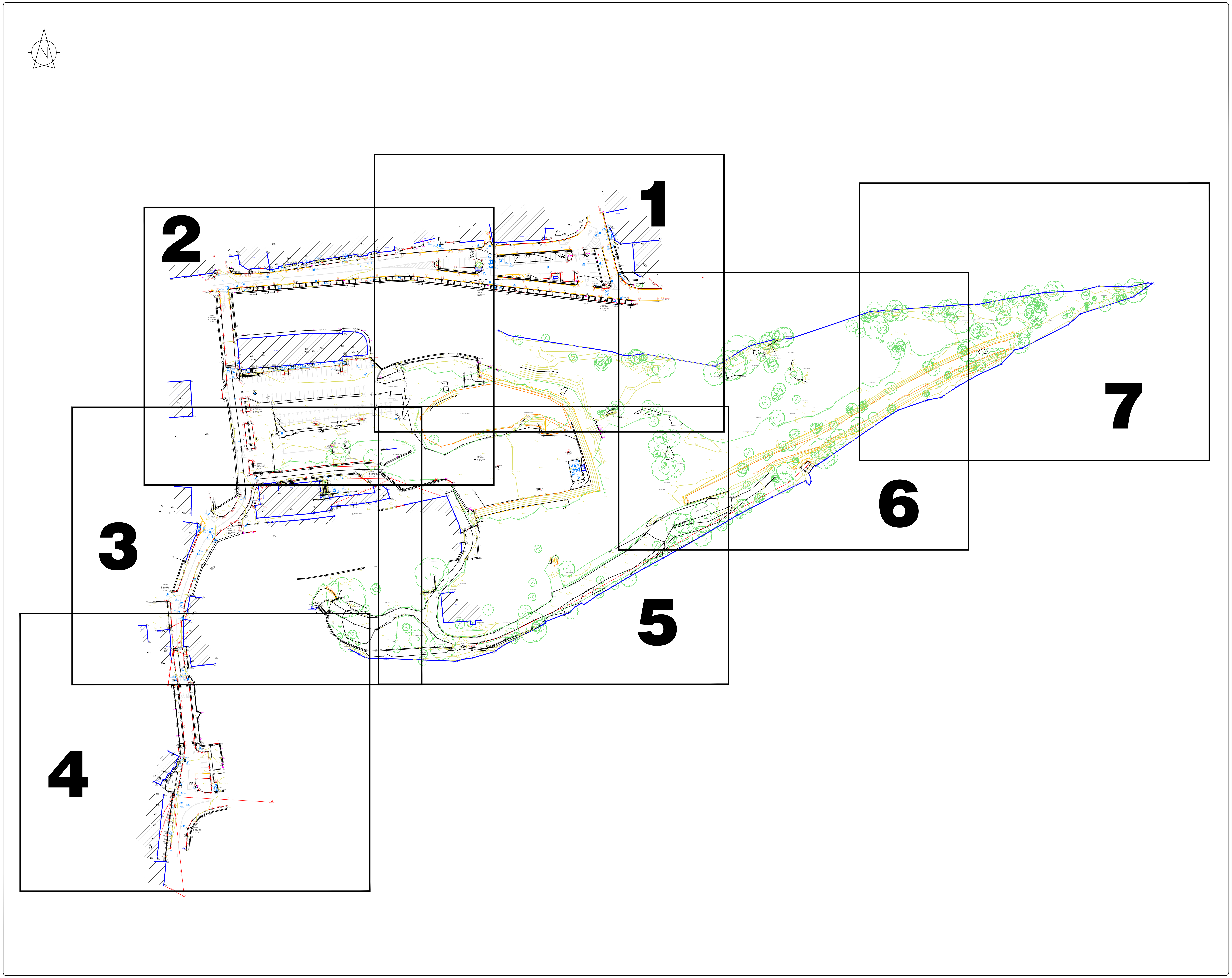
Checked By: LP | Scale: AS INDICATED@ A1 | CSEA Job No.

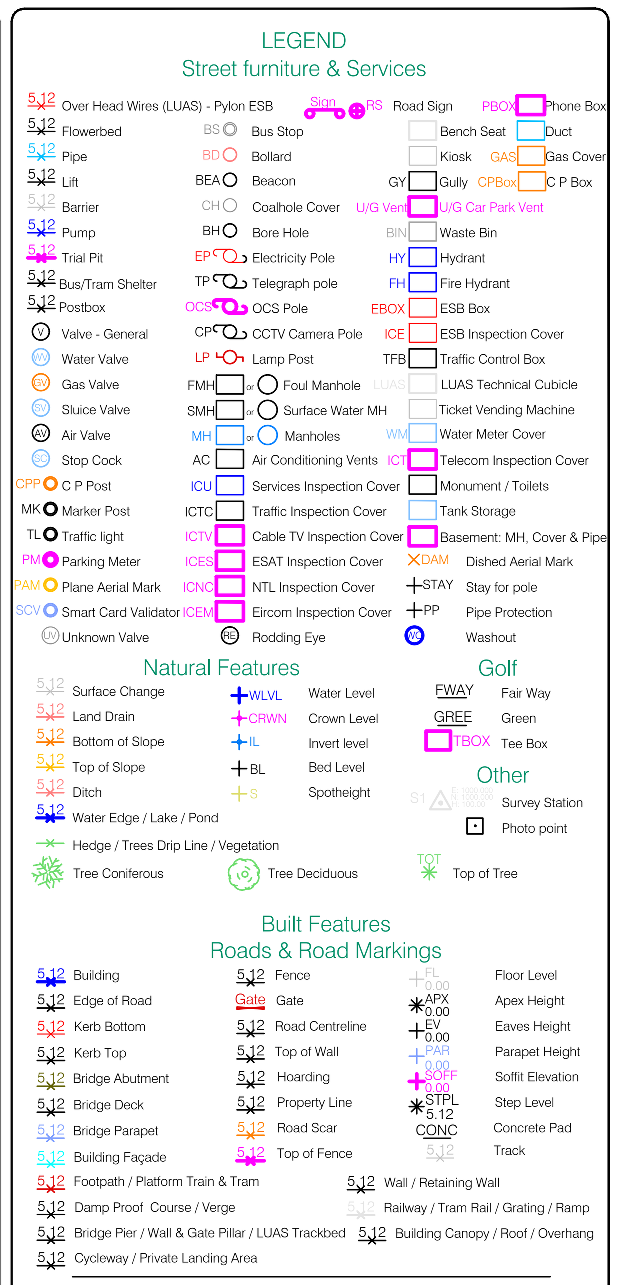
Project Code | Originator | Zone/ Phase | Level | Type | Role | Dwg. No.

20_071 - CSE - GEN - XX - DR - C - 2262

S2 — Status Code | SUITABLE FOR INFORMATION — Suitability Description

PL01 — Revision | ISSUED FOR PLANNING — Project Status





Murphy Surveys Ltd. Disclaimer

The user or recipient of this survey data understands and acknowledges this data may be inaccurate or contain errors or omissions and the user or recipient assumes full responsibility for any risks or damages resulting from, arising from, or in connection with any use of or reliance upon data displayed herein. Although significant care has been exercised to produce surveys that satisfy survey accuracy standards, these surveys are only as accurate as the source data from which they were compiled. Although all reasonable steps have been taken to locate all features visible at the time of the survey, there is no guarantee that all will be shown on the drawing, as some above ground features may have obstructed the survey. Wherever possible, areas unable to be surveyed will be labelled as "UTS".

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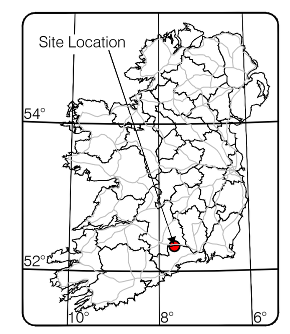
The Client must promptly notify the Company of any errors in mapping of which it becomes aware. If misleading, inaccurate or otherwise inappropriate information is brought to the Company's attention or the Company itself identifies any such imprecision or error in a survey, it shall use its reasonable 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.

North



Map Sheet Layout:

Surveyed by : IT — Date: 11-13 Sept 2017 — Datum : Malin Head
Drawn by : CSI — Date: 15 Sept 2017 — Grid System:
Checked by : PK — Date: 15 Sept 2017 — Irish National Grid ☐ ITM (15) ☒

Revisions

No.	Date	Description
0	15.09.2017	First Drawing
1	26.09.2017	Details added

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

Client : MPA Consulting

Project : Suir Island GPR & TOPO Survey

Date : 15.09.2017 **Scale :** NTS

Description : Topographical Survey

Drawing Number : MSL22204_T_3D_Rev1_0

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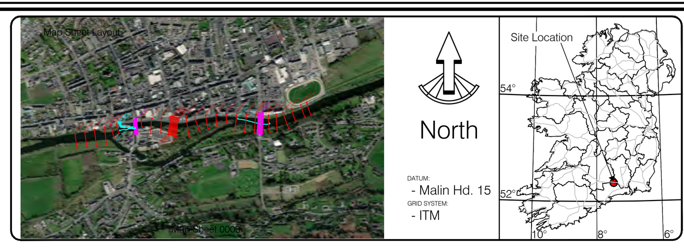
LEGEND

section plan details

- Surveyed Section Lines with References & Section Orientation (at Open channel)
- Surveyed Section Lines with References & Section Orientation (at Structures)
- Surveyed Section Lines with References & Section Orientation (at Additional items)



Surveyed by : MGS Date: FEB 2022
Drawn by : COS Date: FEB 2022
Checked by : BK Date: 11.02.2022

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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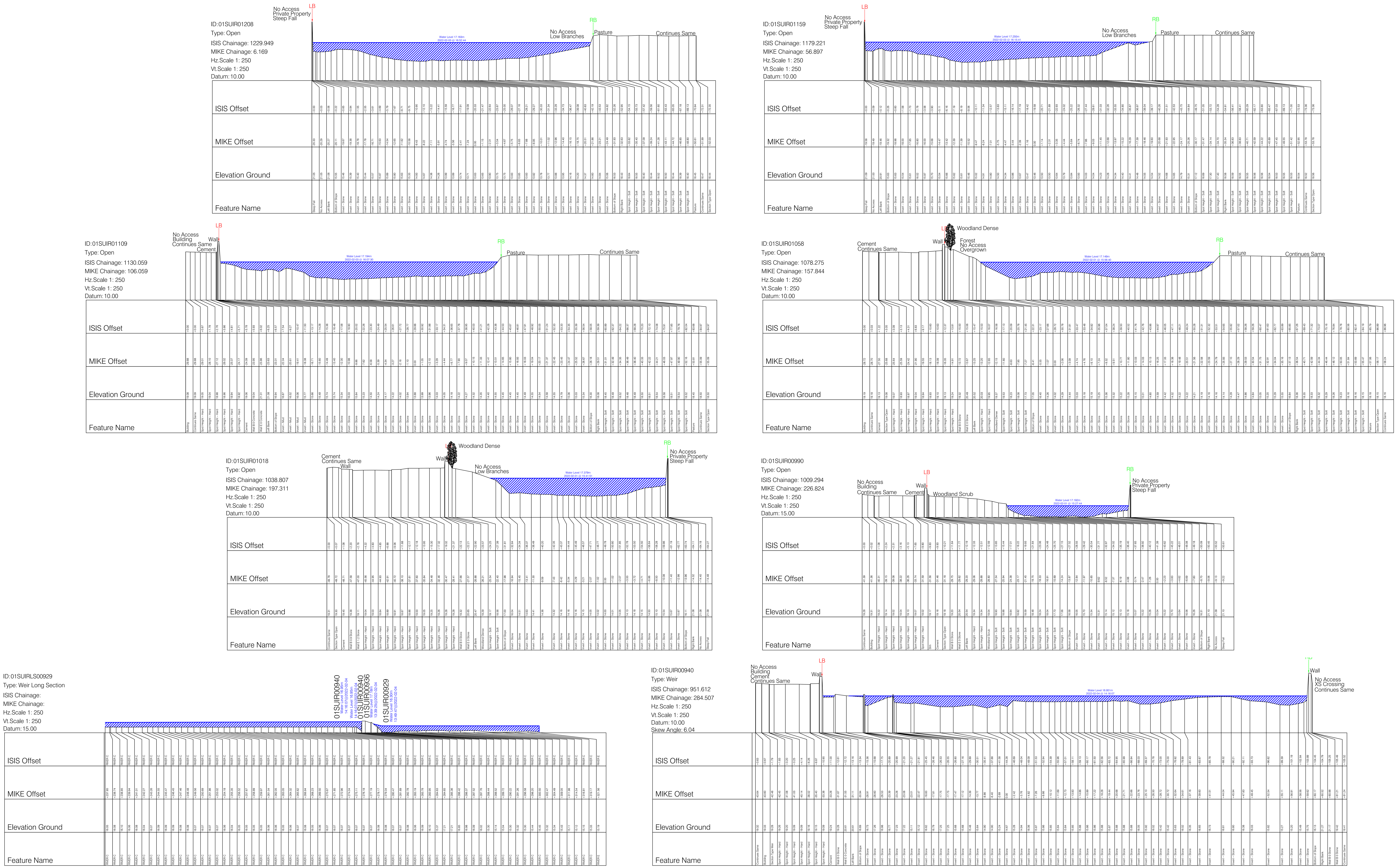
Client :	Clifton Scannell Emerson
Project :	44342 Suir Island Bathymetric Survey
Date :	11.02.2022
Scale :	1:1000
Description :	SECTIONS PLAN
Drawing Number :	MGS44342_01SUIR_PLAN_01



LEGEND

cross section details

River Profile	LB Left Bank
Water Level	RB Right Bank
Ground Level	Building Line
Road Line	Wall Line
Wall Line	Fence Line
Bridge Line	Pipe Profile

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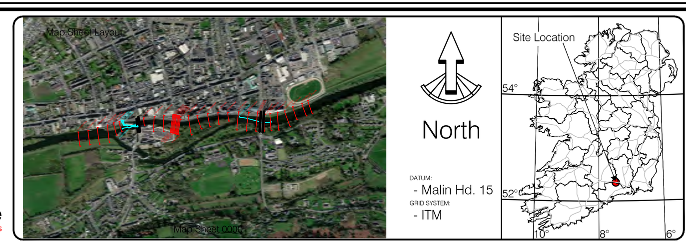

North

Surveyed by : MGS	Date: FEB 2022
Drawn by : COS	Date: FEB 2022
Checked by : BK	Date: 11.02.2022

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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Email: info@murphygs.ie

Client : Clifton Scannell Emerson

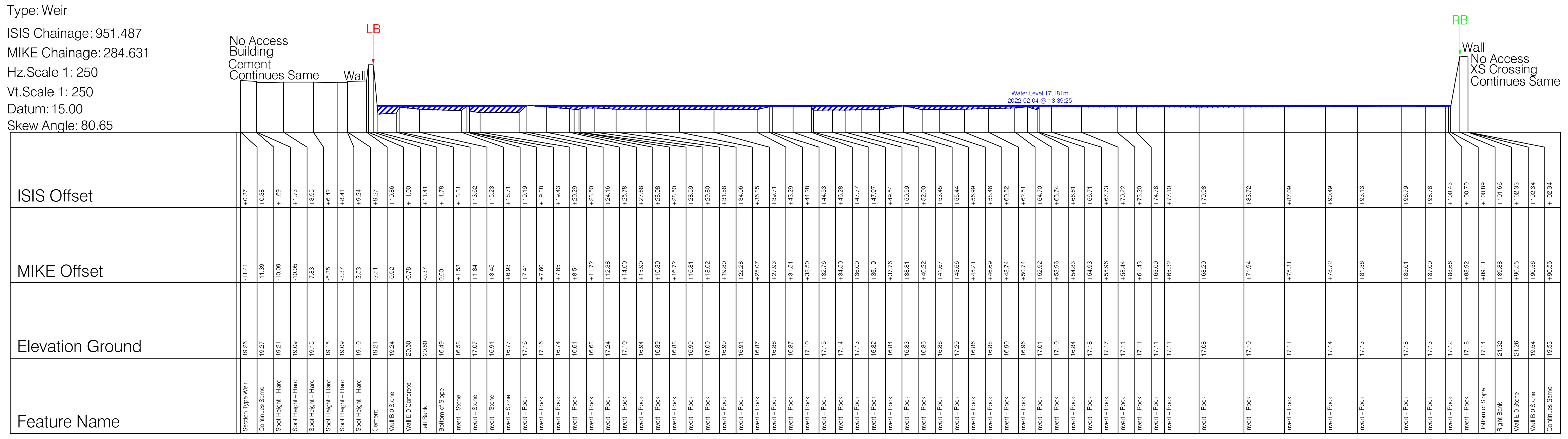
Project : 44342 Suir Island Bathymetric Survey

Date : 11.02.2022 **Scale :** AS SHOWN

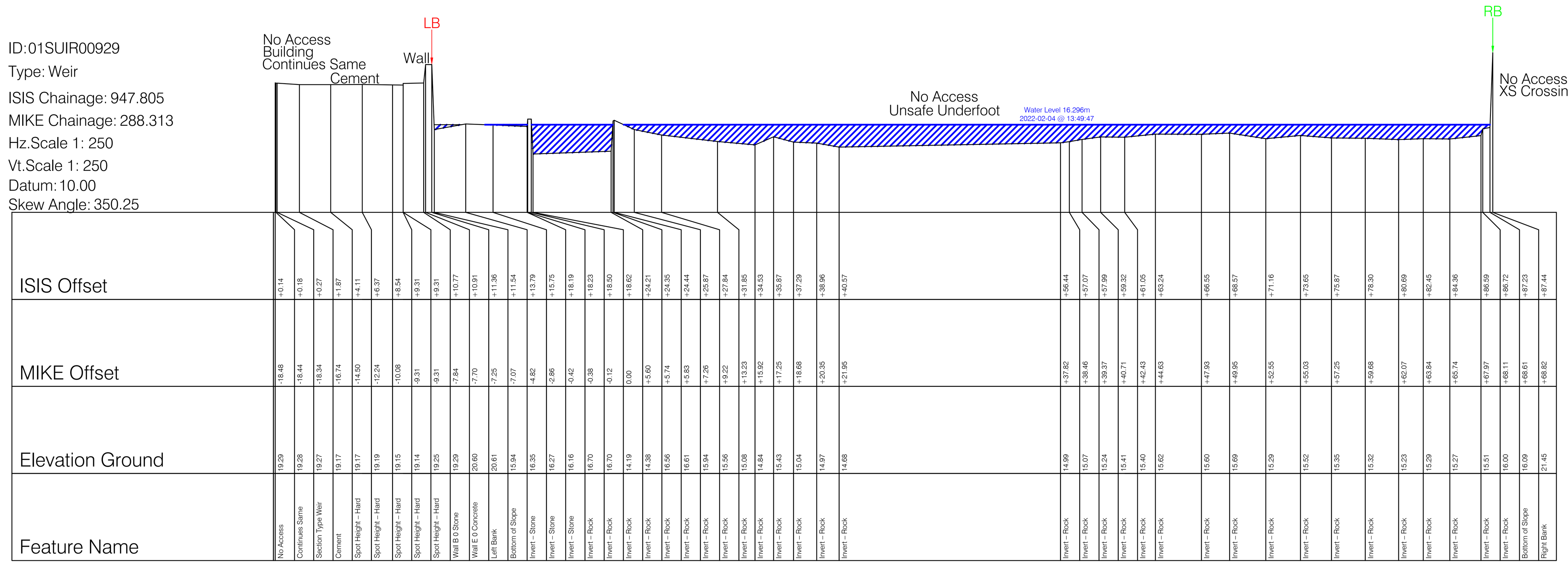
Description : CROSS SECTIONS

Drawing Number : MGS44342_01SUIR_XS_01

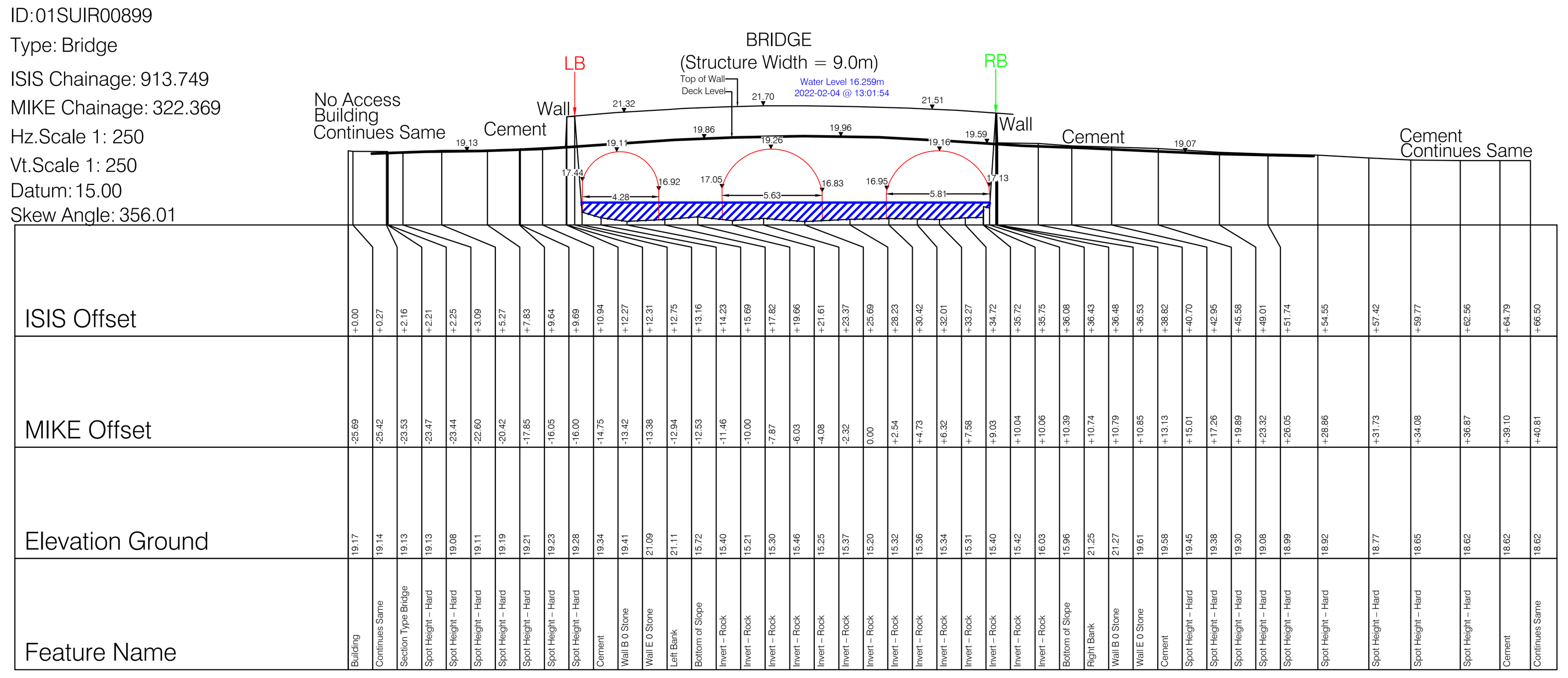
ID:01SUIR00936
Type: Weir
ISIS Chainage: 951.487
MIKE Chainage: 284.631
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00
Skew Angle: 80.65



ID:01SUIR00929
Type: Weir
ISIS Chainage: 947.805
MIKE Chainage: 288.313
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 10.00
Skew Angle: 350.25



ID:01SUIR00899
Type: Bridge
ISIS Chainage: 913.749
MIKE Chainage: 322.369
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00
Skew Angle: 356.01



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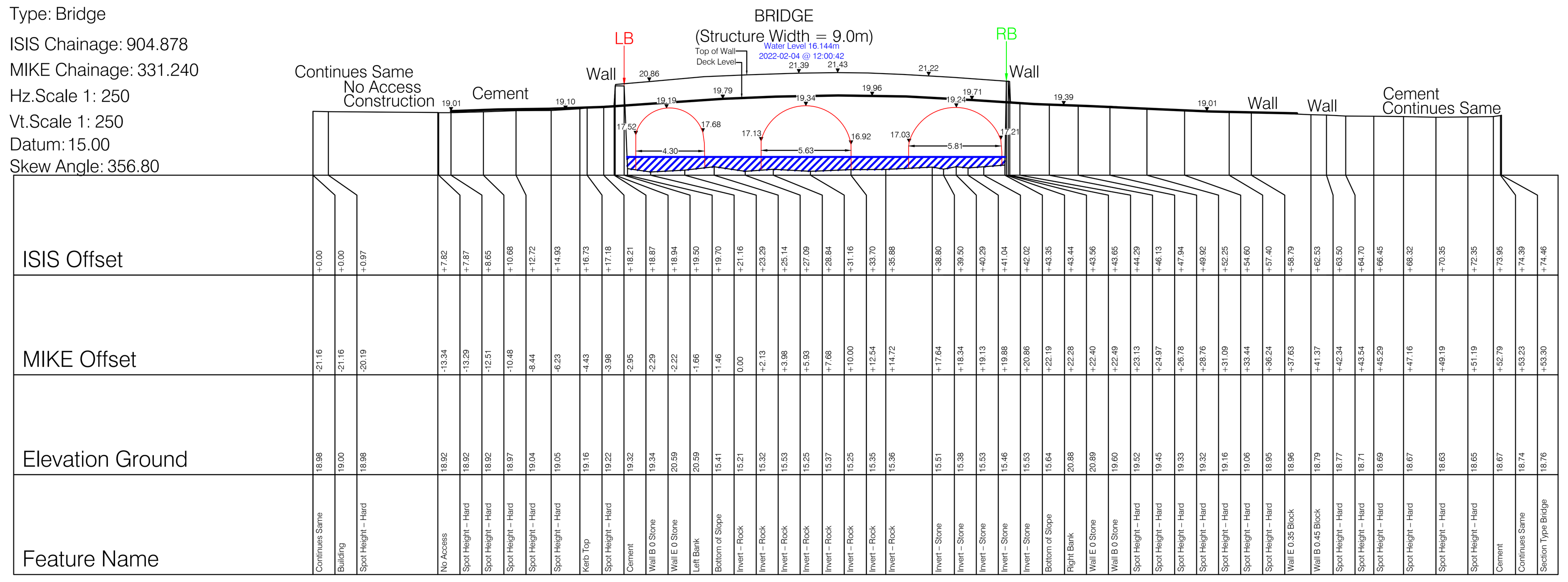
Type: Bridge
ISIS Chainage: 904.878
MIKE Chainage: 331.240
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00
Skew Angle: 356.80



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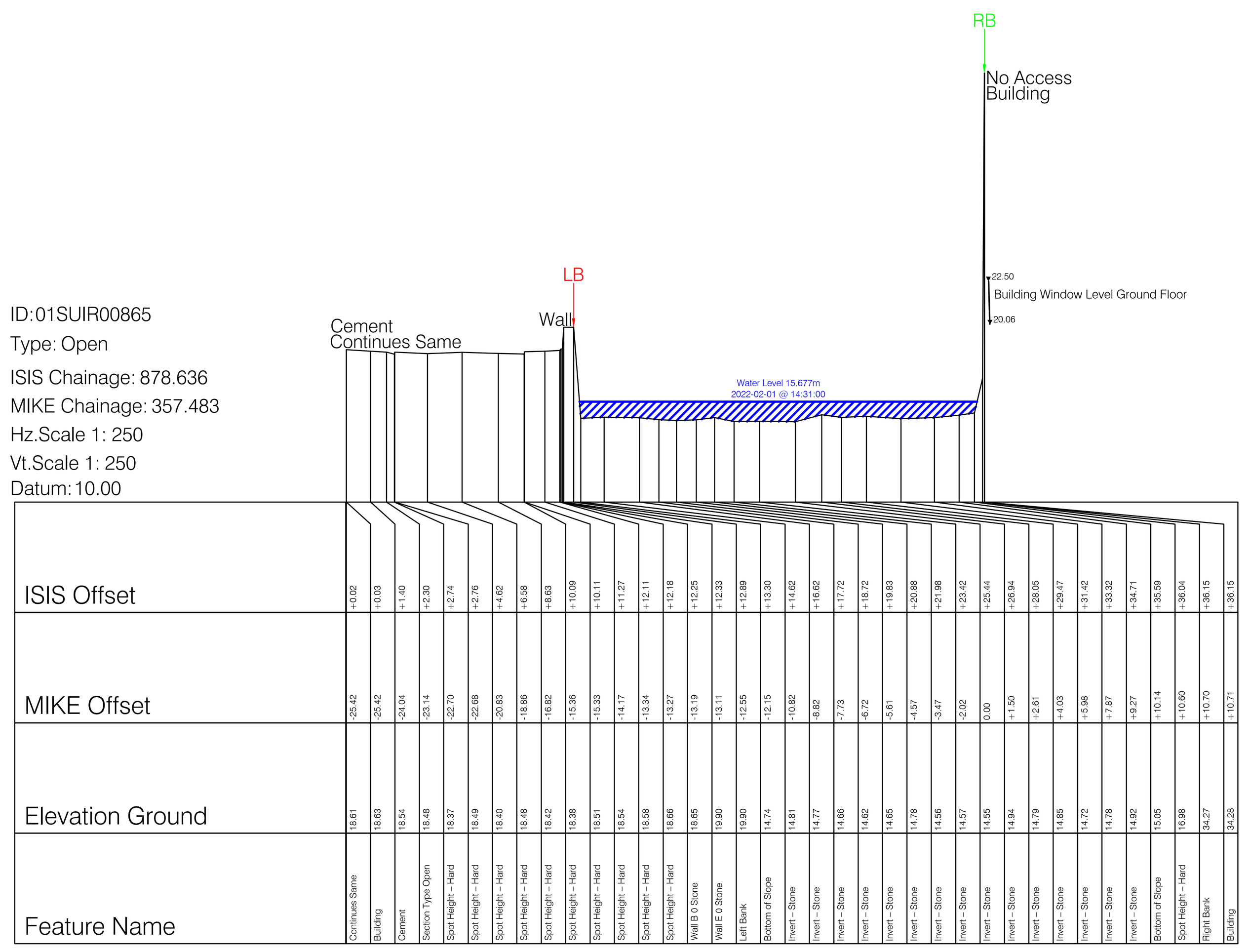
ISIS Chainage: 878.636
MIKE Chainage: 357.483
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 10.00



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MIKE Chainage: 407.155
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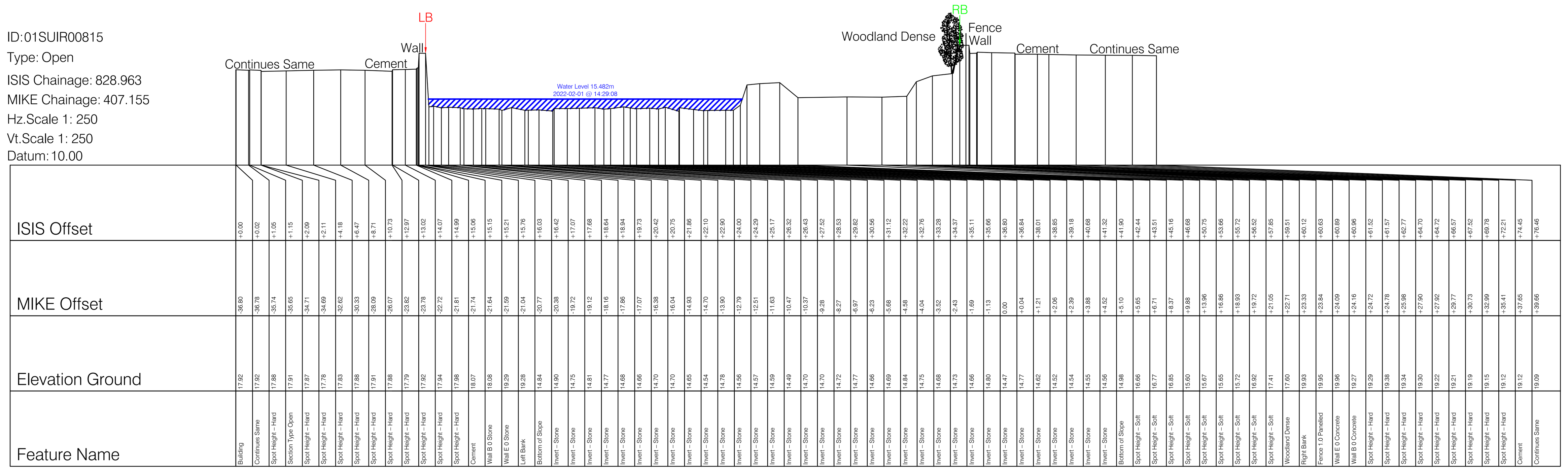
Vt.Scale 1: 250
Datum: 10.00



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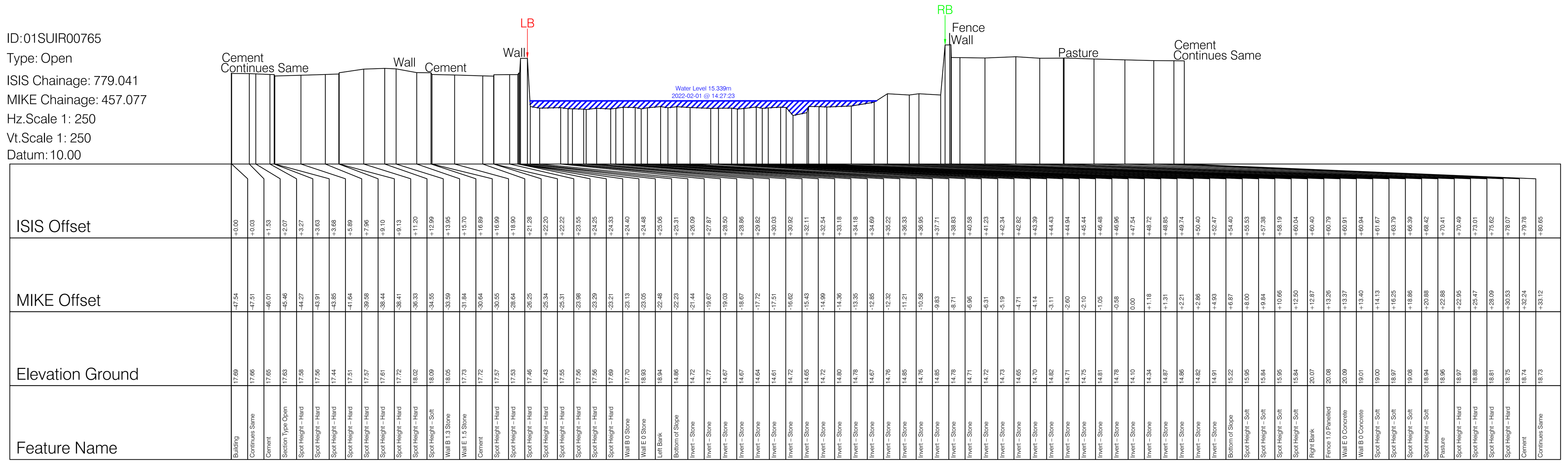
Vt.Scale 1: 250
Datum: 10.00



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Vt.Scale 1: 250
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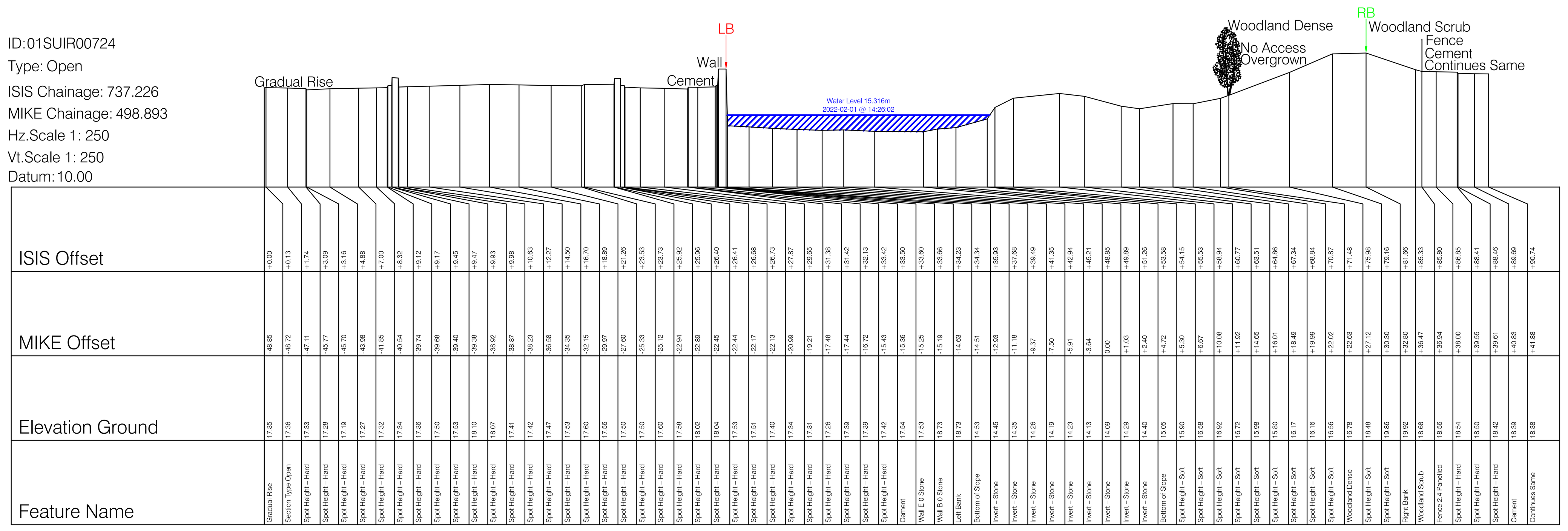

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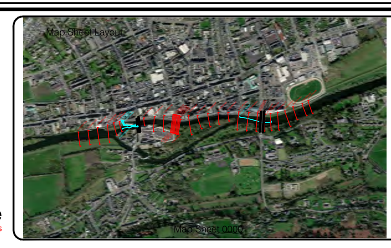
LEGEND

cross section details

River Profile
Water Level
Ground Level
Road Line
Wall Line
Bridge Line
LB Left Bank
RB Right Bank
Building Line
Wall Line
Fence Line
Pipe Profile

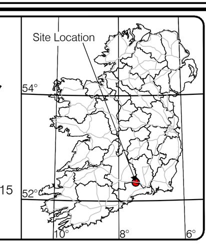
No. 318

Supply-Line



North

Site Location



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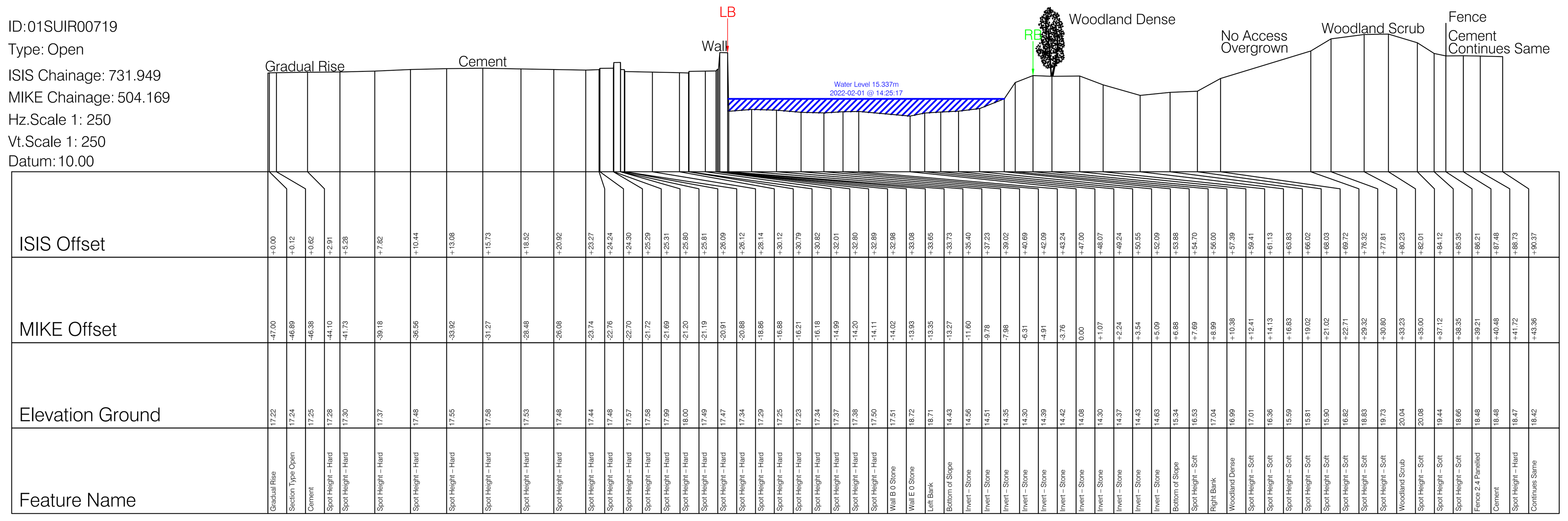
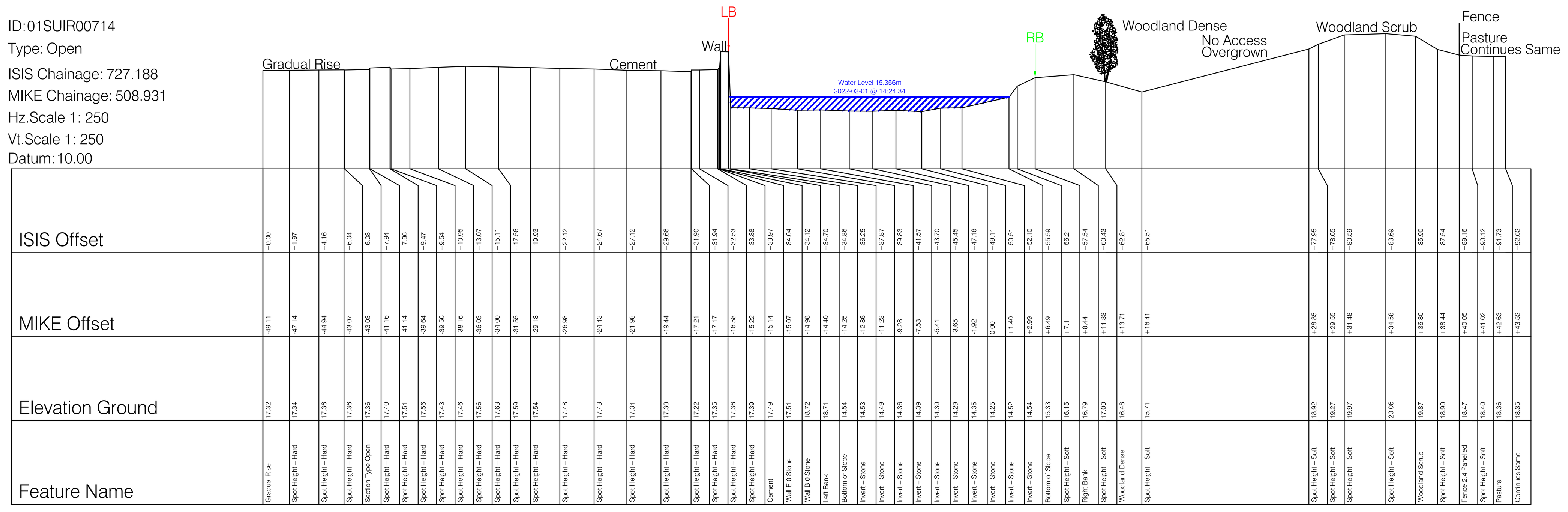
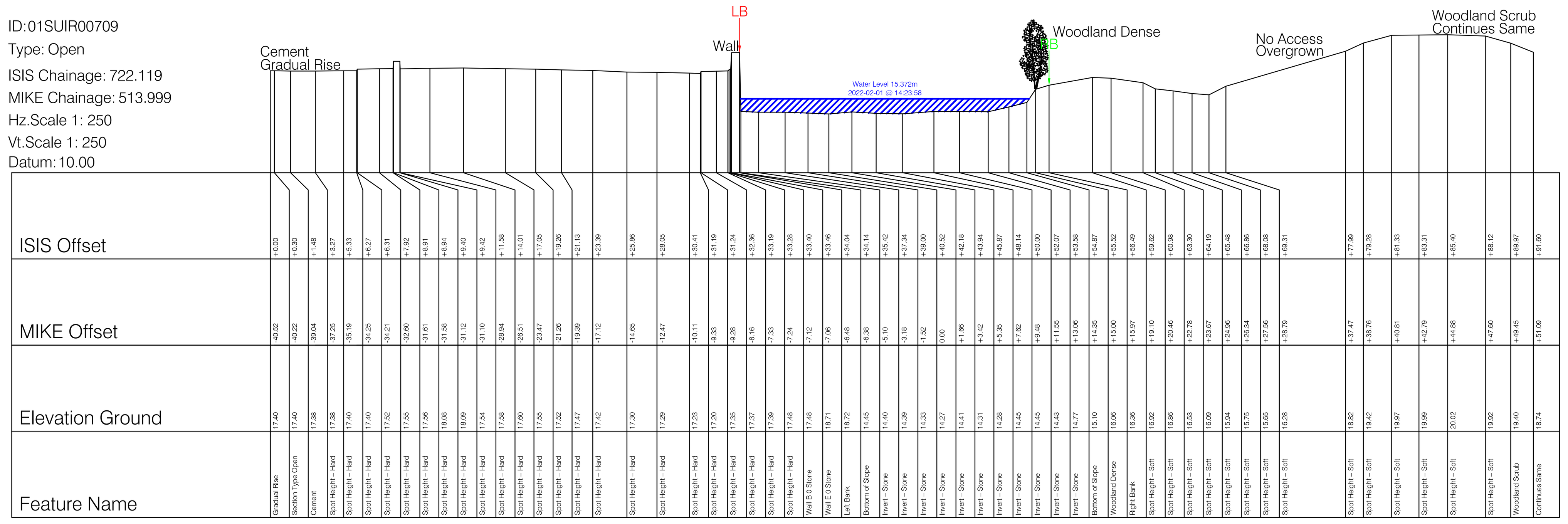
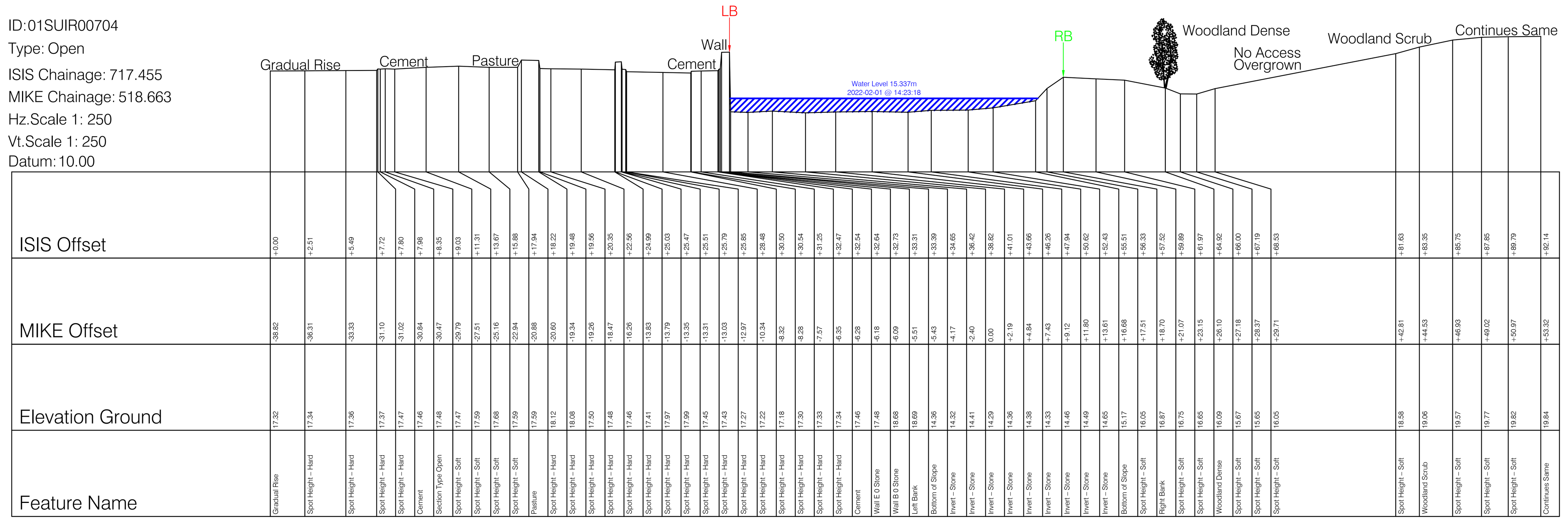
CHARTERED SURVEYORS IRELAND
RICS
THE SURVEY ASSOCIATION
GPR ASSOCIATION

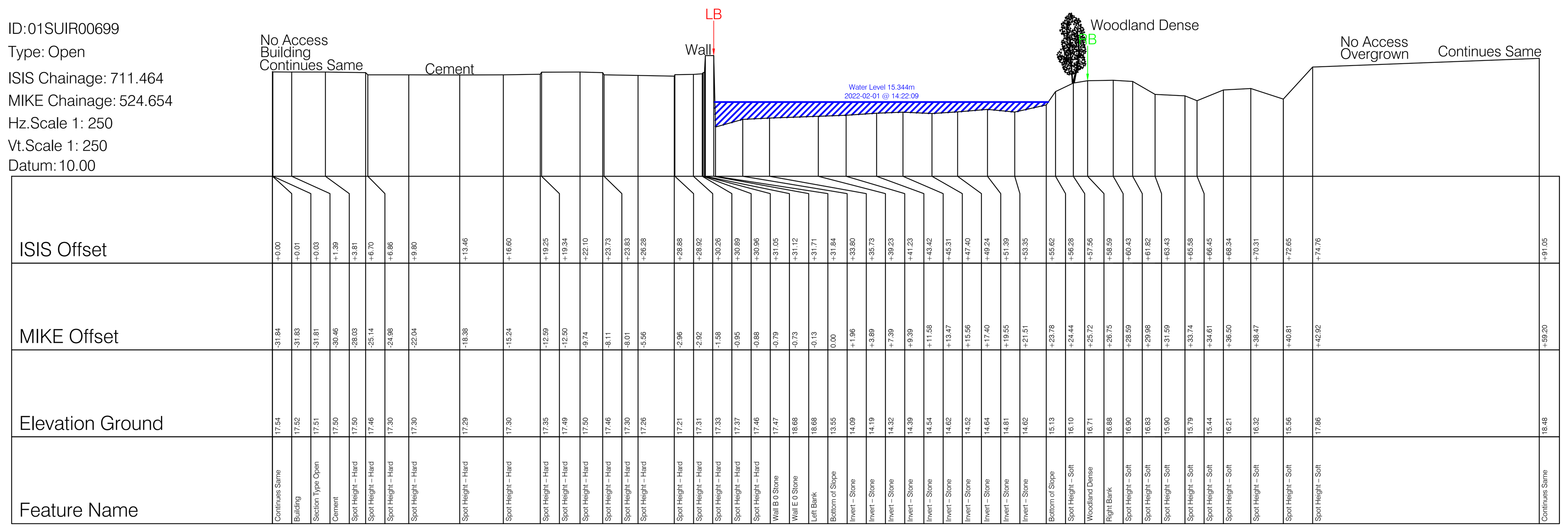
Client :	Clifton Scannell Emerson
Project :	44342 Suir Island Bathymetric Survey
Date : 11.02.2022	Scale : AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MGS44342_01SUIR_XS_02

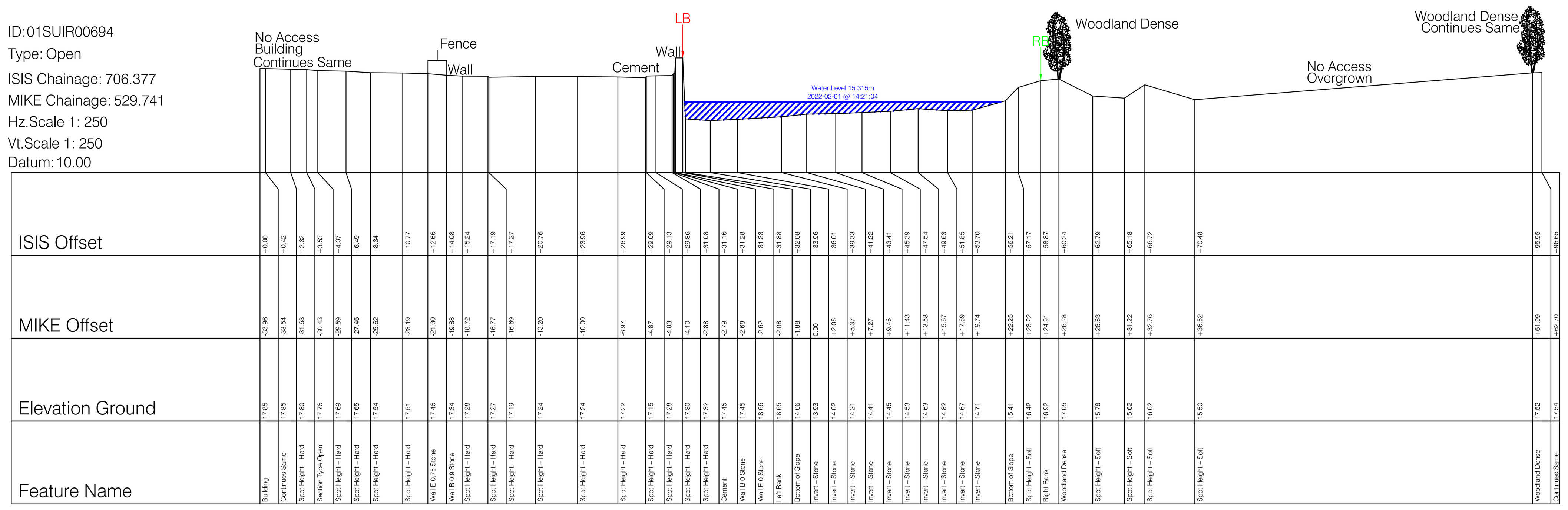


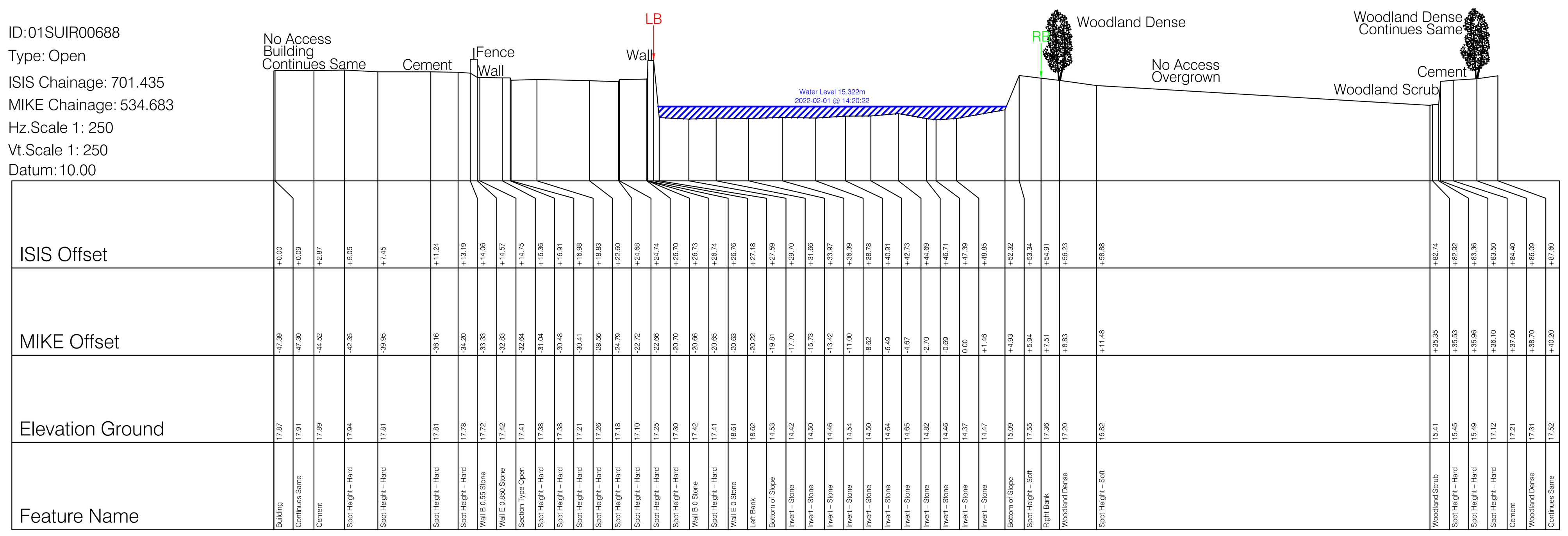


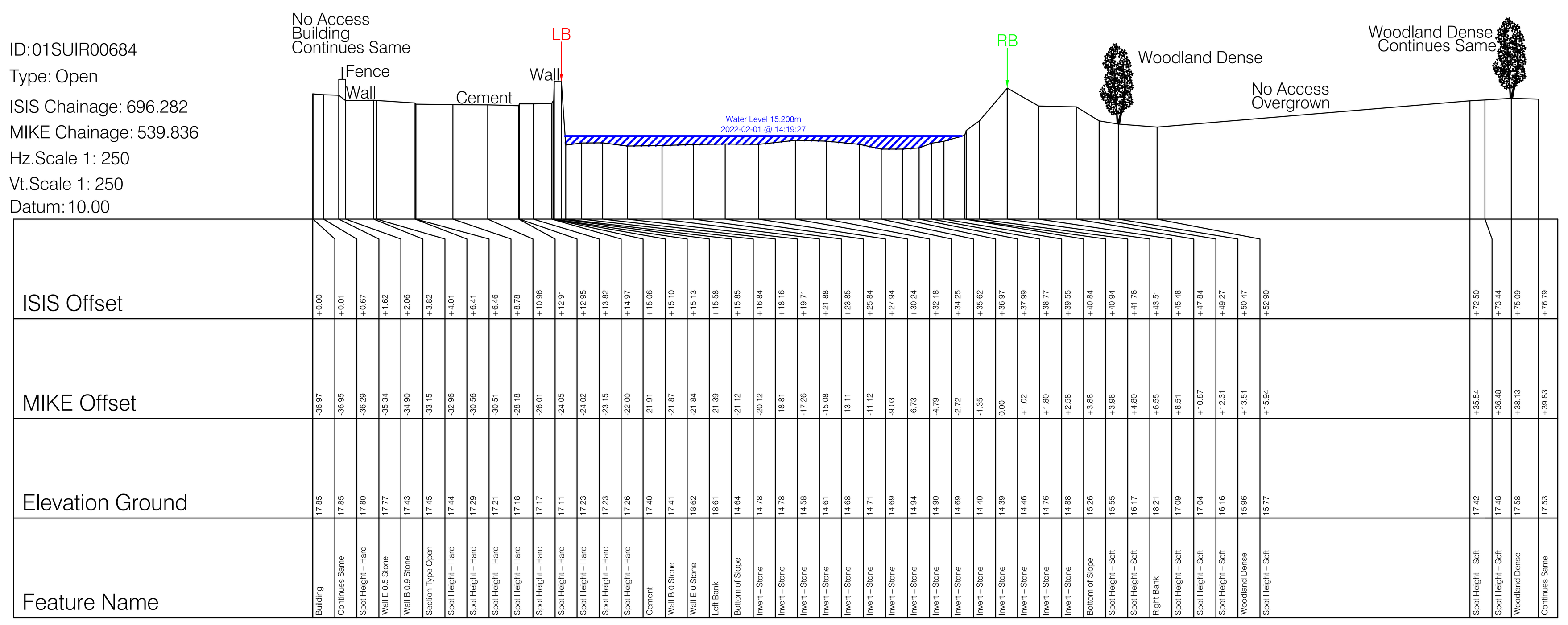












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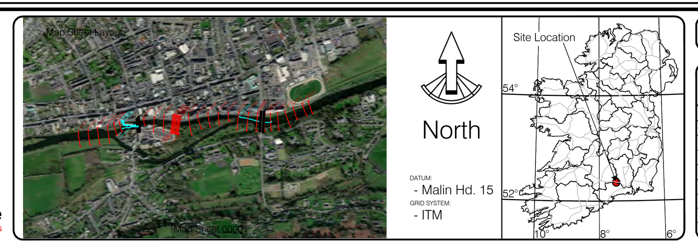
LEGEND

cross section details

River Profile		LB	Left Bank
Water Level		RB	Right Bank
Ground Level			Building Line
Road Line			Wall Line
Wall Line			Fence Line
Bridge Line			Pipe Profile



Surveyed by :	MGS	Date:	FEB 2022
Drawn by :	COS	Date:	FEB 2022
Checked by :	BK	Date:	11.02.2022

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography

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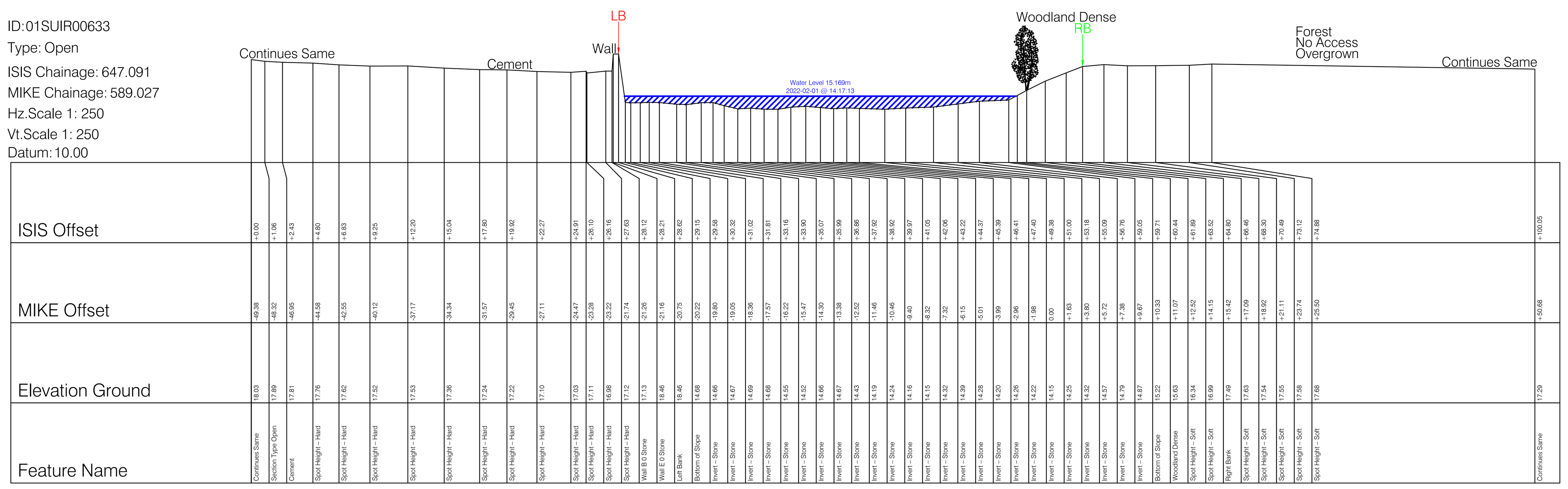
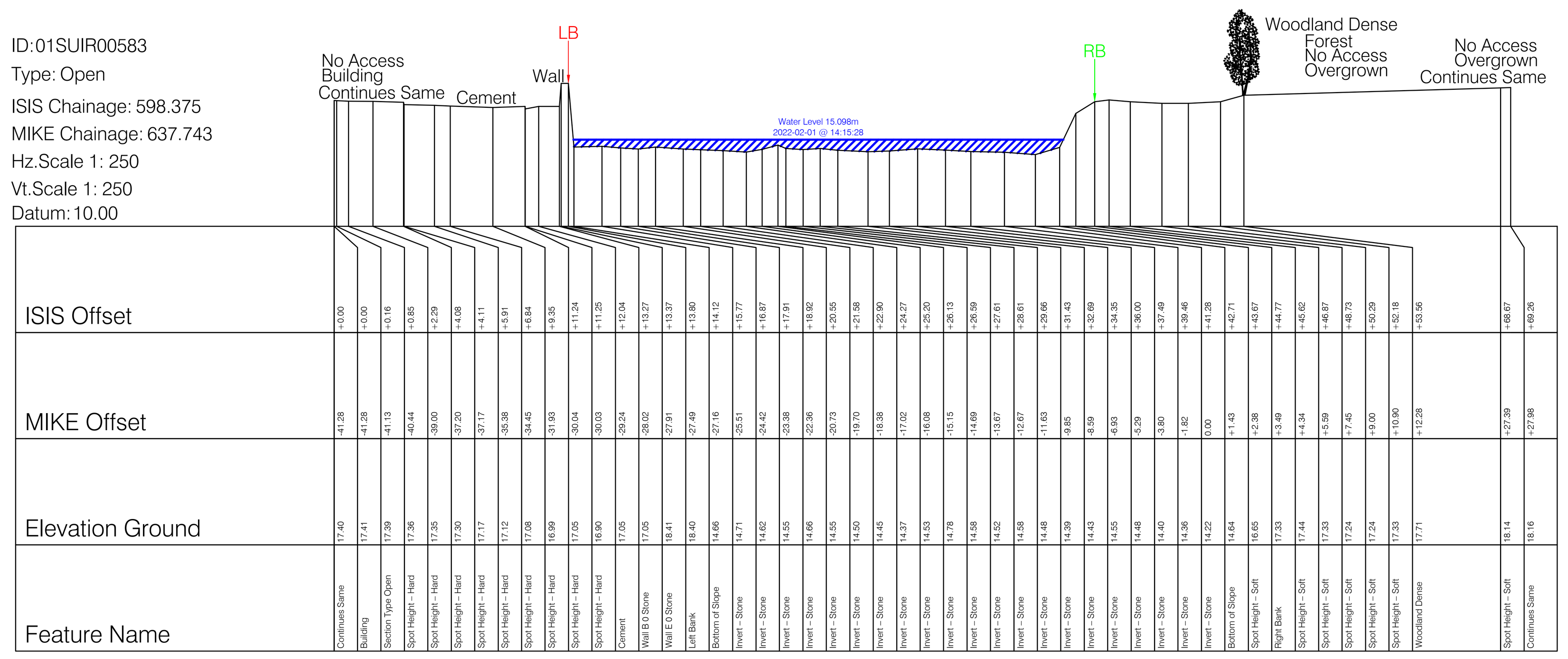
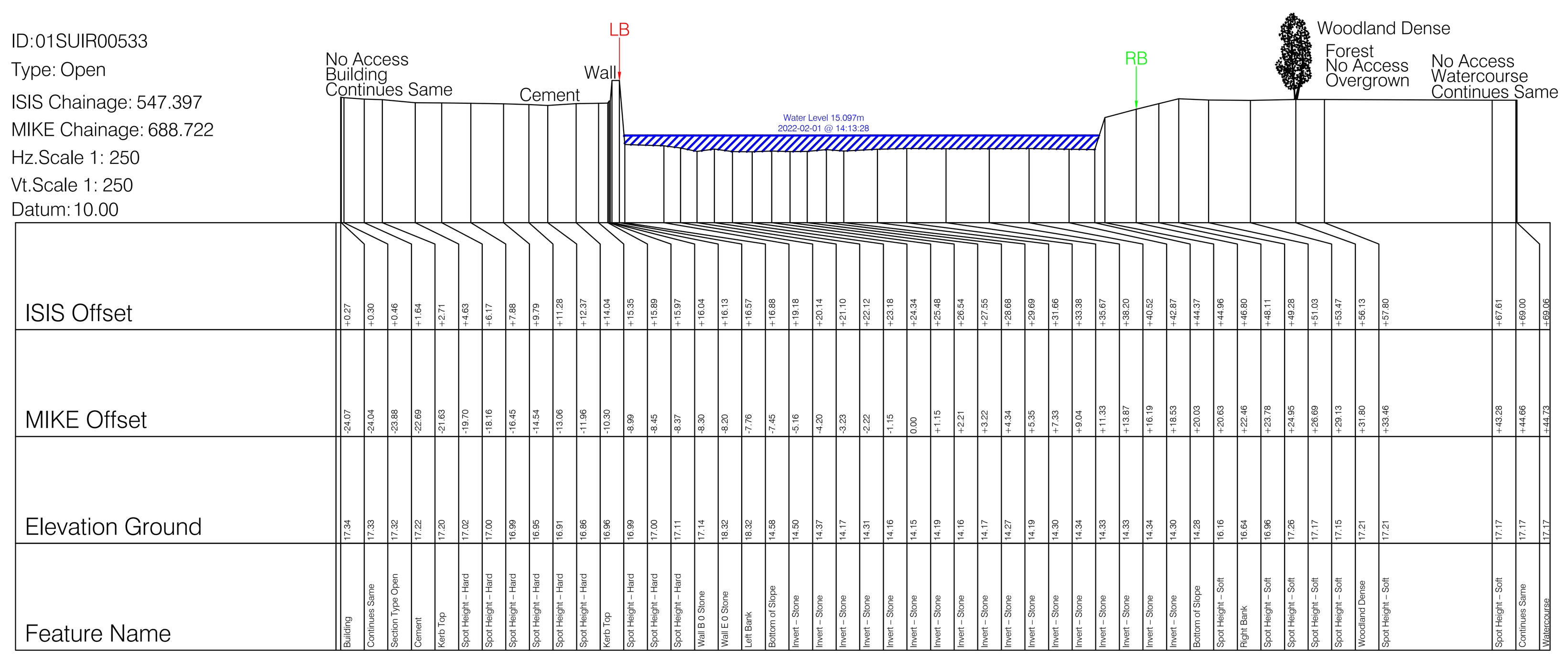
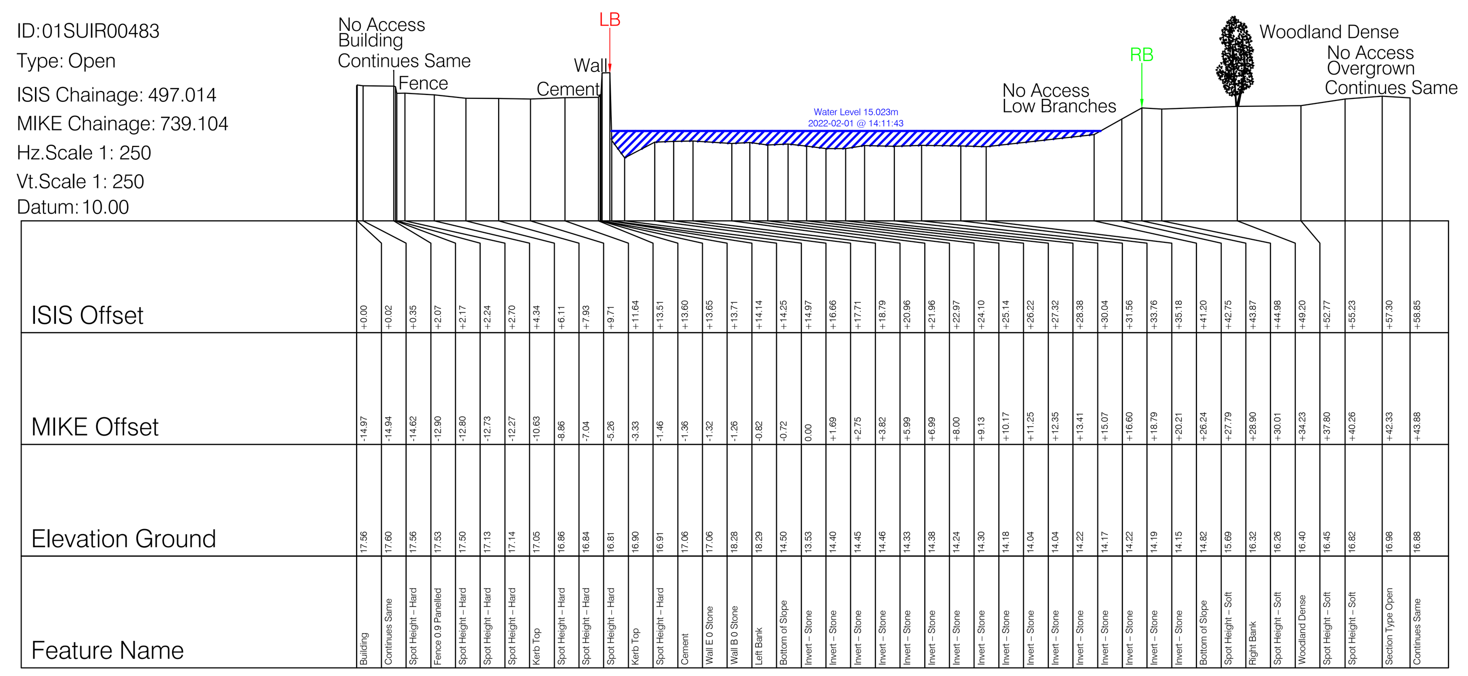
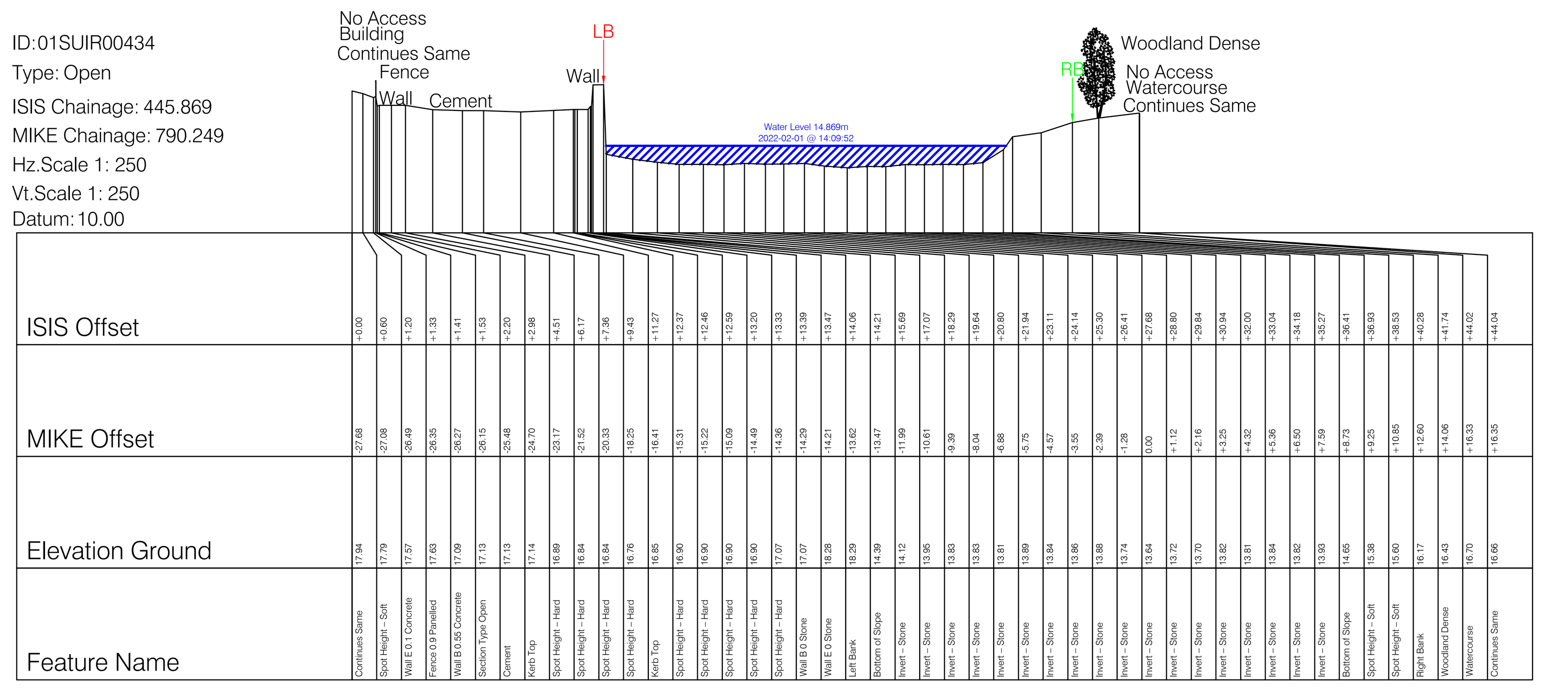
Client :	Clifton Scannell Emerson
Project :	44342 Suir Island Bathymetric Survey
Date :	11.02.2022
Scale :	AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MGS44342_01SUIR_XS_03

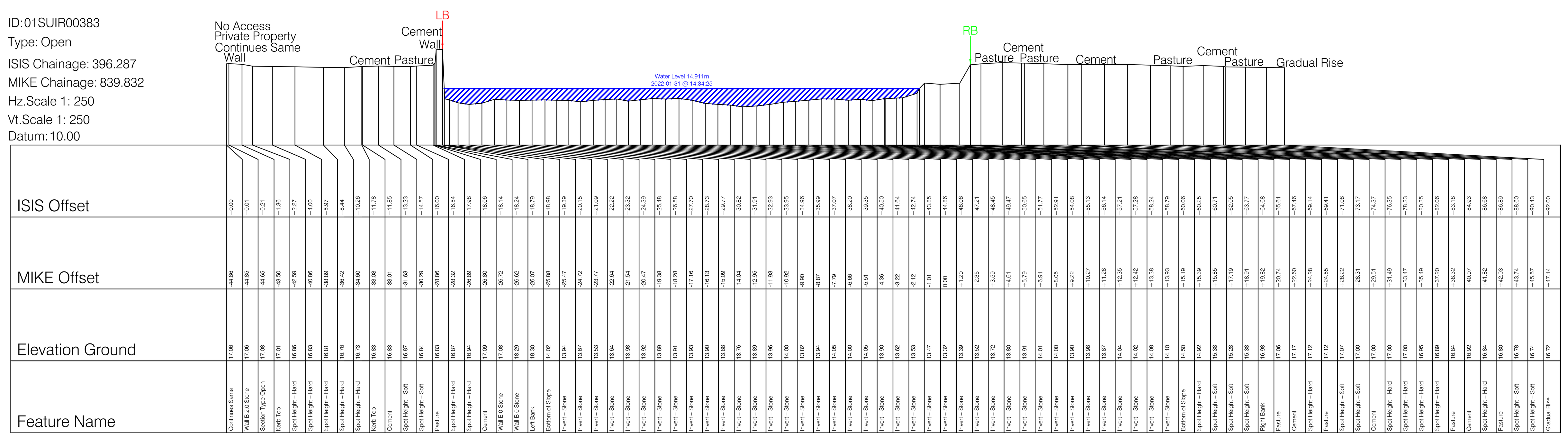


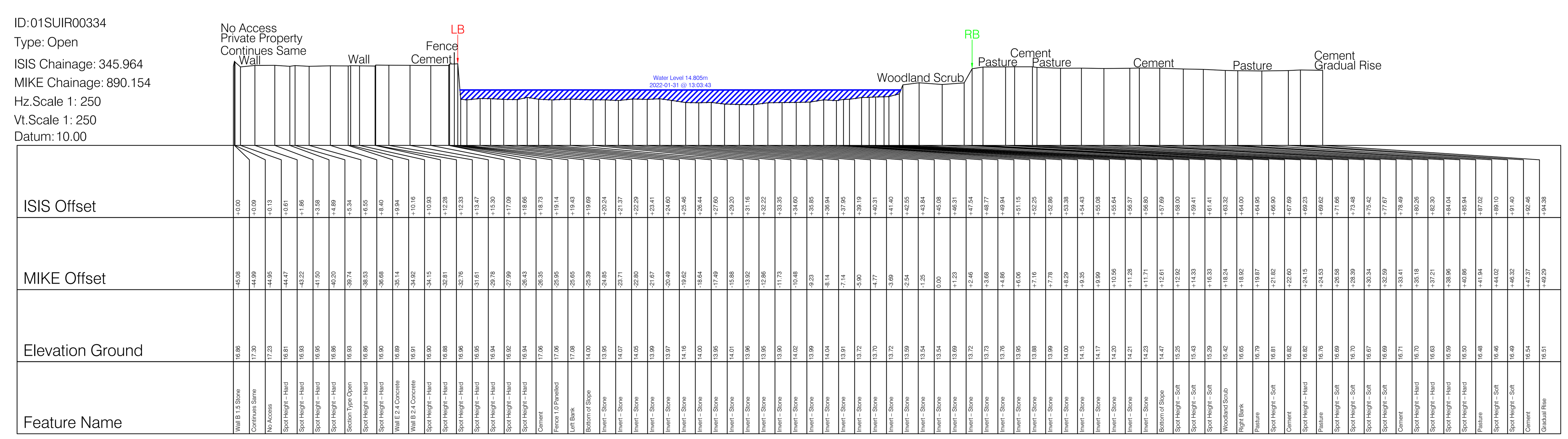


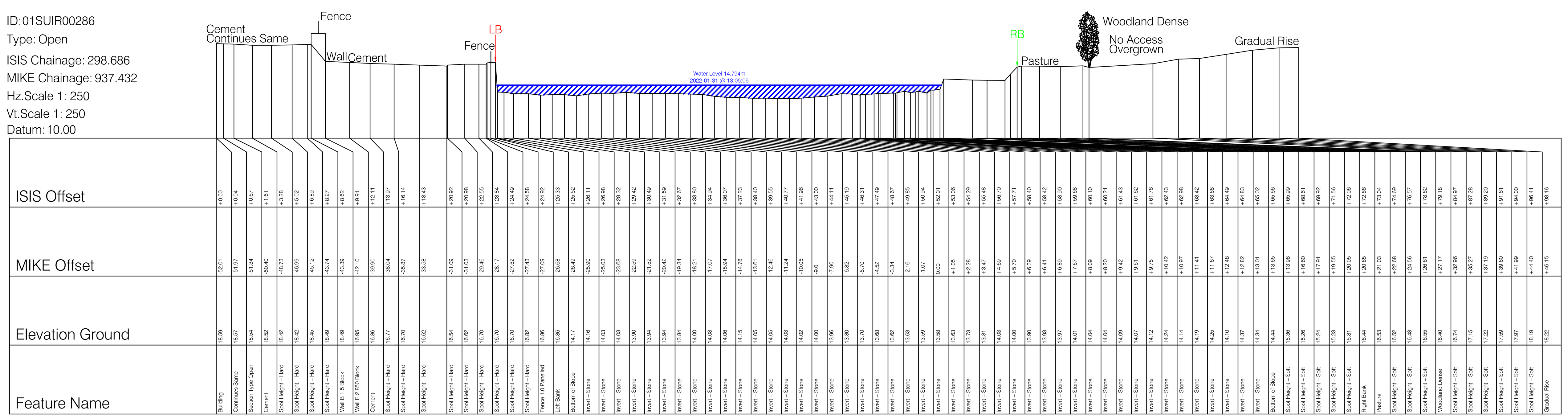


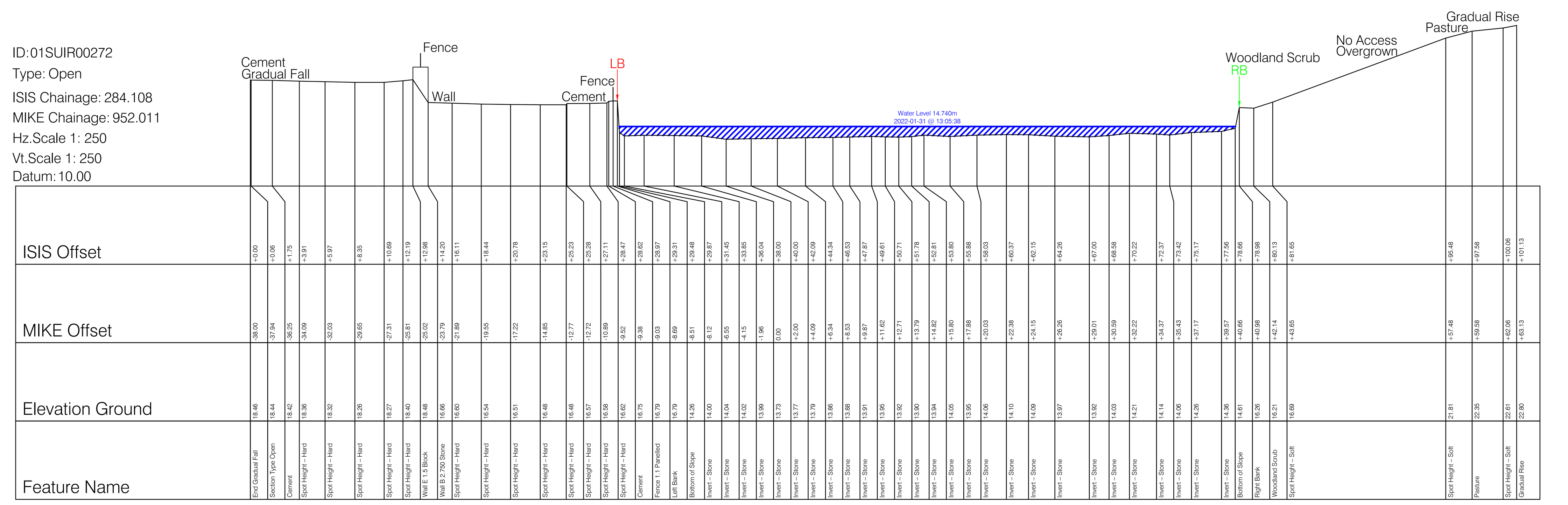












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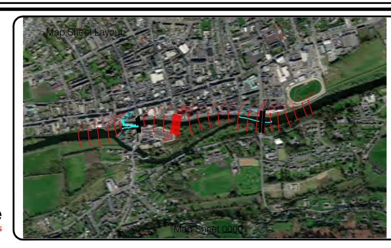
LEGEND

cross section details

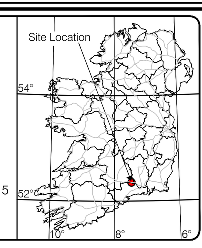
River Profile	LB	Left Bank	
Water Level	RB	Right Bank	
Ground Level		Building Line	
Road Line		Wall Line	
Wall Line		Fence Line	
Bridge Line		Pipe Profile	

No. 318

Supply-Line empowered by Achilles



North



Surveyed by : MGS		Date: FEB 2022	
Drawn by : COS		Date: FEB 2022	
Checked by : BK		Date: 11.02.2022	

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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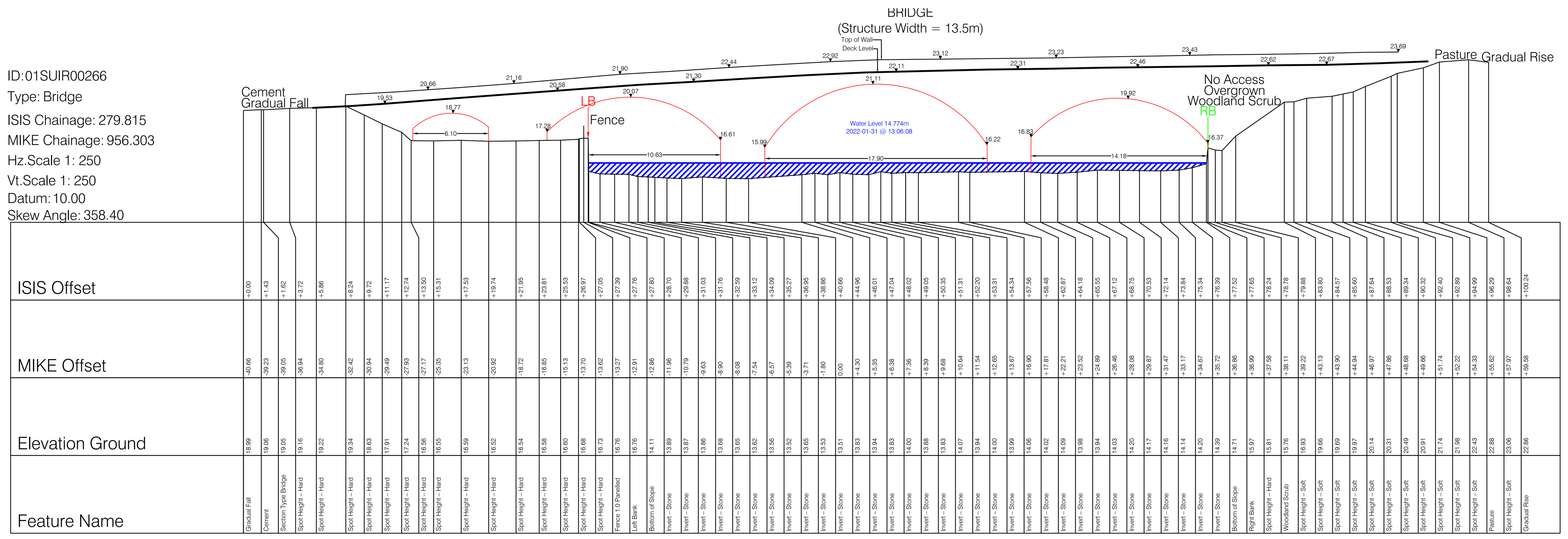
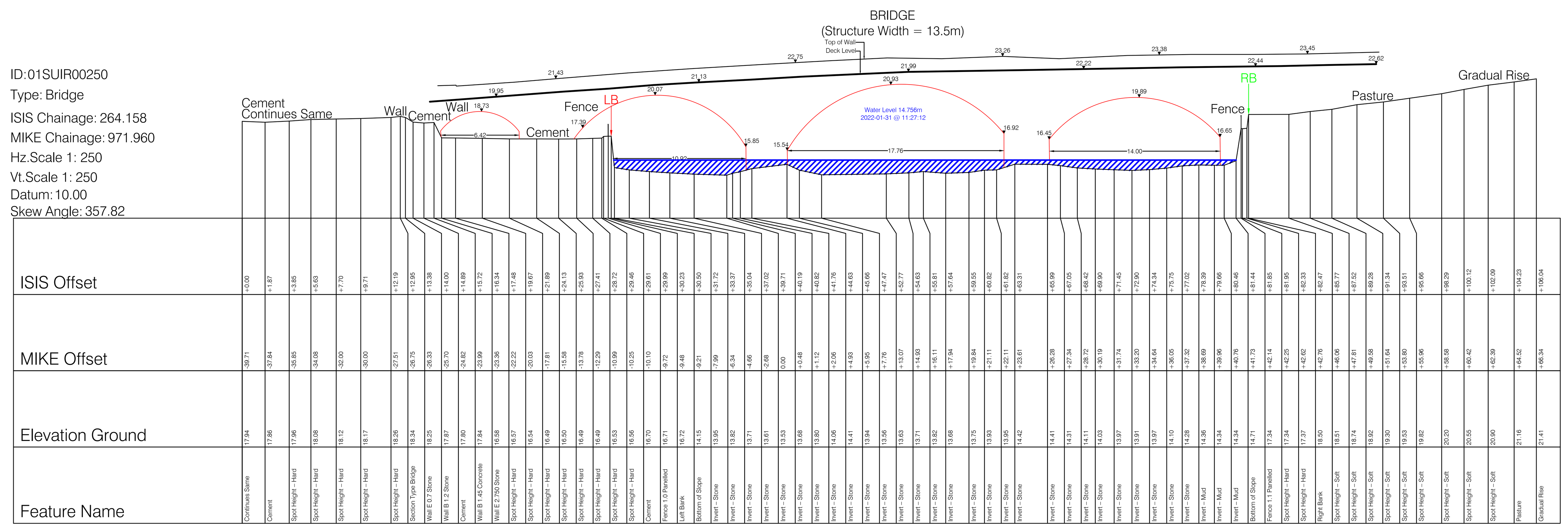
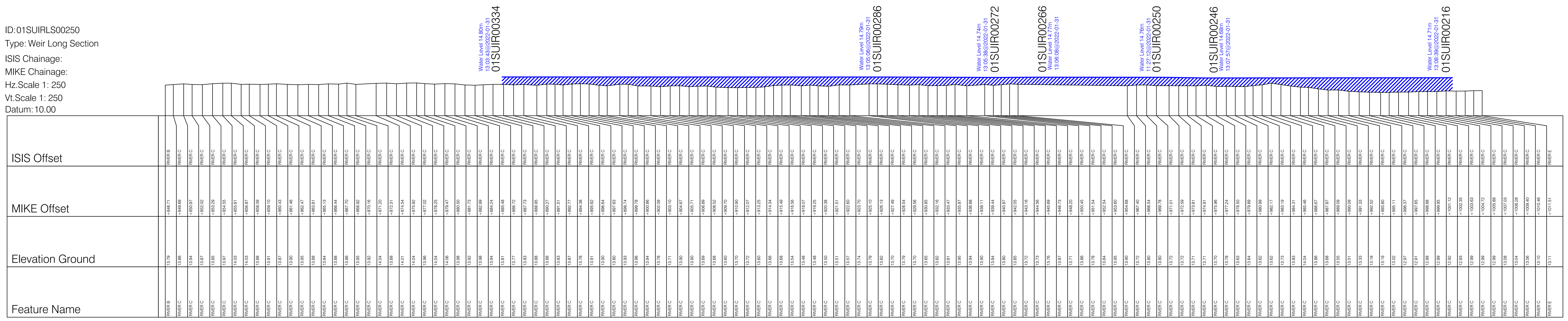
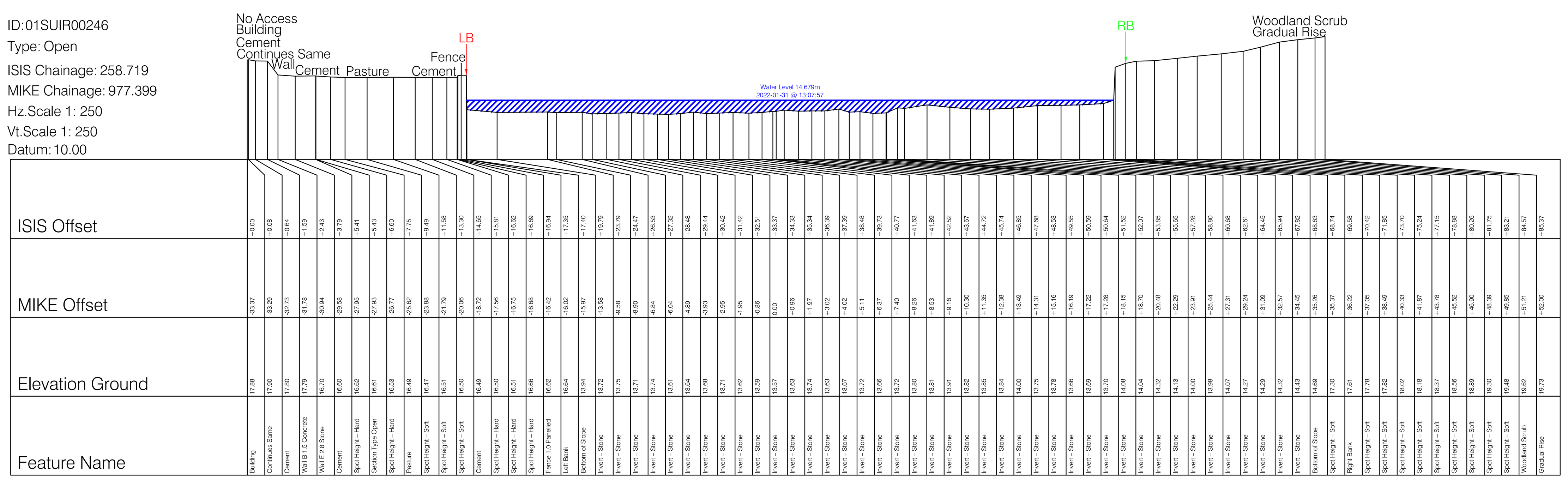
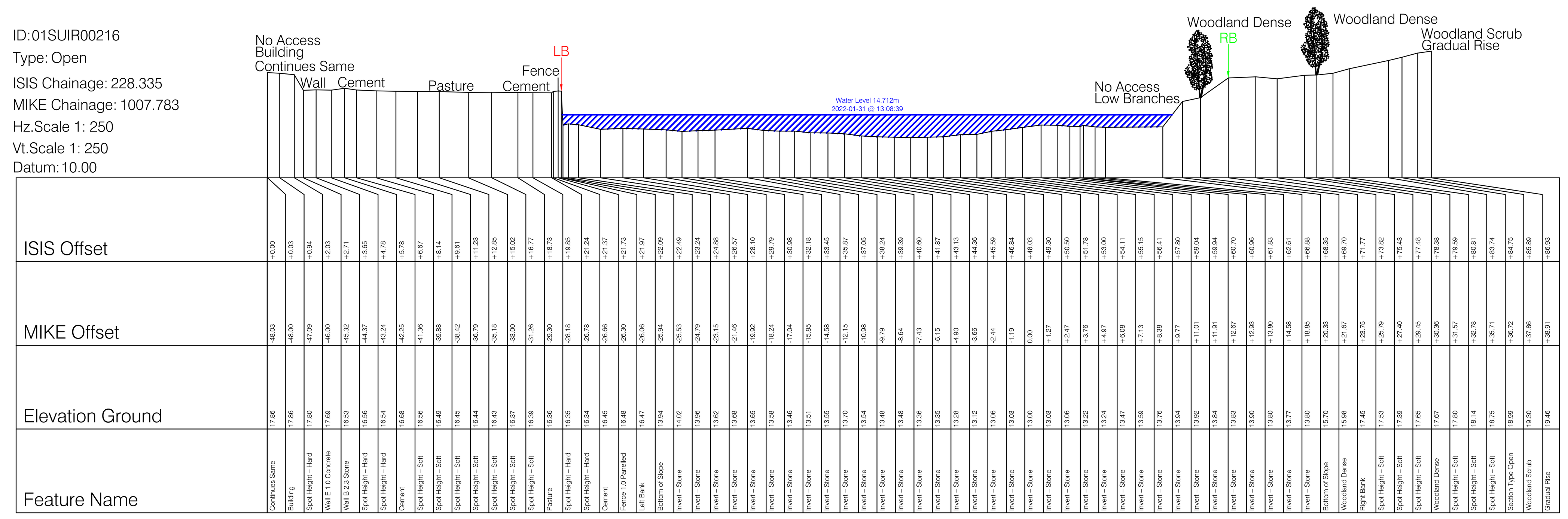
Client : Clifton Scannell Emerson	
Project : 44342 Suir Island Bathymetric Survey	
Date : 11.02.2022	**Scale :** AS SHOWN
Description : CROSS SECTIONS	
Drawing Number : MGS44342_01SUIR_XS_04	

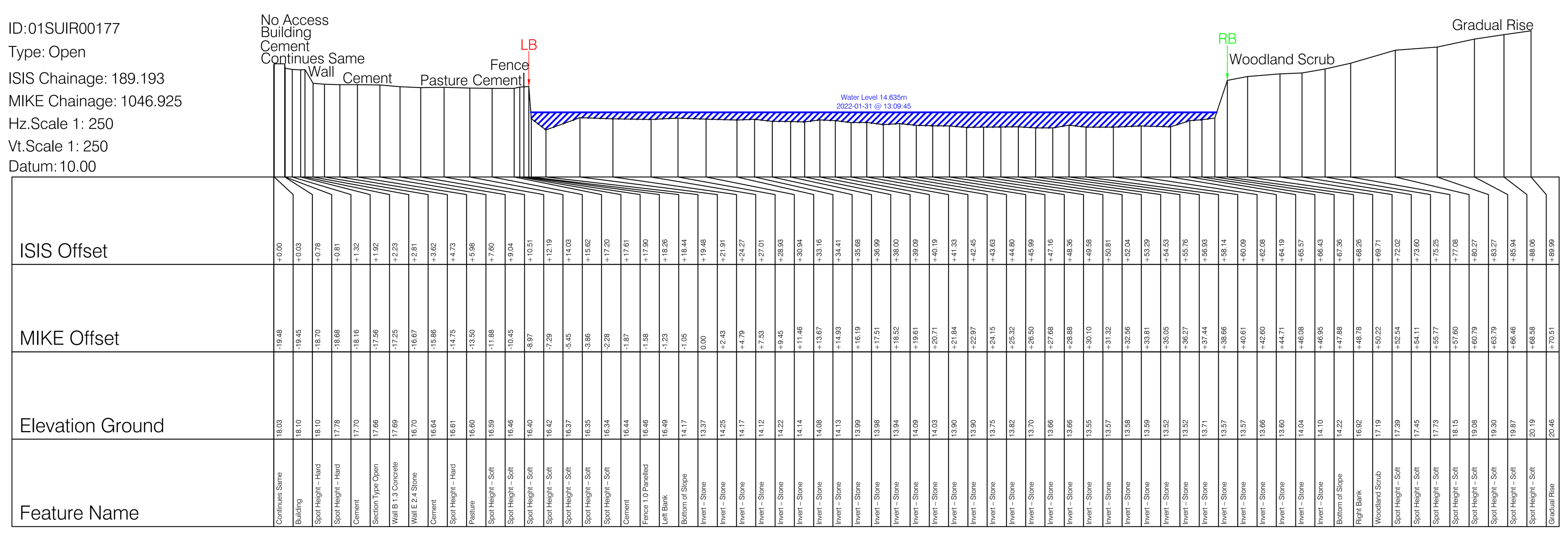


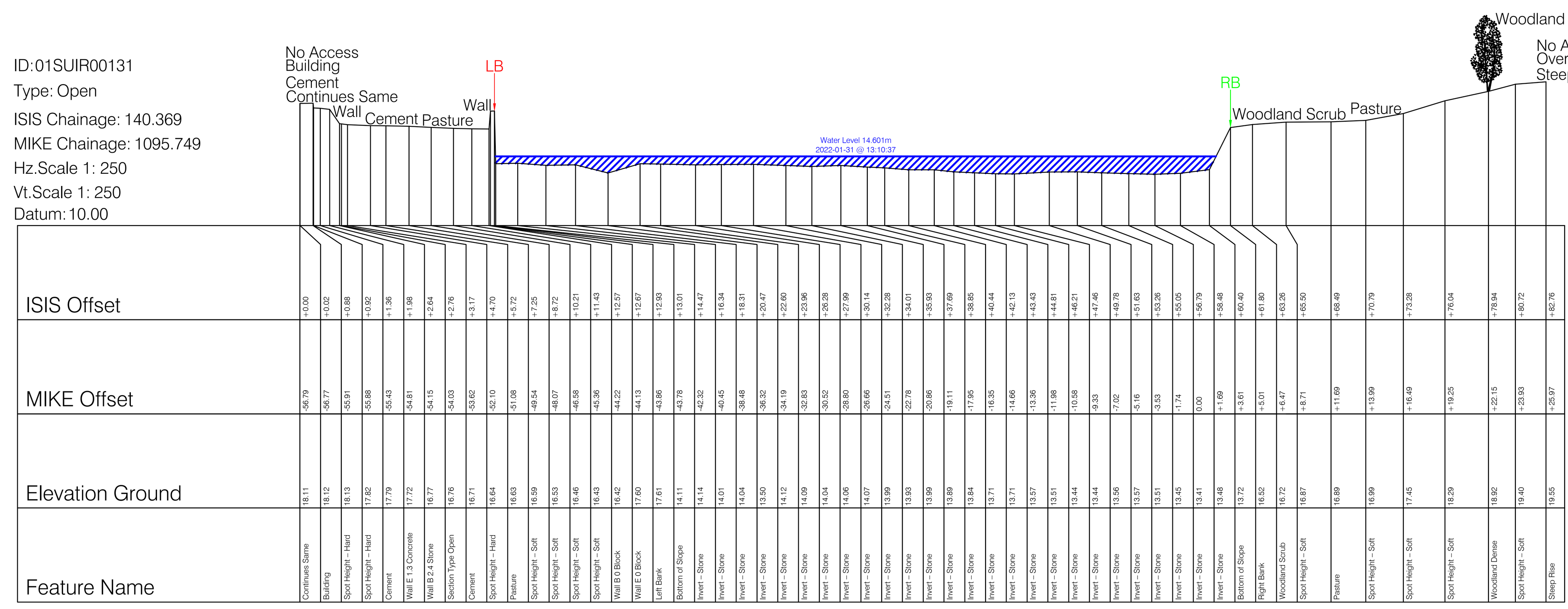












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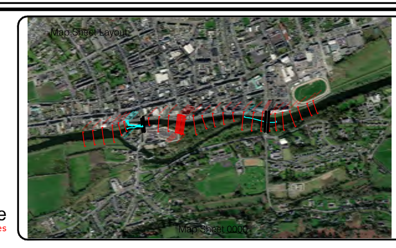
LEGEND

cross section details

River Profile		LB	Left Bank
Water Level		RB	Right Bank
Ground Level			Building Line
Road Line			Wall Line
Wall Line			Fence Line
Bridge Line			Pipe Profile



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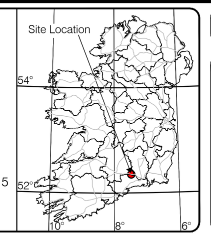

Surveyed by :	MGS	Date:	FEB 2022
Drawn by :	COS	Date:	FEB 2022
Checked by :	BK	Date:	11.02.2022

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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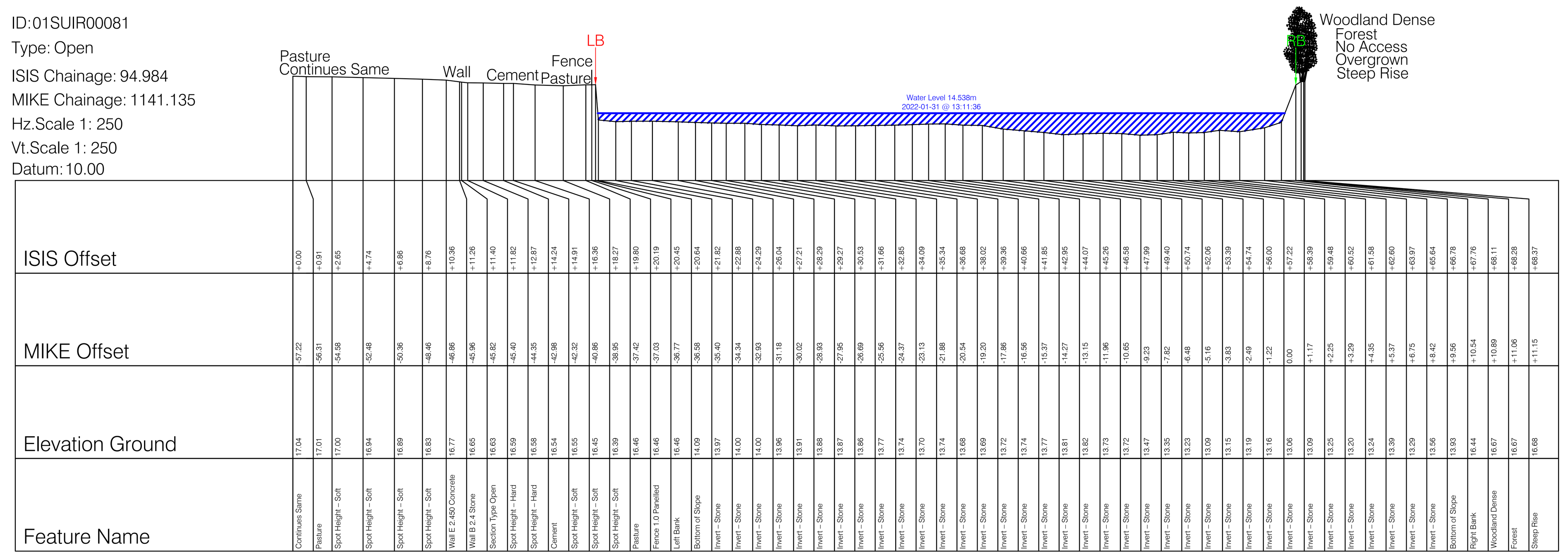
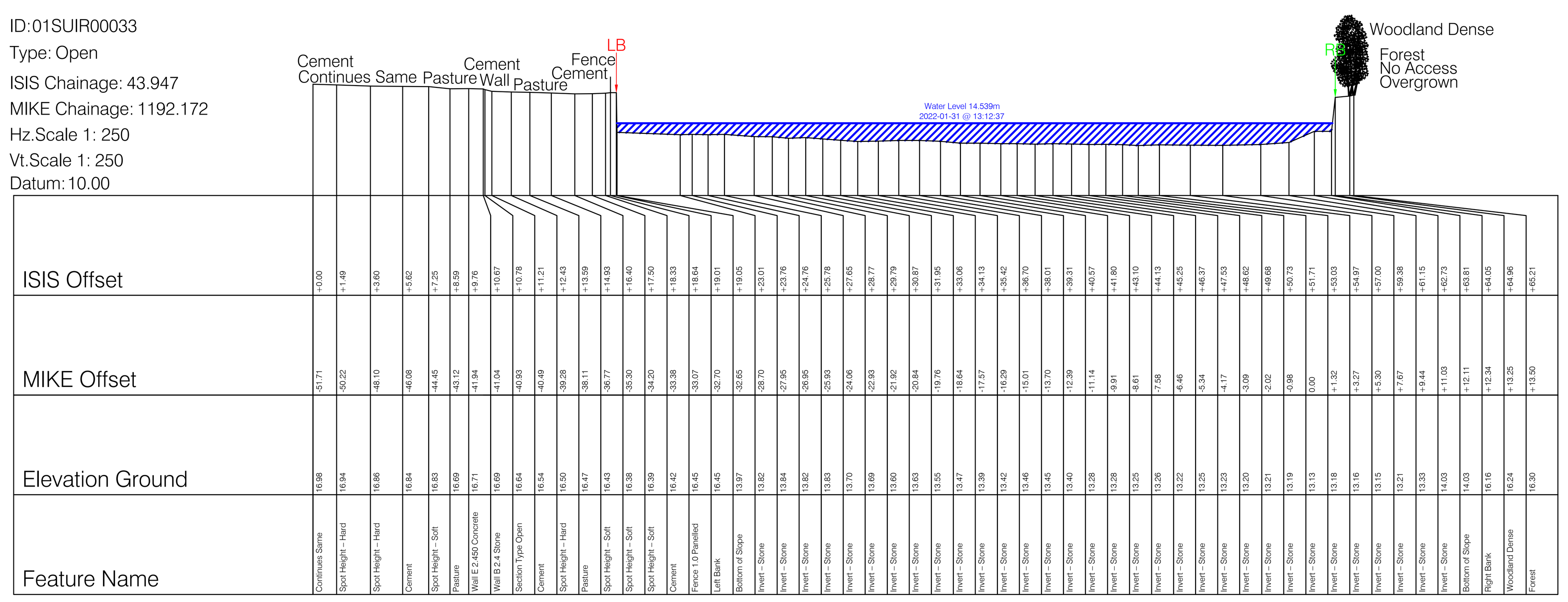
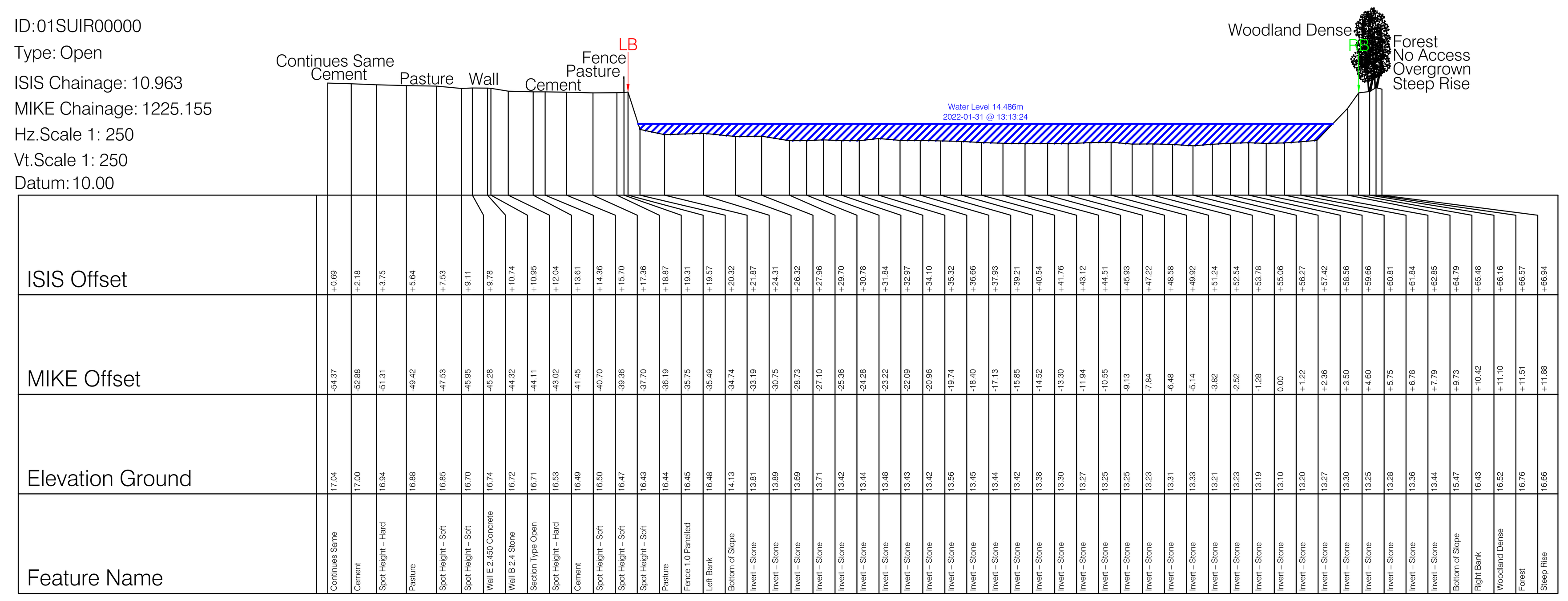
Client : Clifton Scannell Emerson
Project : 44342 Suir Island Bathymetric Survey
Date : 11.02.2022 **Scale :** AS SHOWN
Description : CROSS SECTIONS
Drawing Number : MGS44342_01SUIR_XS_05







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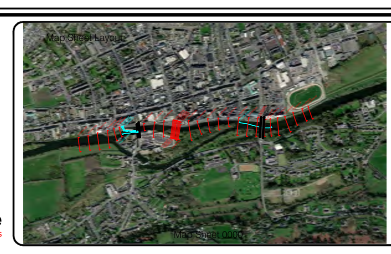
LEGEND

cross section details

	River Profile	LB	Left Bank
	Water Level	RB	Right Bank
	Ground Level		Building Line
	Road Line		Wall Line
	Wall Line		Fence Line
	Bridge Line		Pipe Profile

No. 318

Supply-Line



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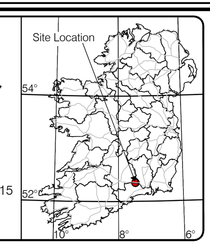

Surveyed by : MGS Date: FEB 2022
Drawn by : COS Date: FEB 2022
Checked by : BK Date: 11.02.2022

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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Client : Clifton Scannell Emerson
Project : 44342 Suir Island Bathymetric Survey
Date : 11.02.2022 **Scale :** AS SHOWN
Description : CROSS SECTIONS
Drawing Number : MGS44342_01SUIR_XS_06

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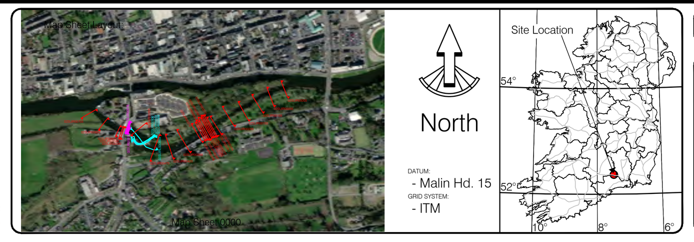
LEGEND

section plan details

- Surveyed Section Lines with References & Section Orientation (at Open channel)
- Surveyed Section Lines with References & Section Orientation (at Structures)
- Surveyed Section Lines with References & Section Orientation (at Additional items)



Surveyed by :	MGS	Date:	FEB 2022
Drawn by :	COS	Date:	FEB 2022
Checked by :	BK	Date:	11.02.2022

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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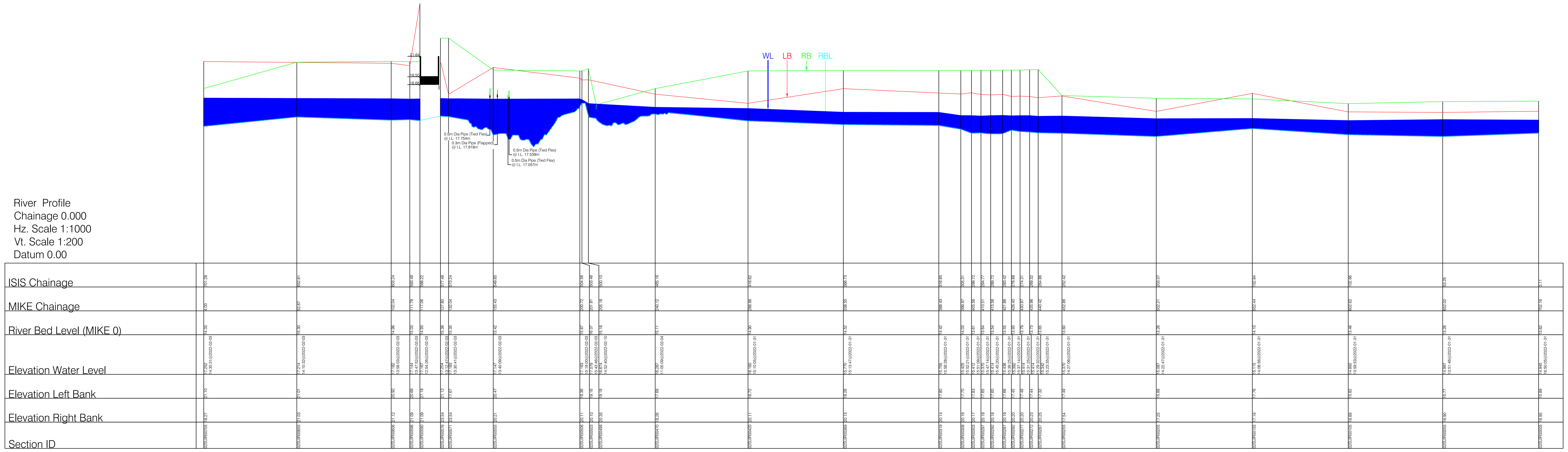
Client :	Clifton Scannell Emerson
Project :	44342 Suir Island Bathymetric Survey
Date : 11.02.2022	**Scale :** 1:1000
Description :	SECTIONS PLAN
Drawing Number :	MGS44342_02SUIR_PLAN_01



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LEGEND

long section details

Water Profile
Water Level
Left Bank Level
Right Bank Level
River Bed Level
Road Level
Structure Level

LB Left Bank Level
RB Right Bank Level
WL Water Level
RBL River Bed Level

North

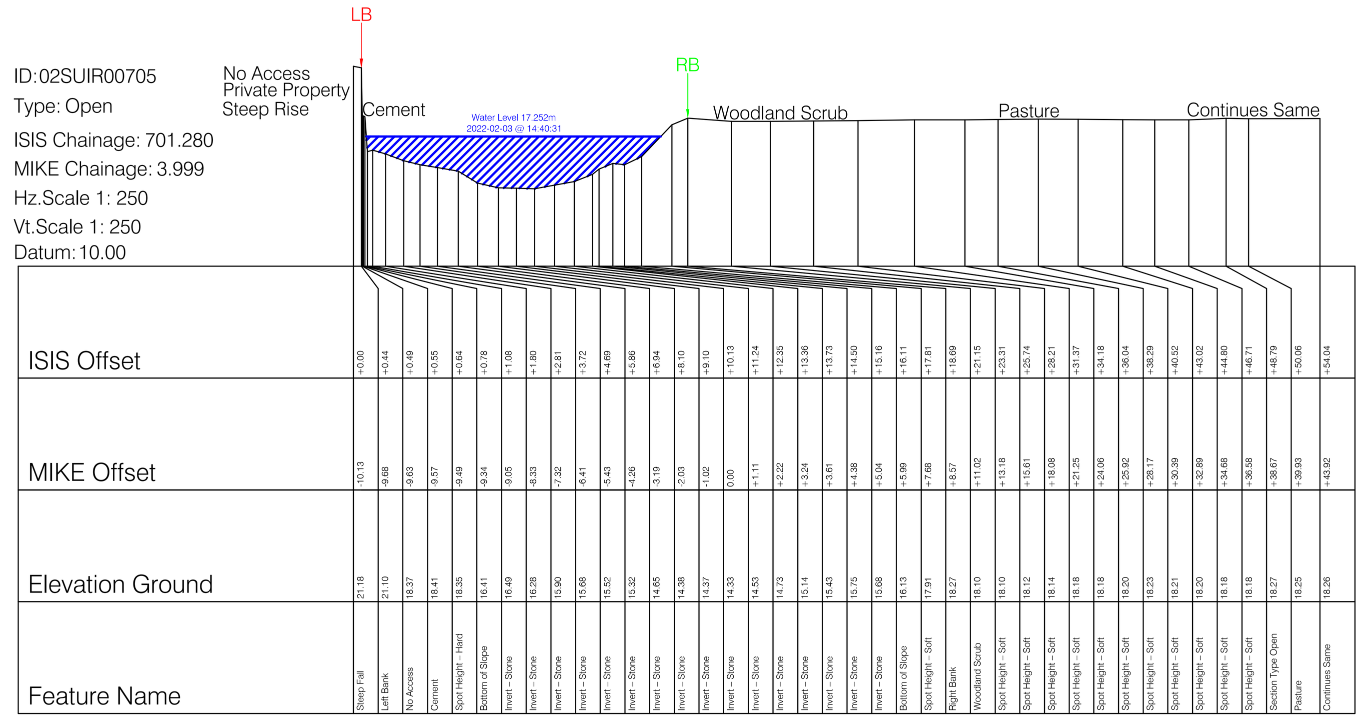
Client : Clifton Scannell Emerson

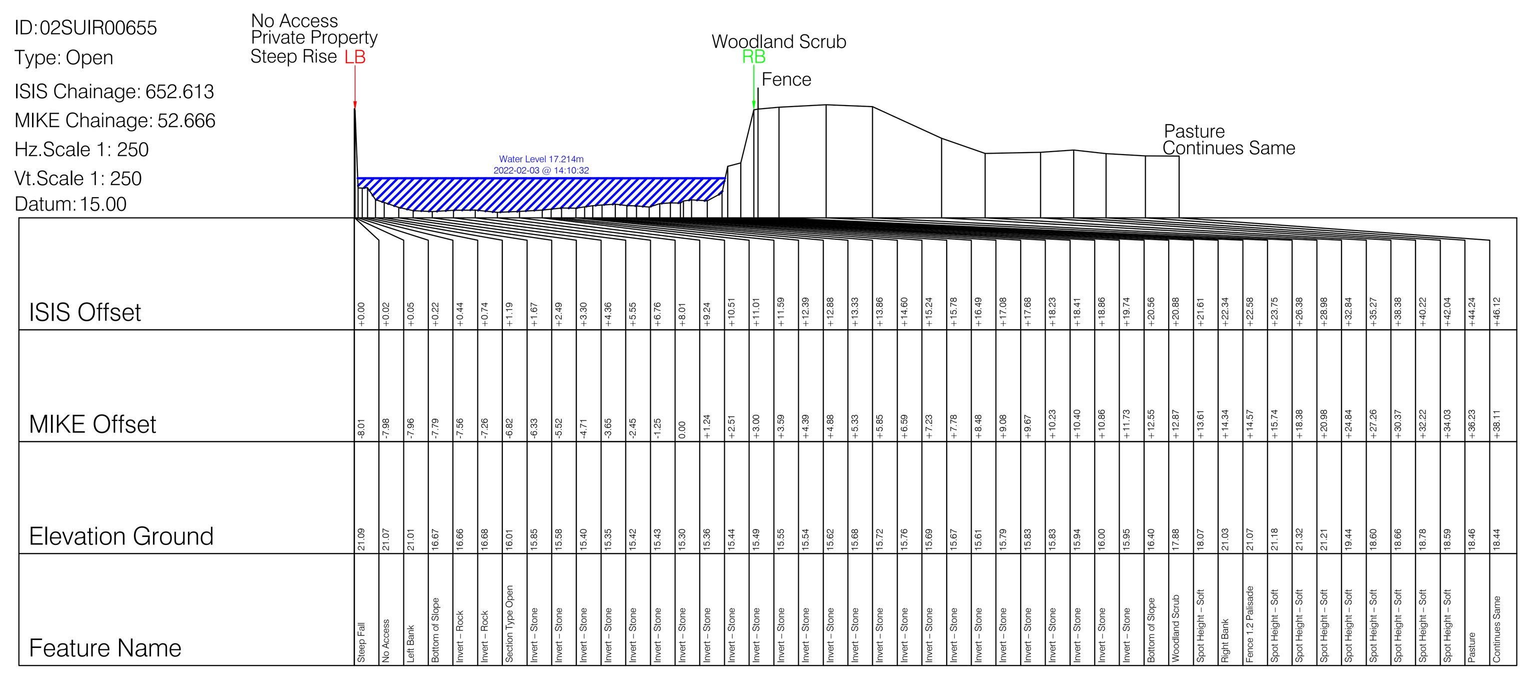
Project : 44342 Suir Island Bathymetric Survey

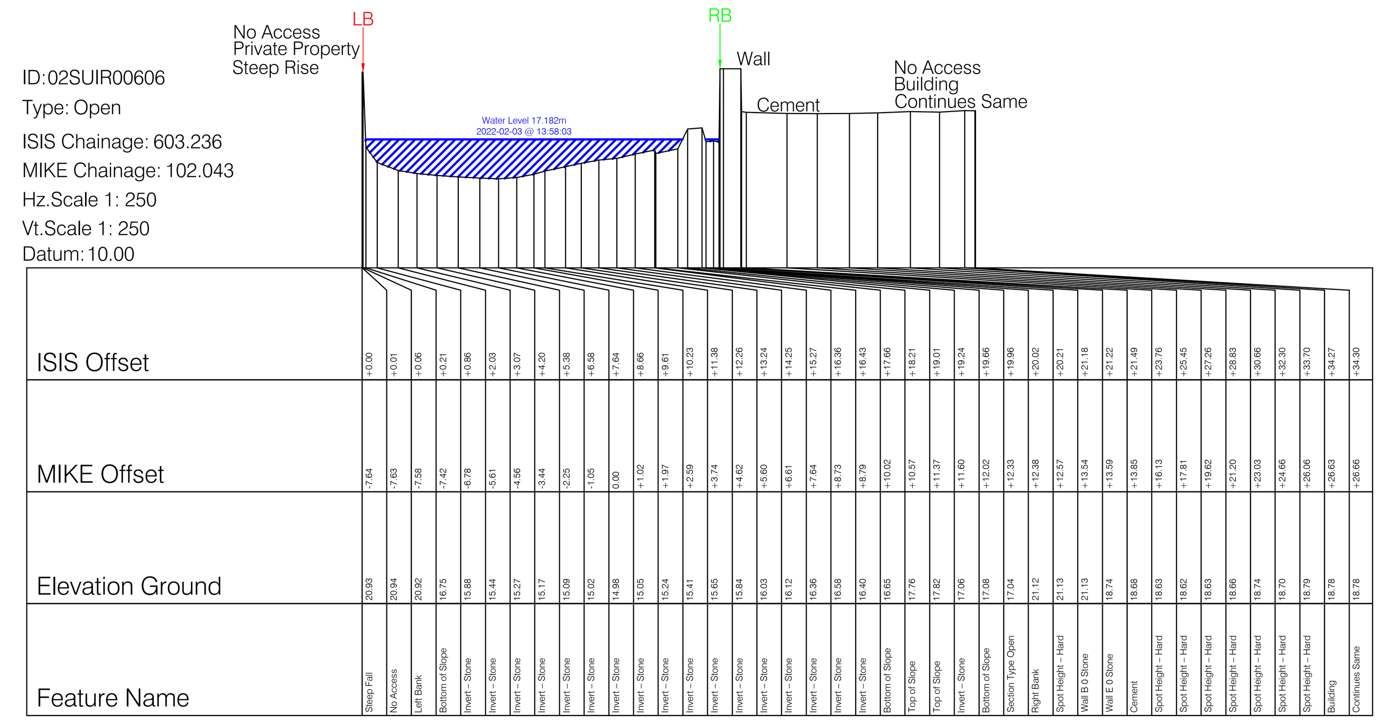
Date : 11.02.2022 **Scale :** 1:1000

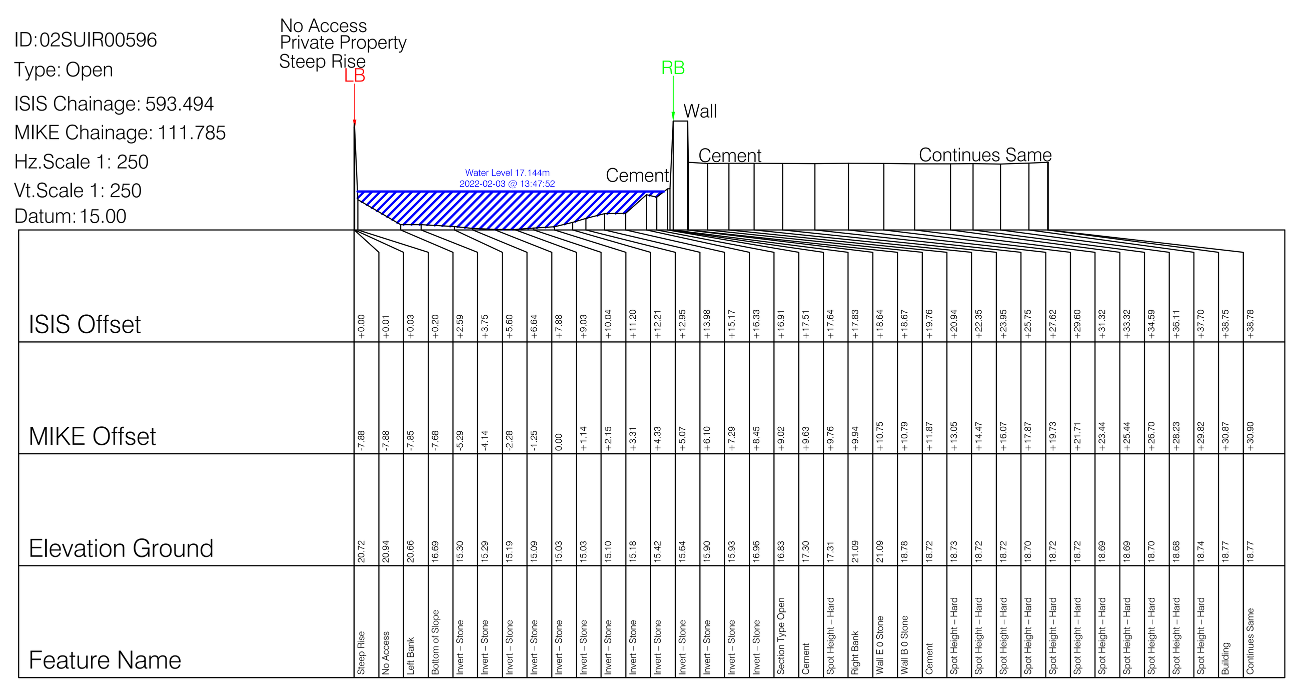
Description : LONG SECTION

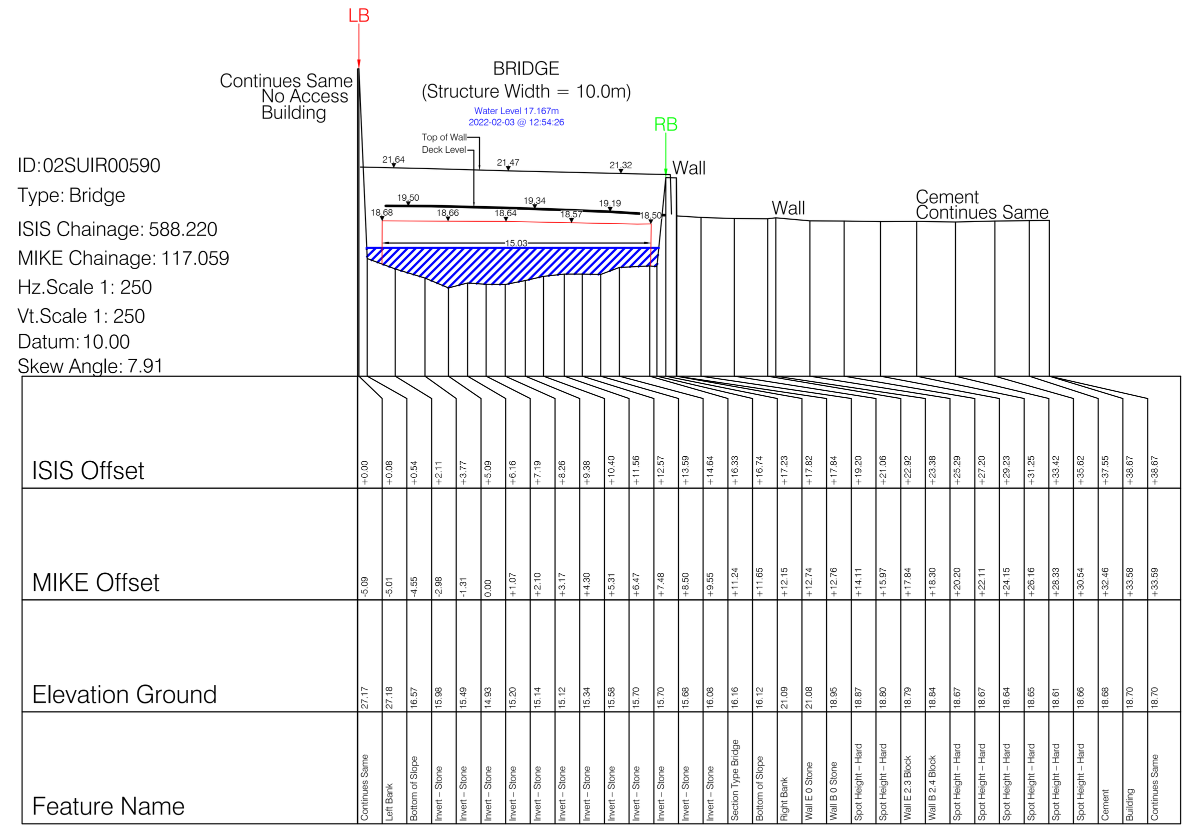
Drawing Number : MGS44342_02SUIR_LS_01

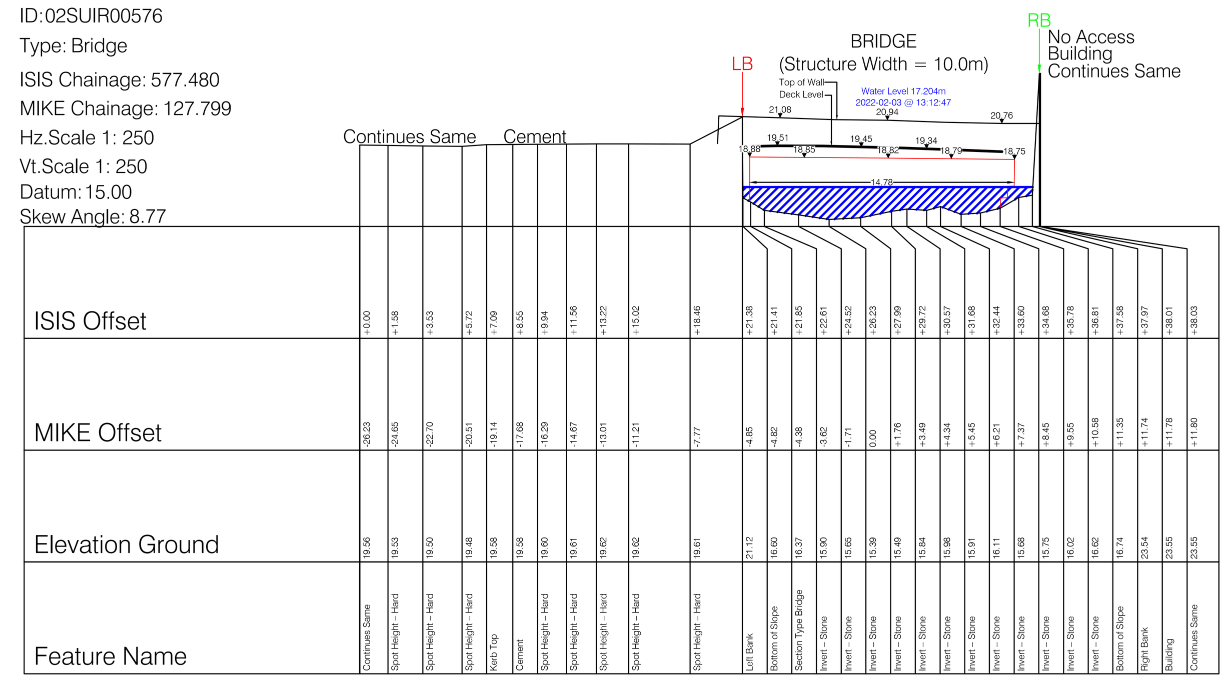


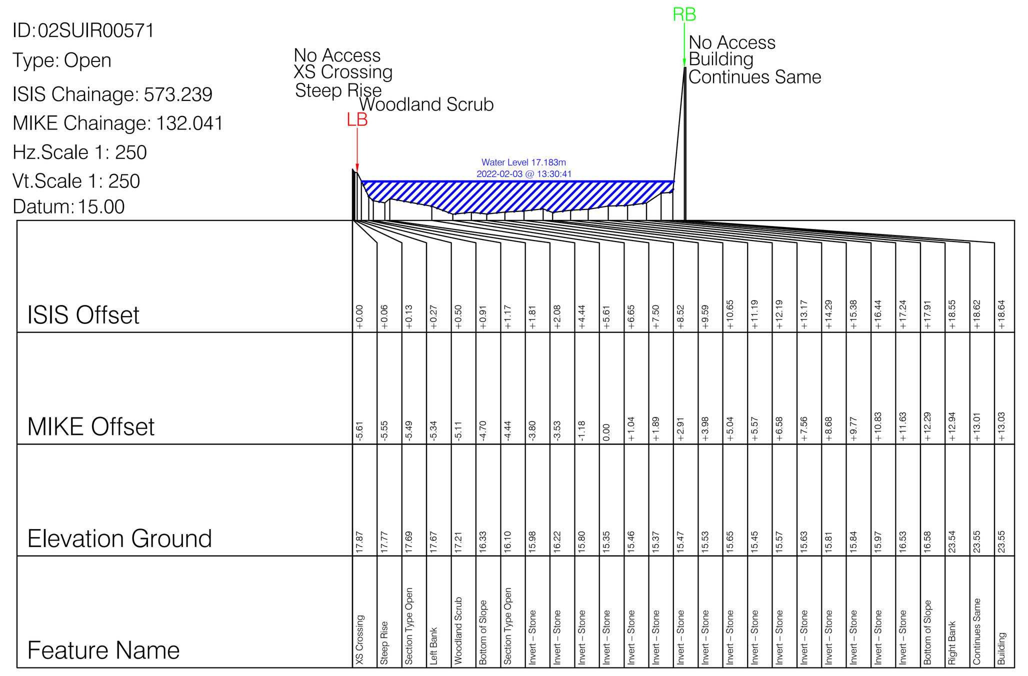


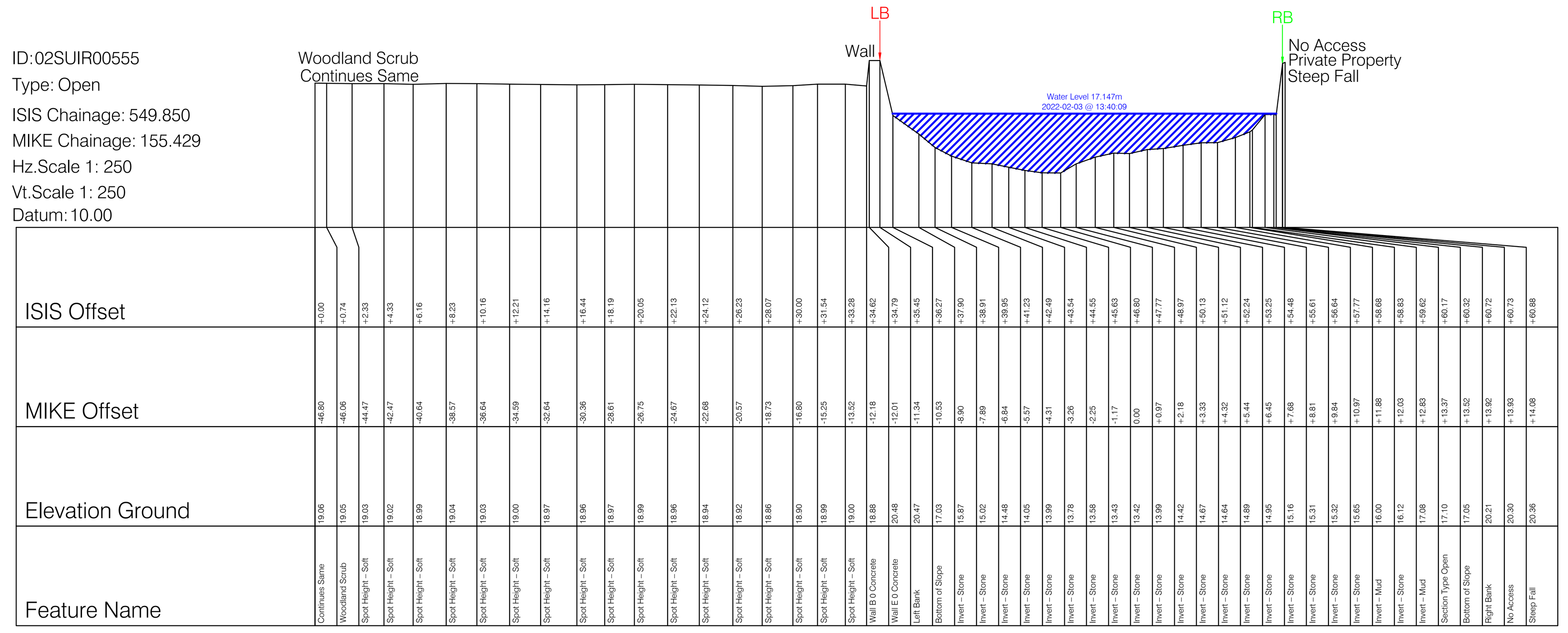


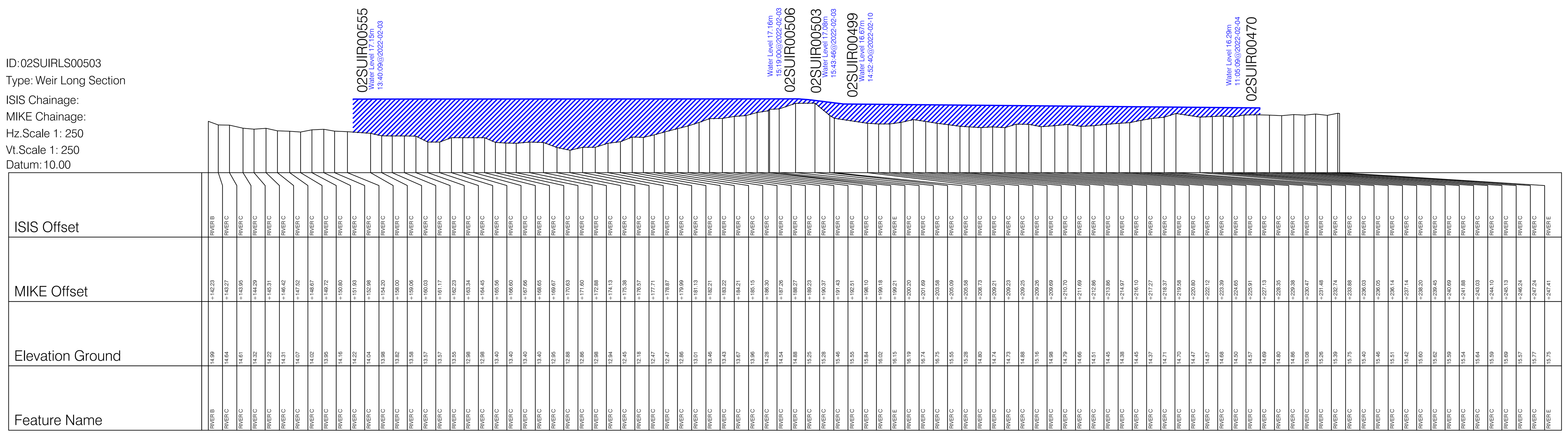


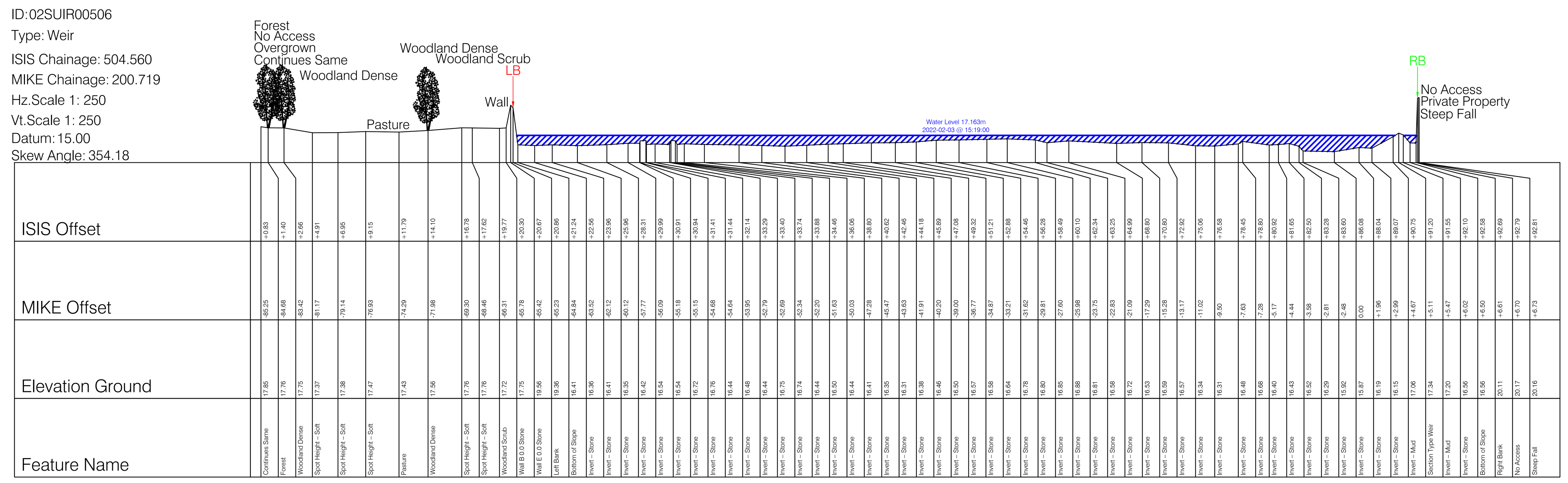












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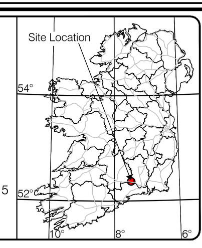
LEGEND

cross section details

	River Profile	LB	Left Bank
	Water Level	RB	Right Bank
	Ground Level		Building Line
	Road Line		Wall Line
	Wall Line		Fence Line
	Bridge Line		Pipe Profile

North



Surveyed by : MGS	Date: FEB 2022
Drawn by : COS	Date: FEB 2022
Checked by : BK	Date: 11.02.2022

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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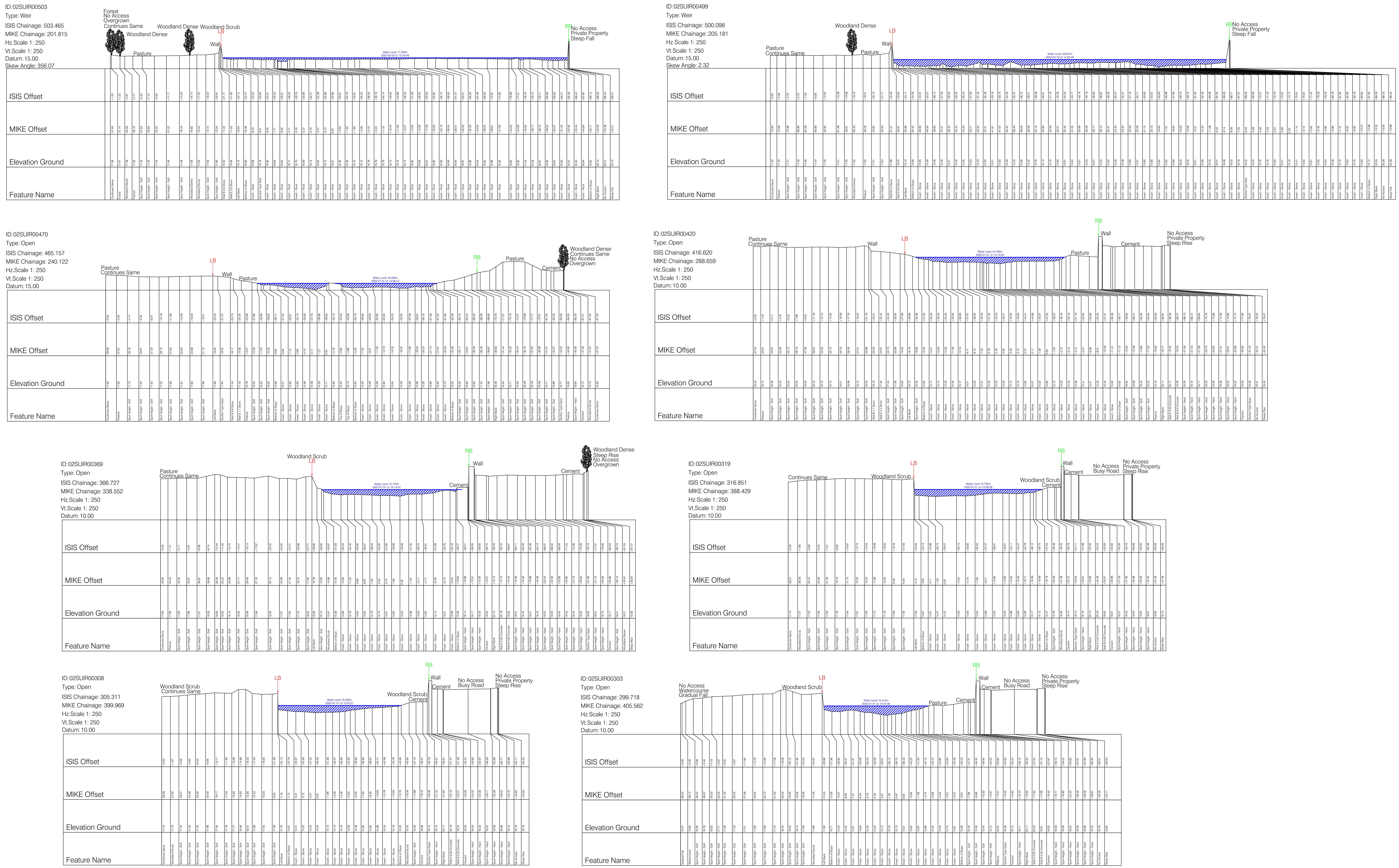
Client :	Clifton Scannell Emerson
Project :	44342 Suir Island Bathymetric Survey
Date :	11.02.2022
Scale :	AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MGS44342_02SUIR_XS_01



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LEGEND

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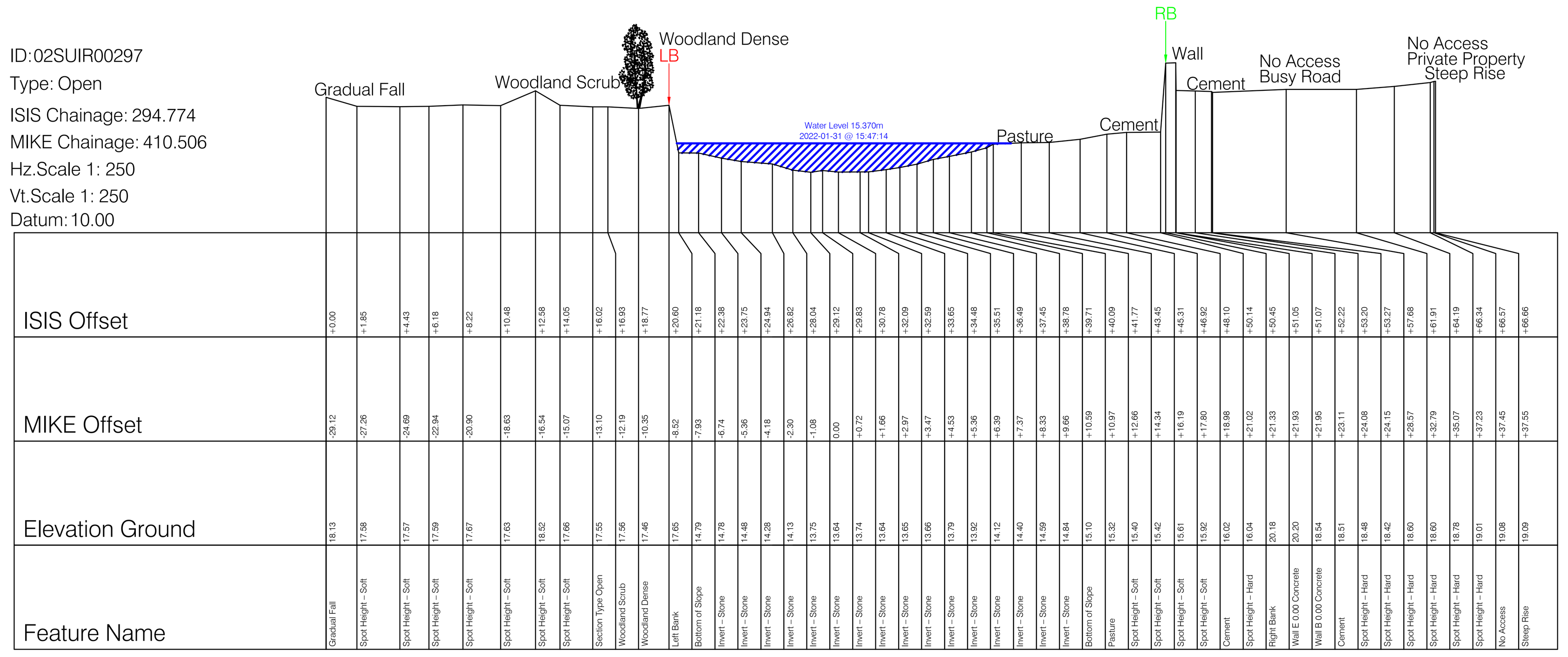
Client : Clifton Scannell Emerson

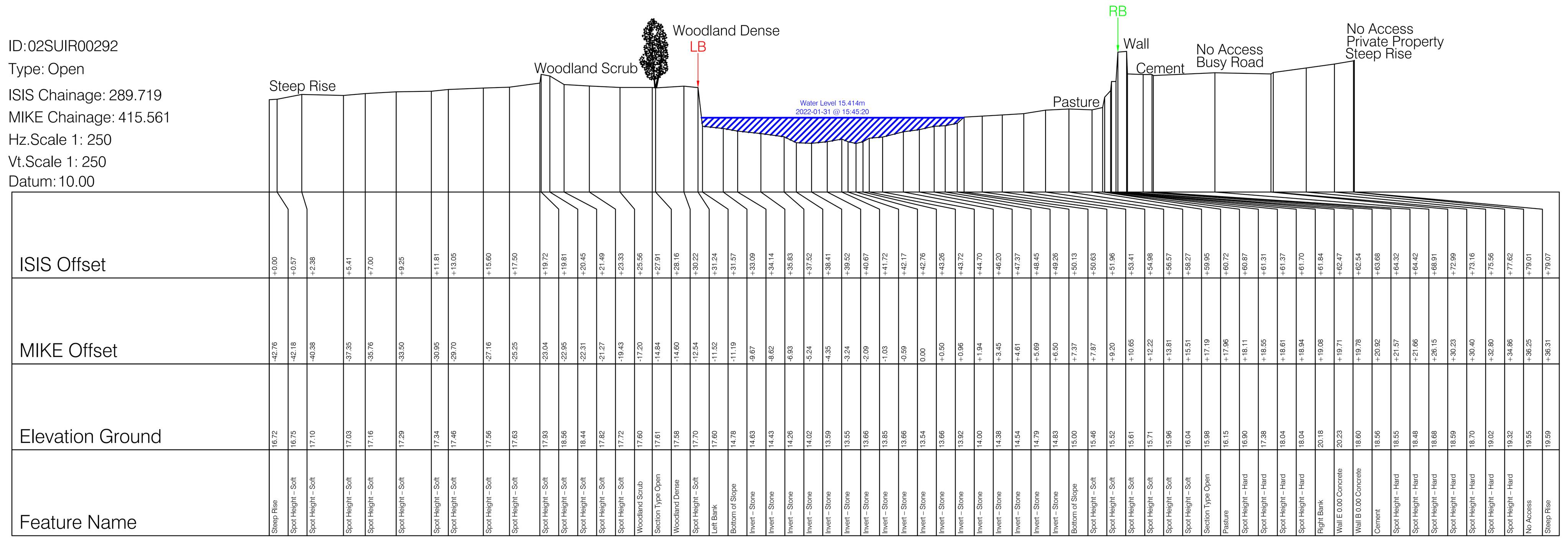
Project : 44342 Suir Island Bathymetric Survey

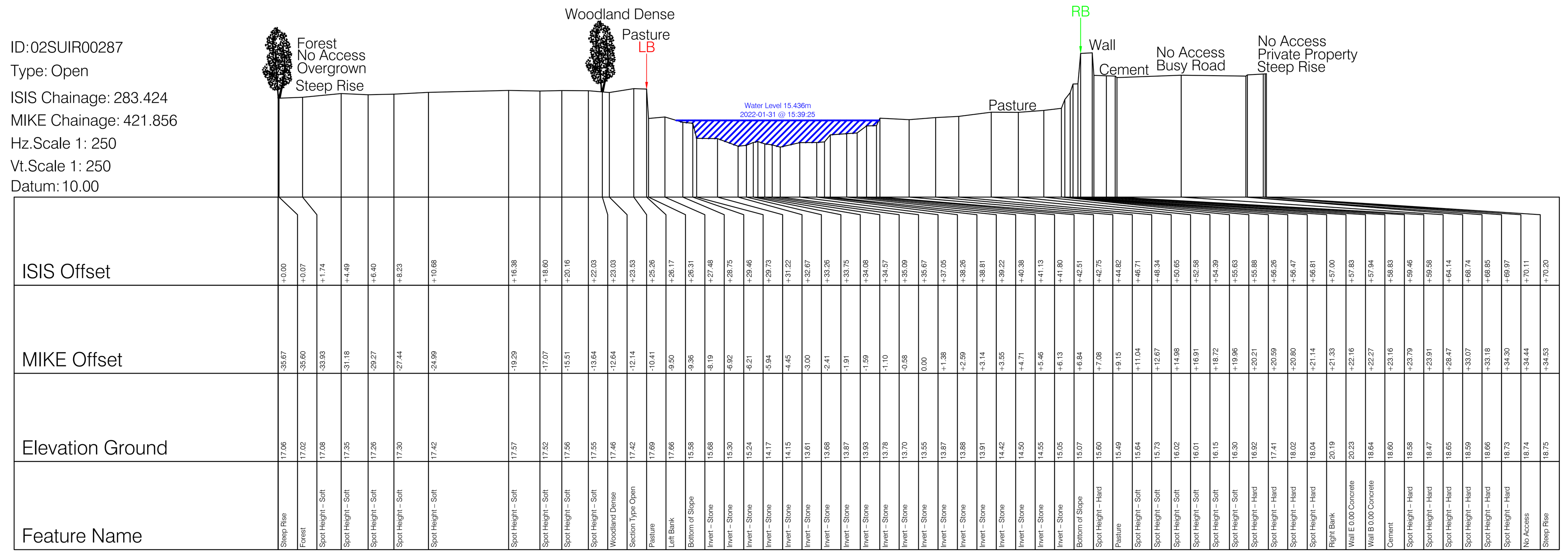
Date : 11.02.2022 | Scale : AS SHOWN

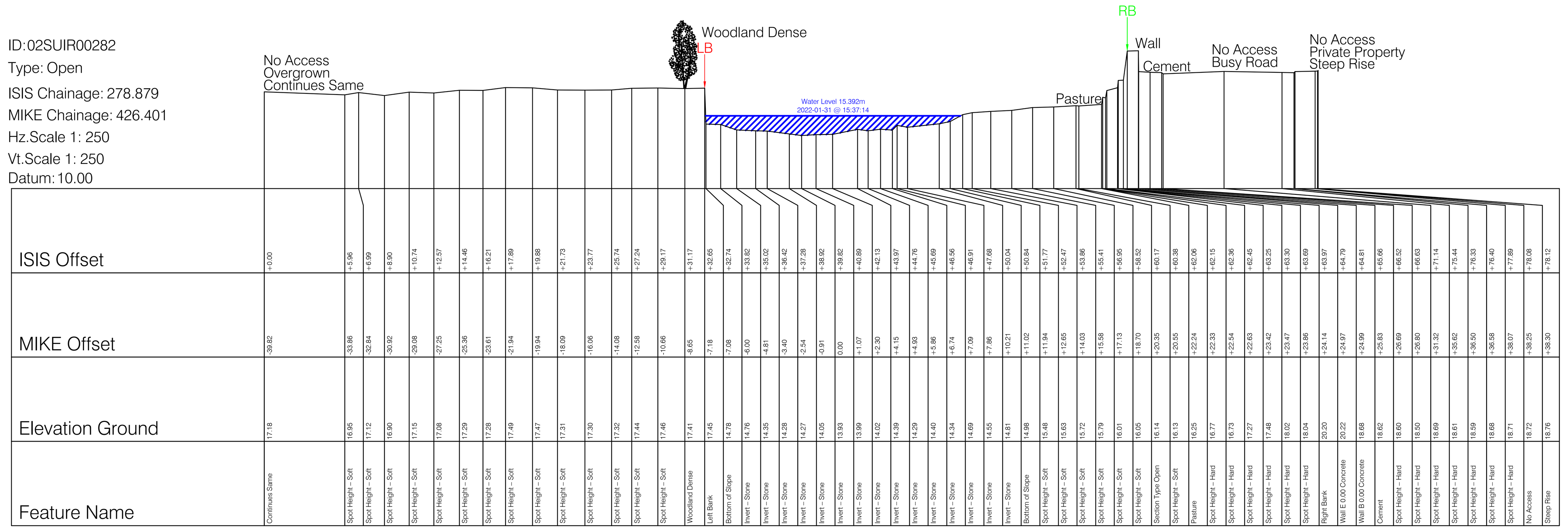
Description : CROSS SECTIONS

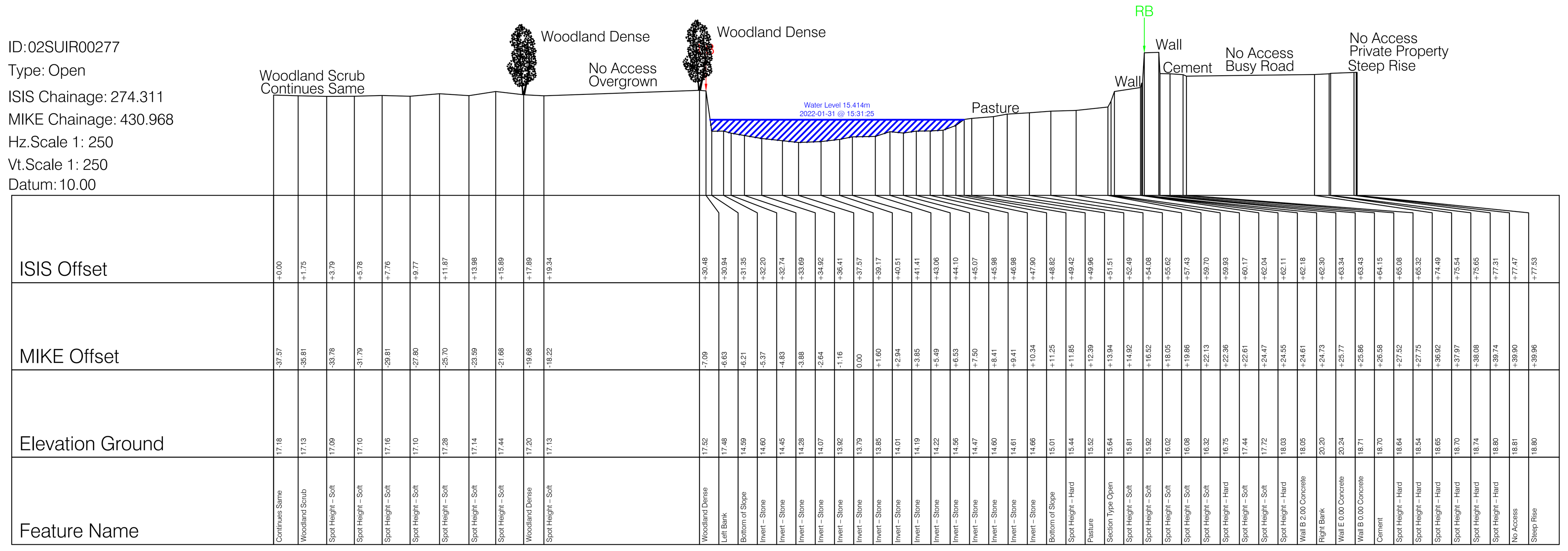
Drawing Number : MGS44342_02SUIR_XS_02

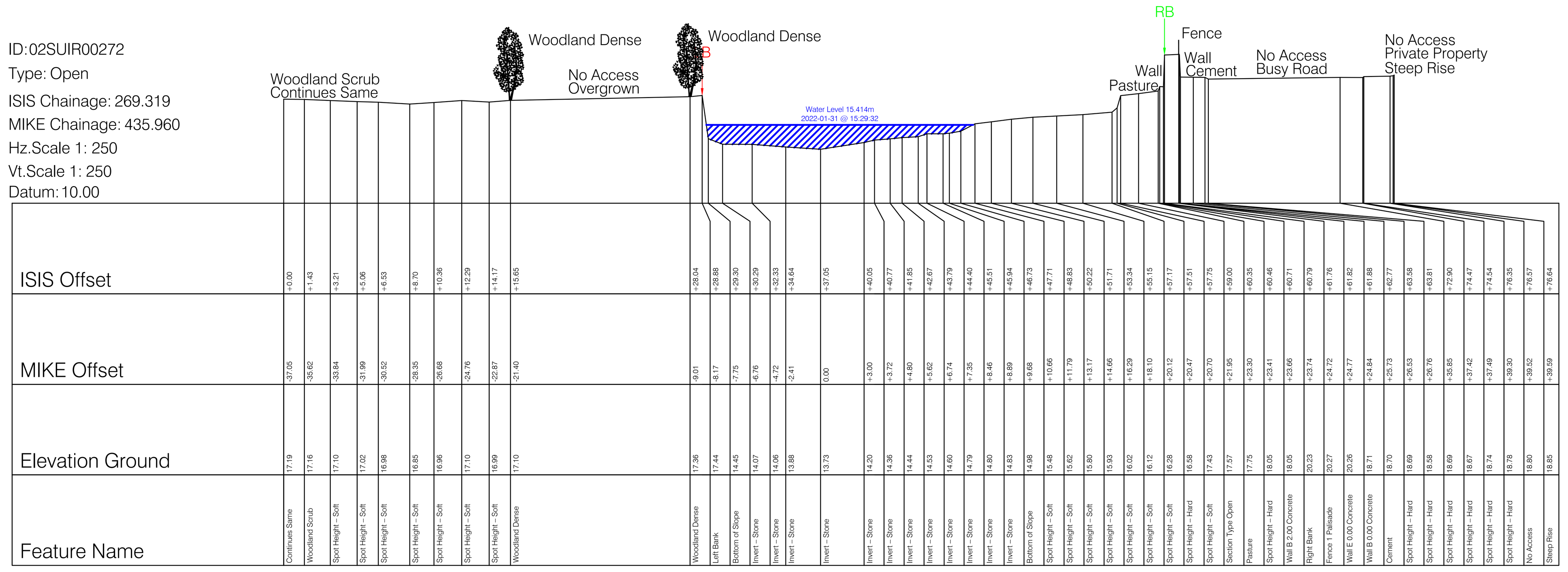


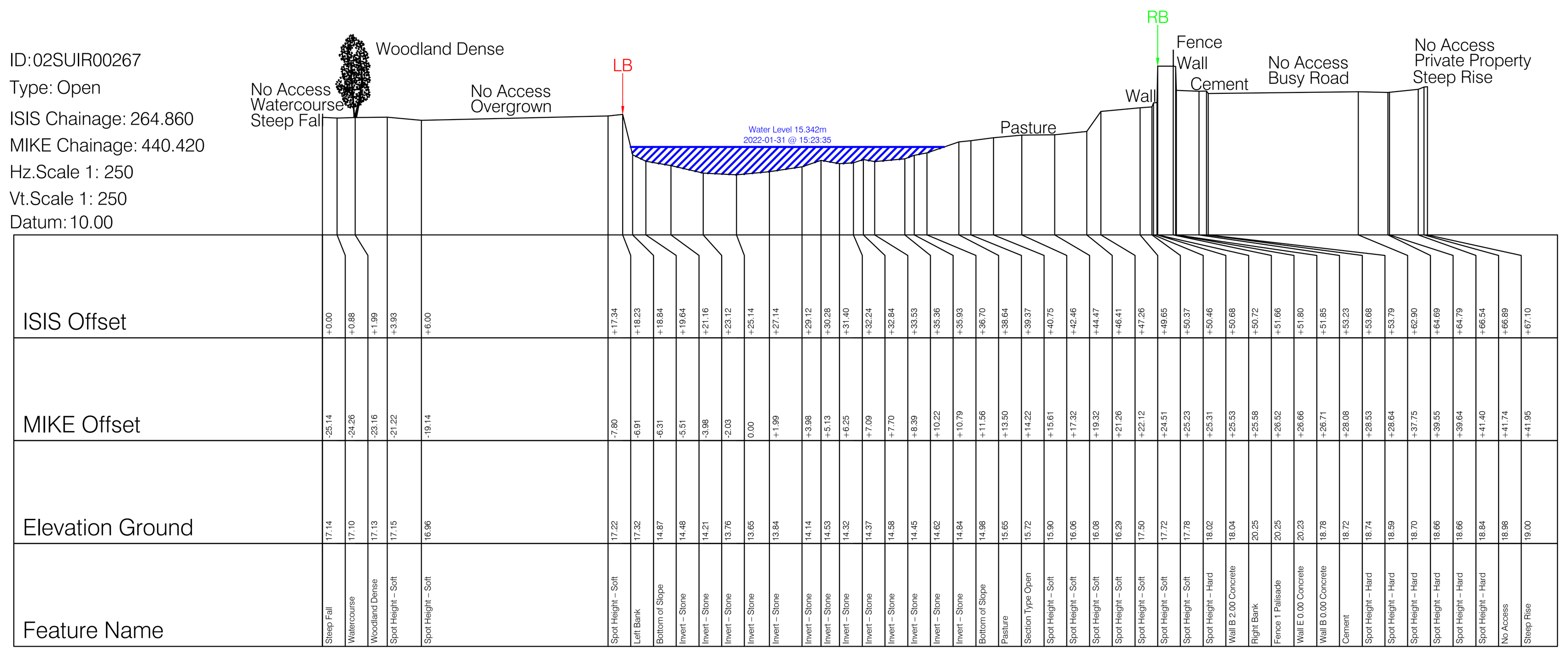


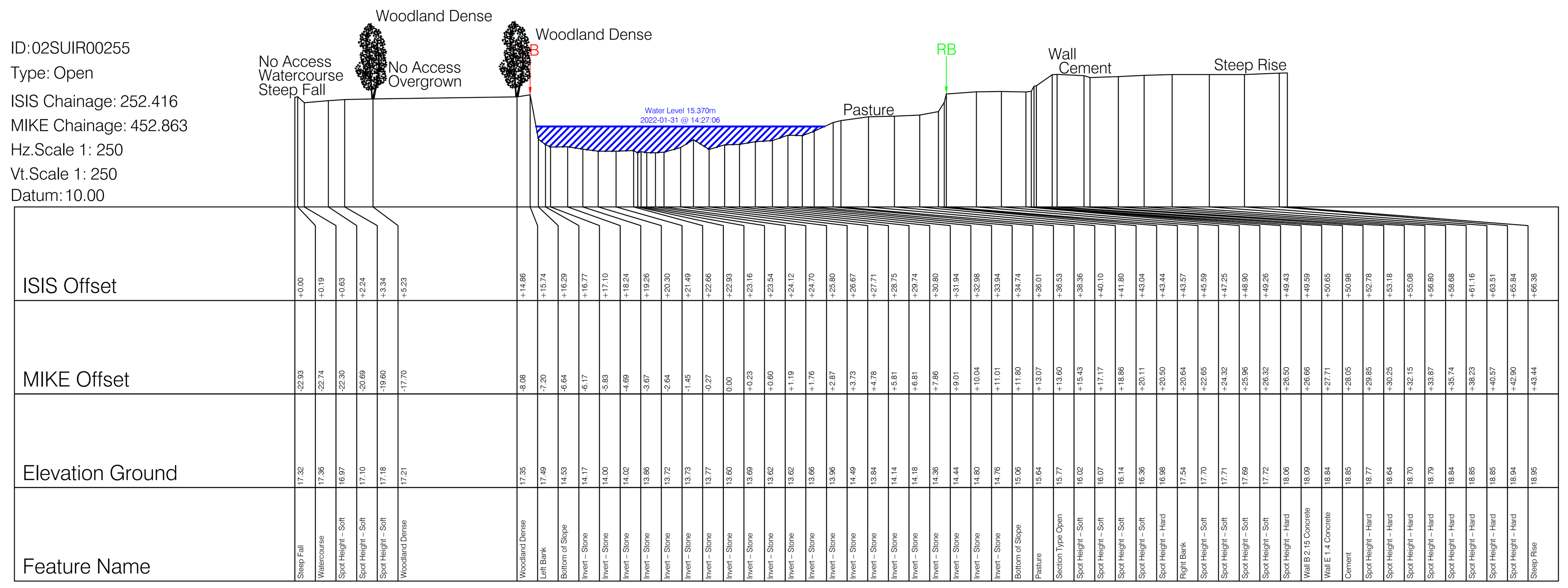












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LEGEND

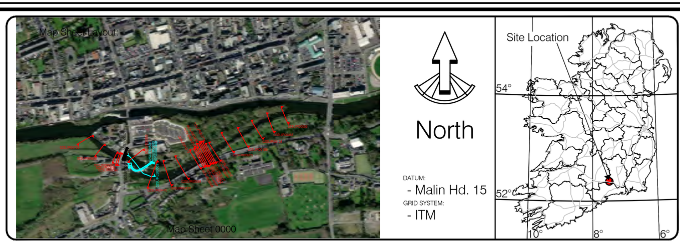
cross section details

River Profile	LB Left Bank	Water Level	RB Right Bank
Ground Level	Building Line	Road Line	Wall Line
Wall Line	Fence Line	Bridge Line	Pipe Profile

No. 318

THE SURVEY ASSOCIATION

Supply-Line empowered by Achilles



North

Surveyed by : MGS	Date: FEB 2022
Drawn by : COS	Date: FEB 2022
Checked by : BK	Date: 11.02.2022

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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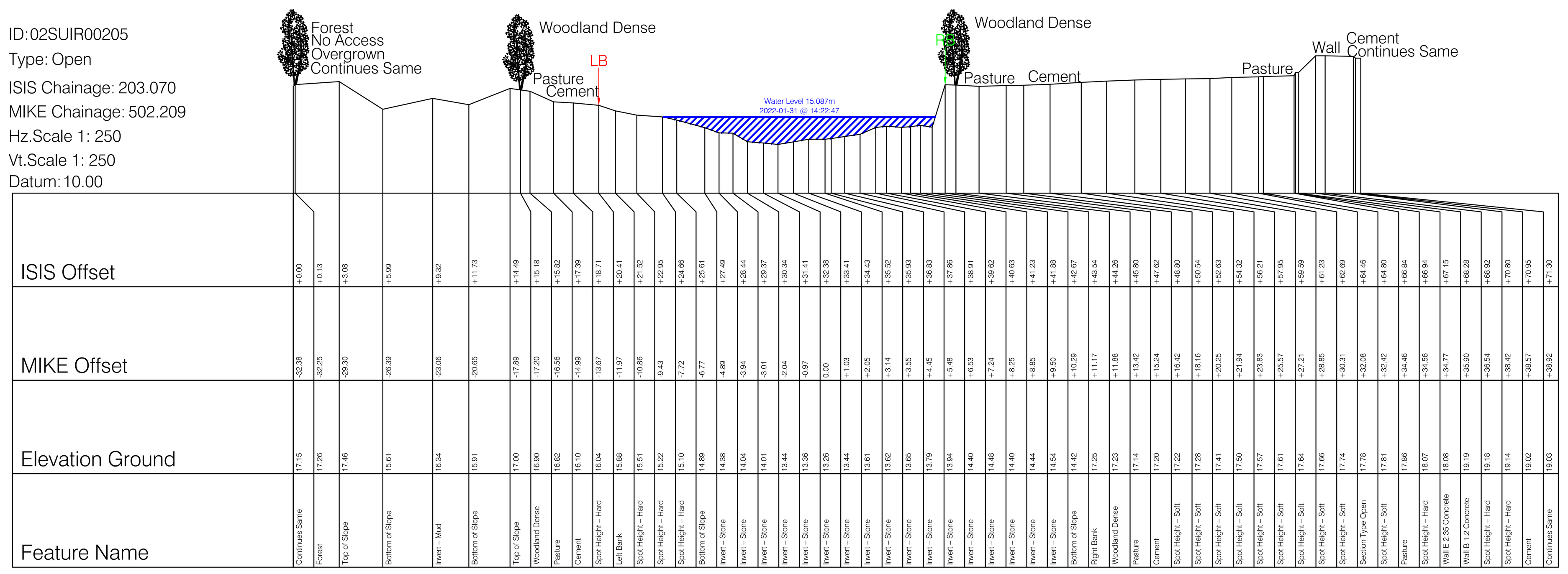
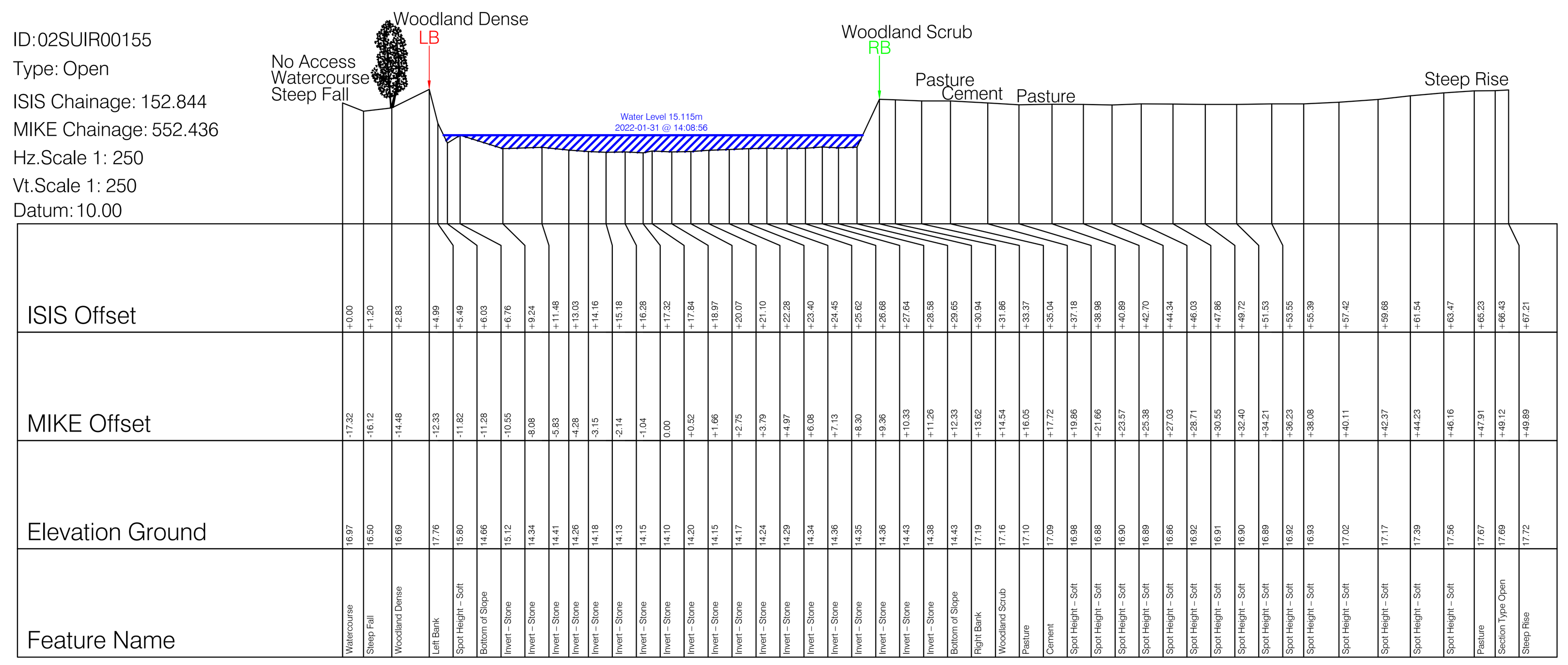
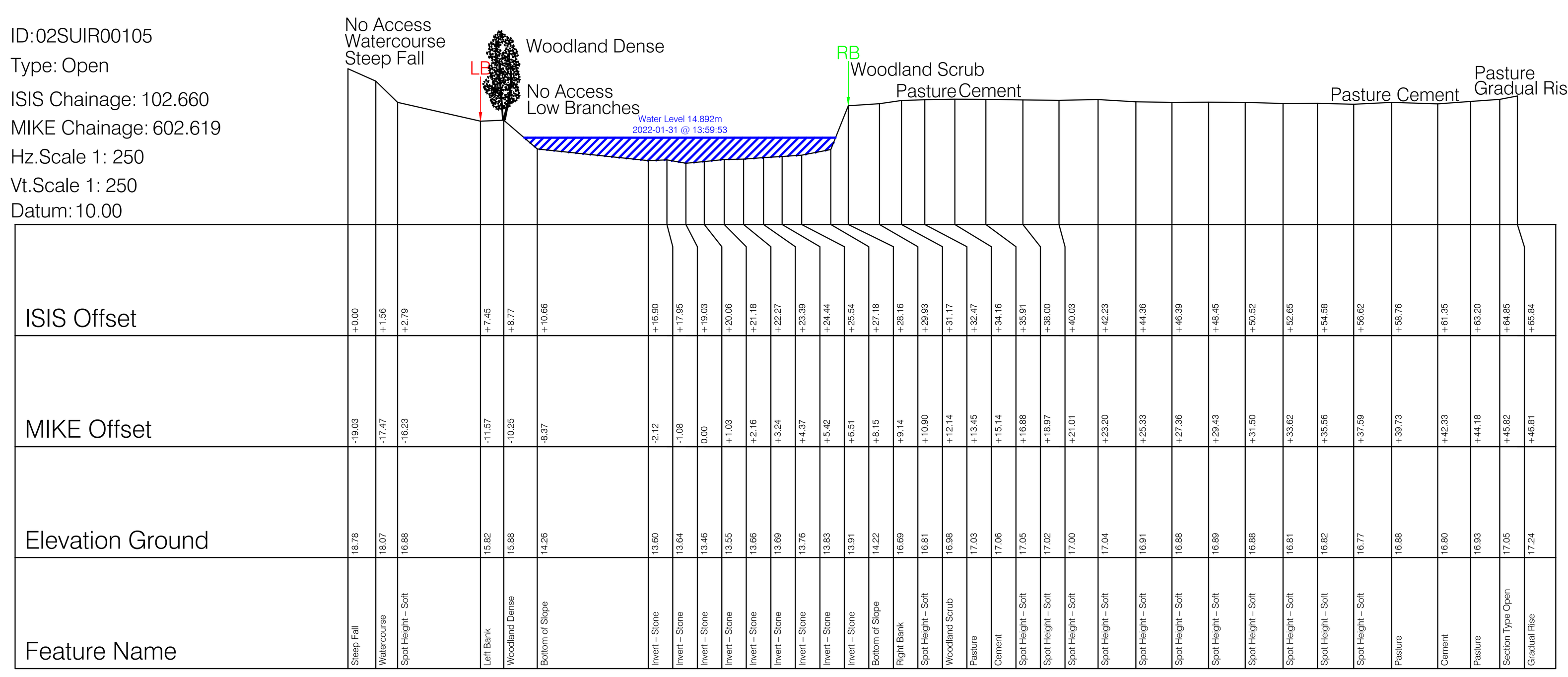
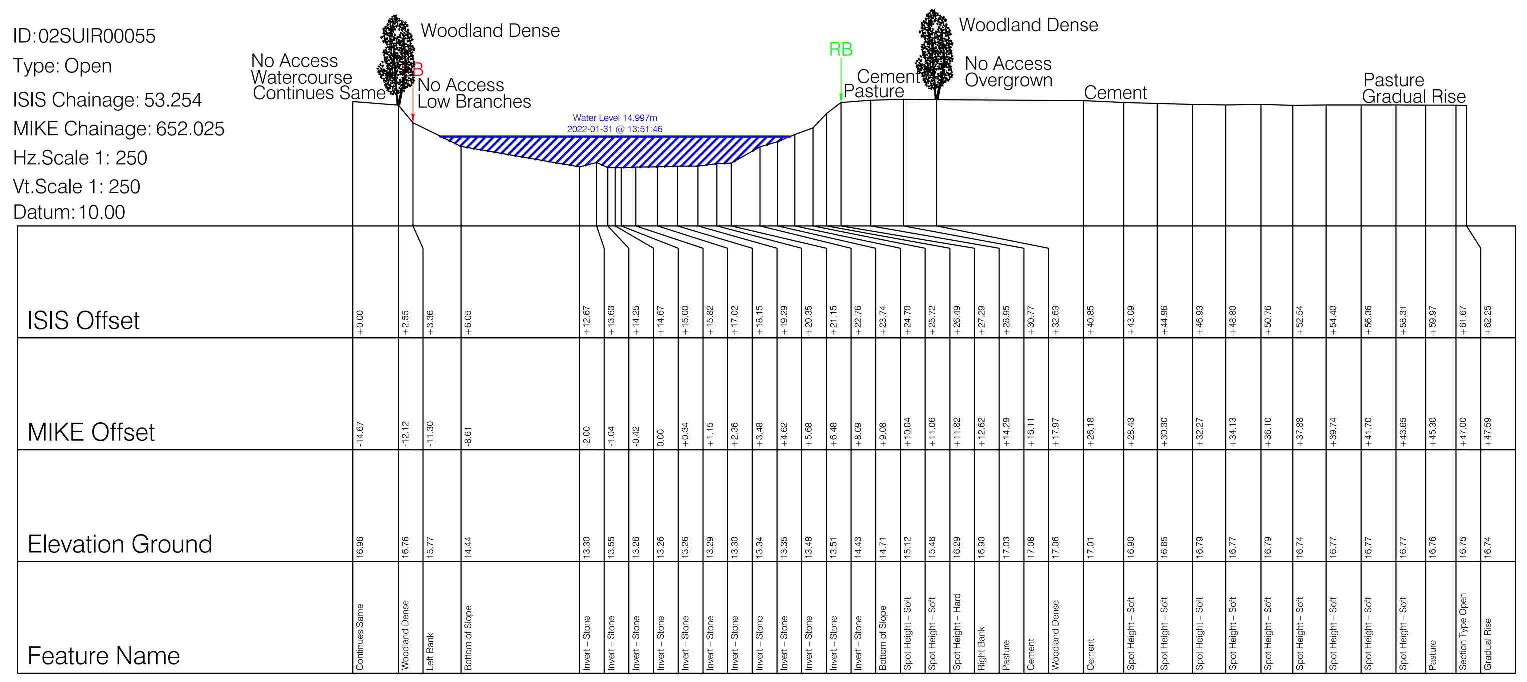
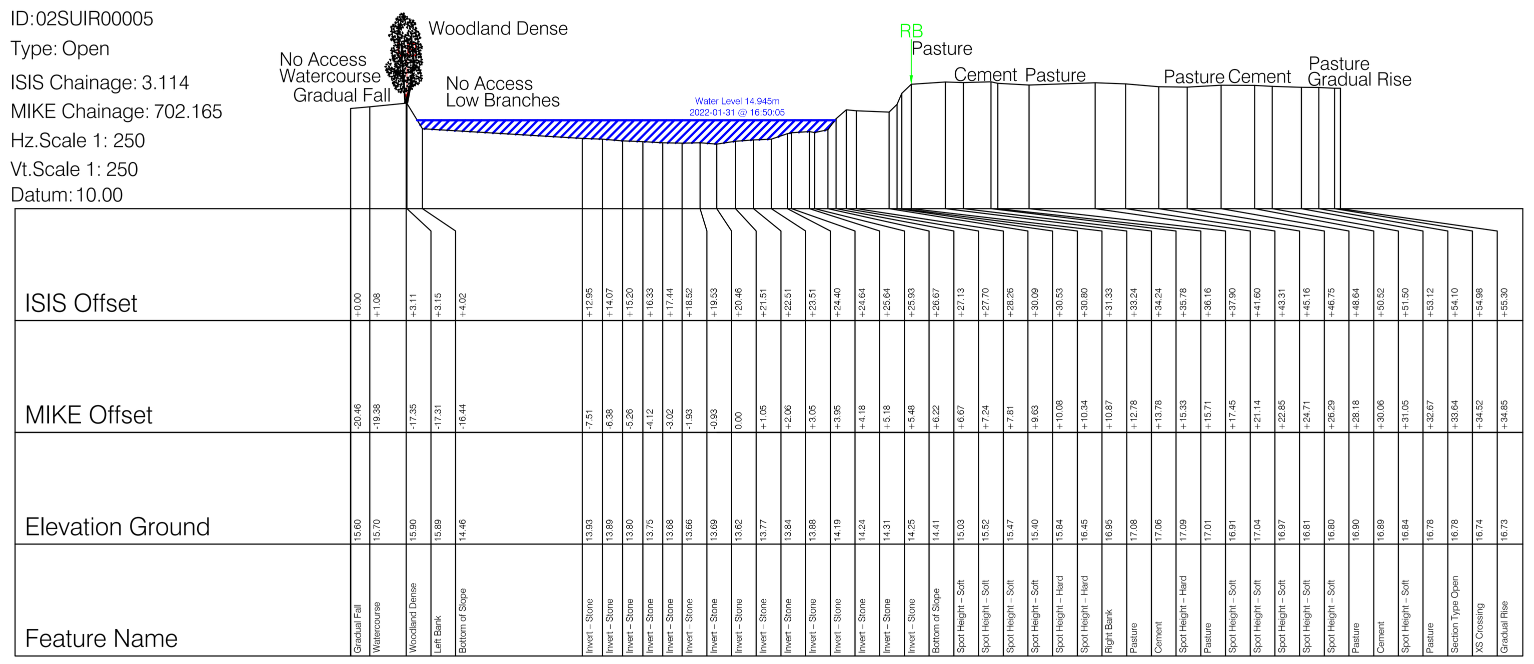
Client :	Clifton Scannell Emerson
Project :	44342 Suir Island Bathymetric Survey
Date : 11.02.2022	**Scale :** AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MGS44342_02SUIR_XS_03











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LEGEND

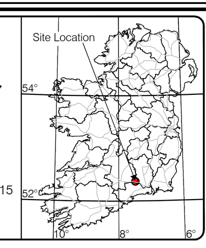
cross section details

	River Profile	LB	Left Bank
	Water Level	RB	Right Bank
	Ground Level		Building Line
	Road Line		Wall Line
	Wall Line		Fence Line
	Bridge Line		Pipe Profile

No. 318

Supply-Line

North



Surveyed by : MGS	Date: FEB 2022
Drawn by : COS	Date: FEB 2022
Checked by : BK	Date: 11.02.2022

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography

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Email: info@murphygs.ie

Client :	Clifton Scannell Emerson
Project :	44342 Suir Island Bathymetric Survey
Date : 11.02.2022	**Scale :** AS SHOWN
Description :	CROSS SECTIONS
Drawing Number :	MGS44342_02SUIR_XS_04

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LEGEND

section plan details

- Surveyed Section Lines with References & Section Orientation (at Open channel)
- Surveyed Section Lines with References & Section Orientation (at Structures)
- Surveyed Section Lines with References & Section Orientation (at Additional items)

Surveyed by : MGS		Date: FEB 2022	
Drawn by : COS		Date: FEB 2022	
Checked by : BK		Date: 11.02.2022	

Revisions

No.	Date	Description
0	11.02.2022	First Drawing

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Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography

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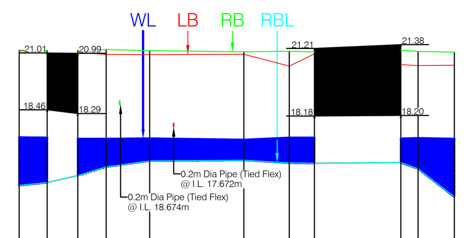
Client :	Clifton Scannell Emerson
Project :	44342 Suir Island Bathymetric Survey
Date : 11.02.2022	**Scale :** 1:1000
Description :	SECTIONS PLAN
Drawing Number :	MGS44342_03SUIR_PLAN_01



River Profile
Chainage 0.000
Hz. Scale 1:1000
Vt. Scale 1:200
Datum 0.00

ISIS Chainage	99.01	92.72	85.88	79.51	69.79	48.68	38.54	32.90	13.58	9.70	1.58
MIKE Chainage	1.72	8.01	14.84	21.22	30.94	52.04	62.19	67.83	87.15	91.03	99.14
River Bed Level (MIKE 0)	15.07	15.20	15.51	15.90	16.17	16.20	16.08	16.06	16.09	15.82	14.56
Elevation Water Level	17.218 10:19:47@2022-02-03	17.208 10:36:27@2022-02-03	17.155 16:50:18@2022-02-02	17.156 16:37:41@2022-02-02	17.173 17:06:59@2022-02-02	17.116 16:26:09@2022-02-02	17.201 16:23:14@2022-02-02	17.206 11:14:44@2022-02-03	17.167 11:24:10@2022-02-03	17.184 11:39:41@2022-02-03	17.156 11:41:48@2022-02-03
Elevation Left Bank	21.12	21.10	21.04	20.94	20.93	20.94	20.42	20.96	20.48	20.44	20.45
Elevation Right Bank	21.09	21.12	21.13	21.16	21.11	21.06	21.08	21.05	21.13	21.07	21.04
Section ID	03SUIR00102	03SUIR00095	03SUIR00087	03SUIR00082	03SUIR00072	03SUIR00051	03SUIR00041	03SUIR00036	03SUIR00017	03SUIR00012	03SUIR00005

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LEGEND

long section details

Water Profile
Water Level
Left Bank Level
Right Bank Level
River Bed Level
Road Level
Structure Level

LB Left Bank Level
RB Right Bank Level
WL Water Level
RBL River Bed Level

No. 318

SURVEY ASSOCIATION

Supply-Line

North

Site Location

Revisions

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CHARTERED SURVEYORS IRELAND

RICS

THE SURVEY ASSOCIATION

EUROPEAN GPR ASSOCIATION

Client : Clifton Scannell Emerson

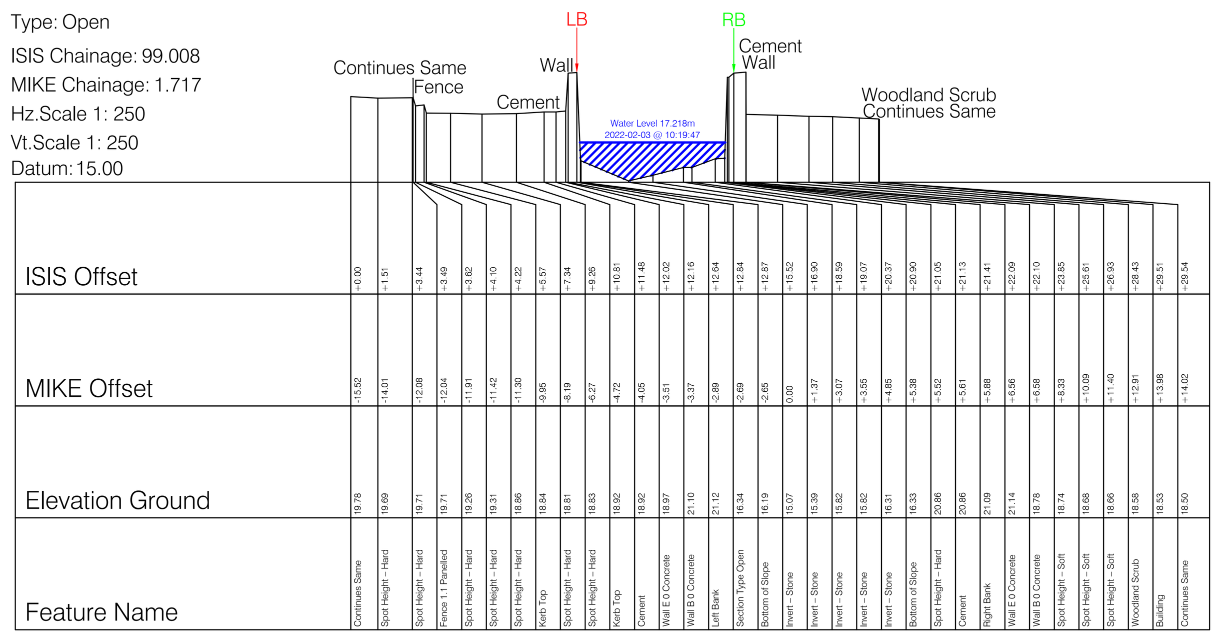
Project : 44342 Suir Island Bathymetric Survey

Date : 11.02.2022 **Scale :** 1:1000

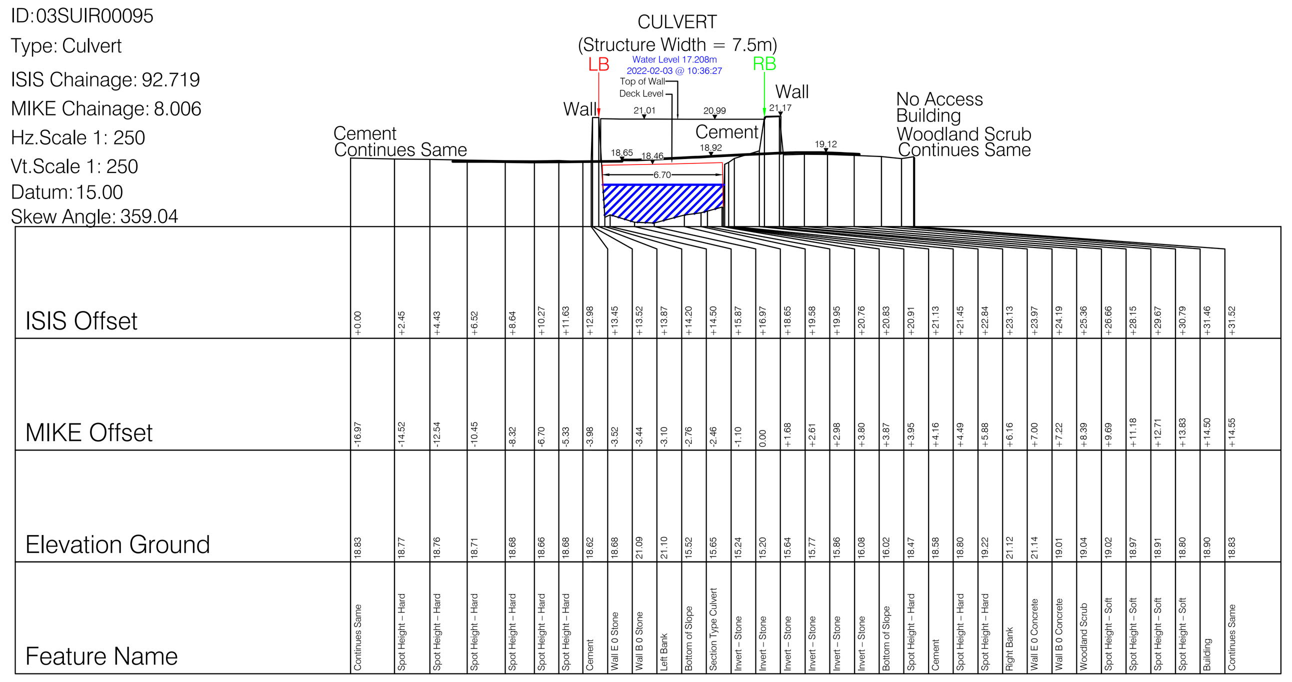
Description : LONG SECTION

Drawing Number : MGS44342_03SUIR_LS_01

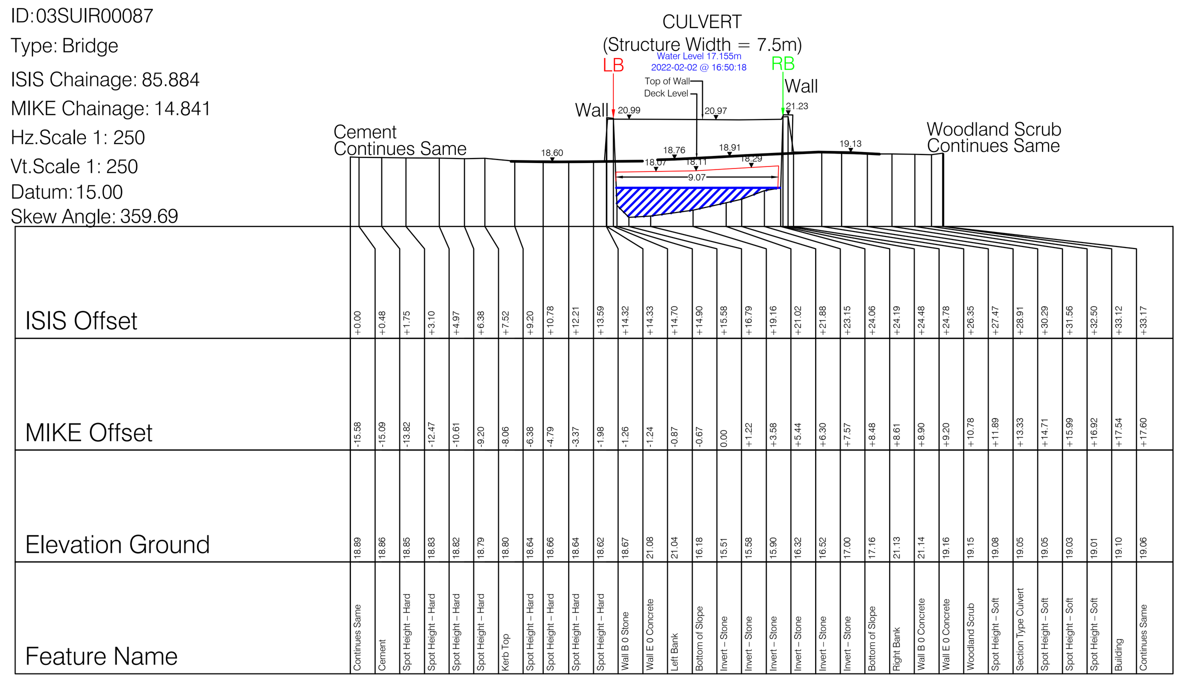
ID:03SUIR00102
Type: Open
ISIS Chainage: 99.008
MIKE Chainage: 1.717
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00



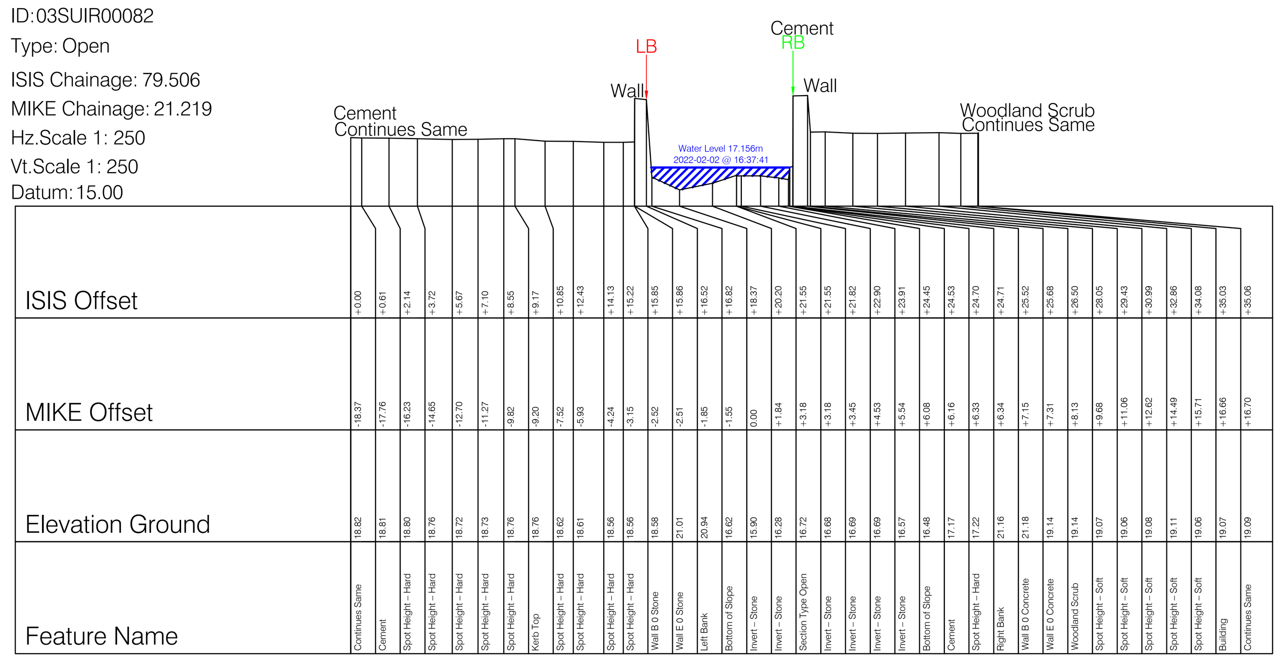
ID:03SUIR00095
Type: Culvert
ISIS Chainage: 92.719
MIKE Chainage: 8.006
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00
Skew Angle: 359.04



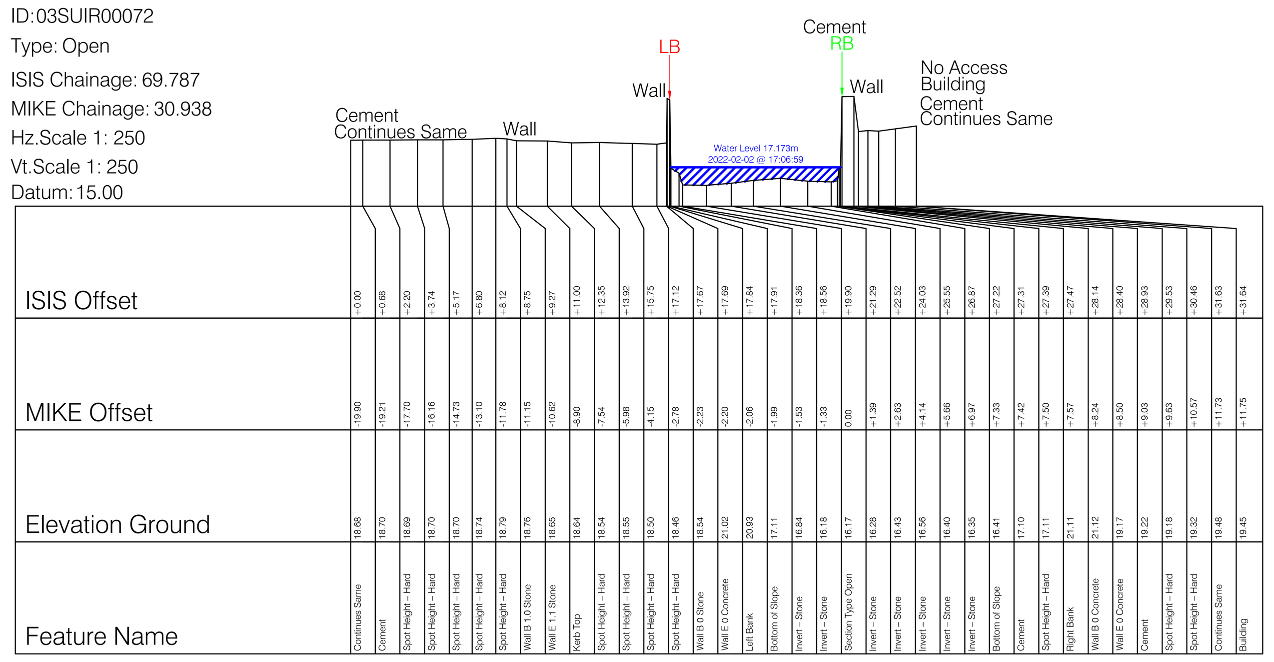
ID:03SUIR00087
Type: Bridge
ISIS Chainage: 85.884
MIKE Chainage: 14.841
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00
Skew Angle: 359.69



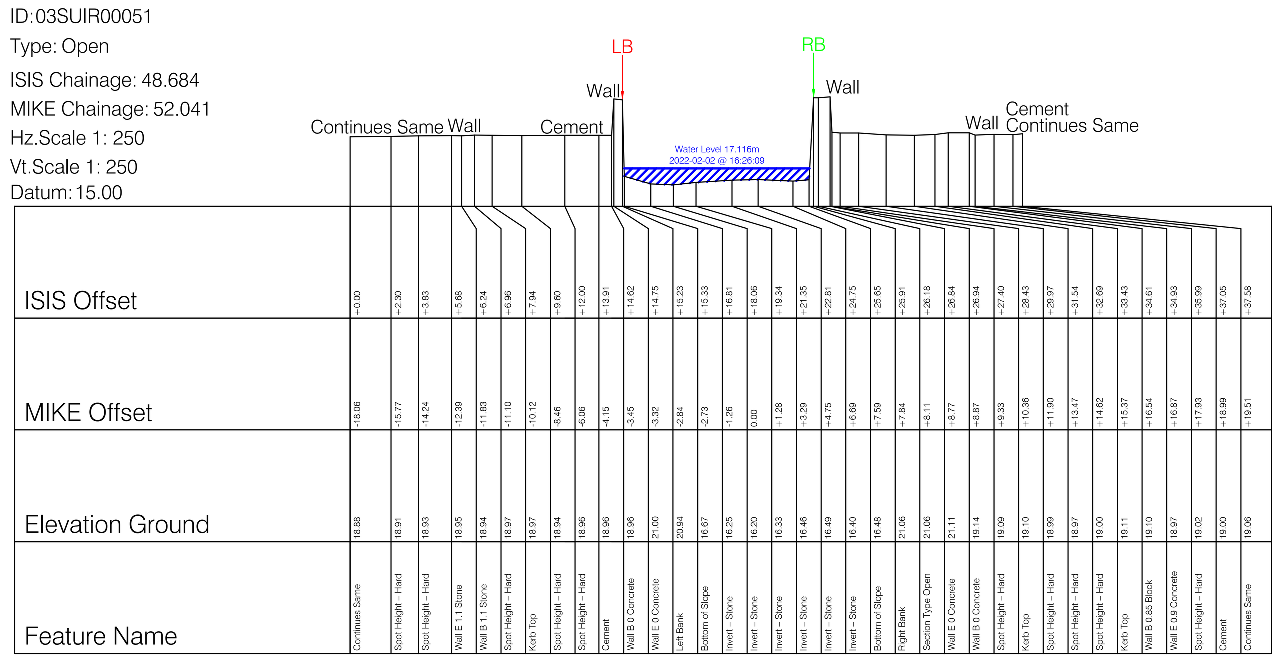
ID:03SUIR00082
Type: Open
ISIS Chainage: 79.506
MIKE Chainage: 21.219
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00



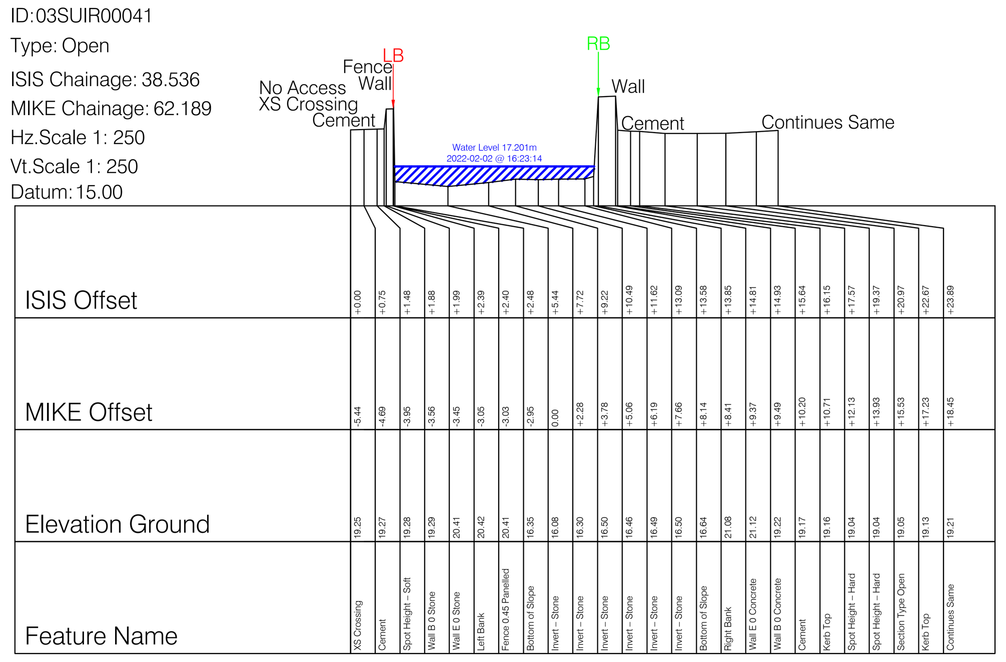
ID:03SUIR00072
Type: Open
ISIS Chainage: 69.787
MIKE Chainage: 30.938
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00



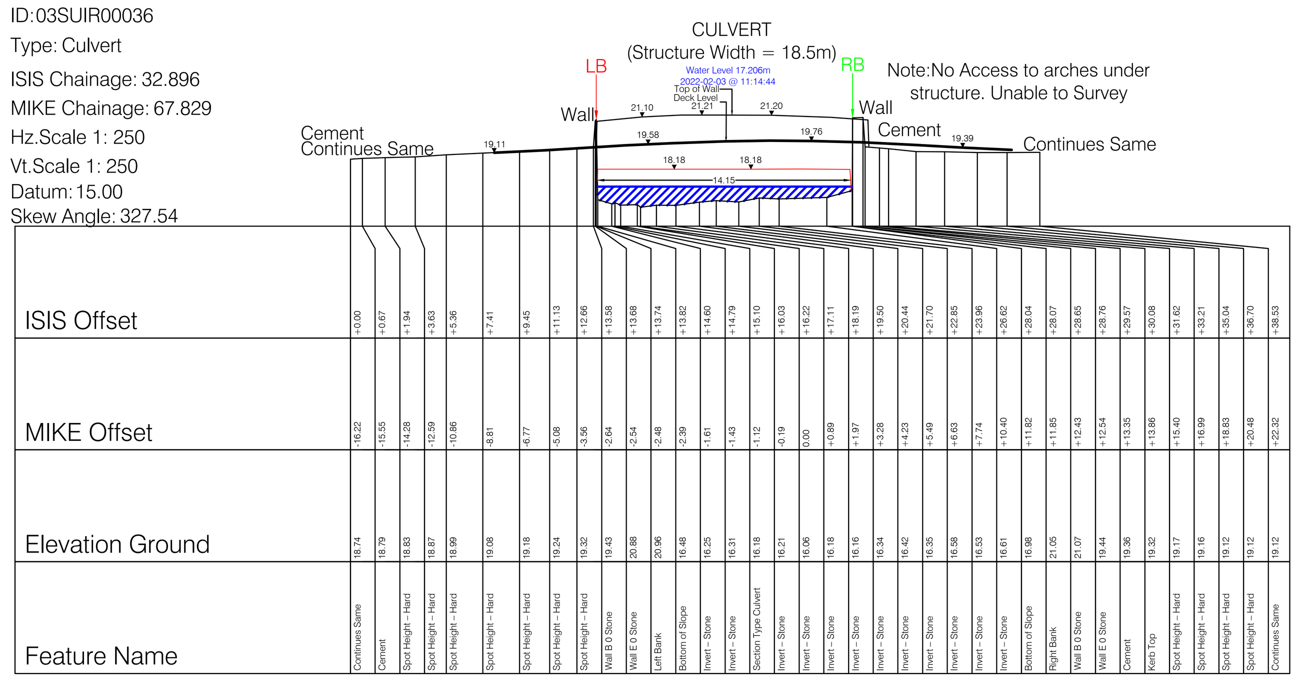
ID:03SUIR00051
Type: Open
ISIS Chainage: 48.684
MIKE Chainage: 52.041
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00



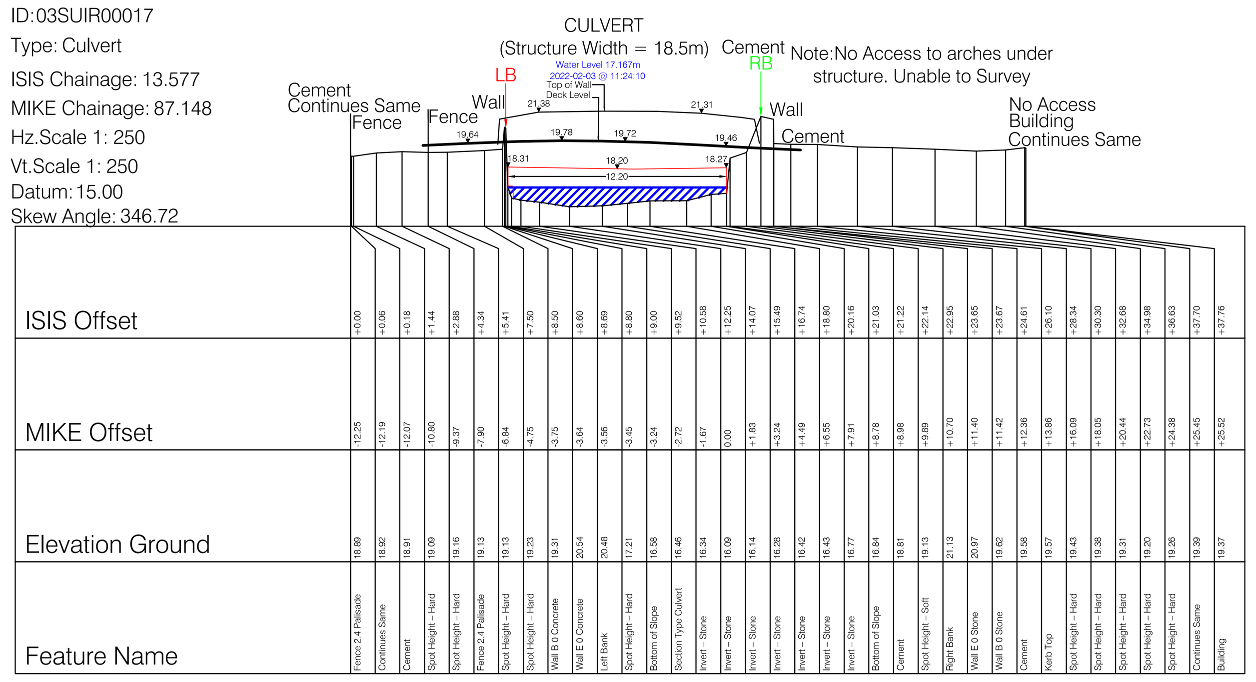
ID:03SUIR00041
Type: Open
ISIS Chainage: 38.536
MIKE Chainage: 62.189
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00



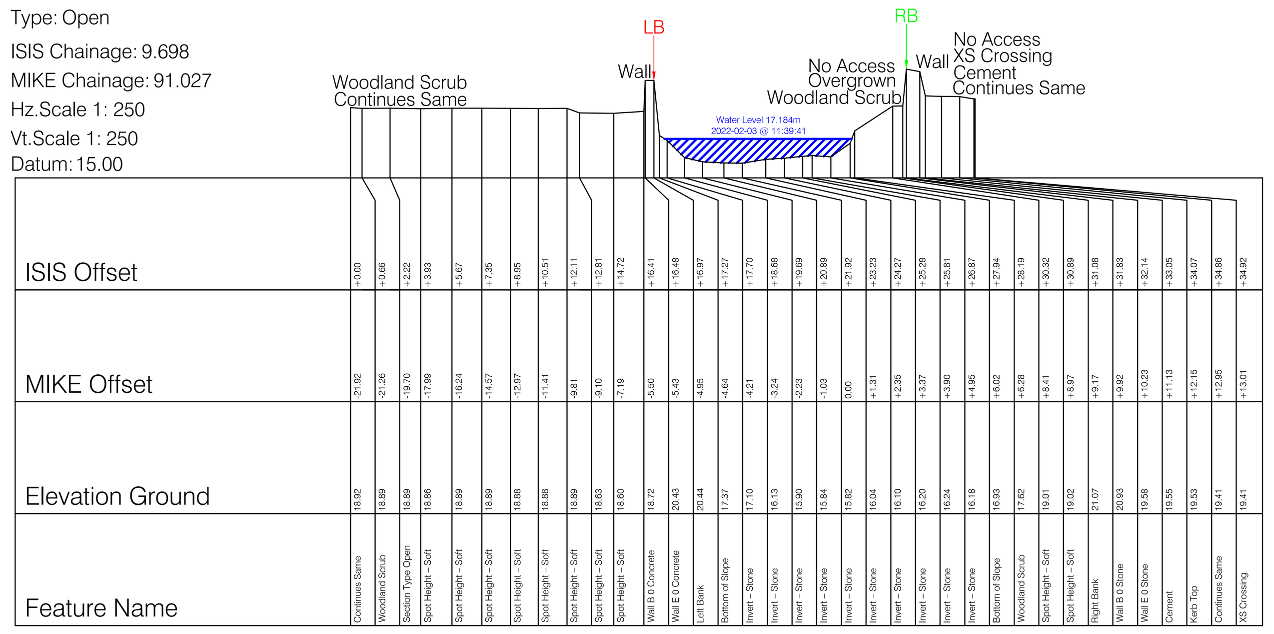
ID:03SUIR00036
Type: Culvert
ISIS Chainage: 32.896
MIKE Chainage: 67.829
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00
Skew Angle: 327.54



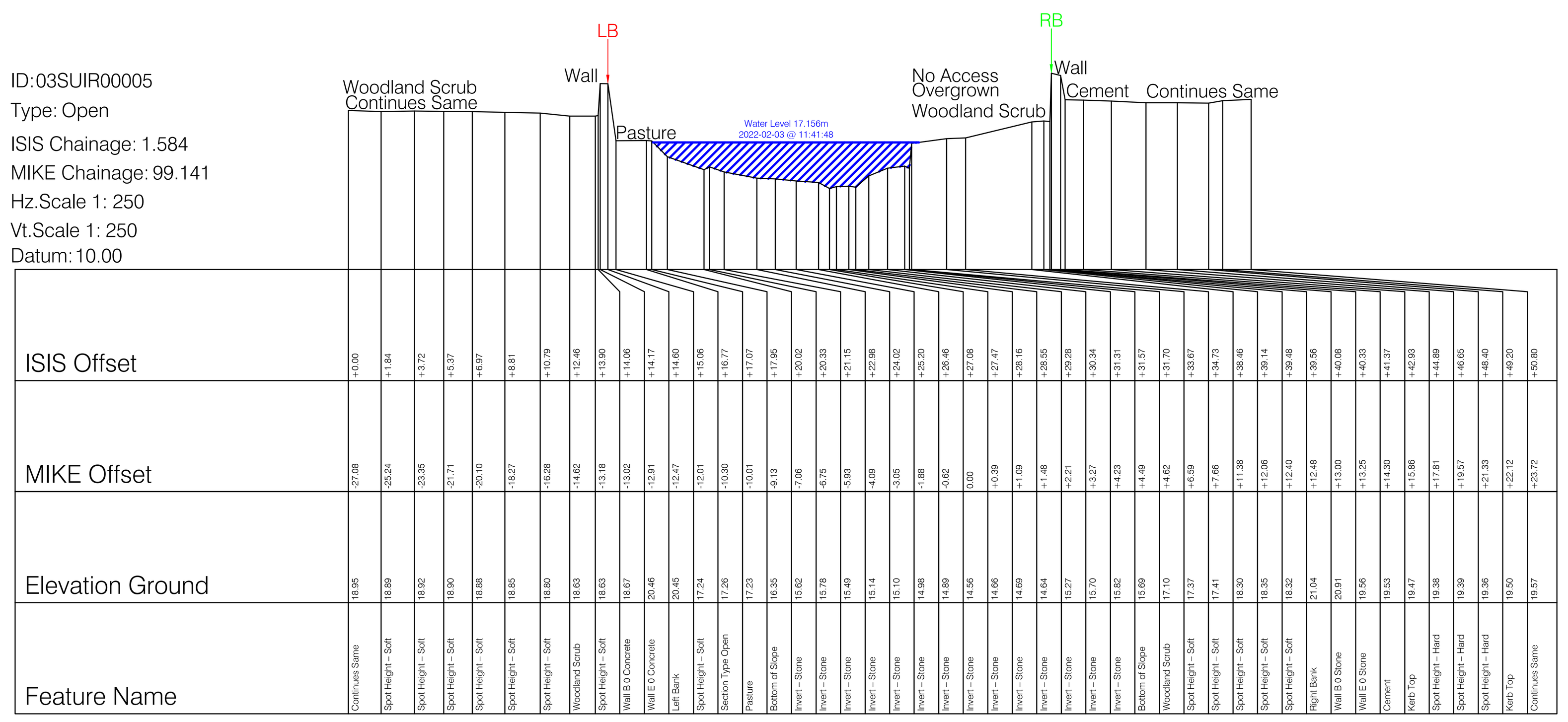
ID:03SUIR00017
Type: Culvert
ISIS Chainage: 13.577
MIKE Chainage: 87.148
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00
Skew Angle: 346.72



ID:03SUIR00012
Type: Open
ISIS Chainage: 9.698
MIKE Chainage: 91.027
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 15.00



ID:03SUIR00005
Type: Open
ISIS Chainage: 1.584
MIKE Chainage: 99.141
Hz.Scale 1: 250
Vt.Scale 1: 250
Datum: 10.00



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LEGEND

Murphy Geospatial
Kildare Cork Dublin Belfast Glasgow Manchester London

Client: Clifton Scannell Emerson
Project: 44342 Suir Island Bathymetric Survey
Date: 11.02.2022
Scale: AS SHOWN
Description: CROSS SECTIONS
Drawing Number: MGS44342_03SUIR_XS_01

Clifton Scannell Emerson Associates

Bathymetric Survey Site Photos

Day 01 – Date: 15 February 2022 – Northern Main River Reach – Refer to Murphy Geospatial Drawing MGS44342_01SUIR_PLAN_01 for section locations	
Section Name	**Photos (in downstream direction)**
01SUIR01208	
01SUIR01159	
01SUIR01109	
01SUIR01058	

01SUIR01018	
01SUIR00990	
01SUIR00940	
01SUIR00936	

01SUIR00929	
01SUIR00899	
01SUIR00890	
01SUIR00865	

01SUIR00765	
01SUIR00724	
01SUIR00719	
01SUIR00714	
01SUIR00709	

01SUIR00704	
01SUIR00699	
01SUIR00694	
01SUIR00688	
01SUIR00684	

01SUIR00633	
01SUIR00583	
01SUIR00533	
01SUIR00483	

01SUIR00434	
01SUIR00383	
01SUIR00334	
01SUIR00286	

01SUIR00272	
01SUIR00266	
01SUIR00250	
01SUIR00246	

01SUIR00216	
01SUIR00177	
01SUIR00131	
01SUIR00081	

01SUIR00033	
01SUIR00000	
Day 02 – Date: 15 February 2022 – Southern River Reach (Slalom Course) – Refer to Murphy Geospatial Drawing MGS44342_02SUIR_PLAN_01 for section locations	
02SUIR00705	
02SUIR00655	

02SUIR00606	
02SUIR00596	
02SUIR00590	
02SUIR00576	

02SUIR00571	
02SUIR00555	
02SUIR00506	
02SUIR00503	

02SUIR00499	
02SUIR00470	
02SUIR00420	
02SUIR00369	

02SUIR00319	
02SUIR00308	
02SUIR00303	
02SUIR00297	

02SUIR00292	
02SUIR00287	
02SUIR00282	
02SUIR00277	

02SUIR00272	
02SUIR00267	
02SUIR00255	
02SUIR00205	

02SUIR00155	
02SUIR00105	
02SUIR00055	
02SUIR00005	
Day 03 – Date: 15 February 2022 – Reach between Upstream and Downstream Suir Islands – Refer to Murphy Geospatial Drawing MGS44342_03SUIR_PLAN_01 for section locations	

03SUIR00102	
03SUIR00095	
03SUIR00087	
03SUIR00082	
03SUIR00072	

03SUIR00051	
03SUIR00041	
03SUIR00036	
03SUIR00017	
03SUIR00005	

Appendix B – Hydrological Review

Flood Estimation Report #13700 (Gauge 16011 Rev 1)

Generated 14-05-2022 14:54

Subject site

Attributes

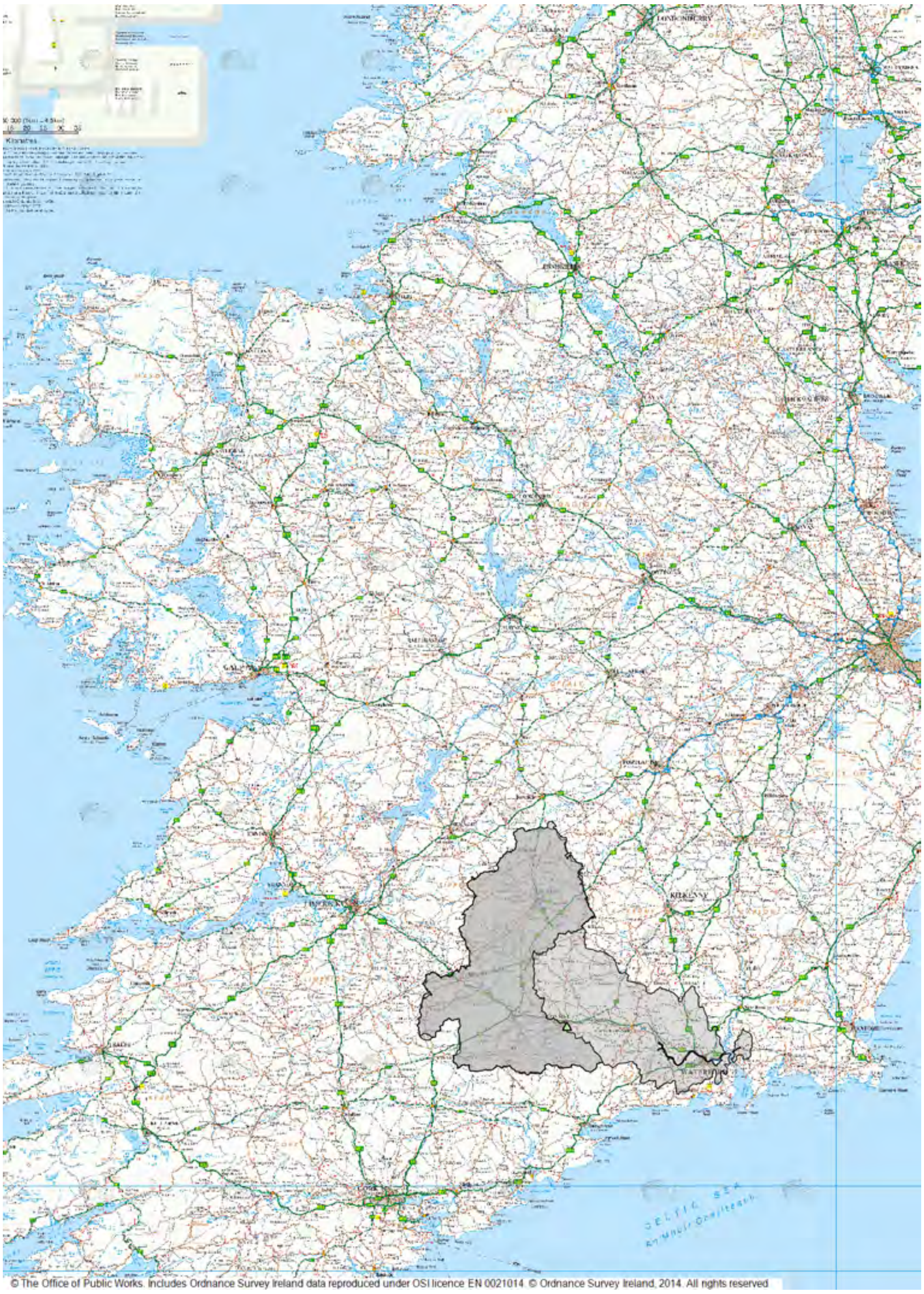
Name	Unit	Value
Coordinate [X]		-856558.941957176
Coordinate [Y]		6863936.86062255
Station Number		16011
Location		CLONMEL
Water Body		SUIR
Catchment		Suir
Hydrometric Area		16
Organisation		OPW
FSU Rating Classification		A1
Drainage works	year	No
Contributing Catchment Area	km^2	2143.6676
Center Northing	m	144850
Center Easting	m	203990
Northing	m	122208
Easting	m	220860
A-Max series gap in years	year	0
A-Max series number of years	year	51
A-Max series number of usable years	year	51
A-Max series end year	year	2003
A-Max series start year	year	1953
FARL		0.998
ALLUV		0.0488
PEAT		0.0819
FOREST		0.1227
PASTURE		0
S1085	m/km	0.95268
MSL	km	116.477
DRAIND	km/km^2	1.045
ALTBAR		0
NETLEN	km	2240.004
T4		0.043604700452365
T3		0.11902480619518
SAAPE	mm	519.47

T2		0.15334396544228
ARTDRAIN2		0
ARTDRAIN		0
TAYSLO		0.200156
STMFRQ		2743
BFISOIL		0.6695
SAAR	mm	1124.95
RWSEG_CD		16_3353
TOP_RWSEG		16_931
Bankfull		N/A
HGF	m^3/s	378
MAF	m^3/s	249
FAI		0.19
FLATWET		0.59
URBEXT		0.0073
HGF/QMED		1.5408446111202
centroidx3857		-882332.096663037
centroidy3857		6894722.33277096
x3857		-856558.941957176
y3857		6863936.86062255
Distance	km	0

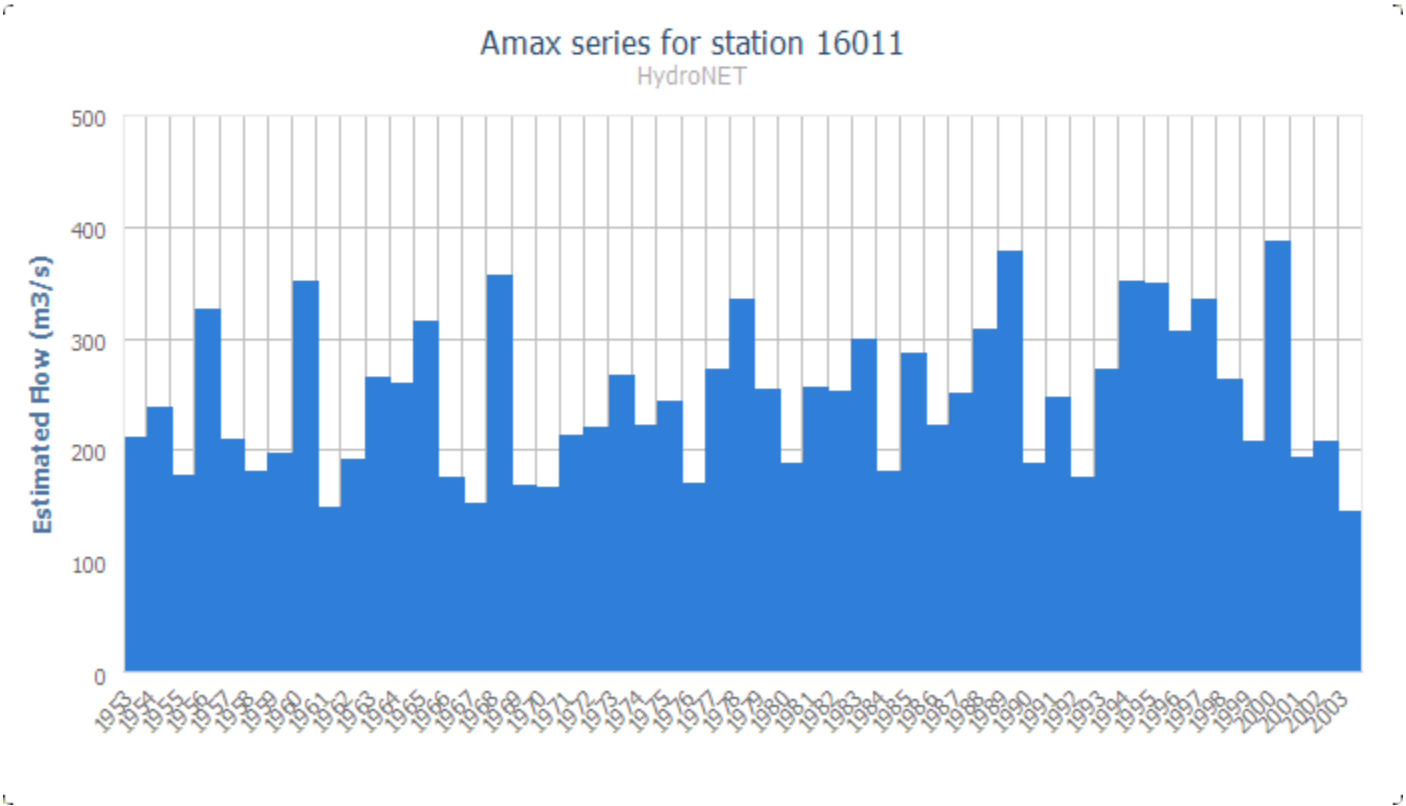
Pivotal site

The subject site is gauged, so the subject site is the pivotal site.

Map



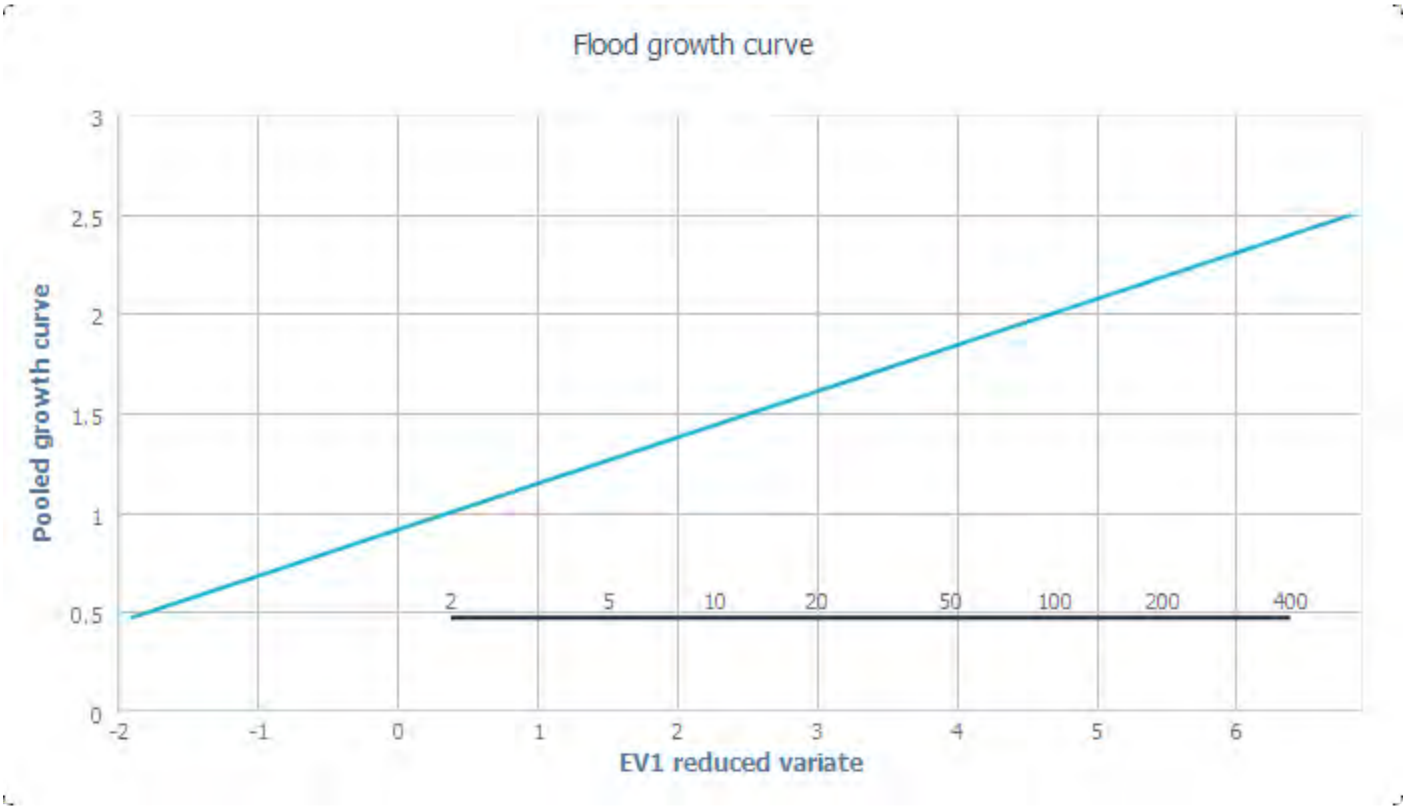
Amax Series Chart



QMED Estimates

Subject rural QMED	228.98
Subject urban QMED	231.46
Pivotal gauged QMED	245.32
Pivotal adjustment factor QMED	1
Subject adjusted QMED	**245.32**

Selected Flood Growth Curve



Combined growth curve	EV1 reduced variate
0.47	-1.92
0.51	-1.76
0.53	-1.67
0.54	-1.6
0.56	-1.55
0.57	-1.51
0.57	-1.47
0.58	-1.44
0.59	-1.41
0.59	-1.38
0.6	-1.35
0.61	-1.33
0.61	-1.31
0.62	-1.29
0.62	-1.27
0.63	-1.25
0.63	-1.23
0.63	-1.21
0.64	-1.2
0.64	-1.18
0.64	-1.16
0.65	-1.15
0.65	-1.14
0.65	-1.12
0.66	-1.11
0.66	-1.09
0.66	-1.08
0.67	-1.07
0.67	-1.06

0.67	-1.04
0.68	-1.03
0.68	-1.02
0.68	-1.01
0.68	-1
0.69	-0.99
0.69	-0.98
0.69	-0.97
0.69	-0.96
0.7	-0.95
0.7	-0.94
0.7	-0.93
0.7	-0.92
0.7	-0.91
0.71	-0.9
0.71	-0.89
0.71	-0.88
0.71	-0.87
0.72	-0.86
0.72	-0.85
0.72	-0.84
0.72	-0.84
0.72	-0.83
0.73	-0.82
0.73	-0.81
0.73	-0.8
0.73	-0.79
0.73	-0.79
0.73	-0.78
0.74	-0.77
0.74	-0.76
0.74	-0.75
0.74	-0.75
0.74	-0.74
0.75	-0.73
0.75	-0.72
0.75	-0.72
0.75	-0.71
0.75	-0.7
0.75	-0.69
0.76	-0.69
0.76	-0.68
0.76	-0.67
0.76	-0.66
0.76	-0.66
0.76	-0.65
0.77	-0.64
0.77	-0.64
0.77	-0.63
0.77	-0.62
0.77	-0.62
0.77	-0.61
0.78	-0.6
0.78	-0.6
0.78	-0.59
0.78	-0.58
0.78	-0.58

0.78	-0.57
0.78	-0.56
0.79	-0.56
0.79	-0.55
0.79	-0.54
0.79	-0.54
0.79	-0.53
0.79	-0.52
0.79	-0.52
0.8	-0.51
0.8	-0.51
0.8	-0.5
0.8	-0.49
0.8	-0.49
0.8	-0.48
0.8	-0.48
0.81	-0.47
0.81	-0.46
0.81	-0.46
0.81	-0.45
0.81	-0.44
0.81	-0.44
0.81	-0.43
0.82	-0.43
0.82	-0.42
0.82	-0.41
0.82	-0.41
0.82	-0.4
0.82	-0.4
0.82	-0.39
0.83	-0.39
0.83	-0.38
0.83	-0.37
0.83	-0.37
0.83	-0.36
0.83	-0.36
0.83	-0.35
0.83	-0.35
0.84	-0.34
0.84	-0.33
0.84	-0.33
0.84	-0.32
0.84	-0.32
0.84	-0.31
0.84	-0.31
0.85	-0.3
0.85	-0.29
0.85	-0.29
0.85	-0.28
0.85	-0.28
0.85	-0.27
0.85	-0.27
0.85	-0.26
0.86	-0.25
0.86	-0.25
0.86	-0.24
0.86	-0.24

0.86	-0.23
0.86	-0.23
0.86	-0.22
0.86	-0.22
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0.89	-0.09
0.9	-0.09
0.9	-0.08
0.9	-0.08
0.9	-0.07
0.9	-0.06
0.9	-0.06
0.9	-0.05
0.9	-0.05
0.9	-0.04
0.91	-0.04
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0.91	-0.02
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0.91	-0.01
0.91	-0.01
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0.92	0.01
0.92	0.02
0.92	0.02
0.92	0.03
0.92	0.03
0.92	0.04
0.92	0.04
0.93	0.05
0.93	0.05
0.93	0.06
0.93	0.06
0.93	0.07

0.93	0.08
0.93	0.08
0.93	0.09
0.94	0.09
0.94	0.1
0.94	0.1
0.94	0.11
0.94	0.11
0.94	0.12
0.94	0.12
0.94	0.13
0.95	0.13
0.95	0.14
0.95	0.15
0.95	0.15
0.95	0.16
0.95	0.16
0.95	0.17
0.95	0.17
0.96	0.18
0.96	0.18
0.96	0.19
0.96	0.19
0.96	0.2
0.96	0.21
0.96	0.21
0.97	0.22
0.97	0.22
0.97	0.23
0.97	0.23
0.97	0.24
0.97	0.24
0.97	0.25
0.97	0.25
0.98	0.26
0.98	0.27
0.98	0.27
0.98	0.28
0.98	0.28
0.98	0.29
0.98	0.29
0.98	0.3
0.99	0.3
0.99	0.31
0.99	0.32
0.99	0.32
0.99	0.33
0.99	0.33
0.99	0.34
0.99	0.34
1	0.35
1	0.36
1	0.36
1	0.37
1	0.37
1	0.38
1	0.38

1.01	0.39
1.01	0.4
1.01	0.4
1.01	0.41
1.01	0.41
1.01	0.42
1.01	0.42
1.01	0.43
1.02	0.44
1.02	0.44
1.02	0.45
1.02	0.45
1.02	0.46
1.02	0.46
1.02	0.47
1.03	0.48
1.03	0.48
1.03	0.49
1.03	0.49
1.03	0.5
1.03	0.51
1.03	0.51
1.04	0.52
1.04	0.52
1.04	0.53
1.04	0.54
1.04	0.54
1.04	0.55
1.04	0.55
1.05	0.56
1.05	0.57
1.05	0.57
1.05	0.58
1.05	0.59
1.05	0.59
1.05	0.6
1.06	0.6
1.06	0.61
1.06	0.62
1.06	0.62
1.06	0.63
1.06	0.64
1.06	0.64
1.07	0.65
1.07	0.65
1.07	0.66
1.07	0.67
1.07	0.67
1.07	0.68
1.07	0.69
1.08	0.69
1.08	0.7
1.08	0.71
1.08	0.71
1.08	0.72
1.08	0.73
1.08	0.73

1.09	0.74
1.09	0.75
1.09	0.75
1.09	0.76
1.09	0.77
1.09	0.77
1.1	0.78
1.1	0.79
1.1	0.79
1.1	0.8
1.1	0.81
1.1	0.81
1.11	0.82
1.11	0.83
1.11	0.83
1.11	0.84
1.11	0.85
1.11	0.86
1.12	0.86
1.12	0.87
1.12	0.88
1.12	0.88
1.12	0.89
1.12	0.9
1.13	0.91
1.13	0.91
1.13	0.92
1.13	0.93
1.13	0.94
1.13	0.94
1.14	0.95
1.14	0.96
1.14	0.97
1.14	0.97
1.14	0.98
1.14	0.99
1.15	1
1.15	1
1.15	1.01
1.15	1.02
1.15	1.03
1.16	1.04
1.16	1.04
1.16	1.05
1.16	1.06
1.16	1.07
1.16	1.08
1.17	1.08
1.17	1.09
1.17	1.1
1.17	1.11
1.17	1.12
1.18	1.13
1.18	1.13
1.18	1.14
1.18	1.15
1.18	1.16

1.19	1.17
1.19	1.18
1.19	1.19
1.19	1.19
1.19	1.2
1.2	1.21
1.2	1.22
1.2	1.23
1.2	1.24
1.2	1.25
1.21	1.26
1.21	1.27
1.21	1.28
1.21	1.29
1.22	1.29
1.22	1.3
1.22	1.31
1.22	1.32
1.22	1.33
1.23	1.34
1.23	1.35
1.23	1.36
1.23	1.37
1.24	1.38
1.24	1.39
1.24	1.4
1.24	1.41
1.25	1.42
1.25	1.43
1.25	1.44
1.25	1.46
1.26	1.47
1.26	1.48
1.26	1.49
1.26	1.5
1.27	1.51
1.27	1.52
1.27	1.53
1.27	1.54
1.28	1.55
1.28	1.57
1.28	1.58
1.28	1.59
1.29	1.6
1.29	1.61
1.29	1.63
1.3	1.64
1.3	1.65
1.3	1.66
1.3	1.68
1.31	1.69
1.31	1.7
1.31	1.71
1.32	1.73
1.32	1.74
1.32	1.75
1.33	1.77

1.33	1.78
1.33	1.8
1.33	1.81
1.34	1.82
1.34	1.84
1.35	1.85
1.35	1.87
1.35	1.88
1.36	1.9
1.36	1.91
1.36	1.93
1.37	1.95
1.37	1.96
1.37	1.98
1.38	1.99
1.38	2.01
1.39	2.03
1.39	2.04
1.39	2.06
1.4	2.08
1.4	2.1
1.41	2.12
1.41	2.13
1.41	2.15
1.42	2.17
1.42	2.19
1.43	2.21
1.43	2.23
1.44	2.25
1.44	2.27
1.45	2.3
1.45	2.32
1.46	2.34
1.46	2.36
1.47	2.39
1.47	2.41
1.48	2.43
1.49	2.46
1.49	2.48
1.5	2.51
1.5	2.54
1.51	2.56
1.52	2.59
1.52	2.62
1.53	2.65
1.54	2.68
1.54	2.71
1.55	2.74
1.56	2.78
1.57	2.81
1.58	2.85
1.58	2.88
1.59	2.92
1.6	2.96
1.61	3
1.62	3.05
1.63	3.09

1.64	3.14
1.65	3.18
1.67	3.24
1.68	3.29
1.69	3.35
1.71	3.41
1.72	3.47
1.74	3.54
1.75	3.61
1.77	3.69
1.79	3.77
1.81	3.86
1.83	3.96
1.86	4.07
1.89	4.2
1.92	4.34
1.96	4.51
2.01	4.71
2.06	4.96
2.14	5.29
2.26	5.78
2.49	6.81

Adopted Growth Factors

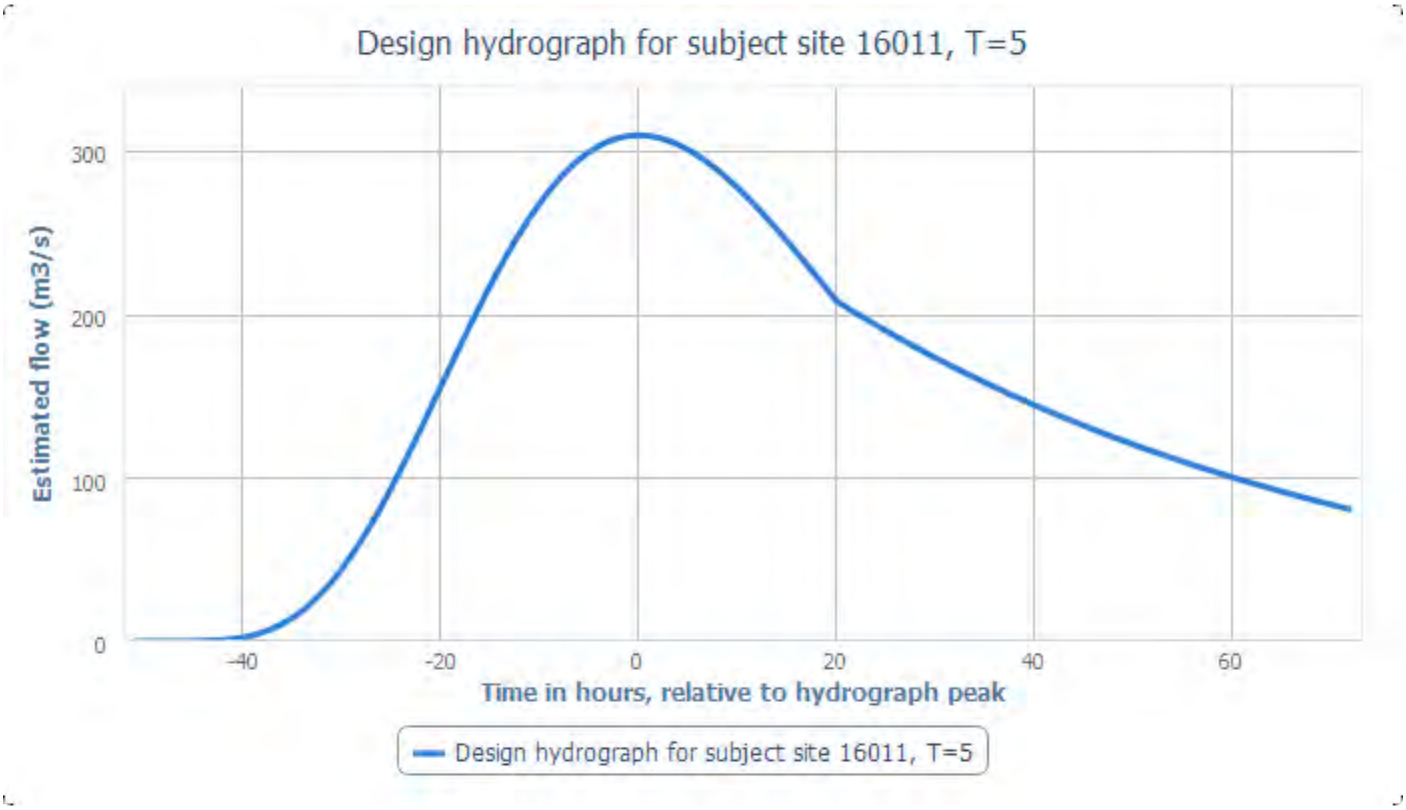
Return Period	Growth Factor	Design Peak Flow (m^3/s)
1.3	0.83	203.62
2	1	245.32
5	1.26	309.1
10	1.44	353.26
20	1.6	392.51
30	1.7	417.04
50	1.82	446.48
100	1.98	485.73
200	2.14	524.98
500	2.36	578.96
1000	2.52	618.21

Hydrograph Width Estimation Summary

Name	Value
Pivotal site	16011 "CLONMEL"
Adjustment type	The user adopted the original PCD hydrograph
Transfer type	The user adjusted the subject site estimate with the pivotal site deformation factor
Deformation factor	1
Custom deformation factor	1
Accepted n	7.46208509604664
Accepted Tr	50.93651927964
Accepted C	54.8755655974483

Hydrograph Plots

Return Period: 5

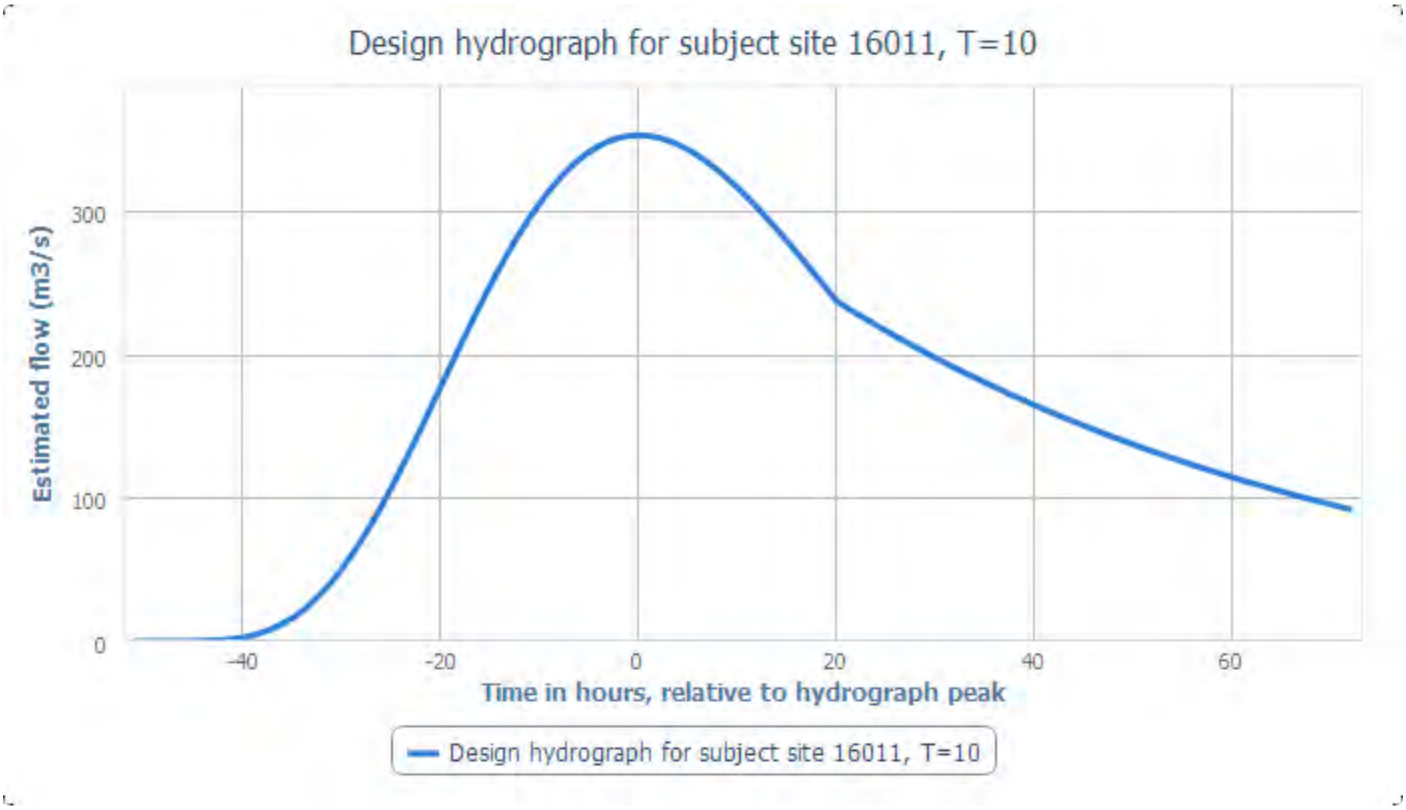


Hours relative to hydrograph peak	Estimated flow (m3/s)
-50.94	0
-50	0
-49	0
-48	0
-47	0.01
-46	0.03
-45	0.09
-44	0.21
-43	0.44
-42	0.83
-41	1.46
-40	2.38
-39	3.7
-38	5.48
-37	7.81
-36	10.76
-35	14.41
-34	18.8
-33	24
-32	30.01
-31	36.87
-30	44.55
-29	53.05
-28	62.33
-27	72.34
-26	83.02
-25	94.28
-24	106.04
-23	118.22

-22	130.71
-21	143.4
-20	156.19
-19	168.98
-18	181.67
-17	194.14
-16	206.31
-15	218.09
-14	229.38
-13	240.12
-12	250.24
-11	259.67
-10	268.37
-9	276.3
-8	283.41
-7	289.69
-6	295.11
-5	299.68
-4	303.39
-3	306.25
-2	308.26
-1	309.45
0	309.84
1	309.46
2	308.34
3	306.52
4	304.03
5	300.91
6	297.22
7	292.98
8	288.25
9	283.07
10	277.48
11	271.53
12	265.26
13	258.71
14	251.92
15	244.94
16	237.8
17	230.53
18	223.17
19	215.76
20	208.31
21	204.41
22	200.72
23	197.1
24	193.54
25	190.04
26	186.61
27	183.24
28	179.93
29	176.68
30	173.49
31	170.36
32	167.28
33	164.26
34	161.3

35	158.38
36	155.52
37	152.72
38	149.96
39	147.25
40	144.59
41	141.98
42	139.42
43	136.9
44	134.43
45	132
46	129.61
47	127.27
48	124.98
49	122.72
50	120.5
51	118.33
52	116.19
53	114.09
54	112.03
55	110.01
56	108.02
57	106.07
58	104.16
59	102.28
60	100.43
61	98.61
62	96.83
63	95.09
64	93.37
65	91.68
66	90.03
67	88.4
68	86.8
69	85.24
70	83.7
71	82.19
72	80.7

Return Period: 10

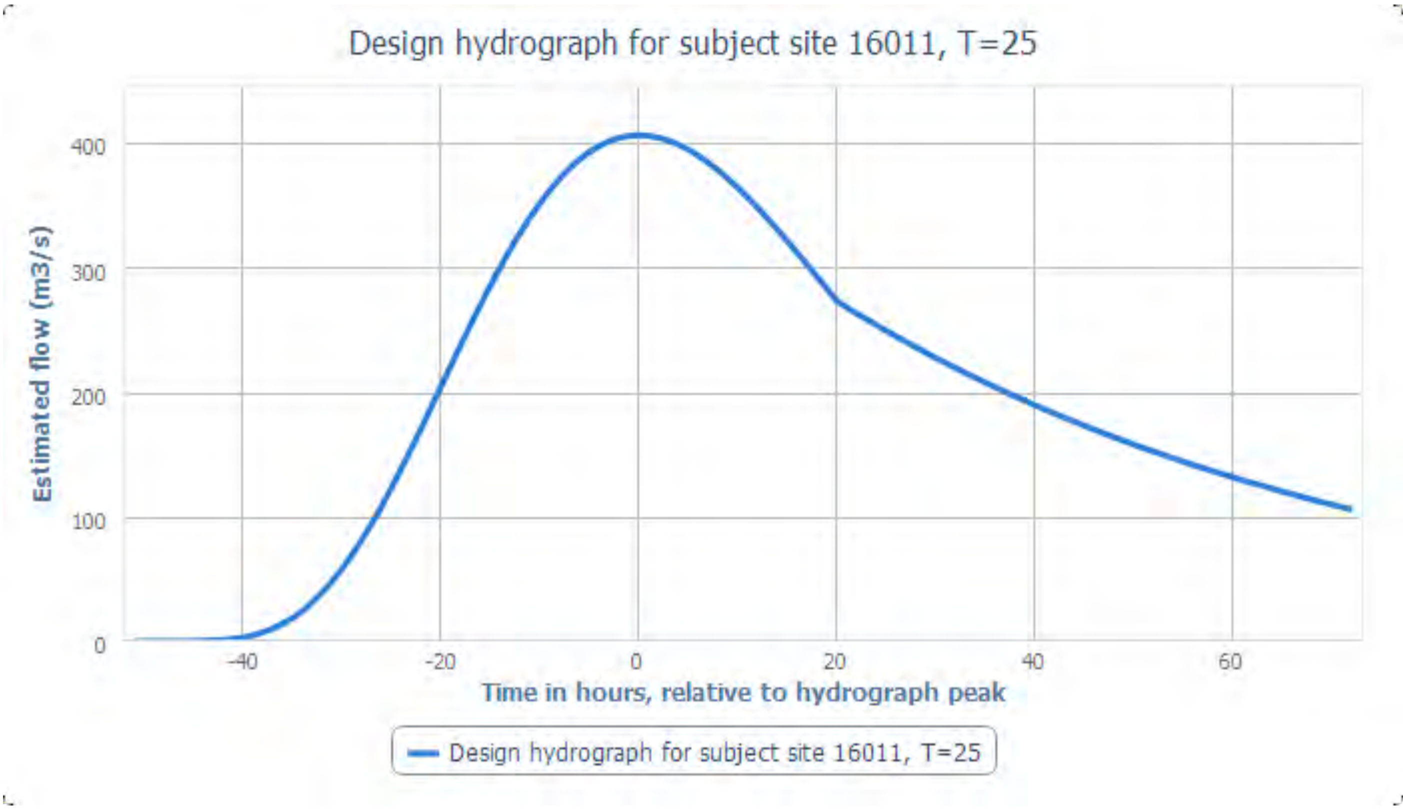


Hours relative to hydrograph peak	Estimated flow (m3/s)
-50.94	0
-50	0
-49	0
-48	0
-47	0.01
-46	0.03
-45	0.1
-44	0.24
-43	0.5
-42	0.95
-41	1.66
-40	2.71
-39	4.21
-38	6.23
-37	8.88
-36	12.24
-35	16.39
-34	21.4
-33	27.3
-32	34.15
-31	41.95
-30	50.7
-29	60.37
-28	70.93
-27	82.32
-26	94.46
-25	107.28
-24	120.66
-23	134.52
-22	148.73
-21	163.17

-20	177.73
-19	192.28
-18	206.71
-17	220.91
-16	234.76
-15	248.16
-14	261.01
-13	273.23
-12	284.74
-11	295.48
-10	305.37
-9	314.39
-8	322.48
-7	329.63
-6	335.8
-5	341
-4	345.22
-3	348.47
-2	350.76
-1	352.11
0	352.56
1	352.13
2	350.85
3	348.78
4	345.94
5	342.4
6	338.2
7	333.38
8	327.99
9	322.1
10	315.74
11	308.97
12	301.83
13	294.38
14	286.66
15	278.71
16	270.58
17	262.31
18	253.94
19	245.5
20	237.03
21	232.6
22	228.4
23	224.27
24	220.22
25	216.25
26	212.34
27	208.51
28	204.74
29	201.04
30	197.41
31	193.85
32	190.35
33	186.91
34	183.53
35	180.22
36	176.97

37	173.77
38	170.63
39	167.55
40	164.53
41	161.55
42	158.64
43	155.77
44	152.96
45	150.2
46	147.49
47	144.82
48	142.21
49	139.64
50	137.12
51	134.64
52	132.21
53	129.82
54	127.48
55	125.18
56	122.92
57	120.7
58	118.52
59	116.38
60	114.27
61	112.21
62	110.18
63	108.2
64	106.24
65	104.32
66	102.44
67	100.59
68	98.77
69	96.99
70	95.24
71	93.52
72	91.83

Return Period: 25

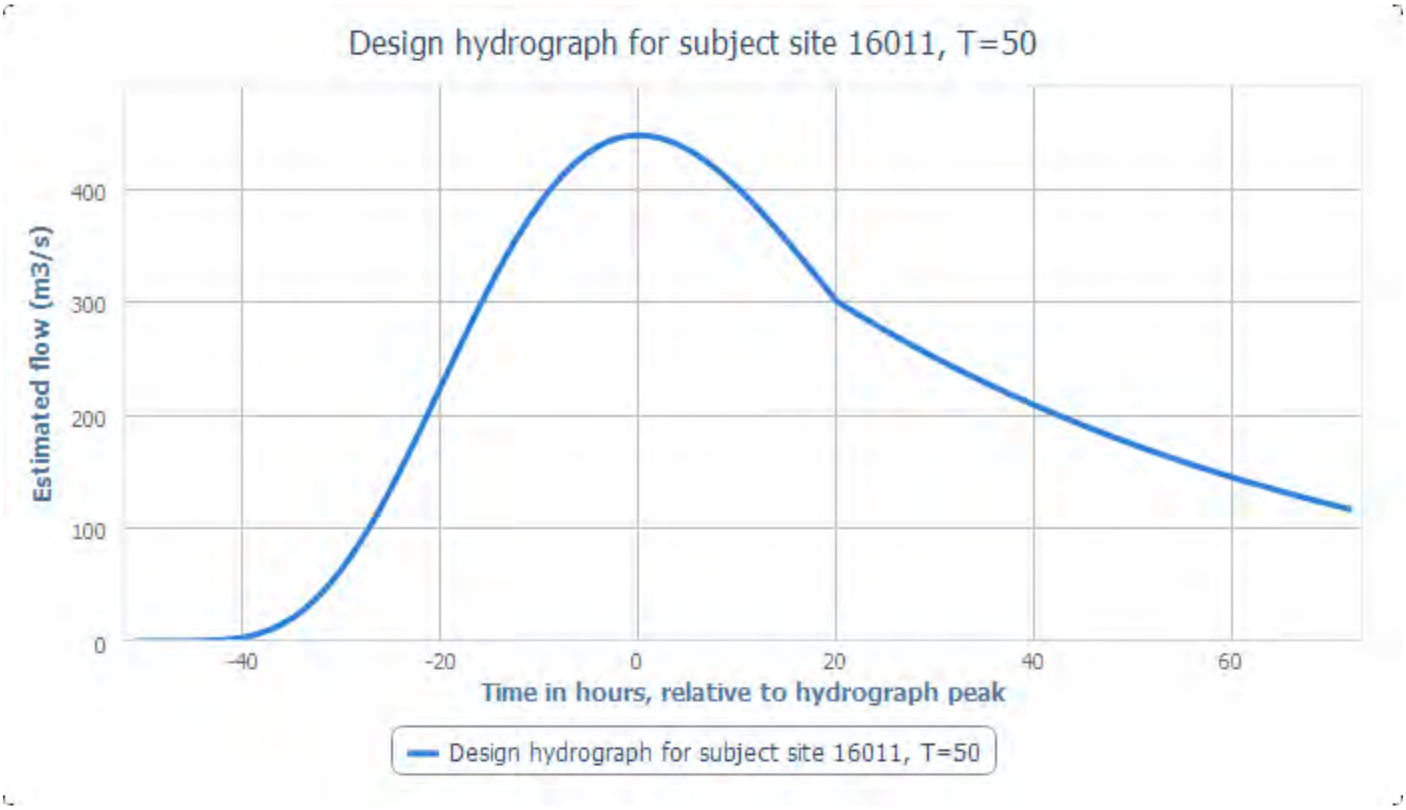


Hours relative to hydrograph peak	Estimated flow (m3/s)
-50.94	0
-50	0
-49	0
-48	0
-47	0.01
-46	0.04
-45	0.11
-44	0.27
-43	0.58
-42	1.09
-41	1.91
-40	3.13
-39	4.85
-38	7.19
-37	10.24
-36	14.12
-35	18.9
-34	24.67
-33	31.48
-32	39.38
-31	48.37
-30	58.46
-29	69.61
-28	81.79
-27	94.92
-26	108.92
-25	123.7
-24	139.14
-23	155.11
-22	171.5
-21	188.15

-20	204.94
-19	221.72
-18	238.36
-17	254.73
-16	270.7
-15	286.15
-14	300.97
-13	315.06
-12	328.33
-11	340.71
-10	352.12
-9	362.52
-8	371.85
-7	380.09
-6	387.21
-5	393.21
-4	398.07
-3	401.82
-2	404.46
-1	406.02
0	406.53
1	406.03
2	404.57
3	402.17
4	398.91
5	394.82
6	389.97
7	384.41
8	378.21
9	371.41
10	364.07
11	356.27
12	348.04
13	339.45
14	330.54
15	321.38
16	312.01
17	302.47
18	292.82
19	283.09
20	273.32
21	268.21
22	263.36
23	258.61
24	253.94
25	249.35
26	244.85
27	240.43
28	236.09
29	231.82
30	227.64
31	223.52
32	219.49
33	215.53
34	211.63
35	207.81
36	204.06

37	200.37
38	196.76
39	193.2
40	189.71
41	186.29
42	182.92
43	179.62
44	176.38
45	173.19
46	170.06
47	166.99
48	163.98
49	161.02
50	158.11
51	155.25
52	152.45
53	149.7
54	146.99
55	144.34
56	141.73
57	139.17
58	136.66
59	134.19
60	131.77
61	129.39
62	127.05
63	124.76
64	122.51
65	120.29
66	118.12
67	115.99
68	113.89
69	111.84
70	109.82
71	107.83
72	105.89

Return Period: 50

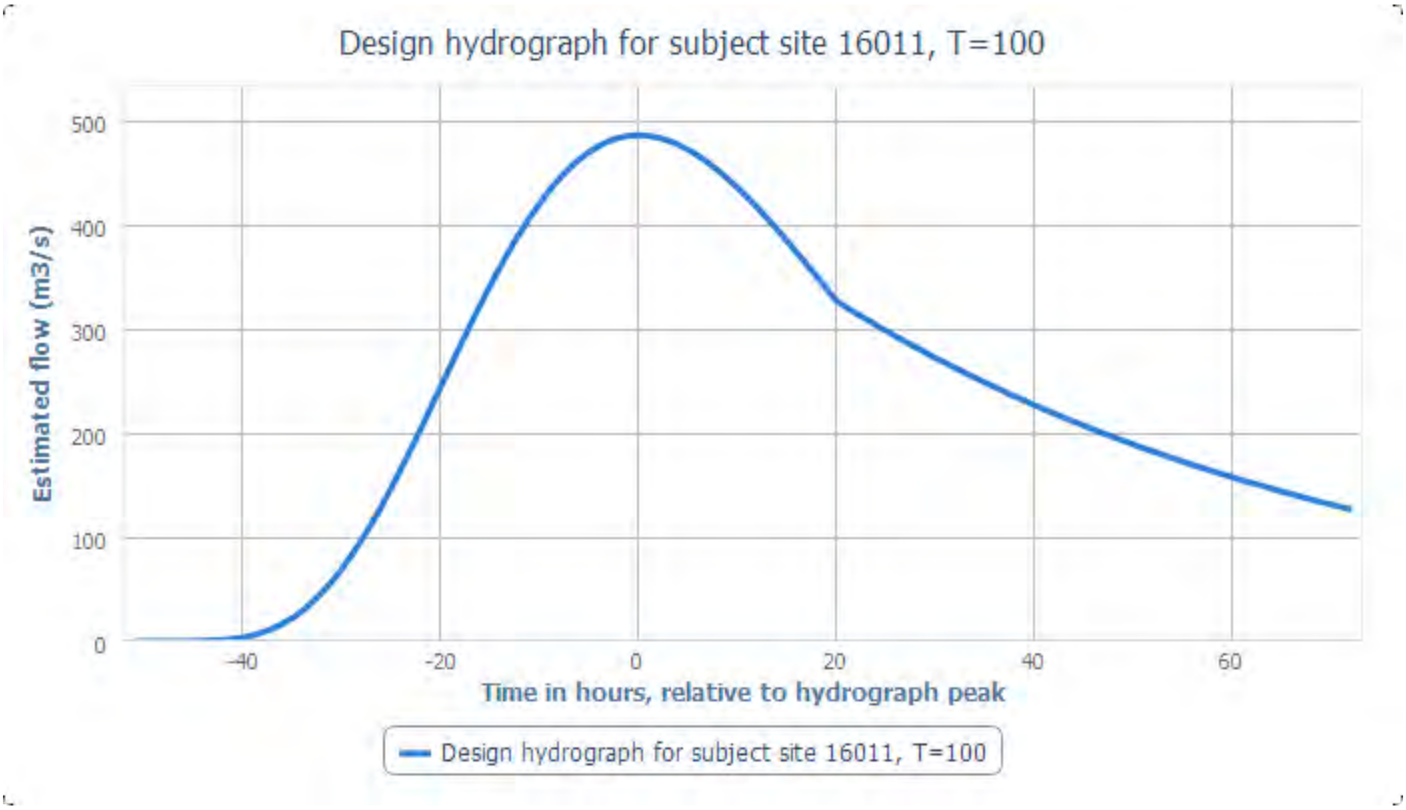


Hours relative to hydrograph peak	Estimated flow (m3/s)
-50.94	0
-50	0
-49	0
-48	0
-47	0.01
-46	0.04
-45	0.13
-44	0.3
-43	0.63
-42	1.2
-41	2.1
-40	3.44
-39	5.33
-38	7.89
-37	11.25
-36	15.51
-35	20.76
-34	27.1
-33	34.59
-32	43.26
-31	53.13
-30	64.21
-29	76.47
-28	89.84
-27	104.27
-26	119.65
-25	135.88
-24	152.84
-23	170.39
-22	188.39
-21	206.68

-20	225.12
-19	243.56
-18	261.84
-17	279.82
-16	297.36
-15	314.33
-14	330.61
-13	346.09
-12	360.67
-11	374.27
-10	386.81
-9	398.23
-8	408.48
-7	417.53
-6	425.35
-5	431.94
-4	437.28
-3	441.4
-2	444.3
-1	446.01
0	446.58
1	446.03
2	444.41
3	441.78
4	438.2
5	433.71
6	428.38
7	422.28
8	415.46
9	407.99
10	399.93
11	391.36
12	382.32
13	372.88
14	363.1
15	353.04
16	342.74
17	332.27
18	321.66
19	310.97
20	300.24
21	294.62
22	289.3
23	284.08
24	278.95
25	273.91
26	268.96
27	264.11
28	259.34
29	254.66
30	250.06
31	245.54
32	241.11
33	236.75
34	232.48
35	228.28
36	224.16

37	220.11
38	216.13
39	212.23
40	208.4
41	204.64
42	200.94
43	197.31
44	193.75
45	190.25
46	186.81
47	183.44
48	180.13
49	176.88
50	173.68
51	170.55
52	167.47
53	164.44
54	161.47
55	158.56
56	155.69
57	152.88
58	150.12
59	147.41
60	144.75
61	142.13
62	139.57
63	137.05
64	134.57
65	132.14
66	129.76
67	127.41
68	125.11
69	122.85
70	120.63
71	118.46
72	116.32

Return Period: 100

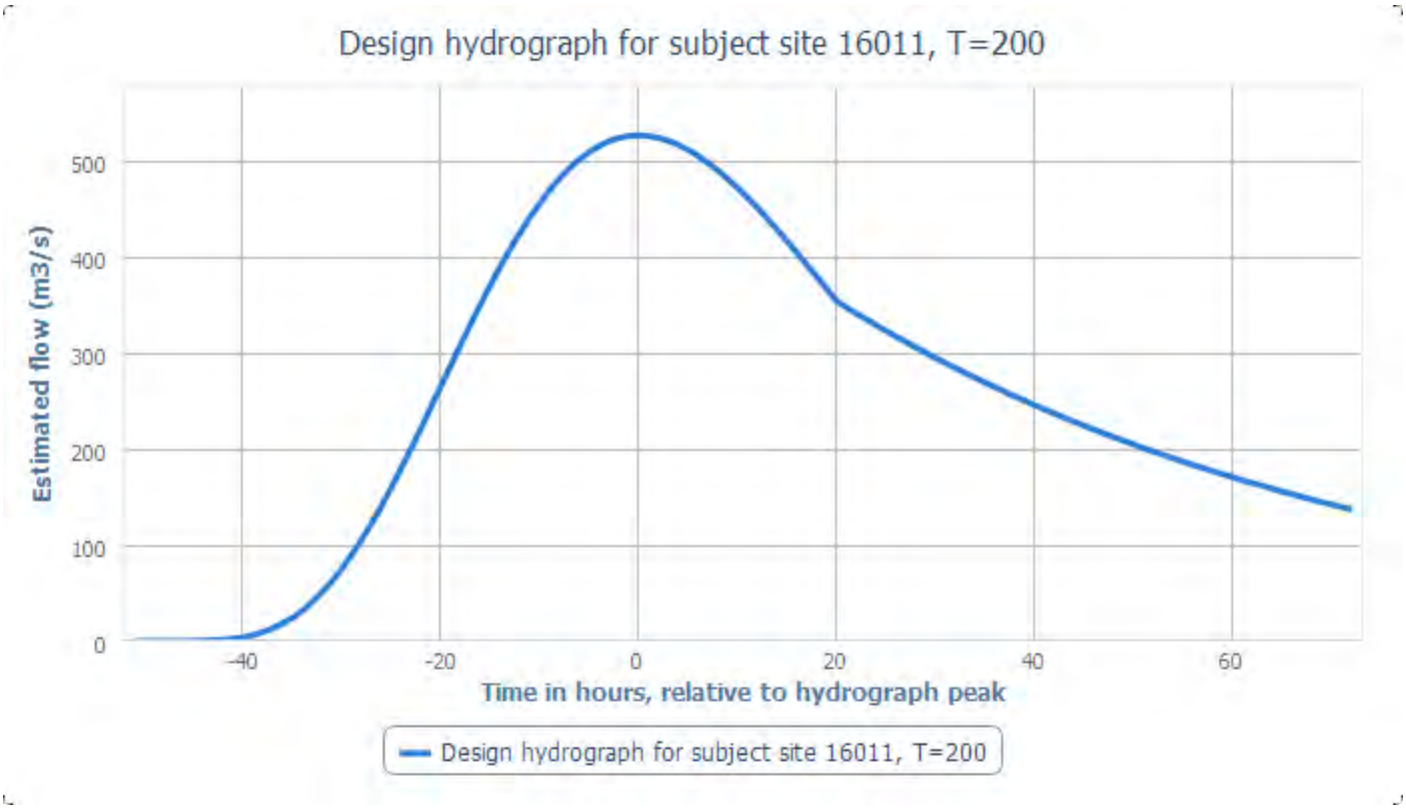


Hours relative to hydrograph peak	Estimated flow (m3/s)
-50.94	0
-50	0
-49	0
-48	0
-47	0.01
-46	0.05
-45	0.14
-44	0.33
-43	0.69
-42	1.31
-41	2.29
-40	3.74
-39	5.8
-38	8.6
-37	12.25
-36	16.89
-35	22.61
-34	29.51
-33	37.66
-32	47.11
-31	57.86
-30	69.93
-29	83.27
-28	97.84
-27	113.55
-26	130.3
-25	147.98
-24	166.45
-23	185.56
-22	205.15
-21	225.08

-20	245.16
-19	265.24
-18	285.14
-17	304.72
-16	323.83
-15	342.31
-14	360.04
-13	376.89
-12	392.77
-11	407.58
-10	421.23
-9	433.67
-8	444.83
-7	454.69
-6	463.21
-5	470.38
-4	476.2
-3	480.68
-2	483.84
-1	485.71
0	486.32
1	485.72
2	483.97
3	481.1
4	477.2
5	472.31
6	466.51
7	459.86
8	452.43
9	444.3
10	435.53
11	426.19
12	416.35
13	406.07
14	395.42
15	384.46
16	373.25
17	361.84
18	350.29
19	338.65
20	326.96
21	320.84
22	315.05
23	309.36
24	303.77
25	298.29
26	292.9
27	287.61
28	282.42
29	277.32
30	272.31
31	267.39
32	262.57
33	257.82
34	253.17
35	248.6
36	244.11

37	239.7
38	235.37
39	231.12
40	226.95
41	222.85
42	218.82
43	214.87
44	210.99
45	207.18
46	203.44
47	199.77
48	196.16
49	192.62
50	189.14
51	185.72
52	182.37
53	179.08
54	175.84
55	172.67
56	169.55
57	166.49
58	163.48
59	160.53
60	157.63
61	154.78
62	151.99
63	149.24
64	146.55
65	143.9
66	141.3
67	138.75
68	136.25
69	133.79
70	131.37
71	129
72	126.67

Return Period: 200



Hours relative to hydrograph peak	Estimated flow (m3/s)
-50.94	0
-50	0
-49	0
-48	0
-47	0.01
-46	0.05
-45	0.15
-44	0.35
-43	0.75
-42	1.41
-41	2.47
-40	4.05
-39	6.27
-38	9.3
-37	13.25
-36	18.26
-35	24.45
-34	31.92
-33	40.73
-32	50.94
-31	62.58
-30	75.62
-29	90.05
-28	105.81
-27	122.8
-26	140.91
-25	160.03
-24	180
-23	200.67
-22	221.86
-21	243.4

-20	265.12
-19	286.83
-18	308.36
-17	329.54
-16	350.19
-15	370.18
-14	389.35
-13	407.58
-12	424.76
-11	440.77
-10	455.53
-9	468.98
-8	481.06
-7	491.71
-6	500.93
-5	508.68
-4	514.98
-3	519.82
-2	523.24
-1	525.26
0	525.92
1	525.28
2	523.38
3	520.28
4	516.06
5	510.77
6	504.5
7	497.31
8	489.27
9	480.48
10	470.99
11	460.89
12	450.25
13	439.13
14	427.62
15	415.76
16	403.64
17	391.3
18	378.81
19	366.22
20	353.58
21	346.97
22	340.7
23	334.55
24	328.51
25	322.58
26	316.75
27	311.03
28	305.42
29	299.9
30	294.49
31	289.17
32	283.95
33	278.82
34	273.78
35	268.84
36	263.99

37	259.22
38	254.54
39	249.94
40	245.43
41	241
42	236.64
43	232.37
44	228.17
45	224.05
46	220.01
47	216.04
48	212.13
49	208.3
50	204.54
51	200.85
52	197.22
53	193.66
54	190.16
55	186.73
56	183.36
57	180.05
58	176.79
59	173.6
60	170.47
61	167.39
62	164.37
63	161.4
64	158.48
65	155.62
66	152.81
67	150.05
68	147.34
69	144.68
70	142.07
71	139.5
72	136.98

IBIDEM Plots and Tables

No IBIDEM plots were saved by the user.

Audit Trail Report #13700 (Gauge 16011 Rev 1)

User ID:	henk.botha@csea.ie
Name:	Botha, Henk
Company:	CSEA
Address:	
Report date & time:	14-05-2022 14:54
Start of Calculation:	14-05-2022 16:39

Decisions made by the user:

Decision	User comment	System information	Date
2.1 Subject site accepted	N/A	Location 16011	14-05-2022 16:39
2.9 Single site analysis accepted	N/A		14-05-2022 16:39
2.9 Single site analysis accepted	N/A		14-05-2022 16:44
2.9 Single site analysis accepted	N/A		14-05-2022 16:44
2.1 Subject site accepted	N/A	Location 16011	14-05-2022 16:47
2.9 Single site analysis accepted	N/A		14-05-2022 16:47
2.1 Subject site accepted	N/A	Location 16011	14-05-2022 16:51
2.9 Single site analysis accepted	N/A		14-05-2022 16:51
2.11 Pooling group accepted	N/A	Pooled group accepted with the following stations: [16009, 18002, 26007, 12001, 16008, 30004, 15012, 26005, 15006, 15002, 26002] and distribution: EV1	14-05-2022 16:51

2.13 Module 2 finalized	N/A	Finished combined analysis using distribution: EV1 and weight: 1.	14-05-2022 16:51
2.1 Subject site accepted	N/A	Location 16011	14-05-2022 16:52
2.9 Single site analysis accepted	N/A		14-05-2022 16:52
2.11 Pooling group accepted	N/A	Pooled group accepted with the following stations: [16009, 18002, 26007, 12001, 16008, 30004, 15012, 26005, 15006, 15002, 26002] and distribution: EV1	14-05-2022 16:52
2.13 Module 2 finalized	N/A	Finished combined analysis using distribution: EV1 and weight: 1.	14-05-2022 16:52
3.1 Hydrograph pivotal site rejected	Clonmel Gauge 16011	Station: 16011 CLONMEL	14-05-2022 16:53
3.3 Proceeded from hydrograph display	N/A		14-05-2022 16:53
3.3 Proceeded from hydrograph display	N/A		14-05-2022 16:53
3.4 Hydrograph inspected and adjusted	N/A	The user adopted the original PCD hydrograph	14-05-2022 16:53
3.5 Hydrograph transferred to subject site	N/A	The user adjusted the subject site estimate with n = 7.46208509604664, Tr = 50.93651927964, C = 54.8755655974483	14-05-2022 16:54

Appendix C – Hydraulic Model Check File

Contents

1. Introduction

This Model Check File has been prepared to document the model build process; it includes information on the modelling approach, parameters, details on hydraulic structures and highlights assumptions made. This document has been prepared as an Appendix to the Suir Island Hydraulic Modelling Report.

2. Modelling Approach

2.1. Overview

The study area extends upstream of Little Island and covers the flow separation and junctions around Little Island, Suir Island and the Little Island Channel connecting the Northern and Southern river reaches and the model extends up to 250m downstream of Old Waterford Road Gashouse Bridge.

The approach taken to model these reaches consists of a 1D model for the river channels and a single 2D area on the right bank upstream of Little Island and the southern Slalom Course. This was necessary to account for the overland flow which by-passes the upper section of the southern river reach and the restriction to 1D section locations due to the junction location between the southern river reach and the Little Island Channel.

2.2. Model Synopsis

Model Construction Summary	
Model Type(s) and reasons	Fluvial model – HEC-RAS combined 1D/2D 3 river reaches were modelled based on the bathymetric survey conducted by Murphy Geospatial in February 2022. Linked 1D/2D modelling was necessary to account for overland flow which by-passes river sections and joins into downstream river sections
Key Purposes of Model	To determine the pre- and post-development water surface elevations to assess the impacts of constructing the bridge supporting structures in the existing floodplain, to assess the available freeboard between the proposed bridge deck soffit and flood water surface levels and to assess the potential scour depth on the bridge support structures.
Model Software Version	HEC-RAS (version 6.2) – March 2022
Model Directory	Q:\2020 Jobs\20_071 - Suir Island Infrastructure Links\Hydraulic Modelling\3. Phase II - Hydraulic Modelling
Survey Data	Bathymetric survey sections of the river channels and flood defence structures (Information provided in **Appendix A**) Topographical survey of bridge structures and Suir Island flood defence berm as summarised in **Section 4.4**. Photogrammetry digital elevation model of floodplains (2m resolution) - BlueSky

<table>
<tr><td>General Schematisation</td><td>All watercourses modelled with an upstream flow-time boundary and downstream Normal Depth (slope) boundary.</td></tr>
<tr><td>Length of Model</td><td>
<table>
<tr><th>River Reach</th><th>Model Reach</th><th>River Length (m)</th><th>No. of Sections</th></tr>
<tr><td rowspan="4">Suir North</td><td>North 01</td><td>151.70</td><td>4</td></tr>
<tr><td>North 02</td><td>29.50</td><td>2</td></tr>
<tr><td>North 03</td><td>527.60</td><td>18</td></tr>
<tr><td>North 04</td><td>370.60</td><td>11</td></tr>
<tr><td rowspan="2">Suir South</td><td>South 01</td><td>128.00</td><td>7</td></tr>
<tr><td>South 02</td><td>567.20</td><td>29</td></tr>
<tr><td>Little Island Channel</td><td>Channel</td><td>97.30</td><td>11</td></tr>
</table>
</td></tr>
<tr><td>Labelling/Numbering System</td><td>As shown in the row above, the Northern Channel is split in 4 reaches, the Southern Channel in 2 reaches and the interconnecting Little Island Channel. The model is set up as follows from upstream to downstream:

<u>River:</u> <u>Reach:</u>

Suir Main North 1, North 2, North 3, North 4

Suir South South 1, South 2

Suir Channel Channel</td></tr>
<tr><td>2D Domain</td><td>
<table>
<tr><th>Area (ha)</th><th>7.8</th><th>Mesh cell spacing (m)</th><th>5x by 5y</th></tr>
<tr><td rowspan="3">Breakline cell spacing</td><td rowspan="3">2.5x by 2.5y</td><td>Max cell size (m^2)</td><td>41.51</td></tr>
<tr><td>Min cell size (m^2)</td><td>0.5</td></tr>
<tr><td>Average cell size (m^2)</td><td>18.02</td></tr>
</table>
</td></tr>
<tr><td>Alterations to bathymetric survey sections</td><td>Bathymetric survey sections were extended from extracting topographic and photogrammetry digital terrain models for Suir Island and Dennis Burke Park and downstream of Gashouse Bridge

Additional sections were interpolated linearly where lateral structures (1D/2D connections) were added or where HEC-RAS indicated the requirement of additional cross sections.

Due to the curvature of the proposed bridge crossings, custom sections had to be created based on the DTM consisting of the linearly interpolated bathymetric survey river sections and the topographical survey of Suir Island which includes the flood protection berm.</td></tr>
</table>

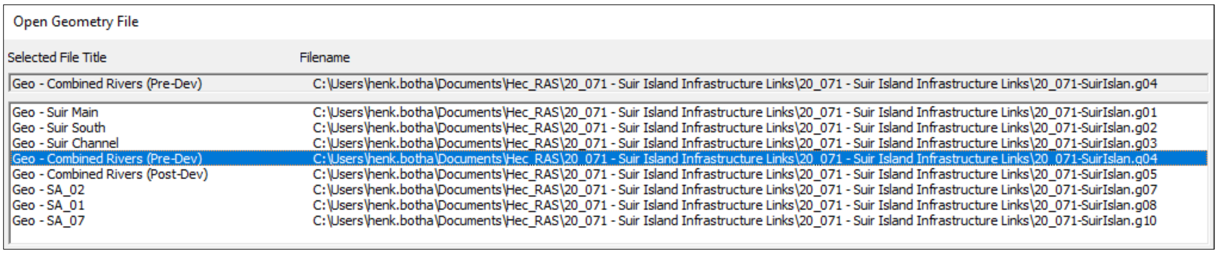
Terrain modifications to 2D Domain	Existing flood protection berms and walls modelled with Terrain Modification functions in Ras-Mapper

2.3. Model Folder Structure

HEC-RAS data is saved in a single folder with various files types and extensions. The data type and file extensions are summarised below:

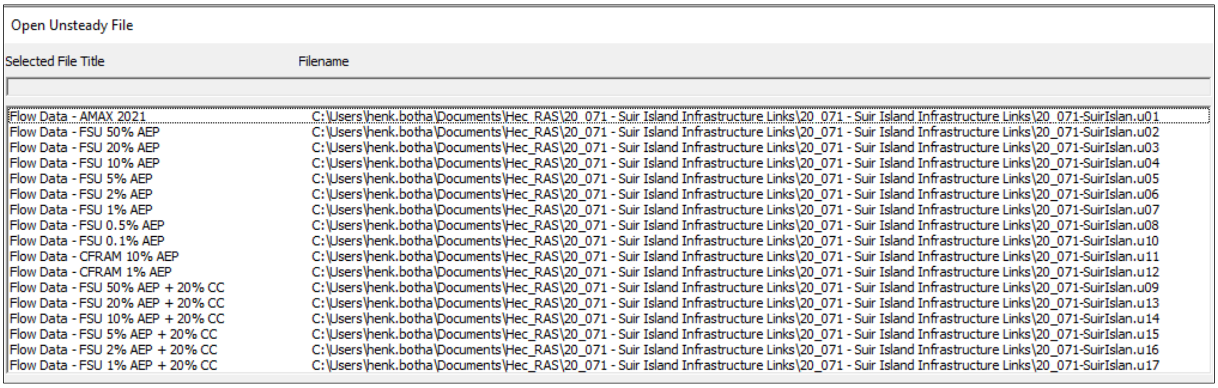
Data type	Data Name	.Extension
Project File	20_071 – Suir Island	.prj
Flow Plan	Various Flow Boundary Conditions	.p(number)
Geometry	Pre-development Post-development Sensitivity Analysis Geometries	.g(number)
Unsteady Flow Analysis	Design Run Simulations	.u(number)
Hydraulic Design Analysis	Bridge Scour	.h(number)

2.4. Summary of Model Files


Open Geometry File

Selected File Title	Filename
Geo - Combined Rivers (Pre-Dev)	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.g04
Geo - Suir Main	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.g01
Geo - Suir South	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.g02
Geo - Suir Channel	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.g03
Geo - Combined Rivers (Pre-Dev)	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.g04
Geo - Combined Rivers (Post-Dev)	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.g05
Geo - SA_02	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.g07
Geo - SA_01	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.g08
Geo - SA_07	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.g10

Figure 2-1: Summary of Geometry Files


Open Unsteady File

Selected File Title	Filename
Flow Data - AMAX 2021	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u01
Flow Data - FSU 50% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u02
Flow Data - FSU 20% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u03
Flow Data - FSU 10% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u04
Flow Data - FSU 5% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u05
Flow Data - FSU 2% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u06
Flow Data - FSU 1% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u07
Flow Data - FSU 0.5% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u08
Flow Data - FSU 0.1% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u10
Flow Data - CFRAM 10% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u11
Flow Data - CFRAM 1% AEP	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u12
Flow Data - FSU 50% AEP + 20% CC	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u09
Flow Data - FSU 20% AEP + 20% CC	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u13
Flow Data - FSU 10% AEP + 20% CC	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u14
Flow Data - FSU 5% AEP + 20% CC	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u15
Flow Data - FSU 2% AEP + 20% CC	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u16
Flow Data - FSU 1% AEP + 20% CC	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.u17

Figure 2-2: Summary of Unsteady Flow Files

Open Plan File

Selected File Title	Time Window	Filename
Flow Plan - FSU 1% AEP (Pre)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p07
Flow Plan - AMAX 2021	23FEB2021 0000 - 27FEB2021 1630	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p01
Flow Plan - FSU 50% AEP (Pre)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p02
Flow Plan - FSU 20% AEP (Pre)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p03
Flow Plan - FSU 10% AEP (Pre)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p04
Flow Plan - FSU 5% AEP (Pre)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p05
Flow Plan - FSU 2% AEP (Pre)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p06
Flow Plan - FSU 1% AEP (Pre)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p07
Flow Plan - FSU 0.5% AEP (Pre)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p08
Flow Plan - FSU 0.1% AEP (Pre)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p10
Flow Plan - FSU 50% AEP (Post)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p15
Flow Plan - FSU 20% AEP (Post)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p16
Flow Plan - FSU 10% AEP (Post)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p17
Flow Plan - FSU 5% AEP (Post)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p18
Flow Plan - FSU 2% AEP (Post)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p19
Flow Plan - FSU 1% AEP (Post)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p20
Flow Plan - FSU 0.5% AEP (Post)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p21
Flow Plan - FSU 0.1% AEP (Post)	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p23
Flow Plan - CFRAM 10% AEP	01JAN2050 0000 - 07JAN2050 0400	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p24
Flow Plan - CFRAM 1% AEP	01JAN2050 0000 - 07JAN2050 0400	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p25
Flow Plan - AMAX 2021 - Rev 1	23FEB2021 0000 - 27FEB2021 1630	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p28
Flow Plan - 1% AEP - SA_01	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p09
Flow Plan - 1% AEP - SA_02	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p11
Flow Plan - 1% AEP - SA_03	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p12
Flow Plan - 1% AEP - SA_04	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p13
Flow Plan - 1% AEP - SA_05	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p14
Flow Plan - 1% AEP - SA_06	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p22
Flow Plan - 1% AEP - SA_07	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p26
Flow Plan - FSU 50% AEP (Pre) + 20% CC	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p27
Flow Plan - FSU 20% AEP (Pre) + 20% CC	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p29
Flow Plan - FSU 10% AEP (Pre) + 20% CC	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p30
Flow Plan - FSU 5% AEP (Pre) + 20% CC	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p31
Flow Plan - FSU 2% AEP (Pre) + 20% CC	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p32
Flow Plan - FSU 1% AEP (Pre) + 20% CC	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p33
Flow Plan - FSU 10% AEP (Post) + 20% CC	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p34
Flow Plan - FSU 1% AEP (Post) + 20% CC	01JAN2050 0000 - 05JAN2050 2300	C:\Users\henk.botha\Documents\Hec_RAS\20_071 - Suir Island Infrastructure Links\20_071 - Suir Island Infrastructure Links\20_071-SuirIslan.p35

Figure 2-3: Summary of Unsteady Flow Simulation Files

2.5. Summary of Design Runs

Model	Fluvial AEP	Current	MRFS	Sensitivities
Pre-development 1D/2D	50%	Y	Y	-
	20%	Y	Y	-
	10%	Y	Y	-
	5%	Y	Y	-
	2%	Y	Y	-
	1%	Y	Y	No. 1 to 8
	0.1%	Y	-	-
Post-development 1D/2D	50%	Y	-	-
	20%	Y	-	-
	10%	Y	Y	-
	5%	Y	-	-
	2%	Y	-	-
	1%	Y	Y	No. 4 and No. 7
	0.1%	Y	-	-

3. Model Build

3.1. Overall Model 1D/2D Schematic

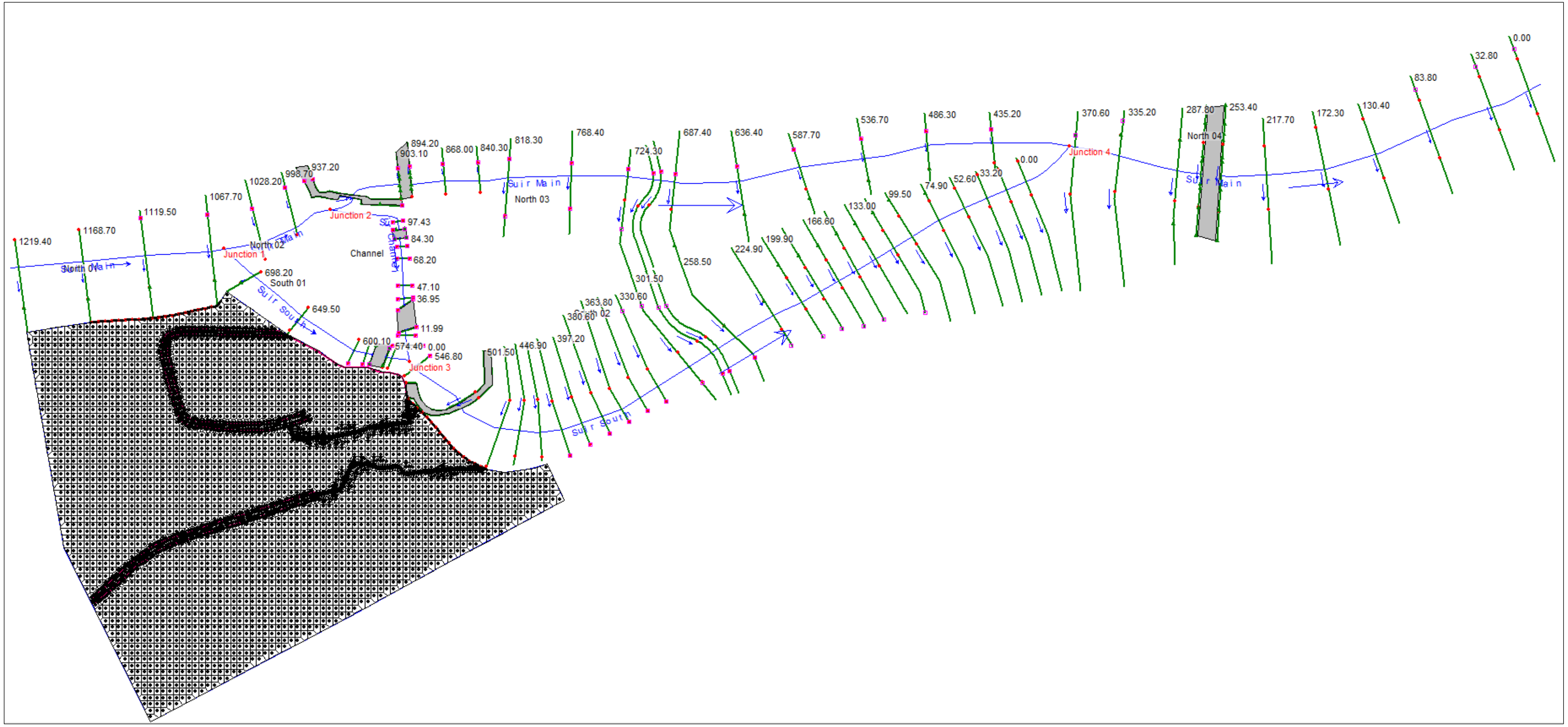


Figure 3-1: Pre-development Model Domain

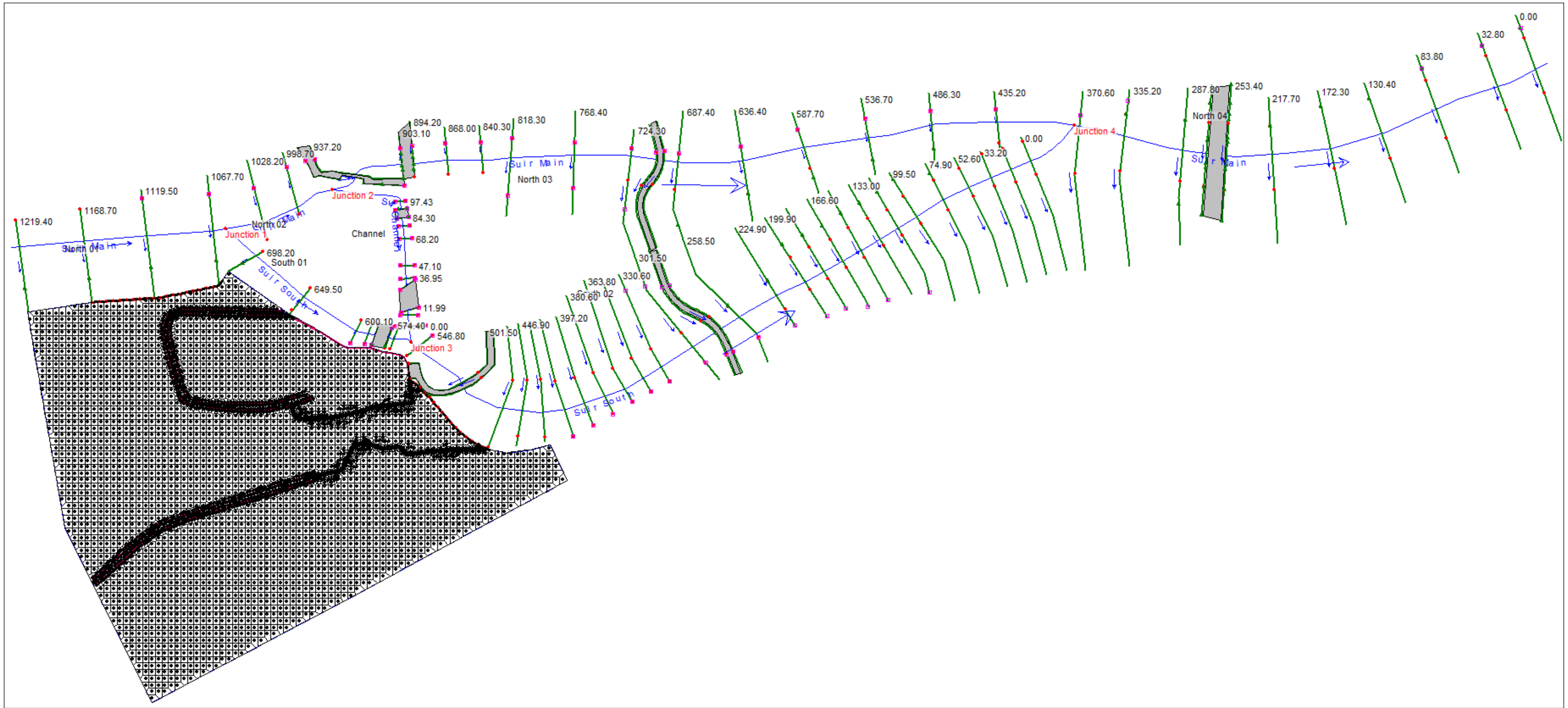


Figure 3-2: Post-Development Model Domain

3.2. Model Parameters

3.3. Model Roughness

Edit Manning's n or k Values

River: Suir Main
Reach: (All Reaches)
Edit Interpolated XS's
All Regions
Channel n Values have a light green background

Selected Area Edit Options
Add Constant ... Multiply Factor ... Set Values ... Replace ... Reduce to L Ch R ...

	Reach	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4
1	North 01	1219.40	n	0.045	0.035	0.06	
2	North 01	1168.70	n	0.045	0.035	0.06	
3	North 01	1168.60	Lat Struct				
4	North 01	1119.50	n	0.045	0.035	0.06	
5	North 01	1067.70	n	0.045	0.035	0.06	
6	North 02	1028.20	n	0.045	0.035	0.045	
7	North 02	998.70	n	0.045	0.035	0.045	
8	North 03	945	n	0.045	0.035	0.045	
9	North 03	941.00	n	0.045	0.035	0.045	
10	North 03	939.1	Inl Struct				
11	North 03	937.20	n	0.045	0.035	0.045	
12	North 03	903.10	n	0.045	0.035	0.045	
13	North 03	898.65	Bridge				
14	North 03	894.20	n	0.045	0.035	0.045	
15	North 03	868.00	n	0.045	0.035	0.045	
16	North 03	840.30	n	0.045	0.035	0.045	
17	North 03	818.30	n	0.045	0.035	0.045	
18	North 03	768.40	n	0.045	0.035	0.045	
19	North 03	724.30	n	0.045	0.035	0.04	0.045
20	North 03	704	n	0.045	0.035	0.04	0.045
21	North 03	701	Bridge				
22	North 03	698	n	0.045	0.035	0.04	0.045
23	North 03	687.40	n	0.045	0.035	0.04	0.045
24	North 03	636.40	n	0.045	0.035	0.08	
25	North 03	587.70	n	0.045	0.035	0.08	
26	North 03	536.70	n	0.045	0.035	0.08	
27	North 03	486.30	n	0.045	0.035	0.08	
28	North 03	435.20	n	0.045	0.035	0.08	
29	North 04	370.60	n	0.045	0.035	0.045	
30	North 04	335.20	n	0.045	0.035	0.045	
31	North 04	287.80	n	0.045	0.035	0.045	
32	North 04	269.10	n	0.045	0.035	0.045	
33	North 04	263.4	Bridge				
34	North 04	253.40	n	0.045	0.035	0.045	
35	North 04	217.70	n	0.045	0.035	0.045	
36	North 04	172.30	n	0.045	0.035	0.045	
37	North 04	130.40	n	0.045	0.035	0.045	
38	North 04	83.80	n	0.045	0.035	0.045	
39	North 04	32.80	n	0.045	0.035	0.045	
40	North 04	0.00	n	0.045	0.035	0.045	

Figure 3-3: Manning's Roughness for Northern River Reach

Edit Manning's n or k Values

River: Suir South

Reach: (All Reaches)

Edit Interpolated XS's

All Regions

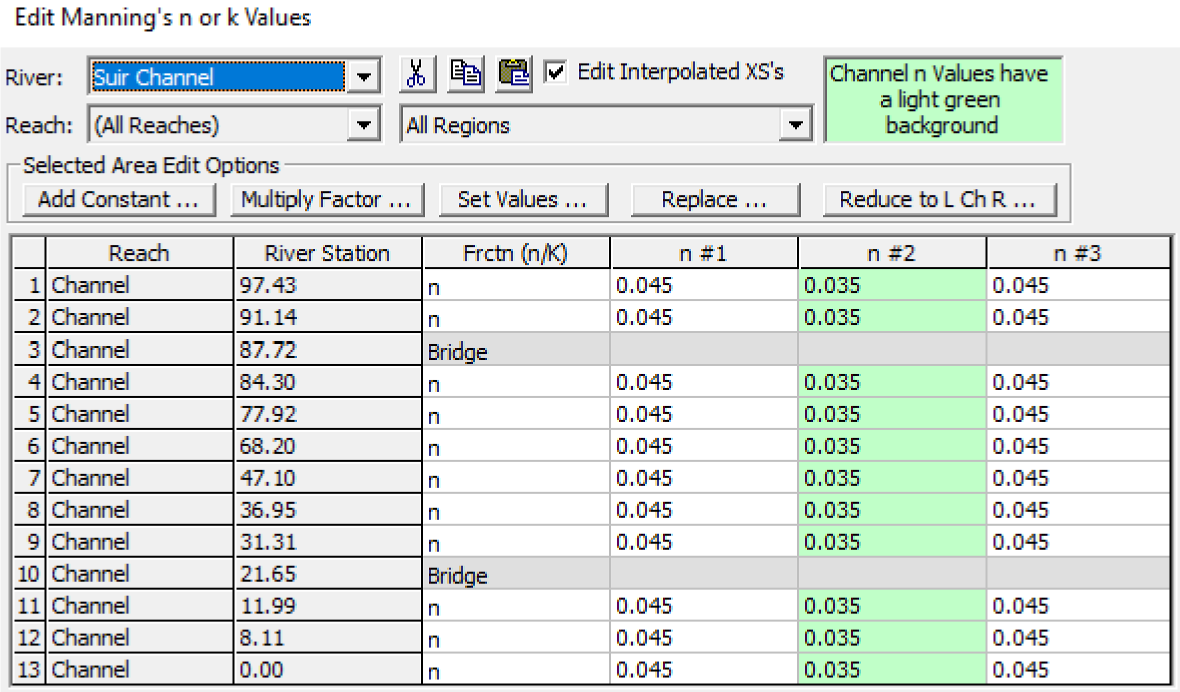
Channel n Values have a light green background

Selected Area Edit Options

Add Constant ... | Multiply Factor ... | Set Values ... | Replace ... | Reduce to L Ch R ...

	Reach	River Station	Frctn (n/K)	n #1	n #2	n #3	n #4	n #5
1	South 01	698.20	n	0.045	0.04	0.06		
2	South 01	649.50	n	0.045	0.04	0.06		
3	South 01	600.10	n	0.045	0.04	0.045		
4	South 01	590.40	n	0.04	0.045			
5	South 01	585.10	n	0.045	0.04	0.045		
6	South 01	579.75	Bridge					
7	South 01	574.40	n	0.045	0.04	0.045		
8	South 01	570.20	n	0.04	0.045			
9	South 02	546.80	n	0.045	0.04	0.045		
10	South 02	501.50	n	0.06	0.04			
11	South 02	499.25	Inl Struct					
12	South 02	497.00	n	0.06	0.04			
13	South 02	496.9	Lat Struct					
14	South 02	462.10	n	0.06	0.04	0.045		
15	South 02	446.90	n	0.04	0.06	0.04	0.045	
16	South 02	430.40	n	0.04	0.06	0.04	0.045	
17	South 02	413.70	n	0.04	0.06	0.04	0.045	
18	South 02	397.20	n	0.04	0.06	0.04	0.045	
19	South 02	380.60	n	0.06	0.04	0.045		
20	South 02	363.80	n	0.06	0.04	0.045		
21	South 02	347.20	n	0.06	0.04	0.06	0.04	0.045
22	South 02	330.60	n	0.06	0.04	0.06	0.04	0.045
23	South 02	301.50	n	0.06	0.04	0.06	0.04	0.045
24	South 02	281	n	0.06	0.04	0.06	0.04	0.045
25	South 02	278	Bridge					
26	South 02	275	n	0.06	0.04	0.06	0.04	0.045
27	South 02	258.50	n	0.06	0.04	0.045		
28	South 02	224.90	n	0.15	0.045	0.04	0.045	
29	South 02	199.90	n	0.15	0.045	0.04	0.045	
30	South 02	183.40	n	0.15	0.045	0.04	0.045	
31	South 02	166.60	n	0.15	0.045	0.04	0.045	
32	South 02	150.10	n	0.15	0.045	0.04	0.045	
33	South 02	133.00	n	0.15	0.045	0.04	0.045	
34	South 02	116.40	n	0.15	0.045	0.04	0.045	
35	South 02	99.50	n	0.15	0.045	0.04	0.045	
36	South 02	74.90	n	0.15	0.045	0.04	0.045	
37	South 02	52.60	n	0.15	0.04	0.045		
38	South 02	33.20	n	0.15	0.04	0.045		
39	South 02	16.70	n	0.15	0.04	0.045		
40	South 02	0.00	n	0.15	0.04	0.045		

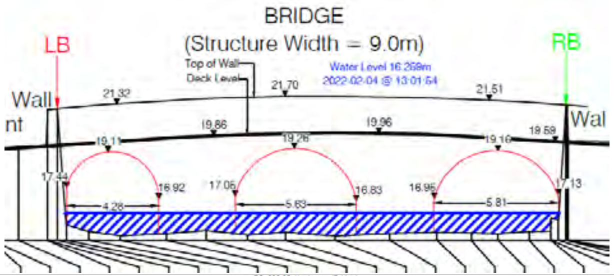
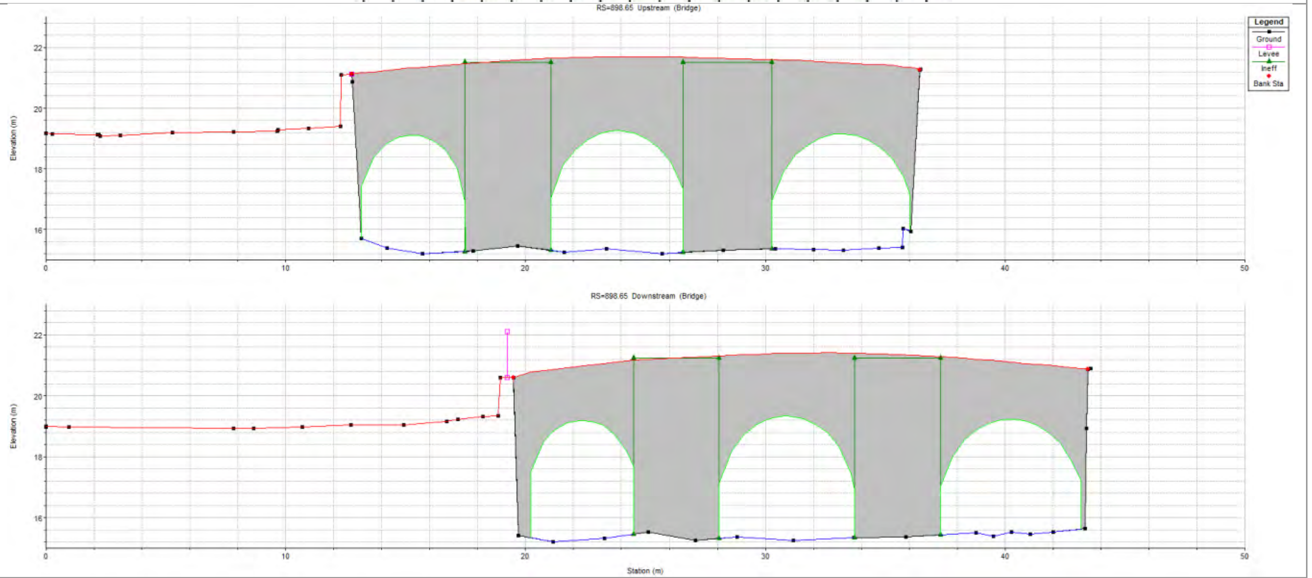
Figure 3-4: Manning's Roughness for Southern River Reach

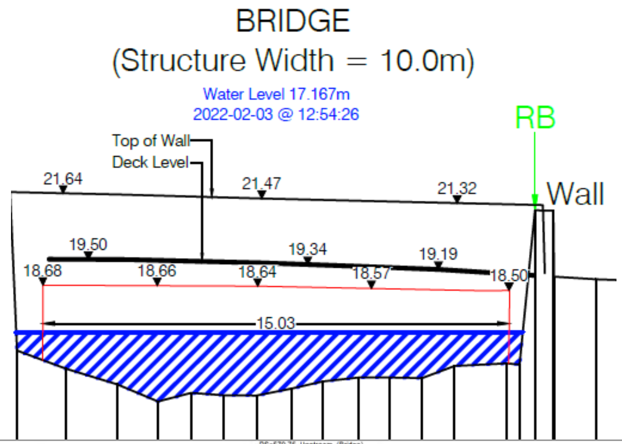


	Reach	River Station	Frctn (n/K)	n #1	n #2	n #3
1	Channel	97.43	n	0.045	0.035	0.045
2	Channel	91.14	n	0.045	0.035	0.045
3	Channel	87.72	Bridge			
4	Channel	84.30	n	0.045	0.035	0.045
5	Channel	77.92	n	0.045	0.035	0.045
6	Channel	68.20	n	0.045	0.035	0.045
7	Channel	47.10	n	0.045	0.035	0.045
8	Channel	36.95	n	0.045	0.035	0.045
9	Channel	31.31	n	0.045	0.035	0.045
10	Channel	21.65	Bridge			
11	Channel	11.99	n	0.045	0.035	0.045
12	Channel	8.11	n	0.045	0.035	0.045
13	Channel	0.00	n	0.045	0.035	0.045

Figure 3-5: Manning's Roughness for Little Island Channel

3.4. Structures

Bridge Name	Survey Section
Old Bridge North, located on the Suir North Reach (Drawing No MGS44342_01SUIR_XS_02)	
HEC-RAS Model showing upstream and downstream view	

<table>
<tr><td>Old Bridge South, located on the Suir South Reach (Drawing No MGS44342_02SUIR_XS_01)</td><td>
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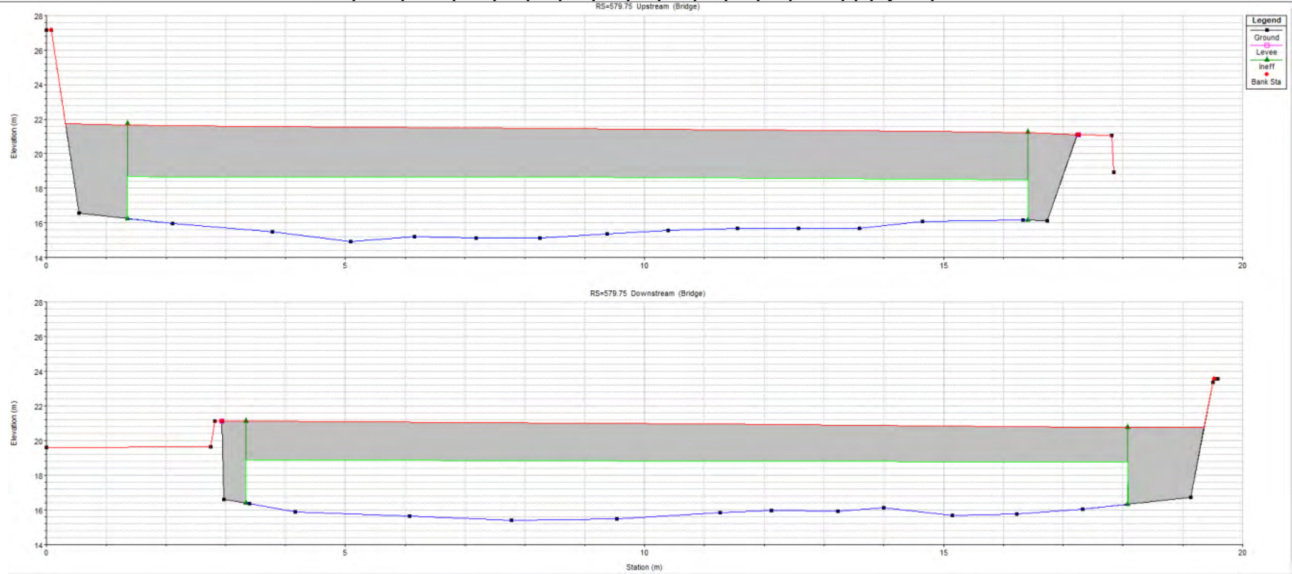
<tr><td>HEC-RAS Model showing upstream and downstream view</td><td>
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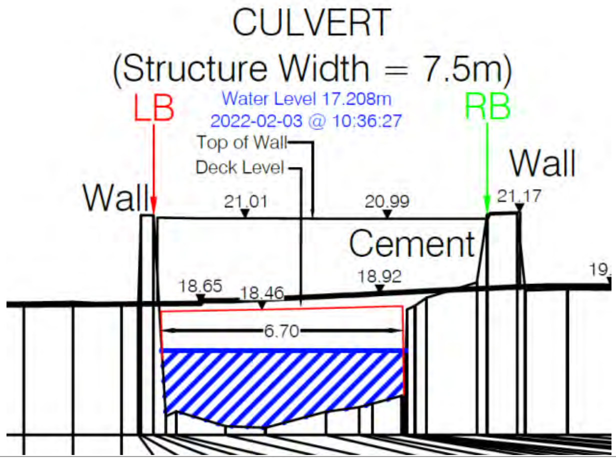
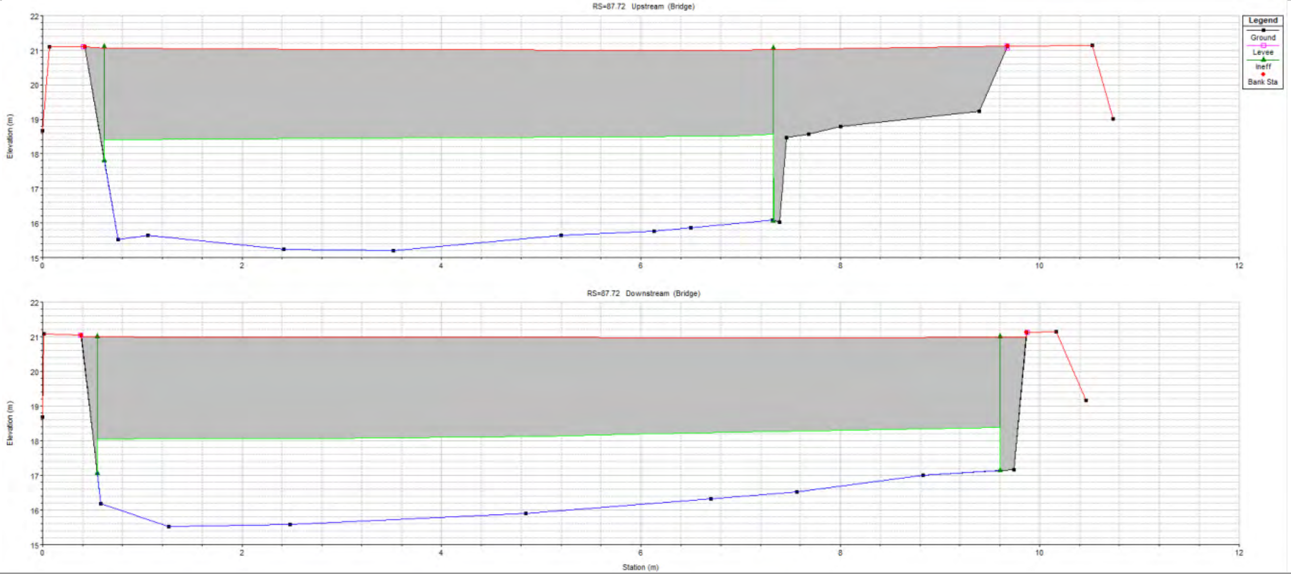
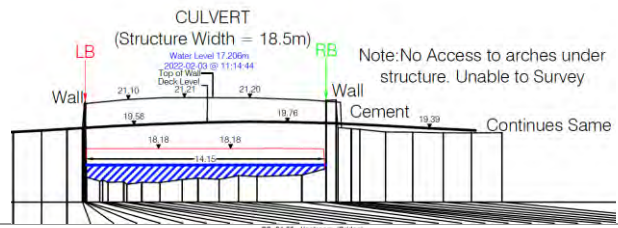
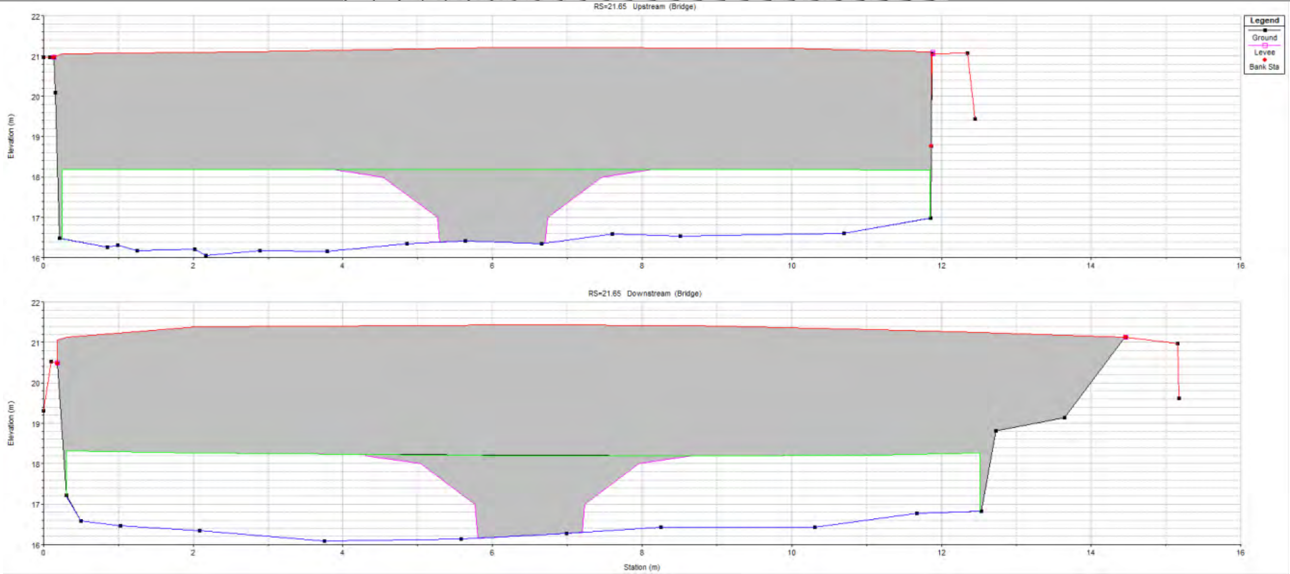
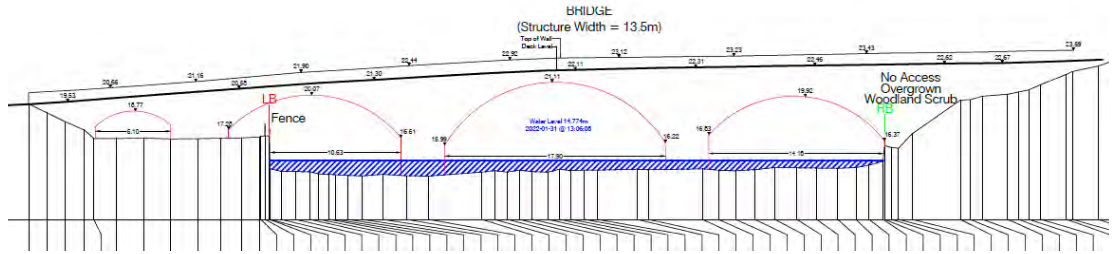
Little Island Bridge 1, located on the Little Island Channel (Drawing No MGS44342_03SUIR_XS_01)	
HEC-RAS Model showing upstream and downstream view	

<table>
<tr>
<td>Little Island Bridge 2, located on the Little Island Channel (Drawing No MGS44342_03SUIR_XS_01)</td>
<td>
</td>
</tr>
<tr>
<td>HEC-RAS Model showing upstream and downstream view

<u>Note: Bridge pier estimated due to safe access restrictions for survey</u></td>
<td></td>
</tr>
<tr>
<td>Gashouse Bridge, located on the Suir North Reach (Drawing No MGS44342_01SUIR_XS_05)</td>
<td>
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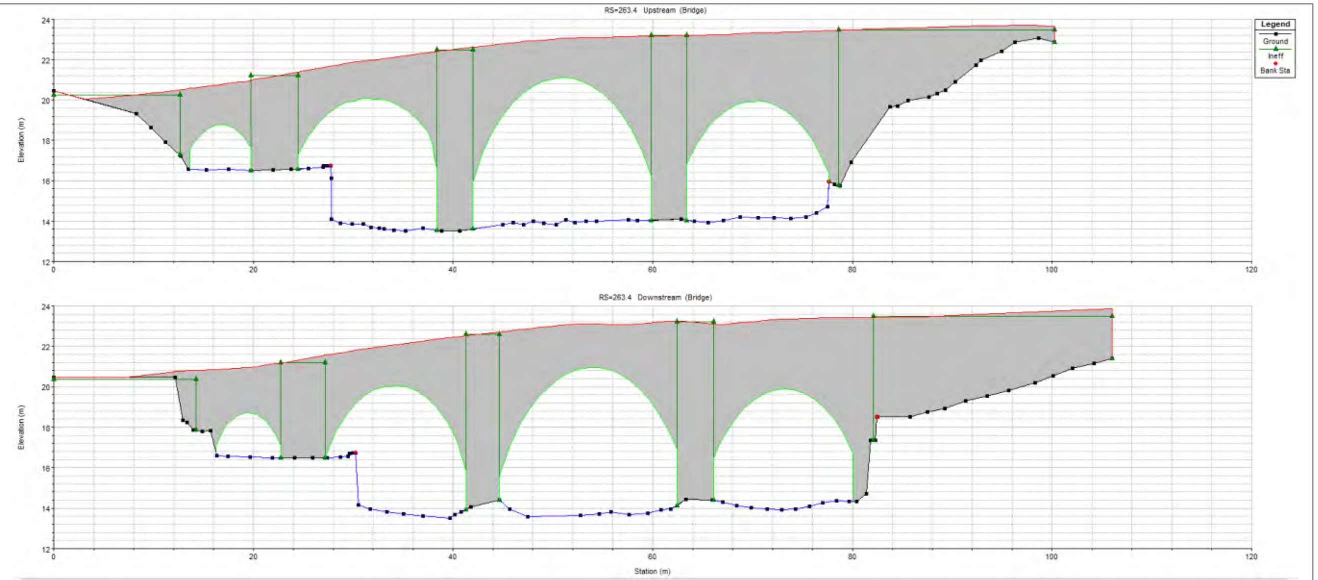
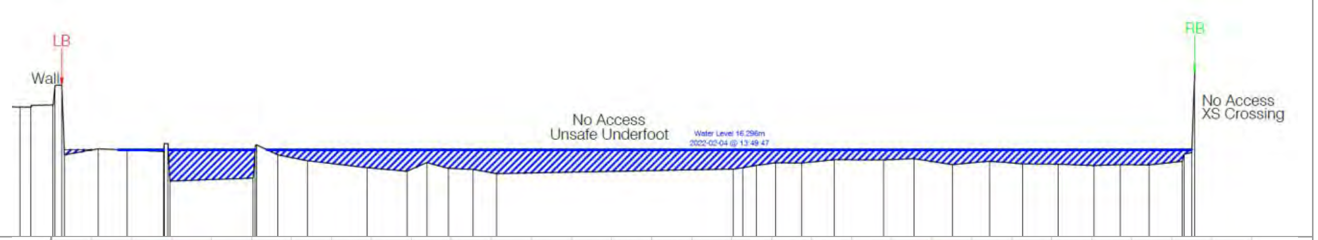
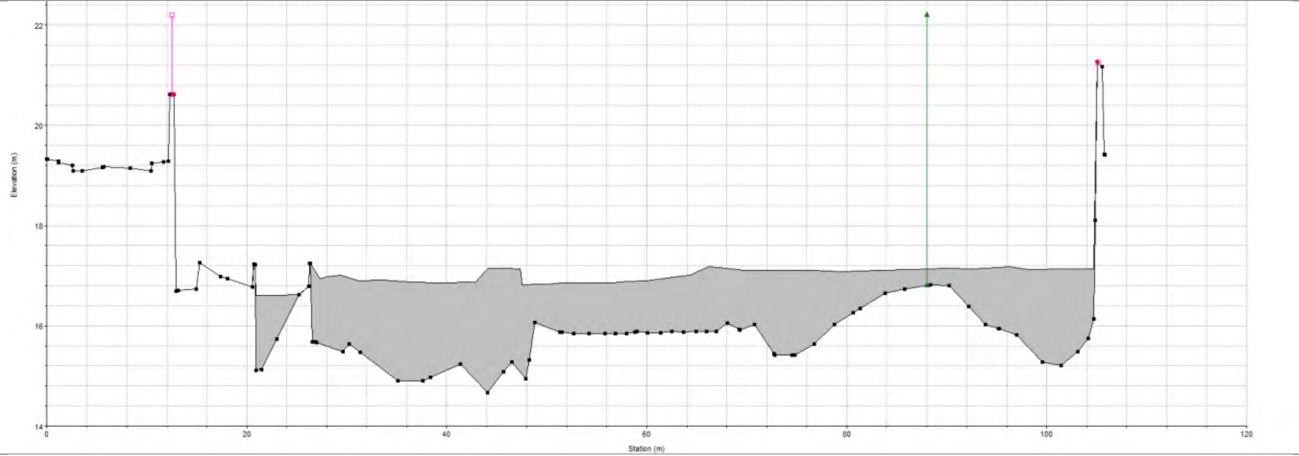
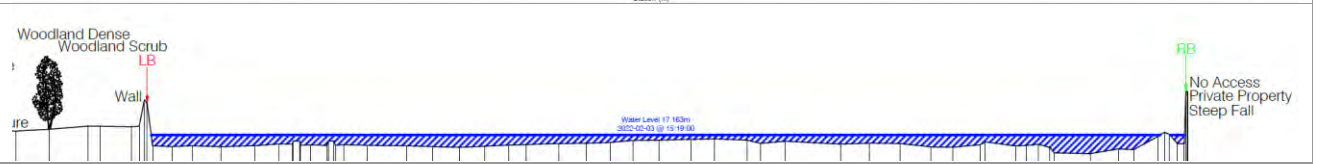
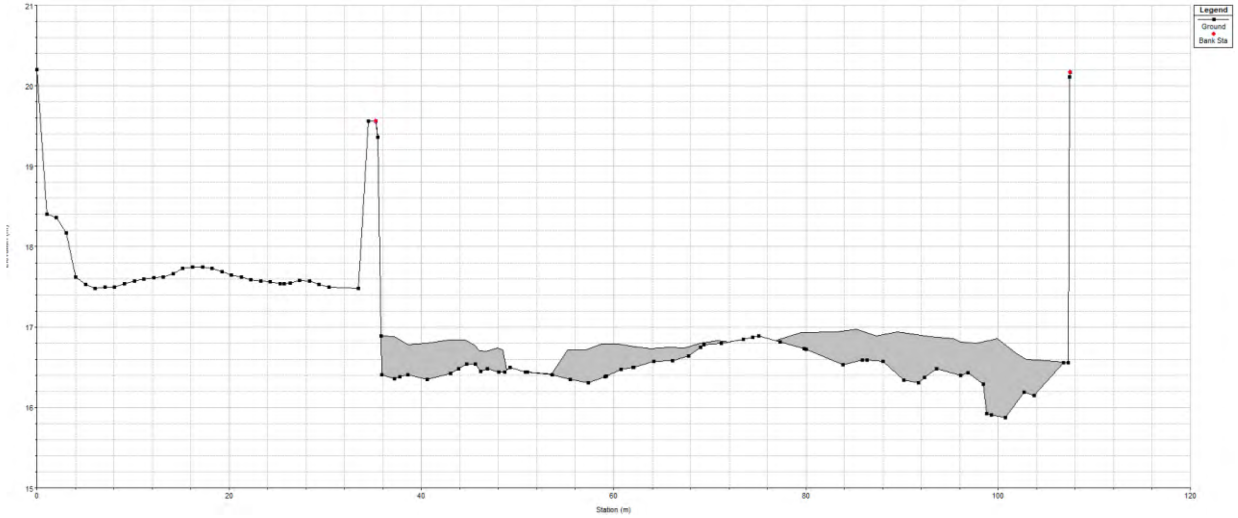
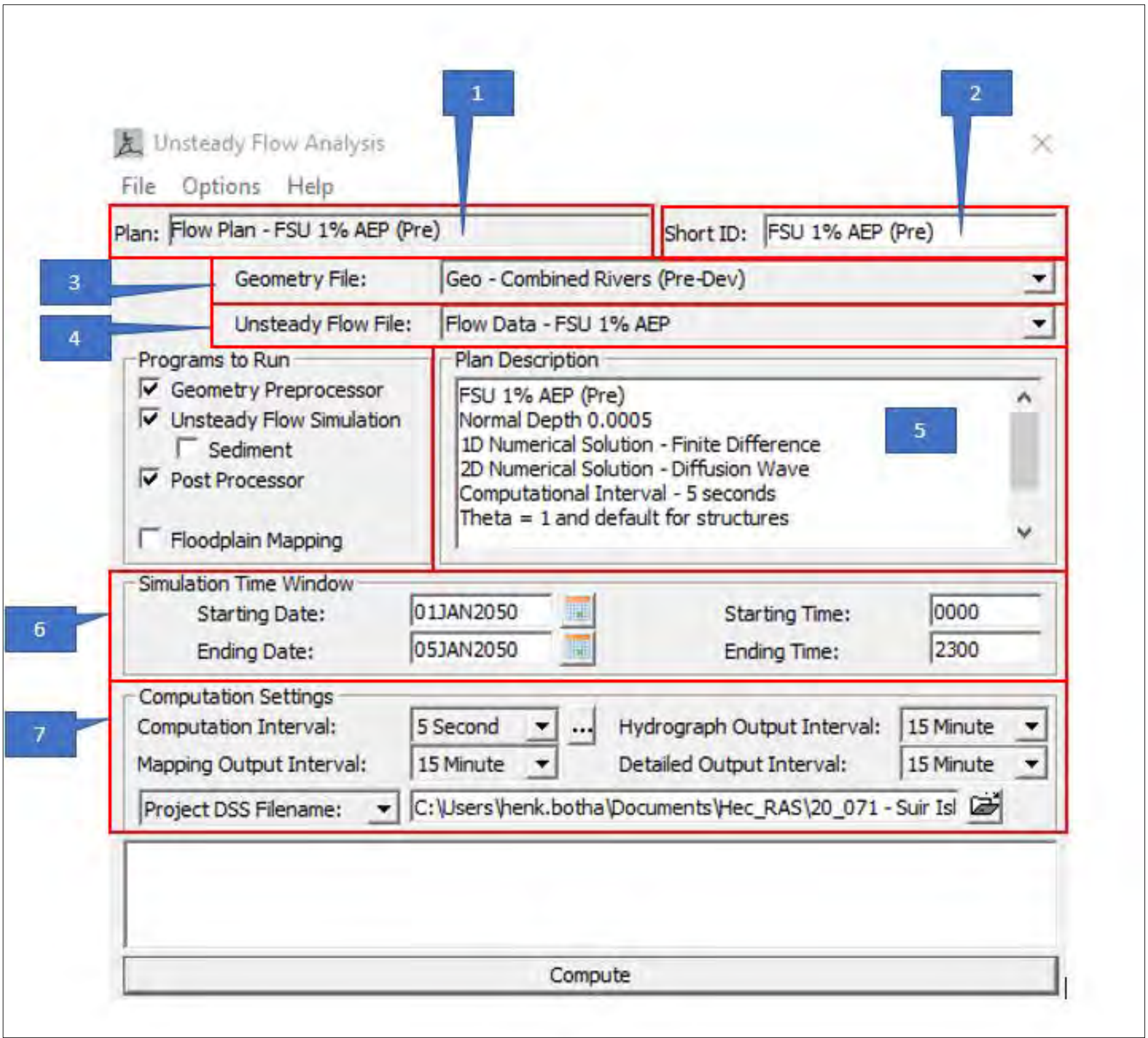
HEC-RAS Model showing upstream and downstream view	

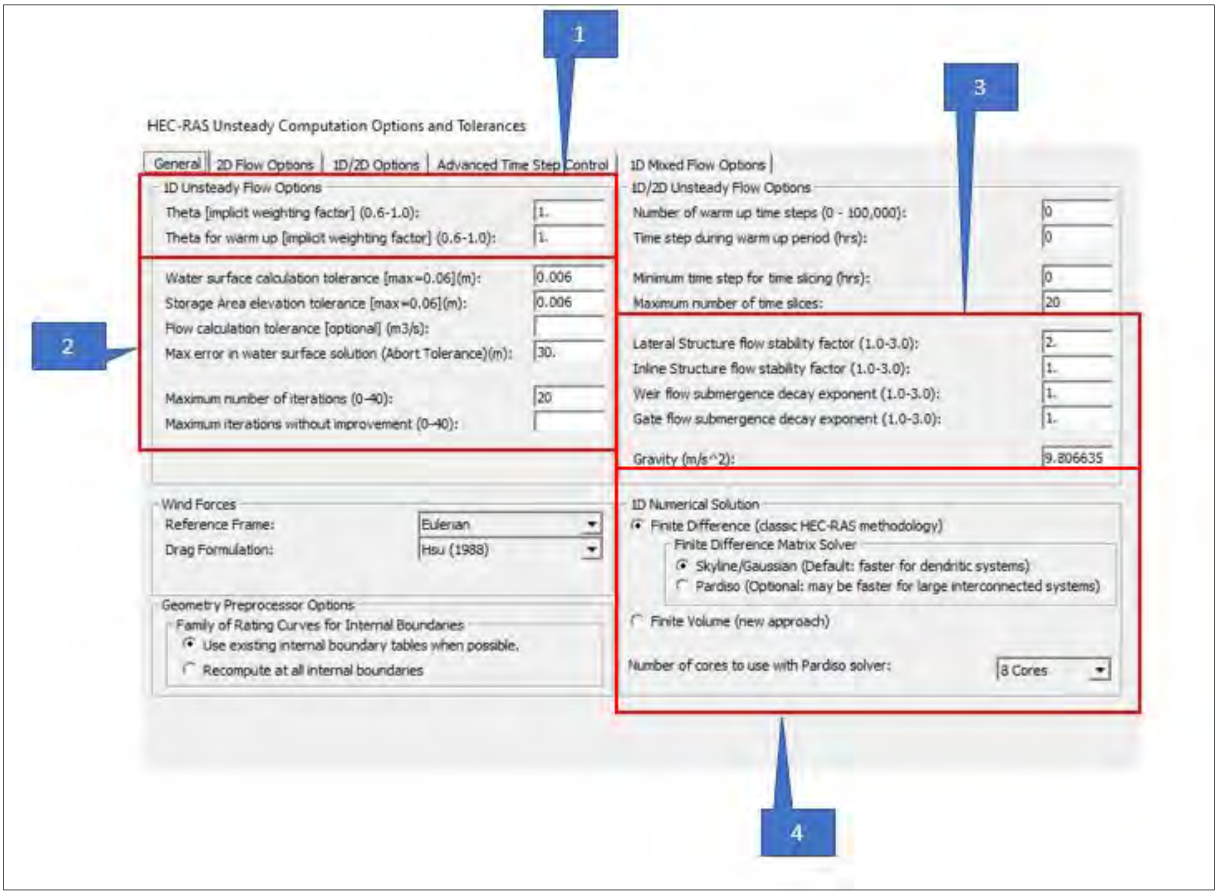
Weir Name	Survey Section
Dudley's Weir located on Suir North Reach (Drawing No. MGS44342_01SUIR_XS_02)	
HEC-RAS Model showing upstream view	
Lady Blessington's Weir located on Suir South Reach (Drawing No. MGS44342_02SUIR_XS_01)	

HEC-RAS Model showing upstream view	

4. Model Run Settings



Model Run Setting	Description
1. Plan: (ex. Flow Plan – FSU 1% AEP (Pre))	Indicates which plan is selected for simulation. FSU identifies the inflow boundary condition % AEP identifies which Annual Exceedance Probability is being simulated (Pre) or (Post) identifies Pre-Development or Post-Development simulation
2. Short ID:	Naming convention for results saved in RAS-MAPPER
3. Geometry	Indicates which geometry files is being used in the simulation (Pre- or Post-Development)
4. Unsteady Flow File	Indicates which flow file is selected for boundary conditions
5. Plan Description	Provides a summary of the model parameters and settings
6. Simulation Time	Indicates the start and end date/time. Dates simulated in the year 2050 indicates analysis simulations and historical dates is used for calibration
7. Computation Settings	Sets the Computational Interval for analysis and Output intervals for hydrographs, mapping and results



Model Run Setting	Description
1. Unsteady Flow Options	Theta values can be changed from 0.6 to 1.0 Theta weighting factors signifies the relationship between numerical accuracy and model stability, where 1.0 is the default value and 0.6 increases numerical accuracy
2. Unsteady Flow Options	Tolerance values, when exceeded simulation is aborted
3. 1D/2D Unsteady Flow Options	Similar principle to Theta factors above but specific for later and in-line structures
4. 1D Numerical Solution	1D numerical equations available in HEC-RAS Finite Difference (Default) and Finite Volume (New)

5. Model Stability

Modelled Event	Overall Volume Accounting Error in 1000 m^3:	Overall Volume Accounting Error as %:
Flow Plan - AMAX 2021 - Rev 1	-8.259802	0.009577
FSU 50% AEP (Pre)	-0.11930	0.00016
FSU 20% AEP (Pre)	-0.42804	0.00052
FSU 10% AEP (Pre)	-0.04881	0.00005
FSU 5% AEP (Pre)	-0.34380	0.00035
FSU 2% AEP (Pre)	-0.13586	0.00054
FSU 1% AEP (Pre)	-0.55209	0.00012
FSU 0.5% AEP (Pre)	-0.53289	0.00043
FSU 0.1% AEP (Pre)	-0.03109	0.00002
FSU 50% AEP (Post)	-0.12669	0.00017
FSU 20% AEP (Post)	-18.05035	0.02186
FSU 10% AEP (Post)	0.73910	0.00082
FSU 5% AEP (Post)	15.66000	0.01574
FSU 2% AEP (Post)	31.45000	0.02934
FSU 1% AEP (Post)	-16.94417	0.01472
FSU 0.5% AEP (Post)	10.49000	0.00852
FSU 0.1% AEP (Post)	-10.27477	0.00721
FSU 50% AEP (Pre) + 20% CC	-0.416249	0.000519
FSU 20% AEP (Pre) + 20% CC	-0.411214	0.000442
FSU 10% AEP (Pre) + 20% CC	-0.353478	0.000344
FSU 5% AEP (Pre) + 20% CC	-0.550446	0.000477
FSU 2% AEP (Pre) + 20% CC	-0.536922	0.000429
FSU 1% AEP (Pre) + 20% CC	-0.573669	0.000424
FSU 10% AEP (Post) + 20% CC	21.19	0.02065
FSU 1% AEP (Post) + 20% CC	68.69	0.05078

Appendix D – Model Output

Pre-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir South	South 01	698.2	Max WS	FSU 50% AEP (Pre)	86.86	14.33	18.457	1.65
Suir South	South 01	698.2	Max WS	FSU 10% AEP (Pre)	129.86	14.33	19.179	1.97
Suir South	South 01	698.2	Max WS	FSU 1% AEP (Pre)	176.12	14.33	20.07	2.15
Suir South	South 01	698.2	Max WS	FSU 0.1% AEP (Pre)	210	14.33	20.957	2.14
Suir South	South 01	649.5	Max WS	FSU 50% AEP (Pre)	86.86	15.31	18.415	1.52
Suir South	South 01	649.5	Max WS	FSU 10% AEP (Pre)	129.86	15.31	19.147	1.78
Suir South	South 01	649.5	Max WS	FSU 1% AEP (Pre)	176.12	15.31	20.058	1.9
Suir South	South 01	649.5	Max WS	FSU 0.1% AEP (Pre)	210	15.31	20.962	1.86
Suir South	South 01	600.1	Max WS	FSU 50% AEP (Pre)	86.86	14.98	18.288	1.79
Suir South	South 01	600.1	Max WS	FSU 10% AEP (Pre)	129.86	14.98	19.006	2.07
Suir South	South 01	600.1	Max WS	FSU 1% AEP (Pre)	176.12	14.98	19.927	2.17
Suir South	South 01	600.1	Max WS	FSU 0.1% AEP (Pre)	210	14.98	20.853	2.11
Suir South	South 01	590.4	Max WS	FSU 50% AEP (Pre)	86.86	15.03	18.251	1.88
Suir South	South 01	590.4	Max WS	FSU 10% AEP (Pre)	129.86	15.03	18.952	2.22
Suir South	South 01	590.4	Max WS	FSU 1% AEP (Pre)	176.12	15.03	19.865	2.36
Suir South	South 01	590.4	Max WS	FSU 0.1% AEP (Pre)	210	15.03	20.794	2.3
Suir South	South 01	585.1	Max WS	FSU 50% AEP (Pre)	86.86	14.93	18.17	2.22
Suir South	South 01	585.1	Max WS	FSU 10% AEP (Pre)	129.86	14.93	18.837	2.64
Suir South	South 01	585.1	Max WS	FSU 1% AEP (Pre)	176.12	14.93	19.738	2.8
Suir South	South 01	585.1	Max WS	FSU 0.1% AEP (Pre)	210	14.93	20.678	2.73
Suir South	South 01	579.75			Bridge			
Suir South	South 01	574.4	Max WS	FSU 50% AEP (Pre)	86.84	15.39	17.636	3.17
Suir South	South 01	574.4	Max WS	FSU 10% AEP (Pre)	129.83	15.39	18.177	3.68
Suir South	South 01	574.4	Max WS	FSU 1% AEP (Pre)	176.07	15.39	18.996	3.71
Suir South	South 01	574.4	Max WS	FSU 0.1% AEP (Pre)	209.93	15.39	19.765	3.57
Suir South	South 01	570.2	Max WS	FSU 50% AEP (Pre)	86.85	15.35	17.82	2.43
Suir South	South 01	570.2	Max WS	FSU 10% AEP (Pre)	129.84	15.35	18.447	2.76
Suir South	South 01	570.2	Max WS	FSU 1% AEP (Pre)	176.08	15.35	19.264	2.85
Suir South	South 01	570.2	Max WS	FSU 0.1% AEP (Pre)	209.96	15.35	20.003	2.79
Suir South	South 02	546.8	Max WS	FSU 50% AEP (Pre)	114.86	13.42	17.92	1.54
Suir South	South 02	546.8	Max WS	FSU 10% AEP (Pre)	161.23	13.42	18.58	1.78
Suir South	South 02	546.8	Max WS	FSU 1% AEP (Pre)	215.79	13.42	19.397	1.95
Suir South	South 02	546.8	Max WS	FSU 0.1% AEP (Pre)	258.4	13.42	20.12	2
Suir South	South 02	501.5	Max WS	FSU 50% AEP (Pre)	114.86	15.87	17.93	1.08
Suir South	South 02	501.5	Max WS	FSU 10% AEP (Pre)	161.24	15.87	18.646	0.96
Suir South	South 02	501.5	Max WS	FSU 1% AEP (Pre)	215.8	15.87	19.494	0.88
Suir South	South 02	501.5	Max WS	FSU 0.1% AEP (Pre)	258.41	15.87	20.229	0.82
Suir South	South 02	499.25			Inl Struct			
Suir South	South 02	497	Max WS	FSU 50% AEP (Pre)	114.86	15.35	17.911	0.79
Suir South	South 02	497	Max WS	FSU 10% AEP (Pre)	161.24	15.35	18.635	0.79
Suir South	South 02	497	Max WS	FSU 1% AEP (Pre)	215.8	15.35	19.486	0.78
Suir South	South 02	497	Max WS	FSU 0.1% AEP (Pre)	258.41	15.35	20.221	0.75
Suir South	South 02	496.9			Lat Struct			

Pre-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir South	South 02	462.1	Max WS	FSU 50% AEP (Pre)	114.86	15.11	17.835	1.29
Suir South	South 02	462.1	Max WS	FSU 10% AEP (Pre)	168.22	15.11	18.58	1.21
Suir South	South 02	462.1	Max WS	FSU 1% AEP (Pre)	249.25	15.11	19.429	1.22
Suir South	South 02	462.1	Max WS	FSU 0.1% AEP (Pre)	327.55	15.11	20.156	1.25
Suir South	South 02	446.9	Max WS	FSU 50% AEP (Pre)	114.86	15.04	17.825	1.25
Suir South	South 02	446.9	Max WS	FSU 10% AEP (Pre)	168.22	15.04	18.573	1.18
Suir South	South 02	446.9	Max WS	FSU 1% AEP (Pre)	249.25	15.04	19.423	1.21
Suir South	South 02	446.9	Max WS	FSU 0.1% AEP (Pre)	327.56	15.04	20.151	1.25
Suir South	South 02	430.4	Max WS	FSU 50% AEP (Pre)	114.86	14.97	17.797	1.31
Suir South	South 02	430.4	Max WS	FSU 10% AEP (Pre)	168.22	14.97	18.557	1.22
Suir South	South 02	430.4	Max WS	FSU 1% AEP (Pre)	249.25	14.97	19.412	1.23
Suir South	South 02	430.4	Max WS	FSU 0.1% AEP (Pre)	327.55	14.97	20.142	1.26
Suir South	South 02	413.7	Max WS	FSU 50% AEP (Pre)	114.86	14.9	17.772	1.32
Suir South	South 02	413.7	Max WS	FSU 10% AEP (Pre)	168.22	14.9	18.532	1.31
Suir South	South 02	413.7	Max WS	FSU 1% AEP (Pre)	249.25	14.9	19.393	1.32
Suir South	South 02	413.7	Max WS	FSU 0.1% AEP (Pre)	327.56	14.9	20.127	1.35
Suir South	South 02	397.2	Max WS	FSU 50% AEP (Pre)	114.86	14.77	17.746	1.36
Suir South	South 02	397.2	Max WS	FSU 10% AEP (Pre)	168.22	14.77	18.506	1.4
Suir South	South 02	397.2	Max WS	FSU 1% AEP (Pre)	249.25	14.77	19.371	1.43
Suir South	South 02	397.2	Max WS	FSU 0.1% AEP (Pre)	327.56	14.77	20.107	1.46
Suir South	South 02	380.6	Max WS	FSU 50% AEP (Pre)	114.86	14.65	17.717	1.42
Suir South	South 02	380.6	Max WS	FSU 10% AEP (Pre)	168.22	14.65	18.474	1.52
Suir South	South 02	380.6	Max WS	FSU 1% AEP (Pre)	249.25	14.65	19.354	1.52
Suir South	South 02	380.6	Max WS	FSU 0.1% AEP (Pre)	327.55	14.65	20.097	1.52
Suir South	South 02	363.8	Max WS	FSU 50% AEP (Pre)	114.85	14.52	17.682	1.52
Suir South	South 02	363.8	Max WS	FSU 10% AEP (Pre)	168.22	14.52	18.45	1.61
Suir South	South 02	363.8	Max WS	FSU 1% AEP (Pre)	249.25	14.52	19.33	1.64
Suir South	South 02	363.8	Max WS	FSU 0.1% AEP (Pre)	327.55	14.52	20.076	1.65
Suir South	South 02	347.2	Max WS	FSU 50% AEP (Pre)	114.85	14.48	17.674	1.47
Suir South	South 02	347.2	Max WS	FSU 10% AEP (Pre)	168.22	14.48	18.455	1.49
Suir South	South 02	347.2	Max WS	FSU 1% AEP (Pre)	249.24	14.48	19.332	1.52
Suir South	South 02	347.2	Max WS	FSU 0.1% AEP (Pre)	327.55	14.48	20.079	1.52
Suir South	South 02	330.6	Max WS	FSU 50% AEP (Pre)	114.85	14.45	17.706	1.14
Suir South	South 02	330.6	Max WS	FSU 10% AEP (Pre)	168.22	14.45	18.482	1.15
Suir South	South 02	330.6	Max WS	FSU 1% AEP (Pre)	249.25	14.45	19.351	1.23
Suir South	South 02	330.6	Max WS	FSU 0.1% AEP (Pre)	327.55	14.45	20.092	1.27
Suir South	South 02	301.5	Max WS	FSU 50% AEP (Pre)	114.86	14.06	17.69	1.12
Suir South	South 02	301.5	Max WS	FSU 10% AEP (Pre)	168.22	14.06	18.467	1.16
Suir South	South 02	301.5	Max WS	FSU 1% AEP (Pre)	249.25	14.06	19.335	1.26
Suir South	South 02	301.5	Max WS	FSU 0.1% AEP (Pre)	327.55	14.06	20.086	1.26
Suir South	South 02	281	Max WS	FSU 50% AEP (Pre)	114.86	13.62	17.673	1.12
Suir South	South 02	281	Max WS	FSU 10% AEP (Pre)	168.22	13.62	18.454	1.16
Suir South	South 02	281	Max WS	FSU 1% AEP (Pre)	249.24	13.62	19.323	1.26
Suir South	South 02	281	Max WS	FSU 0.1% AEP (Pre)	327.55	13.62	20.062	1.34

Pre-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir South	South 02	275	Max WS	FSU 50% AEP (Pre)	114.85	13.88	17.645	1.31
Suir South	South 02	275	Max WS	FSU 10% AEP (Pre)	168.22	13.88	18.432	1.34
Suir South	South 02	275	Max WS	FSU 1% AEP (Pre)	249.24	13.88	19.304	1.43
Suir South	South 02	275	Max WS	FSU 0.1% AEP (Pre)	327.55	13.88	20.043	1.5
Suir South	South 02	258.5	Max WS	FSU 50% AEP (Pre)	114.85	13.68	17.623	1.29
Suir South	South 02	258.5	Max WS	FSU 10% AEP (Pre)	168.22	13.68	18.43	1.21
Suir South	South 02	258.5	Max WS	FSU 1% AEP (Pre)	249.24	13.68	19.312	1.24
Suir South	South 02	258.5	Max WS	FSU 0.1% AEP (Pre)	327.55	13.68	20.057	1.28
Suir South	South 02	224.9	Max WS	FSU 50% AEP (Pre)	114.85	13.44	17.596	1.32
Suir South	South 02	224.9	Max WS	FSU 10% AEP (Pre)	168.22	13.44	18.397	1.37
Suir South	South 02	224.9	Max WS	FSU 1% AEP (Pre)	249.25	13.44	19.278	1.48
Suir South	South 02	224.9	Max WS	FSU 0.1% AEP (Pre)	327.55	13.44	20.022	1.57
Suir South	South 02	199.9	Max WS	FSU 50% AEP (Pre)	114.85	13.26	17.59	1.22
Suir South	South 02	199.9	Max WS	FSU 10% AEP (Pre)	168.22	13.26	18.396	1.24
Suir South	South 02	199.9	Max WS	FSU 1% AEP (Pre)	249.25	13.26	19.278	1.33
Suir South	South 02	199.9	Max WS	FSU 0.1% AEP (Pre)	327.55	13.26	20.024	1.4
Suir South	South 02	183.4	Max WS	FSU 50% AEP (Pre)	114.85	13.54	17.576	1.25
Suir South	South 02	183.4	Max WS	FSU 10% AEP (Pre)	168.22	13.54	18.387	1.25
Suir South	South 02	183.4	Max WS	FSU 1% AEP (Pre)	249.25	13.54	19.271	1.33
Suir South	South 02	183.4	Max WS	FSU 0.1% AEP (Pre)	327.55	13.54	20.018	1.4
Suir South	South 02	166.6	Max WS	FSU 50% AEP (Pre)	114.85	13.82	17.565	1.26
Suir South	South 02	166.6	Max WS	FSU 10% AEP (Pre)	168.22	13.82	18.381	1.25
Suir South	South 02	166.6	Max WS	FSU 1% AEP (Pre)	249.25	13.82	19.268	1.31
Suir South	South 02	166.6	Max WS	FSU 0.1% AEP (Pre)	327.55	13.82	20.017	1.37
Suir South	South 02	150.1	Max WS	FSU 50% AEP (Pre)	114.85	14.1	17.564	1.18
Suir South	South 02	150.1	Max WS	FSU 10% AEP (Pre)	168.22	14.1	18.382	1.15
Suir South	South 02	150.1	Max WS	FSU 1% AEP (Pre)	249.25	14.1	19.269	1.22
Suir South	South 02	150.1	Max WS	FSU 0.1% AEP (Pre)	327.55	14.1	20.018	1.27
Suir South	South 02	133	Max WS	FSU 50% AEP (Pre)	114.85	13.89	17.552	1.21
Suir South	South 02	133	Max WS	FSU 10% AEP (Pre)	168.22	13.89	18.374	1.18
Suir South	South 02	133	Max WS	FSU 1% AEP (Pre)	249.25	13.89	19.263	1.23
Suir South	South 02	133	Max WS	FSU 0.1% AEP (Pre)	327.55	13.89	20.013	1.28
Suir South	South 02	116.4	Max WS	FSU 50% AEP (Pre)	114.85	13.67	17.544	1.22
Suir South	South 02	116.4	Max WS	FSU 10% AEP (Pre)	168.22	13.67	18.368	1.18
Suir South	South 02	116.4	Max WS	FSU 1% AEP (Pre)	249.25	13.67	19.258	1.24
Suir South	South 02	116.4	Max WS	FSU 0.1% AEP (Pre)	327.55	13.67	20.009	1.28
Suir South	South 02	99.5	Max WS	FSU 50% AEP (Pre)	114.85	13.46	17.531	1.23
Suir South	South 02	99.5	Max WS	FSU 10% AEP (Pre)	168.22	13.46	18.36	1.17
Suir South	South 02	99.5	Max WS	FSU 1% AEP (Pre)	249.25	13.46	19.254	1.19
Suir South	South 02	99.5	Max WS	FSU 0.1% AEP (Pre)	327.55	13.46	20.006	1.22
Suir South	South 02	74.9	Max WS	FSU 50% AEP (Pre)	114.85	13.36	17.513	1.24
Suir South	South 02	74.9	Max WS	FSU 10% AEP (Pre)	168.22	13.36	18.343	1.23
Suir South	South 02	74.9	Max WS	FSU 1% AEP (Pre)	249.25	13.36	19.239	1.28
Suir South	South 02	74.9	Max WS	FSU 0.1% AEP (Pre)	327.55	13.36	19.992	1.31

Pre-Development Water Surface Elevations								
					Q Total	Min Ch El	W.S. Elev	Vel
River	Reach	River Sta	Profile	Plan	(m3/s)	(mOD)	(mOD)	(m/s)
Suir South	South 02	52.6	Max WS	FSU 50% AEP (Pre)	114.85	13.26	17.493	1.28
Suir South	South 02	52.6	Max WS	FSU 10% AEP (Pre)	168.22	13.26	18.33	1.27
Suir South	South 02	52.6	Max WS	FSU 1% AEP (Pre)	249.25	13.26	19.227	1.32
Suir South	South 02	52.6	Max WS	FSU 0.1% AEP (Pre)	327.55	13.26	19.982	1.36
Suir South	South 02	33.2	Max WS	FSU 50% AEP (Pre)	114.85	13.38	17.481	1.26
Suir South	South 02	33.2	Max WS	FSU 10% AEP (Pre)	168.22	13.38	18.32	1.26
Suir South	South 02	33.2	Max WS	FSU 1% AEP (Pre)	249.25	13.38	19.218	1.31
Suir South	South 02	33.2	Max WS	FSU 0.1% AEP (Pre)	327.55	13.38	19.972	1.35
Suir South	South 02	16.7	Max WS	FSU 50% AEP (Pre)	114.85	13.5	17.475	1.22
Suir South	South 02	16.7	Max WS	FSU 10% AEP (Pre)	168.22	13.5	18.317	1.21
Suir South	South 02	16.7	Max WS	FSU 1% AEP (Pre)	249.25	13.5	19.216	1.26
Suir South	South 02	16.7	Max WS	FSU 0.1% AEP (Pre)	327.55	13.5	19.971	1.3
Suir South	South 02	0	Max WS	FSU 50% AEP (Pre)	114.85	13.61	17.47	1.19
Suir South	South 02	0	Max WS	FSU 10% AEP (Pre)	168.22	13.61	18.315	1.16
Suir South	South 02	0	Max WS	FSU 1% AEP (Pre)	249.25	13.61	19.215	1.21
Suir South	South 02	0	Max WS	FSU 0.1% AEP (Pre)	327.55	13.61	19.97	1.26
Suir Main	North 01	1219.4	Max WS	FSU 50% AEP (Pre)	245.32	13.63	18.596	1.18
Suir Main	North 01	1219.4	Max WS	FSU 10% AEP (Pre)	352.55	13.63	19.321	1.43
Suir Main	North 01	1219.4	Max WS	FSU 1% AEP (Pre)	486.3	13.63	20.168	1.66
Suir Main	North 01	1219.4	Max WS	FSU 0.1% AEP (Pre)	617.63	13.63	21.001	1.83
Suir Main	North 01	1168.7	Max WS	FSU 50% AEP (Pre)	245.31	13.46	18.568	1.23
Suir Main	North 01	1168.7	Max WS	FSU 10% AEP (Pre)	352.55	13.46	19.287	1.48
Suir Main	North 01	1168.7	Max WS	FSU 1% AEP (Pre)	486.31	13.46	20.131	1.71
Suir Main	North 01	1168.7	Max WS	FSU 0.1% AEP (Pre)	617.63	13.46	20.965	1.87
Suir Main	North 01	1168.6			Lat Struct			
Suir Main	North 01	1119.5	Max WS	FSU 50% AEP (Pre)	245.31	13.89	18.535	1.29
Suir Main	North 01	1119.5	Max WS	FSU 10% AEP (Pre)	347.84	13.89	19.256	1.52
Suir Main	North 01	1119.5	Max WS	FSU 1% AEP (Pre)	469.06	13.89	20.114	1.7
Suir Main	North 01	1119.5	Max WS	FSU 0.1% AEP (Pre)	583.63	13.89	20.968	1.81
Suir Main	North 01	1067.7	Max WS	FSU 50% AEP (Pre)	245.31	14.02	18.458	1.57
Suir Main	North 01	1067.7	Max WS	FSU 10% AEP (Pre)	345.56	14.02	19.168	1.81
Suir Main	North 01	1067.7	Max WS	FSU 1% AEP (Pre)	452.85	14.02	20.045	1.93
Suir Main	North 01	1067.7	Max WS	FSU 0.1% AEP (Pre)	548.31	14.02	20.928	1.96
Suir Main	North 02	1028.2	Max WS	FSU 50% AEP (Pre)	158.46	14	18.457	1.31
Suir Main	North 02	1028.2	Max WS	FSU 10% AEP (Pre)	215.7	14	19.179	1.46
Suir Main	North 02	1028.2	Max WS	FSU 1% AEP (Pre)	276.72	14	20.07	1.52
Suir Main	North 02	1028.2	Max WS	FSU 0.1% AEP (Pre)	338.31	14	20.957	1.56
Suir Main	North 02	998.7	Max WS	FSU 50% AEP (Pre)	158.46	15.04	18.175	2.61
Suir Main	North 02	998.7	Max WS	FSU 10% AEP (Pre)	215.7	15.04	18.901	2.64
Suir Main	North 02	998.7	Max WS	FSU 1% AEP (Pre)	276.72	15.04	19.88	2.36
Suir Main	North 02	998.7	Max WS	FSU 0.1% AEP (Pre)	338.31	15.04	20.808	2.23
Suir Main	North 03	945	Max WS	FSU 50% AEP (Pre)	130.44	14.67	18.248	0.72
Suir Main	North 03	945	Max WS	FSU 10% AEP (Pre)	184.29	14.67	18.978	0.78

Pre-Development Water Surface Elevations								
					Q Total	Min Ch El	W.S. Elev	Vel
River	Reach	River Sta	Profile	Plan	(m3/s)	(mOD)	(mOD)	(m/s)
Suir Main	North 03	945	Max WS	FSU 1% AEP (Pre)	236.99	14.67	19.972	0.76
Suir Main	North 03	945	Max WS	FSU 0.1% AEP (Pre)	289.86	14.67	20.907	0.76
Suir Main	North 03	941	Max WS	FSU 50% AEP (Pre)	130.44	14.67	18.247	0.72
Suir Main	North 03	941	Max WS	FSU 10% AEP (Pre)	184.29	14.67	18.977	0.78
Suir Main	North 03	941	Max WS	FSU 1% AEP (Pre)	236.99	14.67	19.971	0.76
Suir Main	North 03	941	Max WS	FSU 0.1% AEP (Pre)	289.86	14.67	20.907	0.76
Suir Main	North 03	939.1			Inl Struct			
Suir Main	North 03	937.2	Max WS	FSU 50% AEP (Pre)	130.44	14.19	18.192	0.59
Suir Main	North 03	937.2	Max WS	FSU 10% AEP (Pre)	184.29	14.19	18.946	0.66
Suir Main	North 03	937.2	Max WS	FSU 1% AEP (Pre)	236.99	14.19	19.949	0.66
Suir Main	North 03	937.2	Max WS	FSU 0.1% AEP (Pre)	289.86	14.19	20.893	0.68
Suir Main	North 03	903.1	Max WS	FSU 50% AEP (Pre)	130.44	15.2	17.792	3.38
Suir Main	North 03	903.1	Max WS	FSU 10% AEP (Pre)	184.29	15.2	18.49	3.71
Suir Main	North 03	903.1	Max WS	FSU 1% AEP (Pre)	236.99	15.2	19.543	3.55
Suir Main	North 03	903.1	Max WS	FSU 0.1% AEP (Pre)	289.86	15.2	20.501	3.53
Suir Main	North 03	898.65			Bridge			
Suir Main	North 03	894.2	Max WS	FSU 50% AEP (Pre)	130.41	15.21	17.293	4.12
Suir Main	North 03	894.2	Max WS	FSU 10% AEP (Pre)	184.26	15.21	17.98	4.28
Suir Main	North 03	894.2	Max WS	FSU 1% AEP (Pre)	236.97	15.21	18.798	4.18
Suir Main	North 03	894.2	Max WS	FSU 0.1% AEP (Pre)	289.79	15.21	19.447	4.29
Suir Main	North 03	868	Max WS	FSU 50% AEP (Pre)	130.43	14.55	17.715	1.9
Suir Main	North 03	868	Max WS	FSU 10% AEP (Pre)	184.27	14.55	18.469	2.14
Suir Main	North 03	868	Max WS	FSU 1% AEP (Pre)	236.98	14.55	19.273	2.25
Suir Main	North 03	868	Max WS	FSU 0.1% AEP (Pre)	289.83	14.55	19.95	2.39
Suir Main	North 03	840.3	Max WS	FSU 50% AEP (Pre)	130.43	14.55	17.671	1.93
Suir Main	North 03	840.3	Max WS	FSU 10% AEP (Pre)	184.27	14.55	18.424	2.16
Suir Main	North 03	840.3	Max WS	FSU 1% AEP (Pre)	236.98	14.55	19.233	2.27
Suir Main	North 03	840.3	Max WS	FSU 0.1% AEP (Pre)	289.83	14.55	19.911	2.41
Suir Main	North 03	818.3	Max WS	FSU 50% AEP (Pre)	130.43	14.47	17.756	1.22
Suir Main	North 03	818.3	Max WS	FSU 10% AEP (Pre)	184.27	14.47	18.546	1.3
Suir Main	North 03	818.3	Max WS	FSU 1% AEP (Pre)	236.98	14.47	19.376	1.33
Suir Main	North 03	818.3	Max WS	FSU 0.1% AEP (Pre)	289.83	14.47	20.077	1.38
Suir Main	North 03	768.4	Max WS	FSU 50% AEP (Pre)	130.43	14.1	17.706	1.34
Suir Main	North 03	768.4	Max WS	FSU 10% AEP (Pre)	184.27	14.1	18.491	1.48
Suir Main	North 03	768.4	Max WS	FSU 1% AEP (Pre)	236.98	14.1	19.32	1.54
Suir Main	North 03	768.4	Max WS	FSU 0.1% AEP (Pre)	289.83	14.1	20.019	1.62
Suir Main	North 03	724.3	Max WS	FSU 50% AEP (Pre)	130.43	14.09	17.637	1.66
Suir Main	North 03	724.3	Max WS	FSU 10% AEP (Pre)	184.27	14.09	18.441	1.72
Suir Main	North 03	724.3	Max WS	FSU 1% AEP (Pre)	236.98	14.09	19.291	1.7
Suir Main	North 03	724.3	Max WS	FSU 0.1% AEP (Pre)	289.83	14.09	19.999	1.75
Suir Main	North 03	704	Max WS	FSU 50% AEP (Pre)	130.43	14.1	17.637	1.47
Suir Main	North 03	704	Max WS	FSU 10% AEP (Pre)	184.27	14.1	18.447	1.53
Suir Main	North 03	704	Max WS	FSU 1% AEP (Pre)	236.98	14.1	19.299	1.52

Pre-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir Main	North 03	704	Max WS	FSU 0.1% AEP (Pre)	289.83	14.1	20.01	1.58
Suir Main	North 03	698	Max WS	FSU 50% AEP (Pre)	130.43	13.63	17.637	1.44
Suir Main	North 03	698	Max WS	FSU 10% AEP (Pre)	184.27	13.63	18.446	1.51
Suir Main	North 03	698	Max WS	FSU 1% AEP (Pre)	236.98	13.63	19.3	1.51
Suir Main	North 03	698	Max WS	FSU 0.1% AEP (Pre)	289.83	13.63	20.014	1.54
Suir Main	North 03	687.4	Max WS	FSU 50% AEP (Pre)	130.43	14.39	17.64	1.35
Suir Main	North 03	687.4	Max WS	FSU 10% AEP (Pre)	184.27	14.39	18.462	1.32
Suir Main	North 03	687.4	Max WS	FSU 1% AEP (Pre)	236.98	14.39	19.33	1.21
Suir Main	North 03	687.4	Max WS	FSU 0.1% AEP (Pre)	289.83	14.39	20.046	1.21
Suir Main	North 03	636.4	Max WS	FSU 50% AEP (Pre)	130.43	14.15	17.603	1.26
Suir Main	North 03	636.4	Max WS	FSU 10% AEP (Pre)	184.27	14.15	18.413	1.38
Suir Main	North 03	636.4	Max WS	FSU 1% AEP (Pre)	236.98	14.15	19.288	1.34
Suir Main	North 03	636.4	Max WS	FSU 0.1% AEP (Pre)	289.83	14.15	20.027	1.19
Suir Main	North 03	587.7	Max WS	FSU 50% AEP (Pre)	130.43	14.22	17.546	1.45
Suir Main	North 03	587.7	Max WS	FSU 10% AEP (Pre)	184.27	14.22	18.36	1.57
Suir Main	North 03	587.7	Max WS	FSU 1% AEP (Pre)	236.98	14.22	19.244	1.55
Suir Main	North 03	587.7	Max WS	FSU 0.1% AEP (Pre)	289.83	14.22	19.979	1.46
Suir Main	North 03	536.7	Max WS	FSU 50% AEP (Pre)	130.42	14.15	17.518	1.39
Suir Main	North 03	536.7	Max WS	FSU 10% AEP (Pre)	184.27	14.15	18.332	1.53
Suir Main	North 03	536.7	Max WS	FSU 1% AEP (Pre)	236.98	14.15	19.22	1.52
Suir Main	North 03	536.7	Max WS	FSU 0.1% AEP (Pre)	289.83	14.15	19.977	1.42
Suir Main	North 03	486.3	Max WS	FSU 50% AEP (Pre)	130.42	13.53	17.478	1.43
Suir Main	North 03	486.3	Max WS	FSU 10% AEP (Pre)	184.27	13.53	18.29	1.59
Suir Main	North 03	486.3	Max WS	FSU 1% AEP (Pre)	236.98	13.53	19.19	1.59
Suir Main	North 03	486.3	Max WS	FSU 0.1% AEP (Pre)	289.83	13.53	19.949	1.51
Suir Main	North 03	435.2	Max WS	FSU 50% AEP (Pre)	130.42	13.64	17.435	1.5
Suir Main	North 03	435.2	Max WS	FSU 10% AEP (Pre)	184.27	13.64	18.244	1.69
Suir Main	North 03	435.2	Max WS	FSU 1% AEP (Pre)	236.98	13.64	19.127	1.78
Suir Main	North 03	435.2	Max WS	FSU 0.1% AEP (Pre)	289.83	13.64	19.903	1.7
Suir Main	North 04	370.6	Max WS	FSU 50% AEP (Pre)	245.28	13.32	17.389	1.54
Suir Main	North 04	370.6	Max WS	FSU 10% AEP (Pre)	352.49	13.32	18.223	1.64
Suir Main	North 04	370.6	Max WS	FSU 1% AEP (Pre)	486.22	13.32	19.122	1.71
Suir Main	North 04	370.6	Max WS	FSU 0.1% AEP (Pre)	617.38	13.32	19.874	1.79
Suir Main	North 04	335.2	Max WS	FSU 50% AEP (Pre)	245.28	13.53	17.356	1.63
Suir Main	North 04	335.2	Max WS	FSU 10% AEP (Pre)	352.49	13.53	18.194	1.71
Suir Main	North 04	335.2	Max WS	FSU 1% AEP (Pre)	486.22	13.53	19.096	1.78
Suir Main	North 04	335.2	Max WS	FSU 0.1% AEP (Pre)	617.38	13.53	19.848	1.86
Suir Main	North 04	287.8	Max WS	FSU 50% AEP (Pre)	245.28	13.59	17.318	1.6
Suir Main	North 04	287.8	Max WS	FSU 10% AEP (Pre)	352.49	13.59	18.144	1.77
Suir Main	North 04	287.8	Max WS	FSU 1% AEP (Pre)	486.22	13.59	19.029	1.93
Suir Main	North 04	287.8	Max WS	FSU 0.1% AEP (Pre)	617.38	13.59	19.765	2.08
Suir Main	North 04	269.1	Max WS	FSU 50% AEP (Pre)	245.28	13.51	17.29	1.69
Suir Main	North 04	269.1	Max WS	FSU 10% AEP (Pre)	352.49	13.51	18.105	1.9
Suir Main	North 04	269.1	Max WS	FSU 1% AEP (Pre)	486.22	13.51	18.976	2.12

Pre-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir Main	North 04	269.1	Max WS	FSU 0.1% AEP (Pre)	617.38	13.51	19.698	2.33
Suir Main	North 04	263.4			Bridge			
Suir Main	North 04	253.4	Max WS	FSU 50% AEP (Pre)	245.28	13.52	17.292	1.61
Suir Main	North 04	253.4	Max WS	FSU 10% AEP (Pre)	352.49	13.52	18.096	1.84
Suir Main	North 04	253.4	Max WS	FSU 1% AEP (Pre)	486.22	13.52	18.943	2.06
Suir Main	North 04	253.4	Max WS	FSU 0.1% AEP (Pre)	617.38	13.52	19.628	2.27
Suir Main	North 04	217.7	Max WS	FSU 50% AEP (Pre)	245.28	13	17.31	1.35
Suir Main	North 04	217.7	Max WS	FSU 10% AEP (Pre)	352.49	13	18.129	1.52
Suir Main	North 04	217.7	Max WS	FSU 1% AEP (Pre)	486.22	13	18.995	1.68
Suir Main	North 04	217.7	Max WS	FSU 0.1% AEP (Pre)	617.38	13	19.698	1.84
Suir Main	North 04	172.3	Max WS	FSU 50% AEP (Pre)	245.28	13.41	17.275	1.43
Suir Main	North 04	172.3	Max WS	FSU 10% AEP (Pre)	352.49	13.41	18.092	1.61
Suir Main	North 04	172.3	Max WS	FSU 1% AEP (Pre)	486.22	13.41	18.956	1.79
Suir Main	North 04	172.3	Max WS	FSU 0.1% AEP (Pre)	617.38	13.41	19.656	1.95
Suir Main	North 04	130.4	Max WS	FSU 50% AEP (Pre)	245.28	13.41	17.25	1.44
Suir Main	North 04	130.4	Max WS	FSU 10% AEP (Pre)	352.49	13.41	18.068	1.62
Suir Main	North 04	130.4	Max WS	FSU 1% AEP (Pre)	486.22	13.41	18.933	1.8
Suir Main	North 04	130.4	Max WS	FSU 0.1% AEP (Pre)	617.37	13.41	19.632	1.96
Suir Main	North 04	83.8	Max WS	FSU 50% AEP (Pre)	245.28	13.06	17.227	1.42
Suir Main	North 04	83.8	Max WS	FSU 10% AEP (Pre)	352.49	13.06	18.039	1.63
Suir Main	North 04	83.8	Max WS	FSU 1% AEP (Pre)	486.22	13.06	18.896	1.85
Suir Main	North 04	83.8	Max WS	FSU 0.1% AEP (Pre)	617.37	13.06	19.59	2.04
Suir Main	North 04	32.8	Max WS	FSU 50% AEP (Pre)	245.28	13.13	17.2	1.44
Suir Main	North 04	32.8	Max WS	FSU 10% AEP (Pre)	352.49	13.13	18.01	1.66
Suir Main	North 04	32.8	Max WS	FSU 1% AEP (Pre)	486.22	13.13	18.865	1.88
Suir Main	North 04	32.8	Max WS	FSU 0.1% AEP (Pre)	617.38	13.13	19.557	2.08
Suir Main	North 04	0	Max WS	FSU 50% AEP (Pre)	245.28	13.1	17.182	1.45
Suir Main	North 04	0	Max WS	FSU 10% AEP (Pre)	352.49	13.1	17.995	1.66
Suir Main	North 04	0	Max WS	FSU 1% AEP (Pre)	486.22	13.1	18.854	1.86
Suir Main	North 04	0	Max WS	FSU 0.1% AEP (Pre)	617.37	13.1	19.554	2.05
Suir Channel	Channel	97.43	Max WS	FSU 50% AEP (Pre)	28.02	15.07	18.248	1.35
Suir Channel	Channel	97.43	Max WS	FSU 10% AEP (Pre)	31.41	15.07	18.978	1.17
Suir Channel	Channel	97.43	Max WS	FSU 1% AEP (Pre)	39.73	15.07	19.972	1.13
Suir Channel	Channel	97.43	Max WS	FSU 0.1% AEP (Pre)	48.45	15.07	20.907	1.13
Suir Channel	Channel	91.14	Max WS	FSU 50% AEP (Pre)	28.02	15.2	18.208	1.57
Suir Channel	Channel	91.14	Max WS	FSU 10% AEP (Pre)	31.41	15.2	18.947	1.38
Suir Channel	Channel	91.14	Max WS	FSU 1% AEP (Pre)	39.73	15.2	19.942	1.35
Suir Channel	Channel	91.14	Max WS	FSU 0.1% AEP (Pre)	48.45	15.2	20.876	1.36
Suir Channel	Channel	87.72			Bridge			
Suir Channel	Channel	84.3	Max WS	FSU 50% AEP (Pre)	28.02	15.51	18.22	1.47
Suir Channel	Channel	84.3	Max WS	FSU 10% AEP (Pre)	31.41	15.51	18.94	1.23
Suir Channel	Channel	84.3	Max WS	FSU 1% AEP (Pre)	39.73	15.51	19.892	1.16
Suir Channel	Channel	84.3	Max WS	FSU 0.1% AEP (Pre)	48.45	15.51	20.771	1.15

Pre-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir Channel	Channel	77.92	Max WS	FSU 50% AEP (Pre)	28.02	15.9	18.086	2.13
Suir Channel	Channel	77.92	Max WS	FSU 10% AEP (Pre)	31.41	15.9	18.878	1.61
Suir Channel	Channel	77.92	Max WS	FSU 1% AEP (Pre)	39.73	15.9	19.849	1.45
Suir Channel	Channel	77.92	Max WS	FSU 0.1% AEP (Pre)	48.45	15.9	20.735	1.4
Suir Channel	Channel	68.2	Max WS	FSU 50% AEP (Pre)	28.02	16.17	18.135	1.7
Suir Channel	Channel	68.2	Max WS	FSU 10% AEP (Pre)	31.41	16.17	18.907	1.32
Suir Channel	Channel	68.2	Max WS	FSU 1% AEP (Pre)	39.73	16.17	19.874	1.2
Suir Channel	Channel	68.2	Max WS	FSU 0.1% AEP (Pre)	48.45	16.17	20.759	1.16
Suir Channel	Channel	47.1	Max WS	FSU 50% AEP (Pre)	28.02	16.2	18.108	1.57
Suir Channel	Channel	47.1	Max WS	FSU 10% AEP (Pre)	31.41	16.2	18.902	1.2
Suir Channel	Channel	47.1	Max WS	FSU 1% AEP (Pre)	39.73	16.2	19.874	1.09
Suir Channel	Channel	47.1	Max WS	FSU 0.1% AEP (Pre)	48.45	16.2	20.761	1.06
Suir Channel	Channel	36.95	Max WS	FSU 50% AEP (Pre)	28.02	16.08	18.112	1.42
Suir Channel	Channel	36.95	Max WS	FSU 10% AEP (Pre)	31.41	16.08	18.906	1.1
Suir Channel	Channel	36.95	Max WS	FSU 1% AEP (Pre)	39.73	16.08	19.879	1
Suir Channel	Channel	36.95	Max WS	FSU 0.1% AEP (Pre)	48.45	16.08	20.765	0.97
Suir Channel	Channel	31.31	Max WS	FSU 50% AEP (Pre)	28.02	16.06	18.102	1.42
Suir Channel	Channel	31.31	Max WS	FSU 10% AEP (Pre)	31.41	16.06	18.905	1.08
Suir Channel	Channel	31.31	Max WS	FSU 1% AEP (Pre)	39.73	16.06	19.879	0.98
Suir Channel	Channel	31.31	Max WS	FSU 0.1% AEP (Pre)	48.45	16.06	20.766	0.95
Suir Channel	Channel	21.65			Bridge			
Suir Channel	Channel	11.99	Max WS	FSU 50% AEP (Pre)	28.01	16.09	18.005	1.4
Suir Channel	Channel	11.99	Max WS	FSU 10% AEP (Pre)	31.39	16.09	18.732	1.08
Suir Channel	Channel	11.99	Max WS	FSU 1% AEP (Pre)	39.72	16.09	19.585	0.98
Suir Channel	Channel	11.99	Max WS	FSU 0.1% AEP (Pre)	48.44	16.09	20.319	0.96
Suir Channel	Channel	8.11	Max WS	FSU 50% AEP (Pre)	28.01	15.82	17.995	1.42
Suir Channel	Channel	8.11	Max WS	FSU 10% AEP (Pre)	31.39	15.82	18.727	1.1
Suir Channel	Channel	8.11	Max WS	FSU 1% AEP (Pre)	39.72	15.82	19.583	0.99
Suir Channel	Channel	8.11	Max WS	FSU 0.1% AEP (Pre)	48.44	15.82	20.318	0.96
Suir Channel	Channel	0	Max WS	FSU 50% AEP (Pre)	28.02	14.56	18.058	0.64
Suir Channel	Channel	0	Max WS	FSU 10% AEP (Pre)	31.4	14.56	18.766	0.52
Suir Channel	Channel	0	Max WS	FSU 1% AEP (Pre)	39.72	14.56	19.614	0.49
Suir Channel	Channel	0	Max WS	FSU 0.1% AEP (Pre)	48.44	14.56	20.347	0.48

Post-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir South	South 01	698.2	Max WS	FSU 50% AEP (Post)	87.04	14.33	18.46	1.65
Suir South	South 01	698.2	Max WS	FSU 10% AEP (Post)	125.92	14.33	19.157	1.92
Suir South	South 01	698.2	Max WS	FSU 1% AEP (Post)	160.61	14.33	19.983	2
Suir South	South 01	698.2	Max WS	FSU 0.1% AEP (Post)	200.94	14.33	20.916	2.06
Suir South	South 01	649.5	Max WS	FSU 50% AEP (Post)	87.04	15.31	18.417	1.52
Suir South	South 01	649.5	Max WS	FSU 10% AEP (Post)	125.9	15.31	19.125	1.74
Suir South	South 01	649.5	Max WS	FSU 1% AEP (Post)	160.55	15.31	19.972	1.76
Suir South	South 01	649.5	Max WS	FSU 0.1% AEP (Post)	191.36	15.31	20.882	1.72
Suir South	South 01	600.1	Max WS	FSU 50% AEP (Post)	87.04	14.98	18.29	1.79
Suir South	South 01	600.1	Max WS	FSU 10% AEP (Post)	125.88	14.98	18.993	2.01
Suir South	South 01	600.1	Max WS	FSU 1% AEP (Post)	160.48	14.98	19.859	2.01
Suir South	South 01	600.1	Max WS	FSU 0.1% AEP (Post)	189.36	14.98	20.781	1.93
Suir South	South 01	590.4	Max WS	FSU 50% AEP (Post)	87.04	15.03	18.253	1.88
Suir South	South 01	590.4	Max WS	FSU 10% AEP (Post)	125.82	15.03	18.944	2.16
Suir South	South 01	590.4	Max WS	FSU 1% AEP (Post)	160.35	15.03	19.806	2.18
Suir South	South 01	590.4	Max WS	FSU 0.1% AEP (Post)	189.21	15.03	20.733	2.1
Suir South	South 01	585.1	Max WS	FSU 50% AEP (Post)	87.04	14.93	18.172	2.22
Suir South	South 01	585.1	Max WS	FSU 10% AEP (Post)	125.8	14.93	18.849	2.55
Suir South	South 01	585.1	Max WS	FSU 1% AEP (Post)	160.33	14.93	19.702	2.58
Suir South	South 01	585.1	Max WS	FSU 0.1% AEP (Post)	189.14	14.93	20.639	2.48
Suir South	South 01	579.75			Bridge			
Suir South	South 01	574.4	Max WS	FSU 50% AEP (Post)	87.03	15.39	17.66	3.14
Suir South	South 01	574.4	Max WS	FSU 10% AEP (Post)	125.78	15.39	18.418	3.24
Suir South	South 01	574.4	Max WS	FSU 1% AEP (Post)	160.31	15.39	19.178	3.2
Suir South	South 01	574.4	Max WS	FSU 0.1% AEP (Post)	189.07	15.39	19.982	3.05
Suir South	South 01	570.2	Max WS	FSU 50% AEP (Post)	87.03	15.35	17.838	2.41
Suir South	South 01	570.2	Max WS	FSU 10% AEP (Post)	125.78	15.35	18.511	2.61
Suir South	South 01	570.2	Max WS	FSU 1% AEP (Post)	160.31	15.35	19.361	2.52
Suir South	South 01	570.2	Max WS	FSU 0.1% AEP (Post)	189.08	15.35	20.145	2.43
Suir South	South 02	546.8	Max WS	FSU 50% AEP (Post)	114.57	13.42	17.937	1.53
Suir South	South 02	546.8	Max WS	FSU 10% AEP (Post)	157.07	13.42	18.626	1.71
Suir South	South 02	546.8	Max WS	FSU 1% AEP (Post)	193.7	13.42	19.465	1.72
Suir South	South 02	546.8	Max WS	FSU 0.1% AEP (Post)	230.89	13.42	20.233	1.75
Suir South	South 02	501.5	Max WS	FSU 50% AEP (Post)	114.57	15.87	17.949	1.06
Suir South	South 02	501.5	Max WS	FSU 10% AEP (Post)	157.07	15.87	18.687	0.91
Suir South	South 02	501.5	Max WS	FSU 1% AEP (Post)	193.7	15.87	19.541	0.78
Suir South	South 02	501.5	Max WS	FSU 0.1% AEP (Post)	230.57	15.87	20.316	0.72
Suir South	South 02	499.25			Inl Struct			
Suir South	South 02	497	Max WS	FSU 50% AEP (Post)	114.57	15.35	17.931	0.78
Suir South	South 02	497	Max WS	FSU 10% AEP (Post)	157.07	15.35	18.677	0.76
Suir South	South 02	497	Max WS	FSU 1% AEP (Post)	193.71	15.35	19.535	0.69
Suir South	South 02	497	Max WS	FSU 0.1% AEP (Post)	230.57	15.35	20.308	0.66
Suir South	South 02	496.9			Lat Struct			

Post-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir South	South 02	462.1	Max WS	FSU 50% AEP (Post)	114.57	15.11	17.859	1.27
Suir South	South 02	462.1	Max WS	FSU 10% AEP (Post)	172.37	15.11	18.616	1.22
Suir South	South 02	462.1	Max WS	FSU 1% AEP (Post)	255.35	15.11	19.464	1.23
Suir South	South 02	462.1	Max WS	FSU 0.1% AEP (Post)	340.38	15.11	20.227	1.27
Suir South	South 02	446.9	Max WS	FSU 50% AEP (Post)	114.57	15.04	17.849	1.23
Suir South	South 02	446.9	Max WS	FSU 10% AEP (Post)	172.37	15.04	18.61	1.19
Suir South	South 02	446.9	Max WS	FSU 1% AEP (Post)	255.35	15.04	19.459	1.23
Suir South	South 02	446.9	Max WS	FSU 0.1% AEP (Post)	340.33	15.04	20.222	1.27
Suir South	South 02	430.4	Max WS	FSU 50% AEP (Post)	114.57	14.97	17.823	1.29
Suir South	South 02	430.4	Max WS	FSU 10% AEP (Post)	172.37	14.97	18.594	1.23
Suir South	South 02	430.4	Max WS	FSU 1% AEP (Post)	255.35	14.97	19.448	1.25
Suir South	South 02	430.4	Max WS	FSU 0.1% AEP (Post)	340.3	14.97	20.213	1.28
Suir South	South 02	413.7	Max WS	FSU 50% AEP (Post)	114.57	14.9	17.798	1.3
Suir South	South 02	413.7	Max WS	FSU 10% AEP (Post)	172.37	14.9	18.568	1.32
Suir South	South 02	413.7	Max WS	FSU 1% AEP (Post)	255.35	14.9	19.429	1.34
Suir South	South 02	413.7	Max WS	FSU 0.1% AEP (Post)	340.28	14.9	20.198	1.37
Suir South	South 02	397.2	Max WS	FSU 50% AEP (Post)	114.56	14.77	17.774	1.34
Suir South	South 02	397.2	Max WS	FSU 10% AEP (Post)	172.37	14.77	18.543	1.41
Suir South	South 02	397.2	Max WS	FSU 1% AEP (Post)	255.35	14.77	19.406	1.45
Suir South	South 02	397.2	Max WS	FSU 0.1% AEP (Post)	340.27	14.77	20.177	1.49
Suir South	South 02	380.6	Max WS	FSU 50% AEP (Post)	114.56	14.65	17.745	1.4
Suir South	South 02	380.6	Max WS	FSU 10% AEP (Post)	172.37	14.65	18.513	1.53
Suir South	South 02	380.6	Max WS	FSU 1% AEP (Post)	255.35	14.65	19.389	1.54
Suir South	South 02	380.6	Max WS	FSU 0.1% AEP (Post)	340.26	14.65	20.167	1.54
Suir South	South 02	363.8	Max WS	FSU 50% AEP (Post)	114.56	14.52	17.712	1.5
Suir South	South 02	363.8	Max WS	FSU 10% AEP (Post)	172.37	14.52	18.488	1.62
Suir South	South 02	363.8	Max WS	FSU 1% AEP (Post)	255.35	14.52	19.364	1.66
Suir South	South 02	363.8	Max WS	FSU 0.1% AEP (Post)	340.26	14.52	20.147	1.67
Suir South	South 02	347.2	Max WS	FSU 50% AEP (Post)	114.56	14.48	17.705	1.45
Suir South	South 02	347.2	Max WS	FSU 10% AEP (Post)	172.37	14.48	18.493	1.5
Suir South	South 02	347.2	Max WS	FSU 1% AEP (Post)	255.35	14.48	19.367	1.54
Suir South	South 02	347.2	Max WS	FSU 0.1% AEP (Post)	340.25	14.48	20.15	1.55
Suir South	South 02	330.6	Max WS	FSU 50% AEP (Post)	114.56	14.45	17.736	1.12
Suir South	South 02	330.6	Max WS	FSU 10% AEP (Post)	172.37	14.45	18.519	1.16
Suir South	South 02	330.6	Max WS	FSU 1% AEP (Post)	255.35	14.45	19.385	1.25
Suir South	South 02	330.6	Max WS	FSU 0.1% AEP (Post)	340.25	14.45	20.163	1.29
Suir South	South 02	301.5	Max WS	FSU 50% AEP (Post)	114.57	14.06	17.72	1.1
Suir South	South 02	301.5	Max WS	FSU 10% AEP (Post)	172.37	14.06	18.503	1.18
Suir South	South 02	301.5	Max WS	FSU 1% AEP (Post)	255.35	14.06	19.37	1.28
Suir South	South 02	301.5	Max WS	FSU 0.1% AEP (Post)	340.25	14.06	20.156	1.28
Suir South	South 02	281	Max WS	FSU 50% AEP (Post)	114.57	13.62	17.705	1.1
Suir South	South 02	281	Max WS	FSU 10% AEP (Post)	172.37	13.62	18.49	1.18
Suir South	South 02	281	Max WS	FSU 1% AEP (Post)	255.35	13.62	19.358	1.28
Suir South	South 02	281	Max WS	FSU 0.1% AEP (Post)	340.25	13.62	20.131	1.37

Post-Development Water Surface Elevations								
					Q Total	Min Ch El	W.S. Elev	Vel
River	Reach	River Sta	Profile	Plan	(m3/s)	(mOD)	(mOD)	(m/s)
Suir South	South 02	278			Bridge			
Suir South	South 02	275	Max WS	FSU 50% AEP (Post)	114.56	13.88	17.645	1.31
Suir South	South 02	275	Max WS	FSU 10% AEP (Post)	172.37	13.88	18.439	1.37
Suir South	South 02	275	Max WS	FSU 1% AEP (Post)	255.35	13.88	19.312	1.46
Suir South	South 02	275	Max WS	FSU 0.1% AEP (Post)	340.25	13.88	20.086	1.54
Suir South	South 02	258.5	Max WS	FSU 50% AEP (Post)	114.56	13.68	17.624	1.29
Suir South	South 02	258.5	Max WS	FSU 10% AEP (Post)	172.37	13.68	18.437	1.24
Suir South	South 02	258.5	Max WS	FSU 1% AEP (Post)	255.35	13.68	19.32	1.27
Suir South	South 02	258.5	Max WS	FSU 0.1% AEP (Post)	340.25	13.68	20.101	1.31
Suir South	South 02	224.9	Max WS	FSU 50% AEP (Post)	114.56	13.44	17.597	1.31
Suir South	South 02	224.9	Max WS	FSU 10% AEP (Post)	172.37	13.44	18.403	1.4
Suir South	South 02	224.9	Max WS	FSU 1% AEP (Post)	255.35	13.44	19.285	1.52
Suir South	South 02	224.9	Max WS	FSU 0.1% AEP (Post)	340.25	13.44	20.064	1.61
Suir South	South 02	199.9	Max WS	FSU 50% AEP (Post)	114.56	13.26	17.591	1.22
Suir South	South 02	199.9	Max WS	FSU 10% AEP (Post)	172.37	13.26	18.401	1.27
Suir South	South 02	199.9	Max WS	FSU 1% AEP (Post)	255.35	13.26	19.285	1.36
Suir South	South 02	199.9	Max WS	FSU 0.1% AEP (Post)	340.24	13.26	20.066	1.44
Suir South	South 02	183.4	Max WS	FSU 50% AEP (Post)	114.56	13.54	17.577	1.25
Suir South	South 02	183.4	Max WS	FSU 10% AEP (Post)	172.37	13.54	18.393	1.28
Suir South	South 02	183.4	Max WS	FSU 1% AEP (Post)	255.35	13.54	19.278	1.36
Suir South	South 02	183.4	Max WS	FSU 0.1% AEP (Post)	340.25	13.54	20.06	1.44
Suir South	South 02	166.6	Max WS	FSU 50% AEP (Post)	114.56	13.82	17.567	1.25
Suir South	South 02	166.6	Max WS	FSU 10% AEP (Post)	172.37	13.82	18.386	1.28
Suir South	South 02	166.6	Max WS	FSU 1% AEP (Post)	255.35	13.82	19.275	1.34
Suir South	South 02	166.6	Max WS	FSU 0.1% AEP (Post)	340.25	13.82	20.059	1.41
Suir South	South 02	150.1	Max WS	FSU 50% AEP (Post)	114.56	14.1	17.566	1.18
Suir South	South 02	150.1	Max WS	FSU 10% AEP (Post)	172.37	14.1	18.387	1.18
Suir South	South 02	150.1	Max WS	FSU 1% AEP (Post)	255.35	14.1	19.276	1.24
Suir South	South 02	150.1	Max WS	FSU 0.1% AEP (Post)	340.25	14.1	20.06	1.31
Suir South	South 02	133	Max WS	FSU 50% AEP (Post)	114.56	13.89	17.554	1.21
Suir South	South 02	133	Max WS	FSU 10% AEP (Post)	172.37	13.89	18.379	1.2
Suir South	South 02	133	Max WS	FSU 1% AEP (Post)	255.35	13.89	19.269	1.26
Suir South	South 02	133	Max WS	FSU 0.1% AEP (Post)	340.24	13.89	20.055	1.31
Suir South	South 02	116.4	Max WS	FSU 50% AEP (Post)	114.56	13.67	17.545	1.22
Suir South	South 02	116.4	Max WS	FSU 10% AEP (Post)	172.37	13.67	18.372	1.21
Suir South	South 02	116.4	Max WS	FSU 1% AEP (Post)	255.35	13.67	19.264	1.27
Suir South	South 02	116.4	Max WS	FSU 0.1% AEP (Post)	340.25	13.67	20.05	1.32
Suir South	South 02	99.5	Max WS	FSU 50% AEP (Post)	114.56	13.46	17.532	1.23
Suir South	South 02	99.5	Max WS	FSU 10% AEP (Post)	172.37	13.46	18.365	1.2
Suir South	South 02	99.5	Max WS	FSU 1% AEP (Post)	255.35	13.46	19.259	1.22
Suir South	South 02	99.5	Max WS	FSU 0.1% AEP (Post)	340.25	13.46	20.047	1.25
Suir South	South 02	74.9	Max WS	FSU 50% AEP (Post)	114.56	13.36	17.514	1.24
Suir South	South 02	74.9	Max WS	FSU 10% AEP (Post)	172.37	13.36	18.347	1.26

Post-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir South	South 02	74.9	Max WS	FSU 1% AEP (Post)	255.35	13.36	19.244	1.3
Suir South	South 02	74.9	Max WS	FSU 0.1% AEP (Post)	340.24	13.36	20.033	1.34
Suir South	South 02	52.6	Max WS	FSU 50% AEP (Post)	114.56	13.26	17.495	1.27
Suir South	South 02	52.6	Max WS	FSU 10% AEP (Post)	172.37	13.26	18.333	1.3
Suir South	South 02	52.6	Max WS	FSU 1% AEP (Post)	255.35	13.26	19.232	1.35
Suir South	South 02	52.6	Max WS	FSU 0.1% AEP (Post)	340.24	13.26	20.022	1.39
Suir South	South 02	33.2	Max WS	FSU 50% AEP (Post)	114.56	13.38	17.482	1.26
Suir South	South 02	33.2	Max WS	FSU 10% AEP (Post)	172.37	13.38	18.322	1.29
Suir South	South 02	33.2	Max WS	FSU 1% AEP (Post)	255.35	13.38	19.222	1.34
Suir South	South 02	33.2	Max WS	FSU 0.1% AEP (Post)	340.24	13.38	20.012	1.39
Suir South	South 02	16.7	Max WS	FSU 50% AEP (Post)	114.56	13.5	17.477	1.22
Suir South	South 02	16.7	Max WS	FSU 10% AEP (Post)	172.37	13.5	18.319	1.24
Suir South	South 02	16.7	Max WS	FSU 1% AEP (Post)	255.35	13.5	19.22	1.29
Suir South	South 02	16.7	Max WS	FSU 0.1% AEP (Post)	340.24	13.5	20.011	1.34
Suir South	South 02	0	Max WS	FSU 50% AEP (Post)	114.56	13.61	17.472	1.18
Suir South	South 02	0	Max WS	FSU 10% AEP (Post)	172.37	13.61	18.318	1.19
Suir South	South 02	0	Max WS	FSU 1% AEP (Post)	255.35	13.61	19.219	1.24
Suir South	South 02	0	Max WS	FSU 0.1% AEP (Post)	340.24	13.61	20.01	1.29
Suir Main	North 01	1219.4	Max WS	FSU 50% AEP (Post)	245.31	13.63	18.575	1.19
Suir Main	North 01	1219.4	Max WS	FSU 10% AEP (Post)	352.55	13.63	19.259	1.45
Suir Main	North 01	1219.4	Max WS	FSU 1% AEP (Post)	486.27	13.63	20.021	1.71
Suir Main	North 01	1219.4	Max WS	FSU 0.1% AEP (Post)	616.79	13.63	20.838	1.88
Suir Main	North 01	1168.7	Max WS	FSU 50% AEP (Post)	245.31	13.46	18.551	1.24
Suir Main	North 01	1168.7	Max WS	FSU 10% AEP (Post)	352.41	13.46	19.231	1.5
Suir Main	North 01	1168.7	Max WS	FSU 1% AEP (Post)	485.92	13.46	19.988	1.76
Suir Main	North 01	1168.7	Max WS	FSU 0.1% AEP (Post)	610.36	13.46	20.823	1.89
Suir Main	North 01	1168.6			Lat Struct			
Suir Main	North 01	1119.5	Max WS	FSU 50% AEP (Post)	245.31	13.89	18.524	1.29
Suir Main	North 01	1119.5	Max WS	FSU 10% AEP (Post)	336.27	13.89	19.223	1.48
Suir Main	North 01	1119.5	Max WS	FSU 1% AEP (Post)	432.19	13.89	20.027	1.59
Suir Main	North 01	1119.5	Max WS	FSU 0.1% AEP (Post)	473.58	13.89	20.995	1.46
Suir Main	North 01	1067.7	Max WS	FSU 50% AEP (Post)	245.31	14.02	18.456	1.57
Suir Main	North 01	1067.7	Max WS	FSU 10% AEP (Post)	337.68	14.02	19.142	1.78
Suir Main	North 01	1067.7	Max WS	FSU 1% AEP (Post)	425.37	14.02	19.961	1.85
Suir Main	North 01	1067.7	Max WS	FSU 0.1% AEP (Post)	535.94	14.02	20.888	1.93
Suir Main	North 02	1028.2	Max WS	FSU 50% AEP (Post)	158.27	14	18.46	1.31
Suir Main	North 02	1028.2	Max WS	FSU 10% AEP (Post)	211.76	14	19.157	1.45
Suir Main	North 02	1028.2	Max WS	FSU 1% AEP (Post)	264.76	14	19.983	1.48
Suir Main	North 02	1028.2	Max WS	FSU 0.1% AEP (Post)	335.01	14	20.916	1.55
Suir Main	North 02	998.7	Max WS	FSU 50% AEP (Post)	158.27	15.04	18.179	2.6
Suir Main	North 02	998.7	Max WS	FSU 10% AEP (Post)	211.7	15.04	18.938	2.55
Suir Main	North 02	998.7	Max WS	FSU 1% AEP (Post)	264.61	15.04	19.798	2.31
Suir Main	North 02	998.7	Max WS	FSU 0.1% AEP (Post)	327.15	15.04	20.74	2.19

Post-Development Water Surface Elevations								
					Q Total	Min Ch El	W.S. Elev	Vel
River	Reach	River Sta	Profile	Plan	(m3/s)	(mOD)	(mOD)	(m/s)
Suir Main	North 03	945	Max WS	FSU 50% AEP (Post)	130.73	14.67	18.252	0.72
Suir Main	North 03	945	Max WS	FSU 10% AEP (Post)	180.39	14.67	19.008	0.76
Suir Main	North 03	945	Max WS	FSU 1% AEP (Post)	231.19	14.67	19.883	0.76
Suir Main	North 03	945	Max WS	FSU 0.1% AEP (Post)	284.42	14.67	20.835	0.76
Suir Main	North 03	941	Max WS	FSU 50% AEP (Post)	130.73	14.67	18.251	0.72
Suir Main	North 03	941	Max WS	FSU 10% AEP (Post)	180.28	14.67	19.007	0.76
Suir Main	North 03	941	Max WS	FSU 1% AEP (Post)	230.96	14.67	19.882	0.76
Suir Main	North 03	941	Max WS	FSU 0.1% AEP (Post)	283.02	14.67	20.833	0.75
Suir Main	North 03	939.1			Inl Struct			
Suir Main	North 03	937.2	Max WS	FSU 50% AEP (Post)	130.73	14.19	18.196	0.59
Suir Main	North 03	937.2	Max WS	FSU 10% AEP (Post)	180.28	14.19	18.979	0.64
Suir Main	North 03	937.2	Max WS	FSU 1% AEP (Post)	230.96	14.19	19.86	0.66
Suir Main	North 03	937.2	Max WS	FSU 0.1% AEP (Post)	283.02	14.19	20.82	0.67
Suir Main	North 03	903.1	Max WS	FSU 50% AEP (Post)	130.73	15.2	17.796	3.38
Suir Main	North 03	903.1	Max WS	FSU 10% AEP (Post)	180.27	15.2	18.684	3.41
Suir Main	North 03	903.1	Max WS	FSU 1% AEP (Post)	230.92	15.2	19.458	3.54
Suir Main	North 03	903.1	Max WS	FSU 0.1% AEP (Post)	277.13	15.2	20.444	3.41
Suir Main	North 03	898.65			Bridge			
Suir Main	North 03	894.2	Max WS	FSU 50% AEP (Post)	130.71	15.21	17.29	4.14
Suir Main	North 03	894.2	Max WS	FSU 10% AEP (Post)	180.25	15.21	18.358	3.65
Suir Main	North 03	894.2	Max WS	FSU 1% AEP (Post)	230.9	15.21	18.842	4.02
Suir Main	North 03	894.2	Max WS	FSU 0.1% AEP (Post)	277.04	15.21	19.577	3.98
Suir Main	North 03	868	Max WS	FSU 50% AEP (Post)	130.72	14.55	17.716	1.9
Suir Main	North 03	868	Max WS	FSU 10% AEP (Post)	180.24	14.55	18.472	2.09
Suir Main	North 03	868	Max WS	FSU 1% AEP (Post)	230.89	14.55	19.278	2.19
Suir Main	North 03	868	Max WS	FSU 0.1% AEP (Post)	276.84	14.55	20	2.26
Suir Main	North 03	840.3	Max WS	FSU 50% AEP (Post)	130.72	14.55	17.671	1.93
Suir Main	North 03	840.3	Max WS	FSU 10% AEP (Post)	180.24	14.55	18.431	2.11
Suir Main	North 03	840.3	Max WS	FSU 1% AEP (Post)	230.89	14.55	19.241	2.21
Suir Main	North 03	840.3	Max WS	FSU 0.1% AEP (Post)	276.65	14.55	19.965	2.28
Suir Main	North 03	818.3	Max WS	FSU 50% AEP (Post)	130.72	14.47	17.757	1.22
Suir Main	North 03	818.3	Max WS	FSU 10% AEP (Post)	180.24	14.47	18.541	1.27
Suir Main	North 03	818.3	Max WS	FSU 1% AEP (Post)	230.88	14.47	19.376	1.29
Suir Main	North 03	818.3	Max WS	FSU 0.1% AEP (Post)	276.55	14.47	20.113	1.31
Suir Main	North 03	768.4	Max WS	FSU 50% AEP (Post)	130.72	14.1	17.706	1.35
Suir Main	North 03	768.4	Max WS	FSU 10% AEP (Post)	180.24	14.1	18.489	1.45
Suir Main	North 03	768.4	Max WS	FSU 1% AEP (Post)	230.88	14.1	19.324	1.5
Suir Main	North 03	768.4	Max WS	FSU 0.1% AEP (Post)	276.41	14.1	20.06	1.54
Suir Main	North 03	724.3	Max WS	FSU 50% AEP (Post)	130.72	14.09	17.637	1.66
Suir Main	North 03	724.3	Max WS	FSU 10% AEP (Post)	180.24	14.09	18.442	1.68
Suir Main	North 03	724.3	Max WS	FSU 1% AEP (Post)	230.88	14.09	19.296	1.65
Suir Main	North 03	724.3	Max WS	FSU 0.1% AEP (Post)	276.38	14.09	20.044	1.66
Suir Main	North 03	704	Max WS	FSU 50% AEP (Post)	130.72	14.1	17.638	1.47

Post-Development Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (mOD)	W.S. Elev (mOD)	Vel (m/s)
Suir Main	North 03	704	Max WS	FSU 10% AEP (Post)	180.24	14.1	18.446	1.5
Suir Main	North 03	704	Max WS	FSU 1% AEP (Post)	230.88	14.1	19.304	1.48
Suir Main	North 03	704	Max WS	FSU 0.1% AEP (Post)	276.37	14.1	20.052	1.51
Suir Main	North 03	701			Bridge			
Suir Main	North 03	698	Max WS	FSU 50% AEP (Post)	130.72	13.63	17.639	1.44
Suir Main	North 03	698	Max WS	FSU 10% AEP (Post)	180.24	13.63	18.445	1.48
Suir Main	North 03	698	Max WS	FSU 1% AEP (Post)	230.88	13.63	19.303	1.47
Suir Main	North 03	698	Max WS	FSU 0.1% AEP (Post)	276.37	13.63	20.054	1.45
Suir Main	North 03	687.4	Max WS	FSU 50% AEP (Post)	130.72	14.39	17.642	1.35
Suir Main	North 03	687.4	Max WS	FSU 10% AEP (Post)	180.24	14.39	18.46	1.3
Suir Main	North 03	687.4	Max WS	FSU 1% AEP (Post)	230.88	14.39	19.331	1.18
Suir Main	North 03	687.4	Max WS	FSU 0.1% AEP (Post)	276.37	14.39	20.083	1.15
Suir Main	North 03	636.4	Max WS	FSU 50% AEP (Post)	130.72	14.15	17.605	1.26
Suir Main	North 03	636.4	Max WS	FSU 10% AEP (Post)	180.24	14.15	18.414	1.35
Suir Main	North 03	636.4	Max WS	FSU 1% AEP (Post)	230.88	14.15	19.292	1.31
Suir Main	North 03	636.4	Max WS	FSU 0.1% AEP (Post)	276.37	14.15	20.074	1.12
Suir Main	North 03	587.7	Max WS	FSU 50% AEP (Post)	130.72	14.22	17.548	1.45
Suir Main	North 03	587.7	Max WS	FSU 10% AEP (Post)	180.24	14.22	18.363	1.53
Suir Main	North 03	587.7	Max WS	FSU 1% AEP (Post)	230.88	14.22	19.25	1.51
Suir Main	North 03	587.7	Max WS	FSU 0.1% AEP (Post)	276.36	14.22	20.038	1.38
Suir Main	North 03	536.7	Max WS	FSU 50% AEP (Post)	130.72	14.15	17.519	1.39
Suir Main	North 03	536.7	Max WS	FSU 10% AEP (Post)	180.24	14.15	18.336	1.49
Suir Main	North 03	536.7	Max WS	FSU 1% AEP (Post)	230.88	14.15	19.227	1.48
Suir Main	North 03	536.7	Max WS	FSU 0.1% AEP (Post)	276.37	14.15	20.025	1.34
Suir Main	North 03	486.3	Max WS	FSU 50% AEP (Post)	130.72	13.53	17.48	1.43
Suir Main	North 03	486.3	Max WS	FSU 10% AEP (Post)	180.24	13.53	18.297	1.56
Suir Main	North 03	486.3	Max WS	FSU 1% AEP (Post)	230.88	13.53	19.199	1.54
Suir Main	North 03	486.3	Max WS	FSU 0.1% AEP (Post)	276.36	13.53	20	1.43
Suir Main	North 03	435.2	Max WS	FSU 50% AEP (Post)	130.72	13.64	17.436	1.5
Suir Main	North 03	435.2	Max WS	FSU 10% AEP (Post)	180.24	13.64	18.253	1.65
Suir Main	North 03	435.2	Max WS	FSU 1% AEP (Post)	230.88	13.64	19.14	1.73
Suir Main	North 03	435.2	Max WS	FSU 0.1% AEP (Post)	276.36	13.64	19.96	1.6
Suir Main	North 04	370.6	Max WS	FSU 50% AEP (Post)	245.28	13.32	17.391	1.54
Suir Main	North 04	370.6	Max WS	FSU 10% AEP (Post)	352.61	13.32	18.228	1.64
Suir Main	North 04	370.6	Max WS	FSU 1% AEP (Post)	486.22	13.32	19.129	1.71
Suir Main	North 04	370.6	Max WS	FSU 0.1% AEP (Post)	616.61	13.32	19.921	1.77
Suir Main	North 04	335.2	Max WS	FSU 50% AEP (Post)	245.28	13.53	17.357	1.63
Suir Main	North 04	335.2	Max WS	FSU 10% AEP (Post)	352.61	13.53	18.2	1.71
Suir Main	North 04	335.2	Max WS	FSU 1% AEP (Post)	486.22	13.53	19.103	1.78
Suir Main	North 04	335.2	Max WS	FSU 0.1% AEP (Post)	616.61	13.53	19.896	1.84
Suir Main	North 04	287.8	Max WS	FSU 50% AEP (Post)	245.28	13.59	17.32	1.6
Suir Main	North 04	287.8	Max WS	FSU 10% AEP (Post)	352.61	13.59	18.15	1.76
Suir Main	North 04	287.8	Max WS	FSU 1% AEP (Post)	486.22	13.59	19.036	1.93
Suir Main	North 04	287.8	Max WS	FSU 0.1% AEP (Post)	616.6	13.59	19.814	2.06

Post-Development Water Surface Elevations								
					Q Total	Min Ch El	W.S. Elev	Vel
River	Reach	River Sta	Profile	Plan	(m3/s)	(mOD)	(mOD)	(m/s)
Suir Main	North 04	269.1	Max WS	FSU 50% AEP (Post)	245.28	13.51	17.292	1.68
Suir Main	North 04	269.1	Max WS	FSU 10% AEP (Post)	352.61	13.51	18.111	1.9
Suir Main	North 04	269.1	Max WS	FSU 1% AEP (Post)	486.22	13.51	18.984	2.12
Suir Main	North 04	269.1	Max WS	FSU 0.1% AEP (Post)	616.61	13.51	19.749	2.3
Suir Main	North 04	263.4			Bridge			
Suir Main	North 04	253.4	Max WS	FSU 50% AEP (Post)	245.28	13.52	17.294	1.61
Suir Main	North 04	253.4	Max WS	FSU 10% AEP (Post)	352.61	13.52	18.102	1.83
Suir Main	North 04	253.4	Max WS	FSU 1% AEP (Post)	486.22	13.52	18.951	2.06
Suir Main	North 04	253.4	Max WS	FSU 0.1% AEP (Post)	616.6	13.52	19.678	2.25
Suir Main	North 04	217.7	Max WS	FSU 50% AEP (Post)	245.28	13	17.303	1.39
Suir Main	North 04	217.7	Max WS	FSU 10% AEP (Post)	352.61	13	18.111	1.62
Suir Main	North 04	217.7	Max WS	FSU 1% AEP (Post)	486.22	13	18.962	1.85
Suir Main	North 04	217.7	Max WS	FSU 0.1% AEP (Post)	616.6	13	19.694	2.03
Suir Main	North 04	172.3	Max WS	FSU 50% AEP (Post)	245.28	13.41	17.271	1.45
Suir Main	North 04	172.3	Max WS	FSU 10% AEP (Post)	352.61	13.41	18.084	1.66
Suir Main	North 04	172.3	Max WS	FSU 1% AEP (Post)	486.22	13.41	18.939	1.87
Suir Main	North 04	172.3	Max WS	FSU 0.1% AEP (Post)	616.6	13.41	19.673	2.04
Suir Main	North 04	130.4	Max WS	FSU 50% AEP (Post)	245.28	13.41	17.246	1.46
Suir Main	North 04	130.4	Max WS	FSU 10% AEP (Post)	352.61	13.41	18.058	1.67
Suir Main	North 04	130.4	Max WS	FSU 1% AEP (Post)	486.22	13.41	18.913	1.88
Suir Main	North 04	130.4	Max WS	FSU 0.1% AEP (Post)	616.6	13.41	19.648	2.05
Suir Main	North 04	83.8	Max WS	FSU 50% AEP (Post)	245.28	13.06	17.227	1.42
Suir Main	North 04	83.8	Max WS	FSU 10% AEP (Post)	352.61	13.06	18.04	1.63
Suir Main	North 04	83.8	Max WS	FSU 1% AEP (Post)	486.22	13.06	18.896	1.85
Suir Main	North 04	83.8	Max WS	FSU 0.1% AEP (Post)	616.6	13.06	19.631	2.02
Suir Main	North 04	32.8	Max WS	FSU 50% AEP (Post)	245.28	13.13	17.2	1.44
Suir Main	North 04	32.8	Max WS	FSU 10% AEP (Post)	352.61	13.13	18.011	1.66
Suir Main	North 04	32.8	Max WS	FSU 1% AEP (Post)	486.22	13.13	18.865	1.88
Suir Main	North 04	32.8	Max WS	FSU 0.1% AEP (Post)	616.6	13.13	19.599	2.06
Suir Main	North 04	0	Max WS	FSU 50% AEP (Post)	245.28	13.1	17.182	1.45
Suir Main	North 04	0	Max WS	FSU 10% AEP (Post)	352.61	13.1	17.996	1.66
Suir Main	North 04	0	Max WS	FSU 1% AEP (Post)	486.22	13.1	18.854	1.86
Suir Main	North 04	0	Max WS	FSU 0.1% AEP (Post)	616.6	13.1	19.591	2.03
Suir Channel	Channel	97.43	Max WS	FSU 50% AEP (Post)	27.54	15.07	18.252	1.32
Suir Channel	Channel	97.43	Max WS	FSU 10% AEP (Post)	31.31	15.07	19.008	1.16
Suir Channel	Channel	97.43	Max WS	FSU 1% AEP (Post)	33.43	15.07	19.883	0.97
Suir Channel	Channel	97.43	Max WS	FSU 0.1% AEP (Post)	42.75	15.07	20.835	1.01
Suir Channel	Channel	91.14	Max WS	FSU 50% AEP (Post)	27.54	15.2	18.213	1.54
Suir Channel	Channel	91.14	Max WS	FSU 10% AEP (Post)	31.3	15.2	18.978	1.36
Suir Channel	Channel	91.14	Max WS	FSU 1% AEP (Post)	33.39	15.2	19.861	1.16
Suir Channel	Channel	91.14	Max WS	FSU 0.1% AEP (Post)	42.58	15.2	20.808	1.21
Suir Channel	Channel	87.72			Bridge			

Post-Development Water Surface Elevations								
					Q Total	Min Ch El	W.S. Elev	Vel
River	Reach	River Sta	Profile	Plan	(m3/s)	(mOD)	(mOD)	(m/s)
Suir Channel	Channel	84.3	Max WS	FSU 50% AEP (Post)	27.54	15.51	18.226	1.45
Suir Channel	Channel	84.3	Max WS	FSU 10% AEP (Post)	31.3	15.51	18.97	1.21
Suir Channel	Channel	84.3	Max WS	FSU 1% AEP (Post)	33.39	15.51	19.829	1
Suir Channel	Channel	84.3	Max WS	FSU 0.1% AEP (Post)	42.57	15.51	20.729	1.02
Suir Channel	Channel	77.92	Max WS	FSU 50% AEP (Post)	27.54	15.9	18.098	2.08
Suir Channel	Channel	77.92	Max WS	FSU 10% AEP (Post)	31.29	15.9	18.912	1.58
Suir Channel	Channel	77.92	Max WS	FSU 1% AEP (Post)	33.39	15.9	19.797	1.24
Suir Channel	Channel	77.92	Max WS	FSU 0.1% AEP (Post)	42.45	15.9	20.699	1.24
Suir Channel	Channel	68.2	Max WS	FSU 50% AEP (Post)	27.54	16.17	18.145	1.66
Suir Channel	Channel	68.2	Max WS	FSU 10% AEP (Post)	31.29	16.17	18.939	1.3
Suir Channel	Channel	68.2	Max WS	FSU 1% AEP (Post)	33.39	16.17	19.816	1.03
Suir Channel	Channel	68.2	Max WS	FSU 0.1% AEP (Post)	42.3	16.17	20.715	1.03
Suir Channel	Channel	47.1	Max WS	FSU 50% AEP (Post)	27.54	16.2	18.119	1.53
Suir Channel	Channel	47.1	Max WS	FSU 10% AEP (Post)	31.29	16.2	18.934	1.18
Suir Channel	Channel	47.1	Max WS	FSU 1% AEP (Post)	33.39	16.2	19.815	0.93
Suir Channel	Channel	47.1	Max WS	FSU 0.1% AEP (Post)	42.03	16.2	20.713	0.93
Suir Channel	Channel	36.95	Max WS	FSU 50% AEP (Post)	27.54	16.08	18.123	1.39
Suir Channel	Channel	36.95	Max WS	FSU 10% AEP (Post)	31.29	16.08	18.938	1.08
Suir Channel	Channel	36.95	Max WS	FSU 1% AEP (Post)	33.39	16.08	19.819	0.86
Suir Channel	Channel	36.95	Max WS	FSU 0.1% AEP (Post)	41.93	16.08	20.716	0.85
Suir Channel	Channel	31.31	Max WS	FSU 50% AEP (Post)	27.54	16.06	18.115	1.39
Suir Channel	Channel	31.31	Max WS	FSU 10% AEP (Post)	31.29	16.06	18.937	1.06
Suir Channel	Channel	31.31	Max WS	FSU 1% AEP (Post)	33.39	16.06	19.819	0.84
Suir Channel	Channel	31.31	Max WS	FSU 0.1% AEP (Post)	41.88	16.06	20.716	0.83
Suir Channel	Channel	21.65			Bridge			
Suir Channel	Channel	11.99	Max WS	FSU 50% AEP (Post)	27.54	16.09	18.023	1.36
Suir Channel	Channel	11.99	Max WS	FSU 10% AEP (Post)	31.28	16.09	18.765	1.06
Suir Channel	Channel	11.99	Max WS	FSU 1% AEP (Post)	33.39	16.09	19.615	0.82
Suir Channel	Channel	11.99	Max WS	FSU 0.1% AEP (Post)	41.87	16.09	20.386	0.82
Suir Channel	Channel	8.11	Max WS	FSU 50% AEP (Post)	27.54	15.82	18.014	1.38
Suir Channel	Channel	8.11	Max WS	FSU 10% AEP (Post)	31.28	15.82	18.76	1.08
Suir Channel	Channel	8.11	Max WS	FSU 1% AEP (Post)	33.39	15.82	19.614	0.82
Suir Channel	Channel	8.11	Max WS	FSU 0.1% AEP (Post)	41.85	15.82	20.385	0.81
Suir Channel	Channel	0	Max WS	FSU 50% AEP (Post)	27.54	14.56	18.074	0.63
Suir Channel	Channel	0	Max WS	FSU 10% AEP (Post)	31.28	14.56	18.797	0.51
Suir Channel	Channel	0	Max WS	FSU 1% AEP (Post)	33.39	14.56	19.636	0.41
Suir Channel	Channel	0	Max WS	FSU 0.1% AEP (Post)	41.8	14.56	20.406	0.41

1% AEP + 20% Climate Change Water Surface Elevations								
					Q Total	Min Ch El	W.S. Elev	Vel Chnl
River	Reach	River Sta	Profile	Plan	(m3/s)	(m)	(m)	(m/s)
Suir South	South 01	698.2	Max WS	FSU 1% AEP (Pre) + 20% CC	200.57	14.33	20.74	2.13
Suir South	South 01	698.2	Max WS	FSU 1% AEP (Post) + 20% CC	186.3	14.33	20.654	2.01
Suir South	South 01	649.5	Max WS	FSU 1% AEP (Pre) + 20% CC	200.57	15.31	20.742	1.86
Suir South	South 01	649.5	Max WS	FSU 1% AEP (Post) + 20% CC	180.51	15.31	20.631	1.71
Suir South	South 01	600.1	Max WS	FSU 1% AEP (Pre) + 20% CC	200.56	14.98	20.629	2.11
Suir South	South 01	600.1	Max WS	FSU 1% AEP (Post) + 20% CC	179.72	14.98	20.533	1.93
Suir South	South 01	590.4	Max WS	FSU 1% AEP (Pre) + 20% CC	200.56	15.03	20.571	2.3
Suir South	South 01	590.4	Max WS	FSU 1% AEP (Post) + 20% CC	179.69	15.03	20.485	2.1
Suir South	South 01	585.1	Max WS	FSU 1% AEP (Pre) + 20% CC	200.55	14.93	20.455	2.73
Suir South	South 01	585.1	Max WS	FSU 1% AEP (Post) + 20% CC	179.67	14.93	20.391	2.47
Suir South	South 01	579.75			Bridge			
Suir South	South 01	574.4	Max WS	FSU 1% AEP (Pre) + 20% CC	200.48	15.39	19.608	3.55
Suir South	South 01	574.4	Max WS	FSU 1% AEP (Post) + 20% CC	179.64	15.39	19.792	3.04
Suir South	South 01	570.2	Max WS	FSU 1% AEP (Pre) + 20% CC	200.49	15.35	19.843	2.77
Suir South	South 01	570.2	Max WS	FSU 1% AEP (Post) + 20% CC	179.65	15.35	19.953	2.42
Suir South	South 02	546.8	Max WS	FSU 1% AEP (Pre) + 20% CC	246.5	13.42	19.961	1.97
Suir South	South 02	546.8	Max WS	FSU 1% AEP (Post) + 20% CC	218.76	13.42	20.042	1.72
Suir South	South 02	501.5	Max WS	FSU 1% AEP (Pre) + 20% CC	246.5	15.87	20.065	0.83
Suir South	South 02	501.5	Max WS	FSU 1% AEP (Post) + 20% CC	218.72	15.87	20.122	0.72
Suir South	South 02	499.25			Inl Struct			
Suir South	South 02	497	Max WS	FSU 1% AEP (Pre) + 20% CC	246.51	15.35	20.057	0.75
Suir South	South 02	497	Max WS	FSU 1% AEP (Post) + 20% CC	218.73	15.35	20.115	0.65
Suir South	South 02	496.9			Lat Struct			
Suir South	South 02	462.1	Max WS	FSU 1% AEP (Pre) + 20% CC	306.36	15.11	19.995	1.23
Suir South	South 02	462.1	Max WS	FSU 1% AEP (Post) + 20% CC	317.29	15.11	20.037	1.26
Suir South	South 02	446.9	Max WS	FSU 1% AEP (Pre) + 20% CC	306.36	15.04	19.991	1.23
Suir South	South 02	446.9	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	15.04	20.032	1.25
Suir South	South 02	430.4	Max WS	FSU 1% AEP (Pre) + 20% CC	306.36	14.97	19.981	1.24
Suir South	South 02	430.4	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	14.97	20.022	1.27
Suir South	South 02	413.7	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	14.9	19.966	1.33
Suir South	South 02	413.7	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	14.9	20.006	1.36
Suir South	South 02	397.2	Max WS	FSU 1% AEP (Pre) + 20% CC	306.36	14.77	19.946	1.44
Suir South	South 02	397.2	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	14.77	19.985	1.47
Suir South	South 02	380.6	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	14.65	19.935	1.5
Suir South	South 02	380.6	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	14.65	19.974	1.54
Suir South	South 02	363.8	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	14.52	19.911	1.64

1% AEP + 20% Climate Change Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Vel Chnl (m/s)
Suir South	South 02	363.8	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	14.52	19.95	1.68
Suir South	South 02	347.2	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	14.48	19.913	1.53
Suir South	South 02	347.2	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	14.48	19.954	1.56
Suir South	South 02	330.6	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	14.45	19.927	1.26
Suir South	South 02	330.6	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	14.45	19.965	1.29
Suir South	South 02	301.5	Max WS	FSU 1% AEP (Pre) + 20% CC	306.36	14.06	19.925	1.23
Suir South	South 02	301.5	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	14.06	19.963	1.26
Suir South	South 02	281	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.62	19.902	1.31
Suir South	South 02	281	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	13.62	19.939	1.34
Suir South	South 02	275	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.88	19.884	1.46
Suir South	South 02	275	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	13.88	19.895	1.51
Suir South	South 02	258.5	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.68	19.896	1.26
Suir South	South 02	258.5	Max WS	FSU 1% AEP (Post) + 20% CC	317.28	13.68	19.908	1.3
Suir South	South 02	224.9	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.44	19.863	1.53
Suir South	South 02	224.9	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.44	19.872	1.58
Suir South	South 02	199.9	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.26	19.864	1.37
Suir South	South 02	199.9	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.26	19.873	1.41
Suir South	South 02	183.4	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.54	19.858	1.37
Suir South	South 02	183.4	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.54	19.867	1.41
Suir South	South 02	166.6	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.82	19.856	1.34
Suir South	South 02	166.6	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.82	19.866	1.39
Suir South	South 02	150.1	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	14.1	19.857	1.25
Suir South	South 02	150.1	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	14.1	19.867	1.29
Suir South	South 02	133	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.89	19.852	1.25
Suir South	South 02	133	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.89	19.861	1.29
Suir South	South 02	116.4	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.67	19.848	1.26
Suir South	South 02	116.4	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.67	19.857	1.3
Suir South	South 02	99.5	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.46	19.845	1.2
Suir South	South 02	99.5	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.46	19.853	1.24
Suir South	South 02	74.9	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.36	19.831	1.29
Suir South	South 02	74.9	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.36	19.839	1.33
Suir South	South 02	52.6	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.26	19.821	1.33
Suir South	South 02	52.6	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.26	19.828	1.38
Suir South	South 02	33.2	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.38	19.812	1.33
Suir South	South 02	33.2	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.38	19.818	1.37
Suir South	South 02	16.7	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.5	19.81	1.28
Suir South	South 02	16.7	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.5	19.817	1.32

1% AEP + 20% Climate Change Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Vel Chnl (m/s)
Suir South	South 02	0	Max WS	FSU 1% AEP (Pre) + 20% CC	306.35	13.61	19.81	1.23
Suir South	South 02	0	Max WS	FSU 1% AEP (Post) + 20% CC	317.27	13.61	19.816	1.27
Suir Main	North 01	1219.4	Max WS	FSU 1% AEP (Pre) + 20% CC	583.55	13.63	20.797	1.79
Suir Main	North 01	1219.4	Max WS	FSU 1% AEP (Post) + 20% CC	583.47	13.63	20.652	1.83
Suir Main	North 01	1168.7	Max WS	FSU 1% AEP (Pre) + 20% CC	583.55	13.46	20.761	1.83
Suir Main	North 01	1168.7	Max WS	FSU 1% AEP (Post) + 20% CC	576.21	13.46	20.621	1.85
Suir Main	North 01	1168.6			Lat Struct			
Suir Main	North 01	1119.5	Max WS	FSU 1% AEP (Pre) + 20% CC	553.98	13.89	20.759	1.78
Suir Main	North 01	1119.5	Max WS	FSU 1% AEP (Post) + 20% CC	481.12	13.89	20.715	1.56
Suir Main	North 01	1067.7	Max WS	FSU 1% AEP (Pre) + 20% CC	523.68	14.02	20.713	1.95
Suir Main	North 01	1067.7	Max WS	FSU 1% AEP (Post) + 20% CC	500.58	14.02	20.632	1.89
Suir Main	North 02	1028.2	Max WS	FSU 1% AEP (Pre) + 20% CC	323.11	14	20.74	1.55
Suir Main	North 02	1028.2	Max WS	FSU 1% AEP (Post) + 20% CC	314.28	14	20.654	1.53
Suir Main	North 02	998.7	Max WS	FSU 1% AEP (Pre) + 20% CC	323.11	15.04	20.583	2.25
Suir Main	North 02	998.7	Max WS	FSU 1% AEP (Post) + 20% CC	307.26	15.04	20.478	2.2
Suir Main	North 03	945	Max WS	FSU 1% AEP (Pre) + 20% CC	277.09	14.67	20.681	0.76
Suir Main	North 03	945	Max WS	FSU 1% AEP (Post) + 20% CC	267.99	14.67	20.569	0.75
Suir Main	North 03	941	Max WS	FSU 1% AEP (Pre) + 20% CC	277.09	14.67	20.68	0.76
Suir Main	North 03	941	Max WS	FSU 1% AEP (Post) + 20% CC	267.67	14.67	20.568	0.75
Suir Main	North 03	939.1			Inl Struct			
Suir Main	North 03	937.2	Max WS	FSU 1% AEP (Pre) + 20% CC	277.09	14.19	20.665	0.67
Suir Main	North 03	937.2	Max WS	FSU 1% AEP (Post) + 20% CC	267.67	14.19	20.552	0.66
Suir Main	North 03	903.1	Max WS	FSU 1% AEP (Pre) + 20% CC	277.08	15.2	20.27	3.53
Suir Main	North 03	903.1	Max WS	FSU 1% AEP (Post) + 20% CC	266.57	15.2	20.168	3.47
Suir Main	North 03	898.65			Bridge			
Suir Main	North 03	894.2	Max WS	FSU 1% AEP (Pre) + 20% CC	277.02	15.21	19.336	4.22
Suir Main	North 03	894.2	Max WS	FSU 1% AEP (Post) + 20% CC	266.54	15.21	19.401	3.99
Suir Main	North 03	868	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	14.55	19.821	2.35
Suir Main	North 03	868	Max WS	FSU 1% AEP (Post) + 20% CC	266.53	14.55	19.831	2.25
Suir Main	North 03	840.3	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	14.55	19.782	2.37
Suir Main	North 03	840.3	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	14.55	19.796	2.27
Suir Main	North 03	818.3	Max WS	FSU 1% AEP (Pre) + 20% CC	277.05	14.47	19.941	1.36
Suir Main	North 03	818.3	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	14.47	19.942	1.31
Suir Main	North 03	768.4	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	14.1	19.884	1.59
Suir Main	North 03	768.4	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	14.1	19.889	1.53

1% AEP + 20% Climate Change Water Surface Elevations								
					Q Total	Min Ch El	W.S. Elev	Vel Chnl
River	Reach	River Sta	Profile	Plan	(m3/s)	(m)	(m)	(m/s)
Suir Main	North 03	724.3	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	14.09	19.864	1.72
Suir Main	North 03	724.3	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	14.09	19.871	1.65
Suir Main	North 03	704	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	14.1	19.874	1.54
Suir Main	North 03	704	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	14.1	19.88	1.48
Suir Main	North 03	698	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	13.63	19.877	1.52
Suir Main	North 03	698	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	13.63	19.882	1.46
Suir Main	North 03	687.4	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	14.39	19.909	1.2
Suir Main	North 03	687.4	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	14.39	19.911	1.16
Suir Main	North 03	636.4	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	14.15	19.867	1.37
Suir Main	North 03	636.4	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	14.15	19.873	1.31
Suir Main	North 03	587.7	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	14.22	19.825	1.58
Suir Main	North 03	587.7	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	14.22	19.834	1.51
Suir Main	North 03	536.7	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	14.15	19.821	1.56
Suir Main	North 03	536.7	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	14.15	19.834	1.5
Suir Main	North 03	486.3	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	13.53	19.787	1.64
Suir Main	North 03	486.3	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	13.53	19.805	1.57
Suir Main	North 03	435.2	Max WS	FSU 1% AEP (Pre) + 20% CC	277.04	13.64	19.709	1.86
Suir Main	North 03	435.2	Max WS	FSU 1% AEP (Post) + 20% CC	266.51	13.64	19.729	1.79
Suir Main	North 04	370.6	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.32	19.715	1.76
Suir Main	North 04	370.6	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.32	19.726	1.75
Suir Main	North 04	335.2	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.53	19.69	1.83
Suir Main	North 04	335.2	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.53	19.701	1.83
Suir Main	North 04	287.8	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.59	19.612	2.03
Suir Main	North 04	287.8	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.59	19.623	2.03
Suir Main	North 04	269.1	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.51	19.55	2.26
Suir Main	North 04	269.1	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.51	19.561	2.26
Suir Main	North 04	263.4			Bridge			
Suir Main	North 04	253.4	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.52	19.49	2.21
Suir Main	North 04	253.4	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.52	19.501	2.2
Suir Main	North 04	217.7	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13	19.555	1.79
Suir Main	North 04	217.7	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13	19.515	1.99
Suir Main	North 04	172.3	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.41	19.515	1.9
Suir Main	North 04	172.3	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.41	19.494	2
Suir Main	North 04	130.4	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.41	19.492	1.91
Suir Main	North 04	130.4	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.41	19.469	2.01
Suir Main	North 04	83.8	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.06	19.449	1.98
Suir Main	North 04	83.8	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.06	19.451	1.98

1% AEP + 20% Climate Change Water Surface Elevations								
River	Reach	River Sta	Profile	Plan	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Vel Chnl (m/s)
Suir Main	North 04	32.8	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.13	19.418	2.02
Suir Main	North 04	32.8	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.13	19.42	2.02
Suir Main	North 04	0	Max WS	FSU 1% AEP (Pre) + 20% CC	583.39	13.1	19.409	1.99
Suir Main	North 04	0	Max WS	FSU 1% AEP (Post) + 20% CC	583.78	13.1	19.411	1.99
Suir Channel	Channel	97.43	Max WS	FSU 1% AEP (Pre) + 20% CC	46.03	15.07	20.681	1.12
Suir Channel	Channel	97.43	Max WS	FSU 1% AEP (Post) + 20% CC	39.27	15.07	20.569	0.98
Suir Channel	Channel	91.14	Max WS	FSU 1% AEP (Pre) + 20% CC	46.03	15.2	20.65	1.35
Suir Channel	Channel	91.14	Max WS	FSU 1% AEP (Post) + 20% CC	39.22	15.2	20.545	1.17
Suir Channel	Channel	87.72			Bridge			
Suir Channel	Channel	84.3	Max WS	FSU 1% AEP (Pre) + 20% CC	46.02	15.51	20.561	1.15
Suir Channel	Channel	84.3	Max WS	FSU 1% AEP (Post) + 20% CC	39.22	15.51	20.483	0.99
Suir Channel	Channel	77.92	Max WS	FSU 1% AEP (Pre) + 20% CC	46.02	15.9	20.525	1.4
Suir Channel	Channel	77.92	Max WS	FSU 1% AEP (Post) + 20% CC	39.19	15.9	20.455	1.21
Suir Channel	Channel	68.2	Max WS	FSU 1% AEP (Pre) + 20% CC	46.02	16.17	20.548	1.16
Suir Channel	Channel	68.2	Max WS	FSU 1% AEP (Post) + 20% CC	39.16	16.17	20.473	1.01
Suir Channel	Channel	47.1	Max WS	FSU 1% AEP (Pre) + 20% CC	46.02	16.2	20.55	1.06
Suir Channel	Channel	47.1	Max WS	FSU 1% AEP (Post) + 20% CC	39.13	16.2	20.473	0.91
Suir Channel	Channel	36.95	Max WS	FSU 1% AEP (Pre) + 20% CC	46.02	16.08	20.555	0.97
Suir Channel	Channel	36.95	Max WS	FSU 1% AEP (Post) + 20% CC	39.12	16.08	20.477	0.84
Suir Channel	Channel	31.31	Max WS	FSU 1% AEP (Pre) + 20% CC	46.02	16.06	20.555	0.95
Suir Channel	Channel	31.31	Max WS	FSU 1% AEP (Post) + 20% CC	39.12	16.06	20.477	0.82

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Appendix 7.4: OPW Section 50 Application for Consent

Clifton Scannell Emerson
Associates

OPW Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010

Suir Island Infrastructure Links

Comhairle Contae Thiobraid Árann
Tipperary County Council

Client: Tipperary County Council

Date: September 2023

Job Number: 20_071

Civil Engineering | Structural Engineering | Transport Engineering | Environmental Engineering | Project Management | Health and Safety

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Document Control Sheet

Project Name:	Suir Island Infrastructure Links
Project Number:	20_071
Report Title:	OPW Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010
Filename:	RPT-20_071-019

Issue No.	Issue Status	Date	Prepared by	Checked by
0	Final	22.09.2023	HB	LP

Table of Contents

List of Tables

List of Figures

1 INTRODUCTION

1.1 Commissioning

Tipperary County Council (TCC) appointed Clifton Scannell Emerson Associates (CSEA) to undertake the Office of Public Works (OPW) Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010 for the Suir Island Infrastructure Links proposed development situated in Clonmel, County Tipperary. This report has been compiled based on the OPW guidelines "Construction, Replacement and Alteration of Bridges and Culverts – A Guide to Applying for Consent Under Section 50 of the Arterial Drainage Act, 1945_Rev 201905-3".

In support of the above Section 50 applications for the proposed Suir Island North and South pedestrian bridges, hydrodynamic modelling was completed for the Suir River. The Suir Island Hydraulic Modelling Report (RPT-20_071-055) is included in **Appendix C**. This Section 50 report highlights the findings of the hydraulic modelling report, which was used to compile the Section 50 Application Forms included in **Section 5**.

In addition to this Section 50 Application for Consent Report, consultations were held with the OPW during the review process which resulted in the compilation of a Supplementary Section 50 Report (RPT-20_071-069) which addresses the construction and operational phase concerns brought forward during the review. This supplementary report is available in **Appendix D**. Refer to **Appendix E** for the confirmation of consent from the OPW dated 22nd May 2023.

1.2 Requirements of OPW Section 50 Applications

The proposed pedestrian bridges crossing the Suir River has been designed to meet the technical requirements set out by the OPW guidelines. The key requirements set out in the OPW guidelines for the design of hydraulically efficient bridges/culverts are summarised below:

- A bridge or culvert must be capable of passing a fluvial flood flow within a 1% annual exceedance probability (AEP) or a 1 in 100-year flow without significantly changing the hydraulic characteristics of the watercourse;
- If a bridge or culvert is located within a tidal zone, it must also cater for a tide level with a 0.5% AEP or 1 in 200-year flow without significantly changing the hydraulic characteristics of the watercourse;
- A bridge must be capable of operating under the above design conditions while maintaining a freeboard of at least 300mm;
- If the land potentially affected includes dwelling and infrastructure, it must be demonstrated that those dwellings and/or infrastructure are not adversely affected by the bridge or culvert.

1.3 Layout of this Report

As per the OPW guideline recommendations, this report sets out to provide the following information:

- **Section 1** provides background information on the OPW Section 50 requirements and provided supporting information.
- **Section 2** provides an overview of the project, site and proposed bridges.
- **Section 3** highlights the hydrological assessment undertaken for the Suir River catchment.
- **Section 4** summarises the hydraulic modelling results undertaken for the Suir River.
- **Section 5** presents two Section 50 Application Forms (Revision AF50 Rev1113) prepared for both the North and South Bridge crossings.

The OPW guidelines sets out an information requirement criterion based on the Affected Land classification of a proposed development. The Suir Island pedestrian bridge crossings are located in urbanised land, containing dwellings with critical infrastructure such as transport and flood defence structures for the town of Clonmel. Table 1-1 below highlights the information provided in support of this Section 50 application to satisfy the information criterion.

Table 1-1: Information provided in support of the Section 50 application

Affected Land	Information provided											
	Impact		Survey			Hydrology		Hydraulics			Additional	
	Flood levels	Flood extents	Detailed Plan	Cross section	Topographic and aerial	Design floods	Design hydrographs	Simple hydraulic calculations	Numerical hydraulic modelling	Flood Risk Assessment	Analysis of alternative events	Joint probability analysis for fluvial and tidal events
Urban dwellings and infrastructure	√	√	√	√	√	√	√	√	√	√	√	**N/A**

The information is provided in the following Appendices as indicated in Table 2-1:

Table 1-2: Supporting information and references

Appendix A - Drawings	
Development Layouts and Sections	20_071-CSE-GEN-XX-DR-C-2251 to 2257
Bridge Layouts and Sections	20_071-CSE-GEN-XX-DR-C-2260 to 2262
Appendix B – Site Photographs	
Site Photographs	Photos 1 - 11
Appendix C – Hydraulic Modelling	
Introduction, background and data review	Section 1 to 4
Hydrological Review	Section 5
Hydraulic Modelling	Section 6 to 9

2 Project Description

The development proposes the delivery of a pedestrian plaza (North Plaza) at the Sarsfield Street/The Quay/ Quay Street junction. The proposal also includes the provision of a pedestrian path across Suir Island linking Denis Burke Park in Raheen Road to the proposed North Plaza in Sarsfield Street as shown in Figure 2-1.

Two pedestrian bridges will be delivered with the proposed development (Figure 2-2), the first bridge linking the proposed North Plaza to Suir Island (Figure 2-3), and the second bridge connecting Suir Island to Raheen Road (Figure 2-4). The second bridge will facilitate access to Denis Burke Park, creating a direct connection for pedestrians/cyclists between the park and the Town Centre. An access ramp and steps from the proposed path to the Suir Island Car Park will also be provided with the scheme.

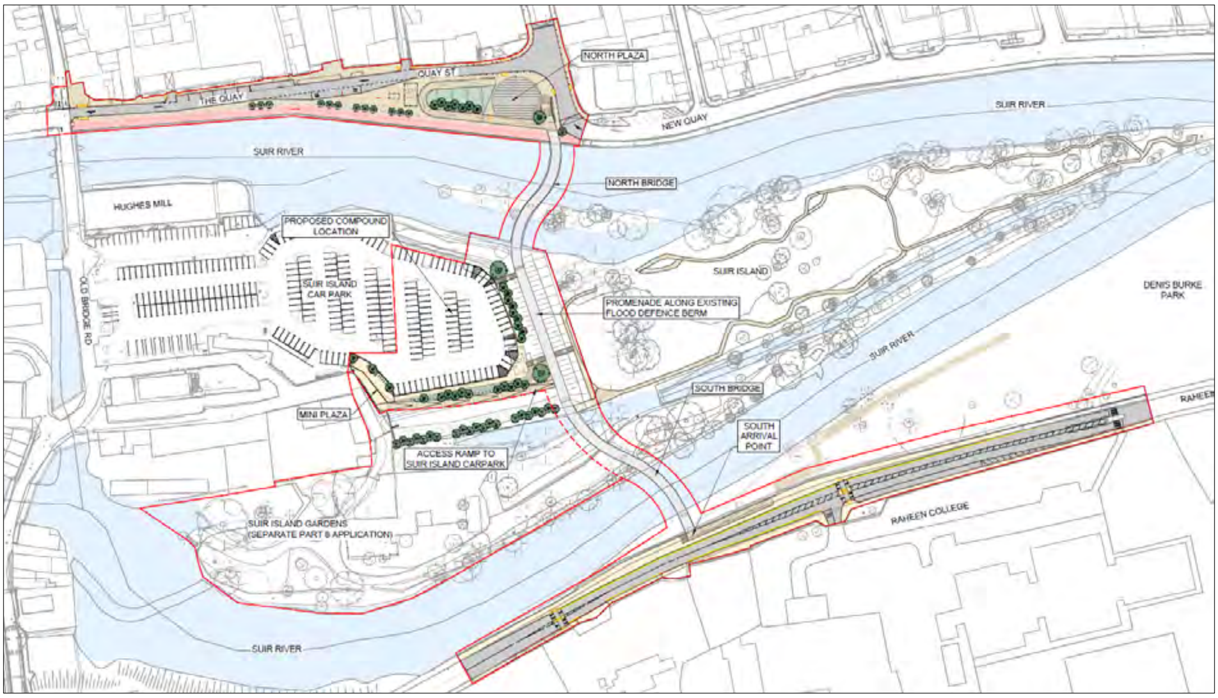


Figure 2-1: Plan layout of proposed development

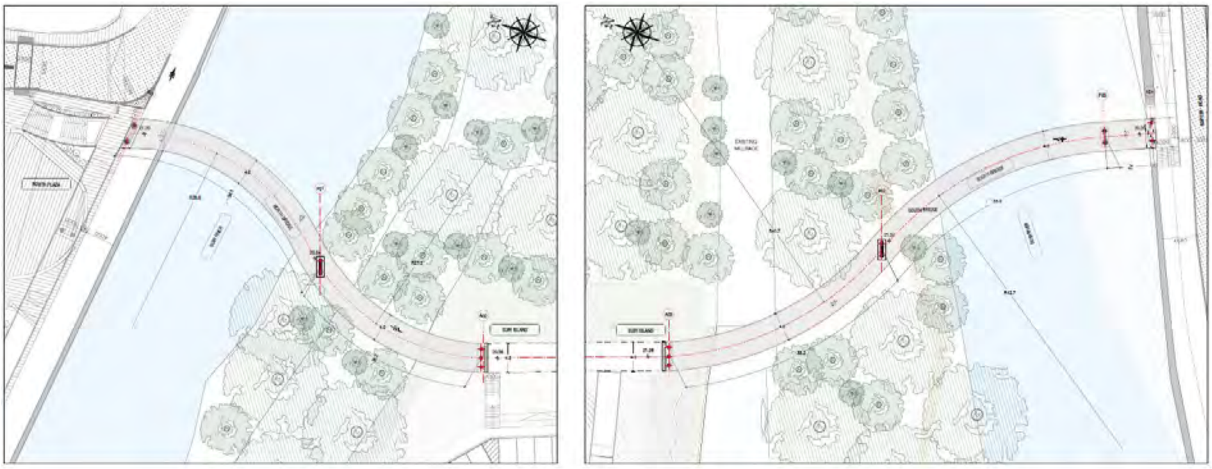


Figure 2-2: Plan layout of proposed bridges

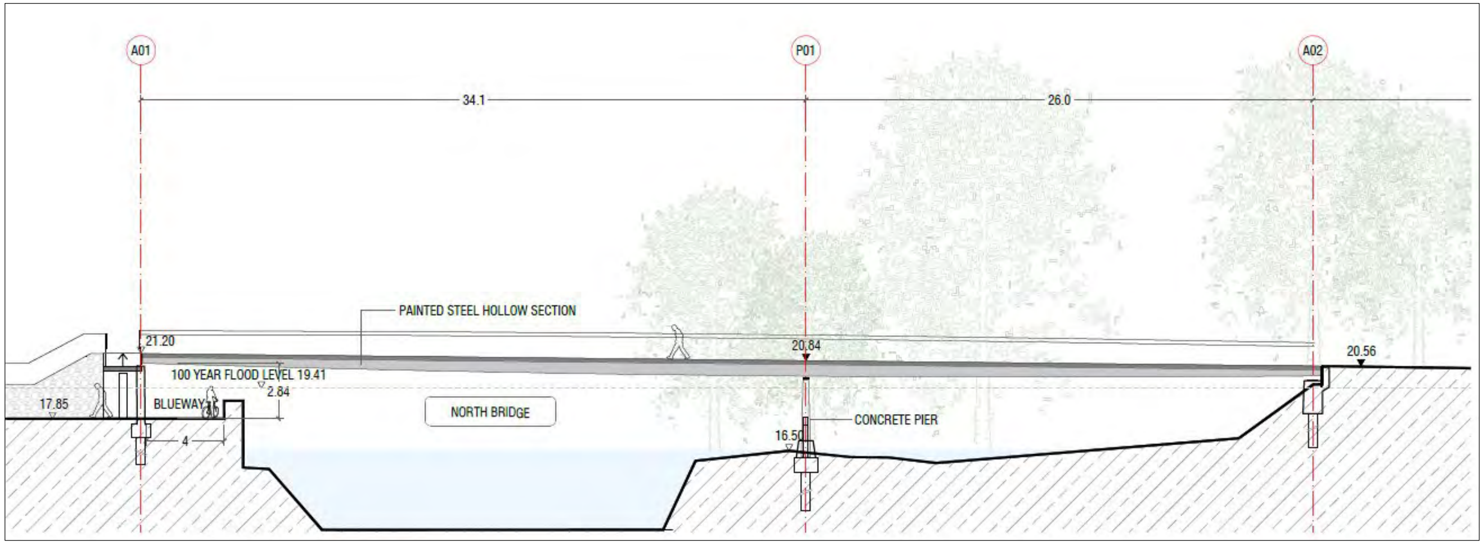


Figure 2-3: Section of proposed Northern Bridge crossing

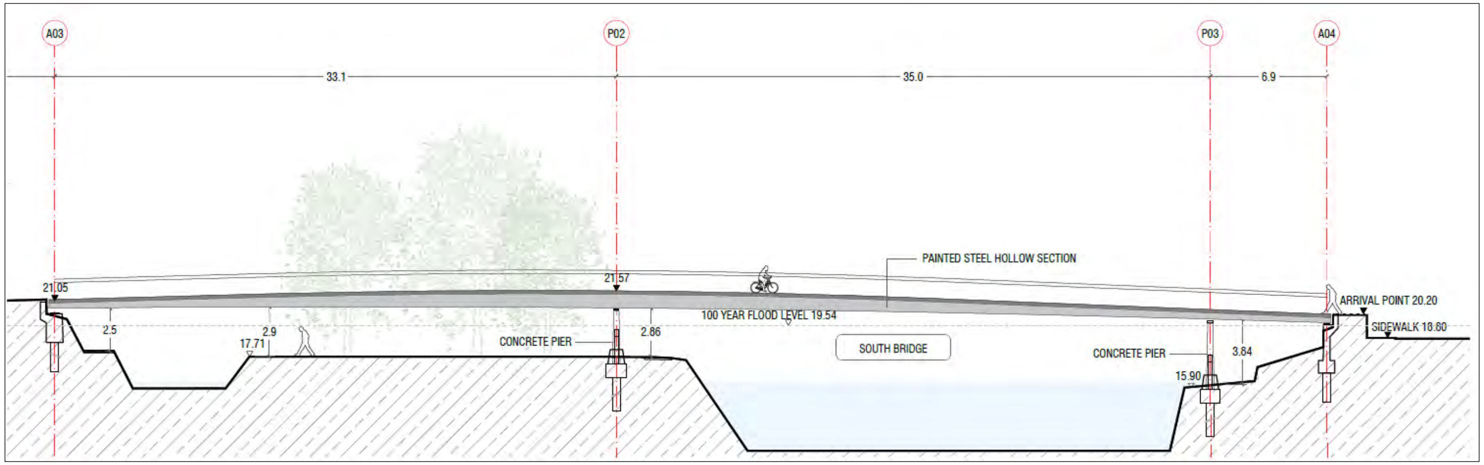


Figure 2-4: Section of proposed Southern Bridge crossing

The proposed development shown in Figure 2-1 will consist of:

- Two pedestrian bridges, the first bridge linking the proposed North Plaza on The Quay/Quay St./Sarsfield St. Junction to Suir Island, and the second bridge connecting Suir Island to Raheen Road.
- Provision of a new public open space called the North Plaza which will be aligned with Sarsfield Street. The steps and ramp will be visible from O'Connell Street creating a new landmark in the town of Clonmel and will encourage pedestrian movement towards the River Suir. The bicycle access ramp is designed to be as transparent as possible so as not to block the view of Suir Island from Sarsfield Street. This plaza is an ideal setting for impromptu performances and social gathering.
- Modification of traffic direction and carriageway width around the North Plaza and The Quay and Quay St.
- Provision of a bus stop on the western side of the North Plaza located on Quay Street with five benches providing comfortable facilities for public transport users.
- Upgrading of the existing 2-metre-wide sidewalk along Quay Street into a 4-metre-wide shared pedestrian/cycle path which will provide unencumbered access to the proposed plaza area underneath the elevated access ramp.
- Provision of a sloping landscaped terrace with public seating, located inside the hairpin-shaped access ramp leading up to the northern bridge crossing, offering unencumbered views of the plaza area.
- Provision of three benches and a 9-metre-long stepped promenade seating area integrated into the circular-shaped plaza, offering exceptional views of the proposed development.
- Planting of various native tree species around the North Plaza to integrate the proposed development with the existing scenery of Suir Island and complement the visual experience of users.
- Installation of a 4-metre-wide curved pedestrian bridge, which allow users to discover the island 'from up high' by walking seamlessly between the trees while linking the project elements (Sarsfield Street, the berm embankment, and the south riverbank) along one sinuous route. The first bridge follows the geometry of Sarsfield Street and arrives on the island following the line of the berm embankment, which then links onto the second bridge facilitating a link to Denis Burke Park on Raheen Road, creating a direct connection for pedestrians/cyclists between the park and the Town Centre.
- Provision of a pedestrian path or promenade along the existing berm embankment across Suir Island linking the two pedestrian bridges, to facilitate access between Denis Burke Park on Raheen Road and the proposed North Plaza on The Quay.
- Construction of a pedestrian/bicycle ramp from the link promenade onto Suir Island Carpark. The ramp is fully integrated into the landscape by using the existing slope of the berm.
- Construction of three sets of steps connecting the link promenade to Suir Island carpark and the eastern end of Suir Island.
- Provision of a mini public space within Suir Island Carpark at the entrance to the proposed Suir Island Gardens.
- Provision of a south arrival point for the second bridge connecting Suir Island to the Raheen Road. The South Arrival Point will consist of one access ramp to the east and one set of steps to the west, integrated with the bridge landing level and running parallel to the footpath. These elements will be located outside the existing flood barrier.
- Road improvements for the safety of pedestrians/cyclists at the South Arrival Point, including the footpaths being widened and the road narrowed to accommodate 3.0-metre-wide lanes. Removal of three carparking spaces from the southern edge of the road to allow for wider footpaths.
- Installation of two uncontrolled pedestrian crossings positioned at either ends of the proposed access ramp and flight of steps to provide traffic calming at the South Arrival Point. This bridge arrival point

will be located close to the school entrance of Raheen College, providing safe and convenient access for the schoolchildren.

- Access ramps and steps are located behind the flood barriers to allow access even during flood events.
- Construction of a new foul pumping station to be located within Suir Island car park which will facilitate future Irish Water connections. Wastewater will be pumped 0.1km approx. via rising main along the proposed bridge linking Suir Island to the proposed North Plaza where it will connect into the existing public network along The Quay.
- Ancillary site development works to include, but not limited to, surface water drainage, lighting and associated electrical works, hard and soft landscaping, road works to include surfacing and line marking, landscaping and installation of street furniture.
- All associated site works.

Within the red line site boundary, there is a development proposal adjacent to the Suir Island Infrastructure Links proposed development. The Suir Island Gardens proposed development is currently under consideration via the Part 8 planning application process. The nature and extent of the proposed development works at Suir Island Gardens is as follows:

- Renovation of existing gardens;
- Provision of lawns and landscape planting to include the provision of trees, hedges and shrubs;
- Seating and picnic areas;
- Hard and soft pathways;
- New entrance gate with adjoining wall cladding;
- Children’s play areas with associated equipment;
- Securing of Suir Island House (A Protected Structure) with decorative steel plates at ground floor level;
- Feature lighting to include internal and external lighting at Suir Island House (A Protected Structure);
- Signage;
- Ancillary site development works that shall include site drainage, provision of water supply for the play area and for wash down purposes, provision of electrical supply for the feature lighting, and removal and reconstruction of approximately 19 metres of boundary wall; and
- All associated site and landscaping works.

2.1 Site Description

The site is located south of the Clonmel Town Centre in County Tipperary. The proposed site is located in the vicinity of mixed-use urban area consisting of transport, business, leisure, residential and flood protection infrastructure/facilities. The two bridges linking the North Plaza to Suir Island and Suir Island to Raheen Road will provide direct access for pedestrians and cyclists to the Town Centre and Denis Burke Park. The site extent is shown on Drawing 2001 included in **Appendix A**.

The study area includes part of the European site, Lower River Suir Special Area of Conservation (SAC), Site Code 002137 and Zone of Archaeological Potential as designated by the National Inventory of Architectural Heritage (NIAH), with a number of other sites of cultural and architectural heritage significance in the surrounding area. Refer to **Appendix B** for photographs of the site.

2.2 Proposed Bridge Crossings

The Northern Bridge crossing (Figure 2-3), connecting the North Plaza to Suir Island, will span over the Suir River for a total distance of 60m. The North Plaza abutment, access ramp and stairs will be constructed behind the permanent flood protection wall, which has been raised by demountable barriers and the Suir Island abutment will be constructed on top of the existing flood protection berm. The clearance between the bridge soffit level and demountable barrier is 300mm. The demountable barrier provides flood protection for the 1% Annual Exceedance Probability event plus a 20% Climate Change allowance. Additional bridge parameters are summarised in Table 2-1, with dimensions measured from the North Plaza abutment to the 1 No. support pier and lastly to the abutment constructed on top of the existing flood protection berm located on Suir Island.

Table 2-1: North Bridge parameters

Parameter	Value
Bridge deck top walkway width	4m
Span (total)	60.1m
Span between supports	34.1m and 26.0m
Bridge deck levels (top)	21.20mOD, 20.84mOD, 20.56mOD
Bridge deck levels (soffit)	20.70mOD, 20.05mOD, 20.05mOD
Bridge deck to river channel invert	5.93m (max) and 3.14m (min)
Bridge deck soffit clearance above flood protection structure	300mm to demountable barrier installed on top of permanent flood defence wall
Supports and foundation	Refer to Drawing 2303 included in **Appendix A**

The South Bridge crossing (Figure 2-4), connecting Suir Island to Raheen Road and Denis Burke Park, will span the Suir River Slalom Course and Millrace for a total distance of 75m. The Suir Island abutment will be constructed on top of the flood protection berm and the Raheen Road abutment will be constructed adjacent to the existing flood protection wall. 2 No. support piers are required, one located on the northern and southern bank of the Slalom Course. Table 2-2 summarises additional parameters for the South Bridge, with dimensions measured from the Suir Island abutment to Pier 1 to Pier 2 and to the Raheen Road abutment.

Table 2-2: South Bridge parameters

Parameter	Value
Bridge deck top walkway width	4m
Span (total)	75.0m
Span between supports	33.1m, 35.0m, 6.9m
Bridge deck levels (top)	21.05mOD, 21.57mOD, 20.30mOD, 20.20mOD
Bridge deck levels (soffit)	20.60mOD, 20.59mOD, 19.87mOD, 19.73mOD
Bridge deck to river channel invert	6.97m (max) and 3.01m (min)
Bridge deck soffit clearance above flood protection structure	Bridge deck level to span over permanent flood protection wall
Supports and foundation	Refer to Drawing 2303 included in **Appendix A**

The bridge construction will include the following:

- Construction of encased bored piles at six locations for the footbridges, to avoid the use of bentonite.
- Insitu concrete poured foundations for the piers will be constructed during dry weather periods to allow access to the piers for the duration of low tidal zones.
- Provision of haul roads on the island for accessibility of machinery for pile construction and installation of bridges.
- Piers to be constructed with concrete up to the flood level height with then steel above to limit the environmental impact of the work.

- Provision of prefabricated steel structures to be transported by exceptional road convoys to site in sections.
- Prefabricated steel sections to be assembled at 3 No. locations, namely the North Plaza, Suir Island Carpark site compound and a temporary assembly platform within Denis Burke Park.
- Footbridge to be installed by crane in approx. 30m length sections into position onto the supporting piers.
- For the northern footbridge, a crane will lift half of the footbridge from the North Plaza along the north river bank while another crane will lift the other half of the footbridge from the Suir Island Carpark.
- For the southern footbridge, a crane will lift half of the footbridge from the temporary assembly platform within Denis Burke Park along the south river bank while another crane will lift the other half of the footbridge from the Suir Island Carpark.
- All site assemblies/installations are envisaged at Suir Island Carpark.

3 HYDROLOGICAL ASSESSMENT

This section of the report summarises the outcomes of the Hydrological Review covered in Section 5 of Suir Island Hydraulic Modelling Report included in **Appendix C**. The review covers key reports and studies completed for the Suir Catchment Flood Risk Assessment and Management (CFRAM) and available information from the Clonmel Flood Relief Scheme. The Flood Studies Update methodology was followed to estimate Design Peaks for the gauged catchment.

3.1 Information Review

The following information was reviewed as part of the hydrological assessment:

Suir CFRAM

The following reports were reviewed which were compiled as part of the Suir CFRAM:

- Hydraulics Report (July 2016) – Report No. 1891_REP_160711_Hydraulic_Final
- Hydrology Report, Draft Final Report (July 2015) – Report No. 1891_RP_ Hydrology Report Draft Final_Rev14
- Review of Selected River Gauges Summary Report (November 2010)
- Suir River Fluvial Flood Extents Maps No. O16CLN_EXFCD_F0_45 and 46

Clonmel Flood Relief Scheme

The following drawing was used to confirm elevations of existing flood defence assets not included in the bathymetric or topographic survey scope:

- Flood Defence Plan, Drawing No. 9986_Clonmel_Flood_Defence_Plan_03, surveyed and compiled by Murphy Surveys in July 2014 for the OPW and Mott MacDonald.

The Clonmel Flood Defence Design Report and related Hydraulic Modelling Report was not available for further review at the time of compiling this report.

Other Models

The following reports were reviewed which consists of the same ISIS (now Flood Modeller) model utilised for the design of the Clonmel Flood Relief Scheme.

- Hydraulic Modelling to Assess the Potential Impact on Flood Risk of a Proposed Development at Galloping Fields in Clonmel, Technical Note MCM6217-01, HR Wallingford (January 2009)

- Flood Risk Assessment, Clonmel Slalom Course – Report No. 349466AI_001, Mott McDonald (March 2016)

Summary

The flows shown in Table 3-1 below were extracted from the Suir CFRAM hydrology report and CFRAM Fluvial Extent Maps for Clonmel Gauge 16011.

Table 3-1: CFRAM design flows for gauge 16011 Clonmel

Gauge	50%	20%	10%	5%	2%	1%	0.5%	0.1%
CFRAM Hydrology Report	244.47	298.25	330.03	359.37	393.60	420.49	444.94	501.16
CFRAM Fluvial Maps			357.299			498.534		-

3.2 Catchment Characteristics

The OPW hydrometric gauge Clonmel 16011 was used for estimating the peak design flows. The catchment area for the gauge is shown in Figure 3-1 and catchment parameters summarised in Table 3-2. The gauge is installed on the downstream face of Old Waterford Road Gashouse Bridge located downstream of the proposed bridge crossings.

Table 3-2: Gauge 16011 Clonmel Parameters

Parameter	Value
Location Number	16011
Contributing Catchment Area	2143.6676 km^2
BFISOIL	0.6695
SAAR	1124.95 mm
FARL	0.998
DRAIND	1.045 km/km^2
S1085	0.9527 m/km
ARTDRAIN2	0
URBEXT	0.0073
Centroid distance	93.3083 km
Q_{med} (gauged)	245.32 m^3/s

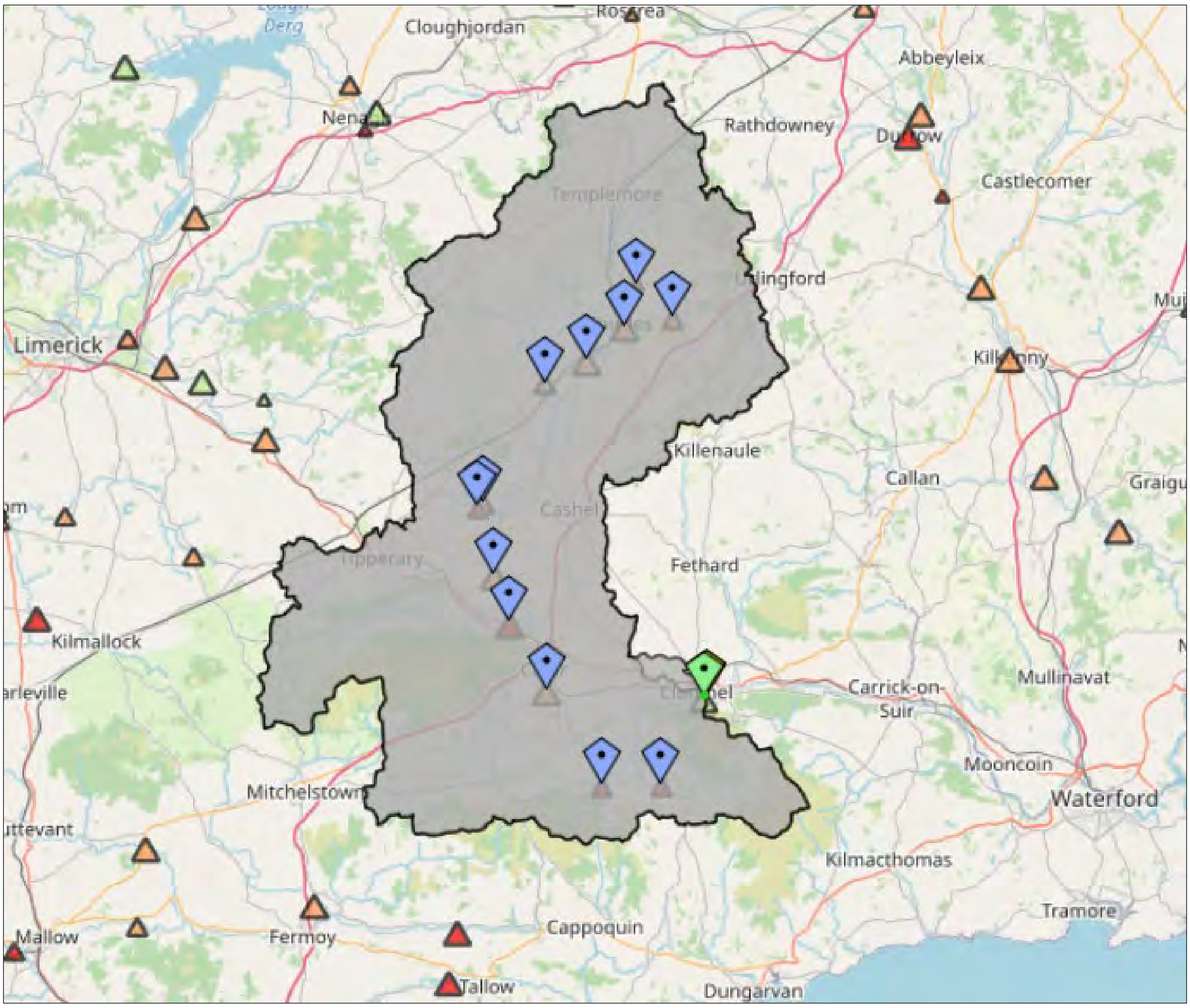


Figure 3-1: Flood Studies Update Catchments

3.3 Estimation of Design Flood Flows

The design flood flows for gauge 16011 Clonmel was estimated by following the Flood Studies Update methodology for Gauged Catchments. This methodology consists of estimating the Index Flood (Q_{med}) and Flood Frequency Analysis to determine the appropriate growth factors based on statistical analysis distribution equations. This process is covered in Sections 5.2 and 5.3 of the Hydraulic Modelling Report.

As this is a gauged catchment, the index flood is gauged as 245.32 m^3/s and does not need to be estimated as per the ungauged catchment methods. The methods to derive growth factors, consist of a Single-Site and Pooled Analysis, which results in a Combined Analysis. The outcome of these steps is summarised in Table 3-3.

As shown below, the difference between the Single-Site and Pooled Analysis resulted in a significant difference in flood peaks. As the Single-Site Analysis yielded flows comparable to that of the Suir CFRAM Fluvial Extents Maps flows (Table 3-1), which was derived from the Clonmel Flood Relief Scheme hydraulic modelling, the Single-Site flows were adopted for use in the Suir Island hydraulic modelling.

Table 3-3: Summary of FSU Flood Frequency Analysis

Single-site Analysis								
AEP	50%	20%	10%	5%	2%	1%	0.5%	0.1%
Growth Factor	1	1.26	1.44	1.6	1.82	1.98	2.14	2.52
Flows (m^3/s)	245.32	309.84	352.56	393.54	446.58	486.32	525.92	617.65
Pooled Analysis								
AEP	50%	20%	10%	5%	2%	1%	0.5%	0.1%
Flows (m^3/s)	1	1.21	1.35	1.48	1.65	1.78	1.91	2.2
Growth Factor	245.32	296.46	330.32	362.8	404.84	436.35	467.73	540.44

Climate Change Scenarios were applied to the derived peak flood flows as per The Flood Risk Management Climate Change Sectoral Adaptation Plan prepared by the Office of Public Works in September 2019 and are summarised in Table 3-4.

Table 3-4: Design peaks for present-day and future scenarios

Design Peaks including Climate Change Scenarios								
AEP	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**	**0.5%**	**0.1%**
Flow (m^3/s) (Present-day)	245.32	309.84	352.56	393.54	446.58	486.32	525.92	617.65
Flow (m^3/s) (20% CC - MRFS)	294.38	371.81	423.07	472.25	535.90	583.58	631.10	741.18
Flow (m^3/s) (30% CC - HEFS)	318.92	402.79	458.33	511.60	580.55	632.22	683.70	802.95

3.4 Estimation of Design Flood Hydrographs

The estimation of the design flood hydrographs followed the Hydrograph Width Analysis methodology included in the Flood Studies Update. This methodology is covered in Section 5.4 of the Suir Island Hydraulic Modelling Report and the design hydrographs are shown in Figure 3-2 below.

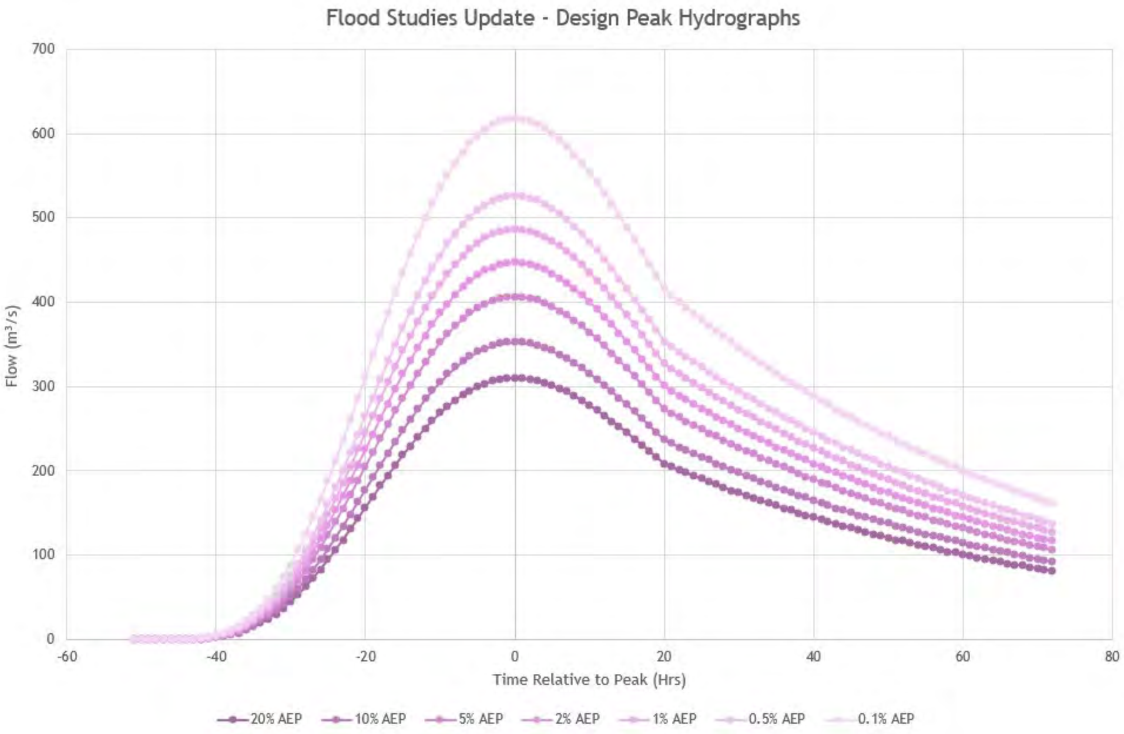


Figure 3-2: Design peak hydrographs

4 HYDRAULIC MODELLING ASSESSMENT

This section of the report summarises the key outcomes of the hydraulic modelling to confirm that the proposed design of the pedestrian bridges complies with the requirements set out in the OPW guidelines “Construction, Replacement and Alteration of Bridges and Culverts – A Guide to Applying for Consent Under Section 50 of the Arterial Drainage Act, 1945_Rev 201905-3”.

The hydraulic model was built in HEC-RAS (Version 6.2) and consists of a 1D/2D linked model. The model schematic is shown in Figure 4-1 and design flow simulations were run for the Pre- and Post-Development Scenarios to determine the effect on the flood water levels. Refer to **Appendix B** for photographs taken during the topographical and bathymetrical surveys.

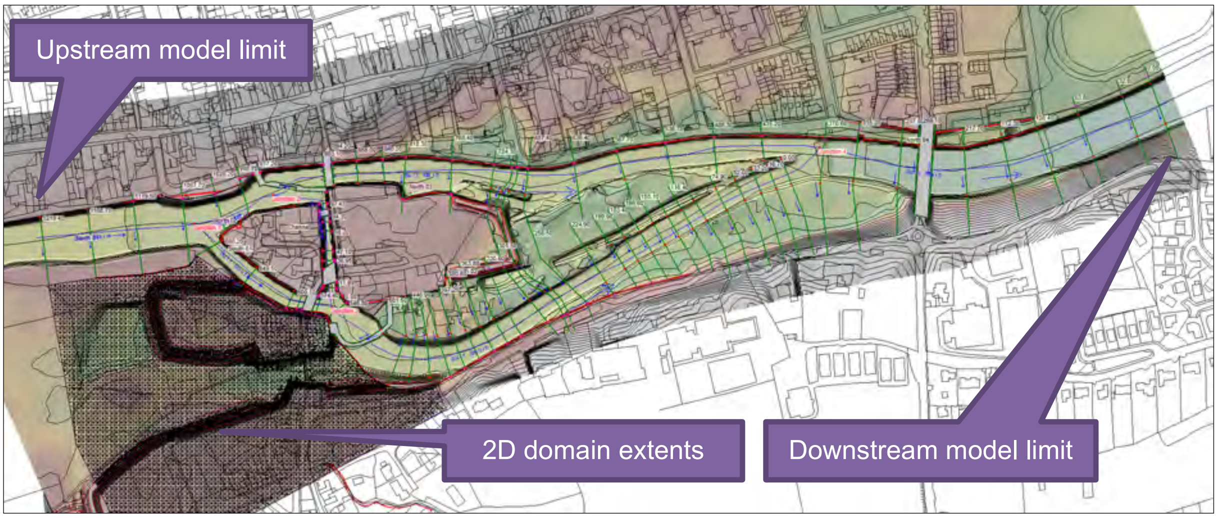


Figure 4-1: Fluvial model schematic

The following pertinent chapters are included in the Hydraulic Modelling Report:

Table 4-1: Hydraulic Modelling Report key sections and references

Description	Section/Chapter reference
Surveys and Data Collection	Section 6
Fluvial Model Development	Section 7.1
Key Model Parameters	Section 7.2
Model Limitations and Assumptions	Section 7.3
Model Calibration and Sensitivity Analysis	Section 7.4 and 7.5
Model Design Simulations	Section 7.6
Model Results	Section 8
Appendix A	Information
Appendix B	Hydrological Review FSU Report
Appendix C	Model Check File
Appendix D	Model Output and Results

4.1 Outcomes of the hydraulic model (post-development)

The proposed bridge crossings are so designed to mitigate and minimise any potential adverse impacts on the existing flood water levels and environment. As required by the OPW, the bridge abutments had to be located behind the existing flood defences with sufficient vertical clearance between the bridge deck soffit levels and flood defence structures.

The section sets out to satisfy the requirements set out in the OPW guidelines for the design of hydraulic efficient bridges:

A bridge or culvert must be capable of passing a fluvial flood flow within a 1% annual exceedance probability (AEP) or a 1 in 100-year flow without significantly changing the hydraulic characteristics of the watercourse; & A bridge must be capable of operating under the above design conditions while maintaining a freeboard of at least 300mm;

As shown in Figure 4-2 and 4-3, the proposed bridge deck elevations have sufficient freeboard between the bridge soffit levels and the 1% AEP event of approximately 0.7m and 0.45m (minimum) for the North and South Bridge crossings, respectively. Compared to the 0.1% AEP event no freeboard would be available but the proposed bridge decks will not be overtopped or significantly increase the water surface elevations.

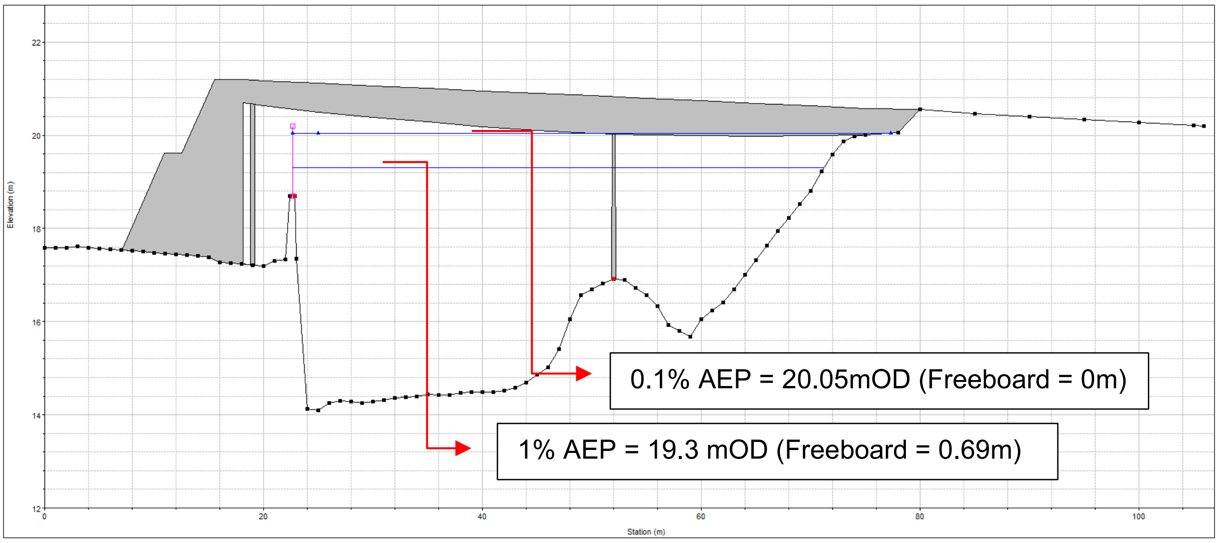


Figure 4-2: North Bridge freeboard to 1% and 0.1% AEP

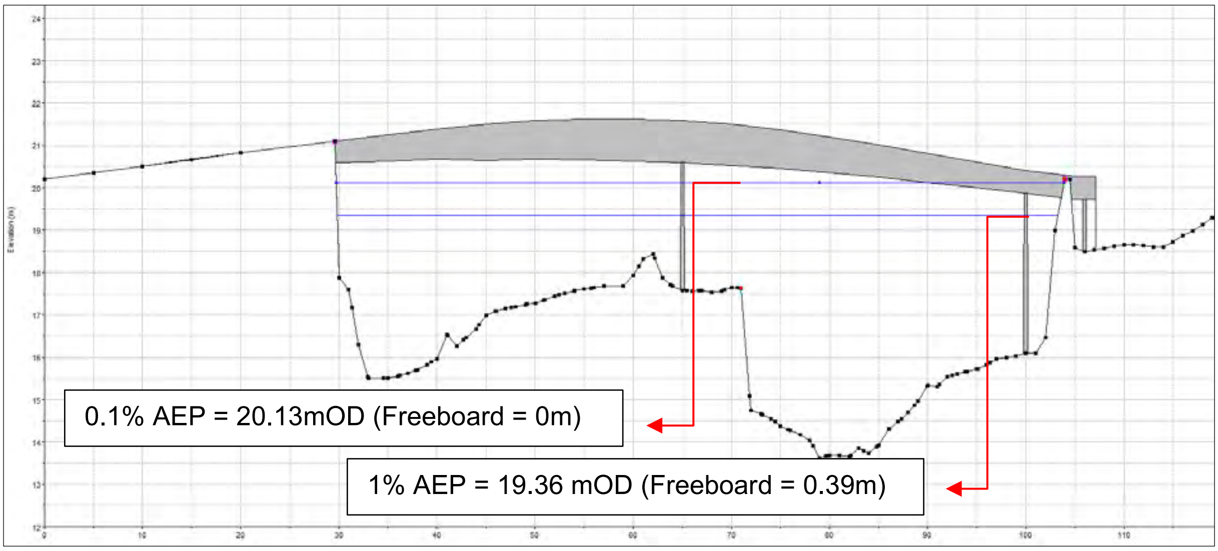


Figure 4-3: South Bridge freeboard to 1% and 0.1% AEP

<u>If the land potentially affected includes dwelling and infrastructure, it must be demonstrated that those dwellings and/or infrastructure are not adversely affected by the bridge or culvert:</u>

As per Table 4-2, the model cross sections upstream and downstream of the proposed North Bridge, consisting of 1 No. support pier constructed in the floodplain, resulted in a negligible increase in the water surface elevations for the 1% AEP event.

Table 4-2: North Bridge Increase in Water Surface Elevation

River	Reach	XS Station	Increase in WSE (m)			
			50% AEP	10% AEP	1% AEP	0.1% AEP
Suir Main	North 03	768.4	0.000	-0.002	0.004	0.041
		724.3	0.000	0.001	0.005	0.045
		704	0.001	-0.001	0.005	0.042
		701	North Bridge Centreline			
		698	0.002	-0.001	0.003	0.040
		687.4	0.002	-0.002	0.001	0.037
		636.4	0.002	0.001	0.004	0.047

As shown in Table 4-3, the South Bridge crossing containing 2 No. support piers constructed in the floodplain, resulted in a more slightly greater impact on the upstream water surface elevations of approximately 35mm for the 1% AEP event and higher energy head losses resulting in a negligible increase in downstream water levels.

Table 4-3: South Bridge Increase in Water Surface Elevation

River	Reach	XS Station	Increase in WSE (m)			
			50% AEP	10% AEP	1% AEP	0.1% AEP
Suir South	South 02	330.6	0.030	0.037	0.034	0.071
		301.5	0.030	0.036	0.035	0.070
		281	0.032	0.036	0.035	0.069
		278	South Bridge Centreline			
		275	0.000	0.007	0.008	0.043
		258.5	0.001	0.007	0.008	0.044
		224.9	0.001	0.006	0.007	0.042

If a bridge or culvert is located within a tidal zone, it must also cater for a tide level with a 0.5% AEP or 1 in 200-year flow without significantly changing the hydraulic characteristics of the watercourse;

As indicated in the Suir CFRAM hydrology report, the Suir River becomes tidal approximately 2km upstream of Carrick-On-Suir as indicated on the CFRAM Tidal Flood Extent Map No. O16COS_EXCCD_F0_07 available of the www.floodinfo.ie website. Tidal influence or joint fluvial/tidal probabilities were not considered for this study.

4.2 Outcomes of the hydraulic model (construction phase)

The temporary works sheet piling around the 3 No. piers is shown on Drawing 20_071-CSE-00-XX-DR-C-2460 included in **Appendix A**. For the proposed access route over the existing flood defence berm on Suir Island, a precast concrete culvert and sheet piling will be utilised to span the old millrace channel to reduce the footprint of the access route and maintain ecological water requirement flows through this sensitive area.

The sheet piling will be localised around each pier (c. 50m^2) with access routes as shown. The main purpose of the localised sheet piling is to:

- Provide protection against rising river water levels up to the 50% AEP levels plus an additional 300mm freeboard; and
- To minimise the ingress of groundwater into the works area and to reduce the volume of groundwater to be pumped, filtered and discharged during the construction phase.

The 50% AEP levels plus 300mm freeboard scenario was selected based on the inundation extents of more extreme events. For the 20% AEP event, the access routes to the pier locations will be inundated for all piers, which would require large-scale sheetpiling and/or protection berms to be constructed. The foundation works in the floodplains shall only be permitted during summer months.

The effect of the proposed temporary structures (Drawing 20_071-CSE-00-XX-DR-C-2460) on the existing flood water surface elevations (WSE) has been determined in the Hec-Ras model and analyses the worst-case scenario, i.e. all three temporary works areas in place at the same time.

For both the northern and southern river reaches, there is little to no variations in WSE when comparing the existing scenario (baseline) and the temporary works scenario (Temp), but with the reduction in flow area, the flow velocities increased by circa 14% to 18% and 5% to 11% for the northern and southern reaches, respectively. Refer to Table 4-4 and 4-5 below for the summary of the temporary works water surface and velocity analysis.

Table 4-4: Northern River Reach temporary works WSE

Flood AEP	WSE (Base)	V (Base) (m/s)	WSE (Temp)	V (Temp) (m/s)
50% AEP	17.64	1.47	17.60	1.67
20% AEP	18.14	1.51	18.10	1.78
10% AEP	18.45	1.53	18.40	1.79
1% AEP	19.30	1.52	19.27	1.75

Table 4-5: Southern River Reach temporary works WSE

Flood AEP	WSE (Base)	V (Base) (m/s)	WSE (Temp)	V (Temp) (m/s)
50% AEP	17.67	1.12	17.66	1.24
20% AEP	18.15	1.14	18.15	1.23
10% AEP	18.45	1.16	18.45	1.24
1% AEP	19.32	1.26	19.32	1.32

5 SECTION 50 APPLICATION FORMS

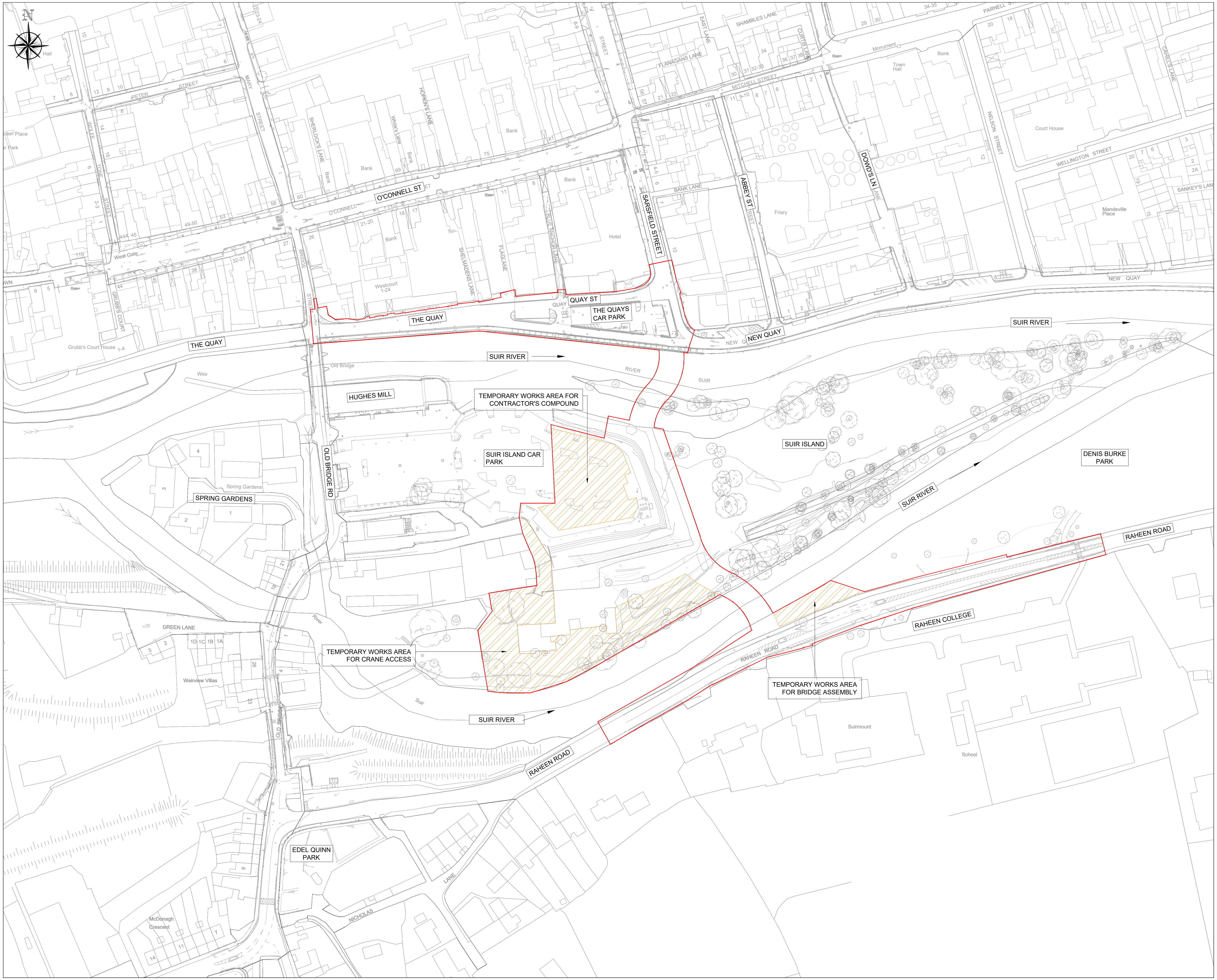
Table 5-1: Description of Section 50 Application Forms

Form No.	Description	OPW Form Revision
1.	Suir River North Bridge Crossing	AF50 Rev1113
2.	Suir River South Bridge Crossing	AF50 Rev1113

APPENDIX A – DRAWINGS

Drawing No.	Description	Scale
20_071-CSE-GEN-XX-DR-C-2001	Site Location Map	1:1000
20_071-CSE-GEN-XX-DR-C-2251	Preferred Option 01 Overall Plan	1:1000
20_071-CSE-GEN-XX-DR-C-2252	Preferred Option 01 Plan Sheet 01 of 04	1:200
20_071-CSE-GEN-XX-DR-C-2253	Preferred Option 01 Plan Sheet 02 of 04	1:200
20_071-CSE-GEN-XX-DR-C-2254	Preferred Option 01 Plan Sheet 03 of 04	1:200
20_071-CSE-GEN-XX-DR-C-2255	Preferred Option 01 Plan Sheet 04 of 04	1:200
20_071-CSE-GEN-XX-DR-C-2256	Preferred Option 01 Typical Section A, B & C	1:100
20_071-CSE-GEN-XX-DR-C-2257	Preferred Option 01 Typical Section D, E, F & G	1:100
20_071-CSE-GEN-XX-DR-C-2260	Preferred Option 01 Bridge Plan & Elevations	A.I.
20_071-CSE-GEN-XX-DR-C-2261	Preferred Option 01 Bridge Pier Sections	1:50
20_071-CSE-GEN-XX-DR-C-2262	Preferred Option 01 Bridge Details	A.I.
20_071-CSE-GEN-XX-DR-C-2450	Indicative Construction Sequence – Sheet 1	1:400
20_071-CSE-GEN-XX-DR-C-2451	Indicative Construction Sequence – Sheet 2	1:400
20_071-CSE-GEN-XX-DR-C-2452	Indicative Construction Sequence – Sheet 3	1:400
20_071-CSE-GEN-XX-DR-C-2460	Proposed Temporary Works for Northern Pier	A.I.

* A.I. – As Indicated



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Douglas Carroll
Consulting Engineers

LEGEND:

SITE BOUNDARY

TEMPORARY WORKS AREAS

Rev	Description	Drawn	Checked	Date

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: SITE LOCATION MAP

Drawn By: FO
Date: SEPT 2023
Checked By: LP
Scale: 1:1000@ A1
CSEA Job No.: 20_071

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
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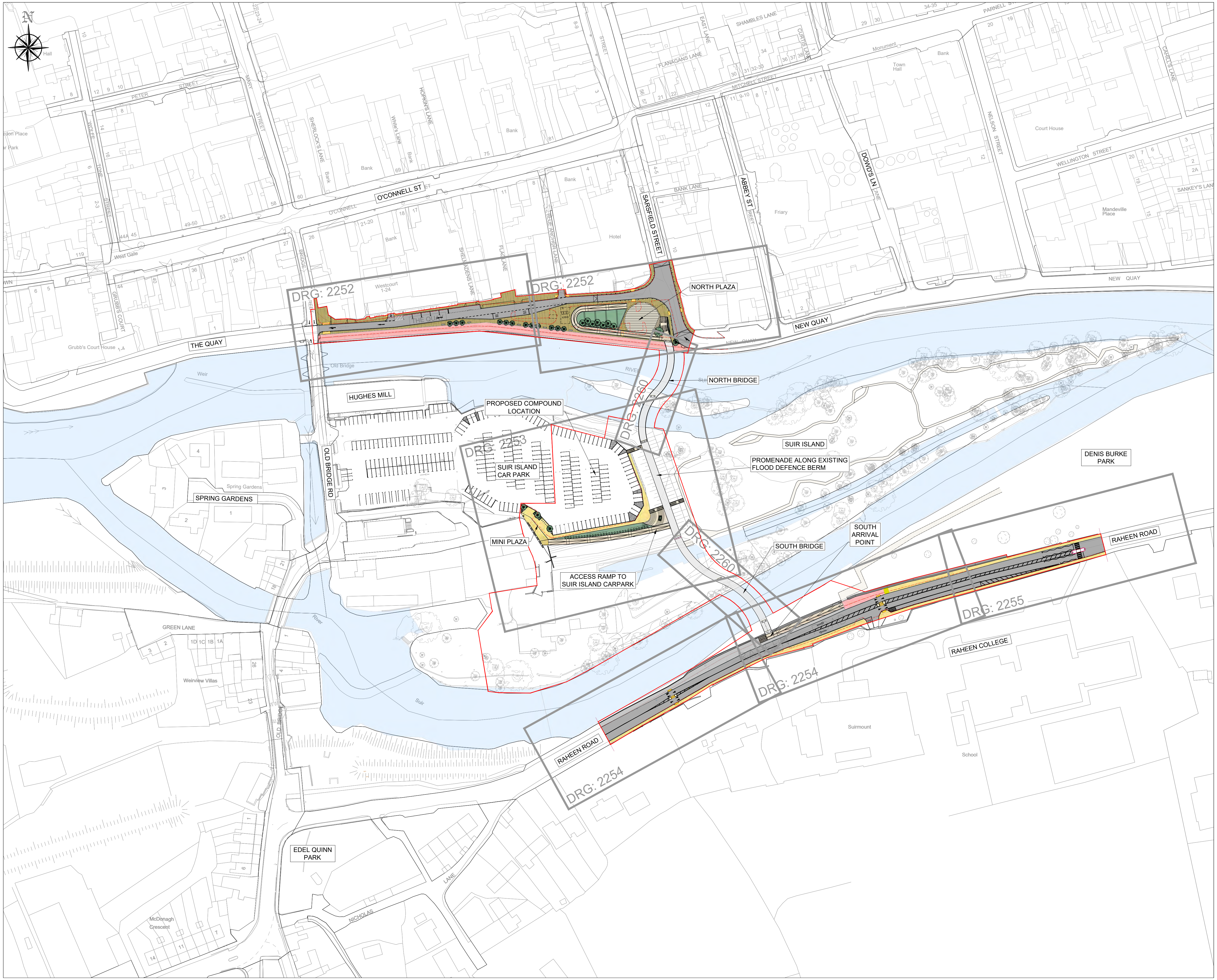
Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 — Project Status: ISSUED FOR PLANNING



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LEGEND :

- SITE BOUNDARY
- PEDESTRIAN BRIDGES - STEEL STRUCTURE - BUSH - HAMMERED CONCRETE FINISH LAID ON A WATERPROOF SURFACE
- VARIOUS SIZES OF STONE PAVING TO FOOTPATH (LIGHT GREY GRANITE AND / OR SANDSTONE)
- STONE AGGREGATE PAVING TO FOOTPATH (SILVER / SANDSTONE)
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- STONE AGGREGATE FINISH TO THE SHARED SURFACE FOR PEDESTRIANS AND BICYCLES (BEIGE/WHITE/LIGHT GREY)
- EXPOSED STONE AGGREGATE FINISH TO STEPS AND RAMP (BEIGE/WHITE/LIGHT GREY)
- GRASSED AND PLANTED AREAS
- TACTILE SURFACE TO PEDESTRIAN CROSSINGS
- STONE KERBS TO FOOTPATH
- STONE KERBS TO PLANTER BED
- EXISTING PATH LINE
- BL SELECTED BOLLARD
- PROPOSED PLANTING (SHRUBS / WILDFLOWER)
- PROPOSED TREE: **BIG TREE**-SALIX ALBA / SWEETGUM / RED MAPLE **MEDIUM TREE**-RIVER BIRCH / ALNUS GLUTINOSA / BETULA PUBESCENS CARPINUS BETULUS **SMALL TREE**-CRATAEGUS
- EXISTING TREE

Rev	Description	Drawn	Checked	Date

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Client: TIPPERARY COUNTY COUNCIL

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Dwg. Title: PREFERRED OPTION 01 OVERALL PLAN

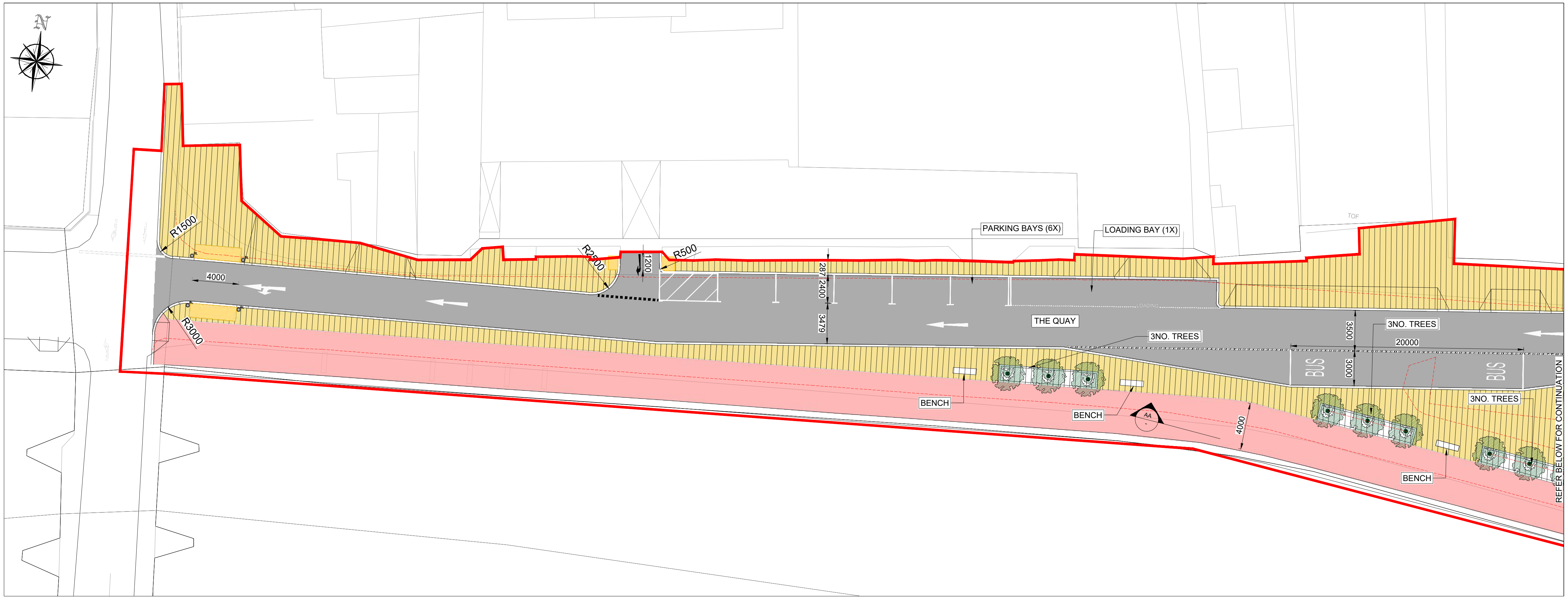
Drawn By: FO
Date: SEPT 2023
Checked By: LP
Scale: 1:1000 @ A1
CSEA Job No.: 20_071

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2251

20_071 - CSE - GEN - XX - DR - C - 2251

Status Code: S2
Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01
Project Status: ISSUED FOR PLANNING



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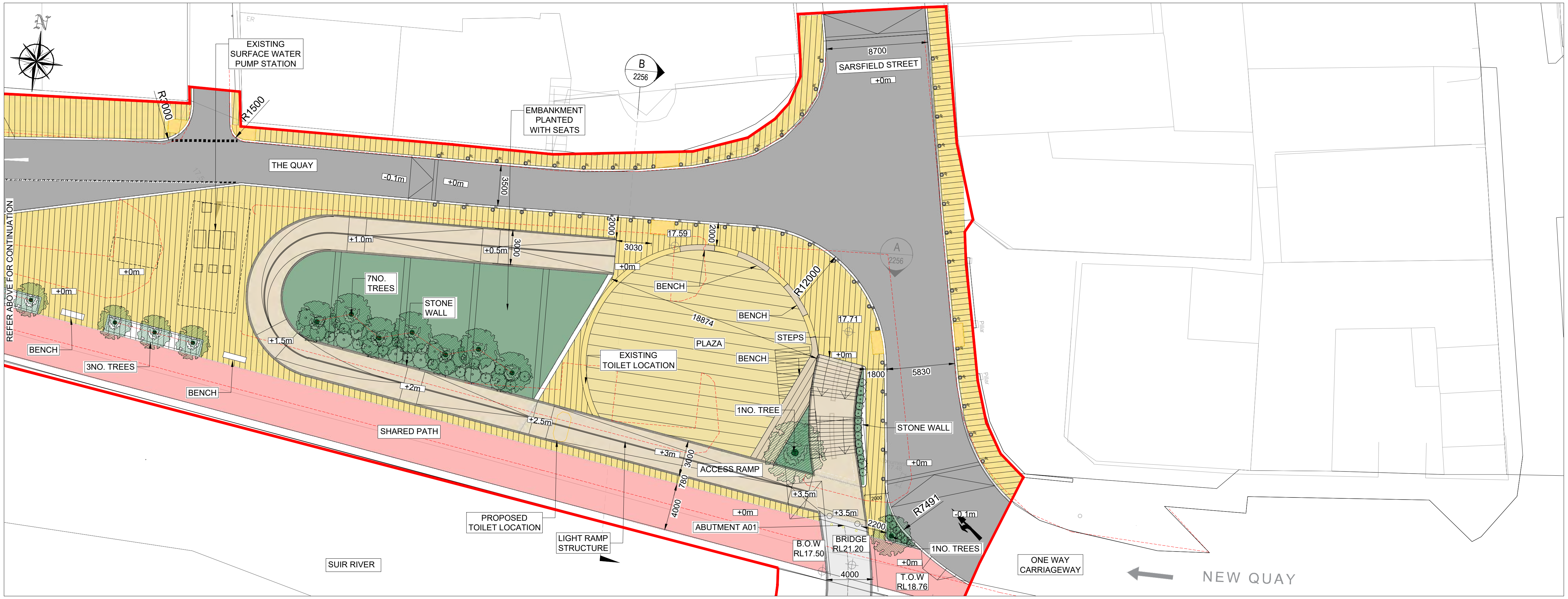

PLAN 2
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ENGINEERS — Clifton Scannell Emerson Associates

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LIGHTING CONSULTANTS — Douglas Carroll

LEGEND :

- SITE BOUNDARY
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Rev	Description	Drawn	Checked	Date

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Dwg. Title: PREFERRED OPTION 01 NORTH PLAZA PLAN SHEET 01 OF 04

Drawn By	Date	CSEA Job No.
FO	SEPT 2023	20_071

Checked By	Scale
LP	1:200@ A1

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	00	XX	DR	C	2252

20_071 - CSE - 00 - XX - DR - C - 2252

Status Code	Suitability Description
S2	SUITABLE FOR INFORMATION

Revision	Project Status
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PLAN 3
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  MEDIUM TREE-RIVER BIRCH / ALNUS GLUTINOSA / BETULA PUBESCENS CARPINUS BETULUS **SMALL TREE**-CRATAEGUS
- EXISTING TREE

Rev	Description	Drawn	Checked	Date
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Dwg. Title: PREFERRED OPTION 01 CARPARK PLAN SHEET 02 OF 04

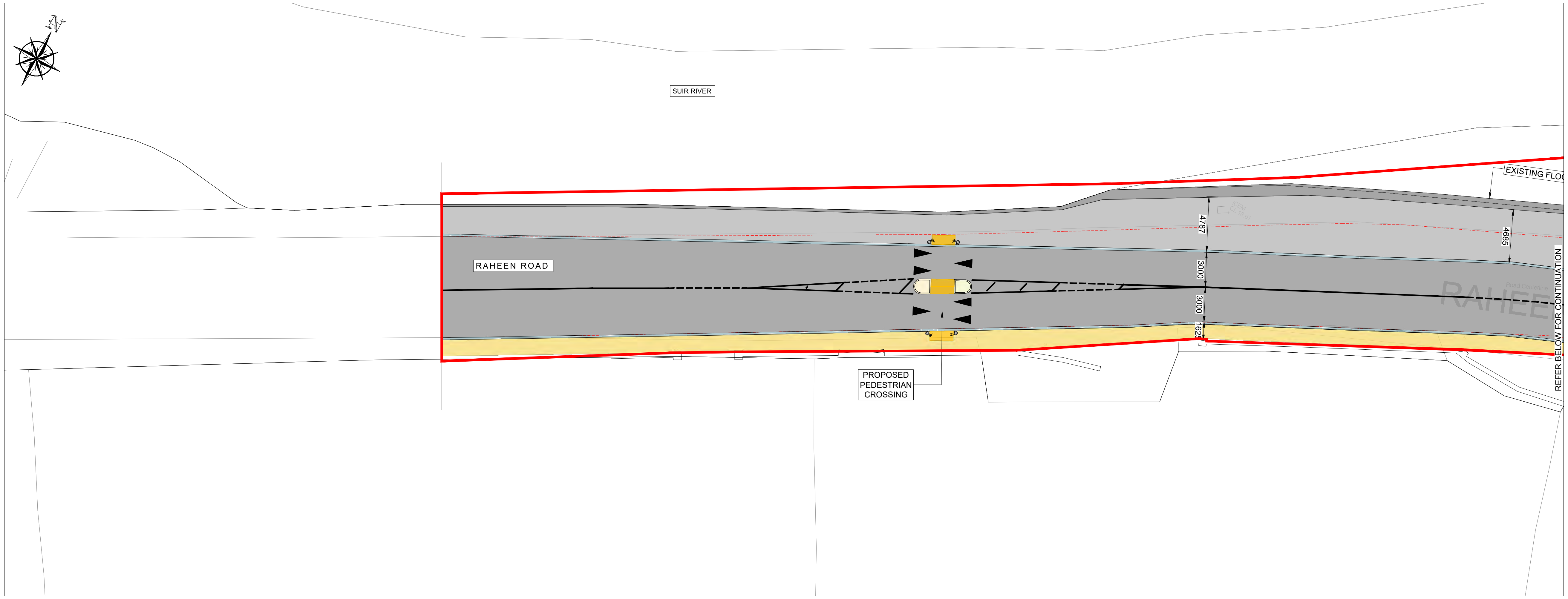
Drawn By: FO	Date: SEPT 2023		CSEA Job No.: 20_071
Checked By: LP	Scale: 1:200@ A1		

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	00	XX	DR	C	2253

20_071 - CSE - 00 - XX - DR - C - 2253

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 — Project Status: ISSUED FOR PLANNING



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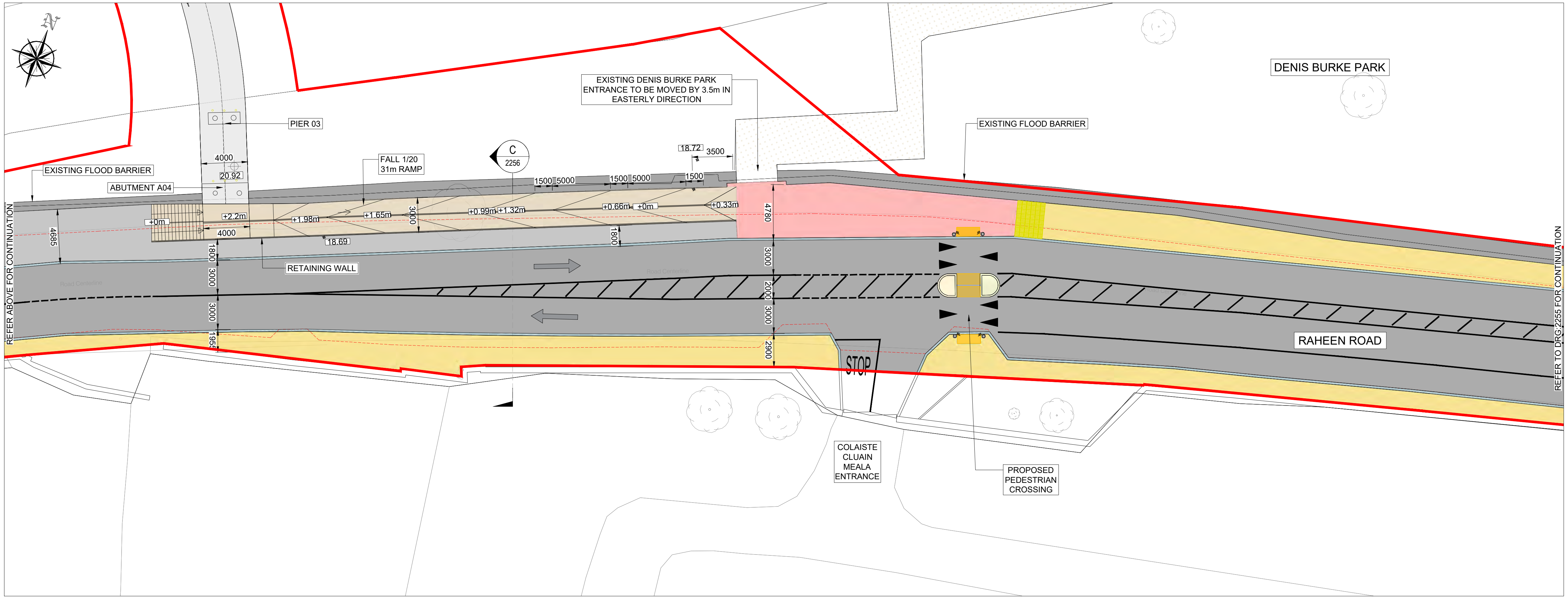

PLAN 5
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LIGHTING CONSULTANTS
Douglas Carroll
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LEGEND :

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- EXISTING TREE

Rev	Description	Drawn	Checked	Date
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Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 SOUTH ARRIVAL PLAN SHEET 03 OF 04

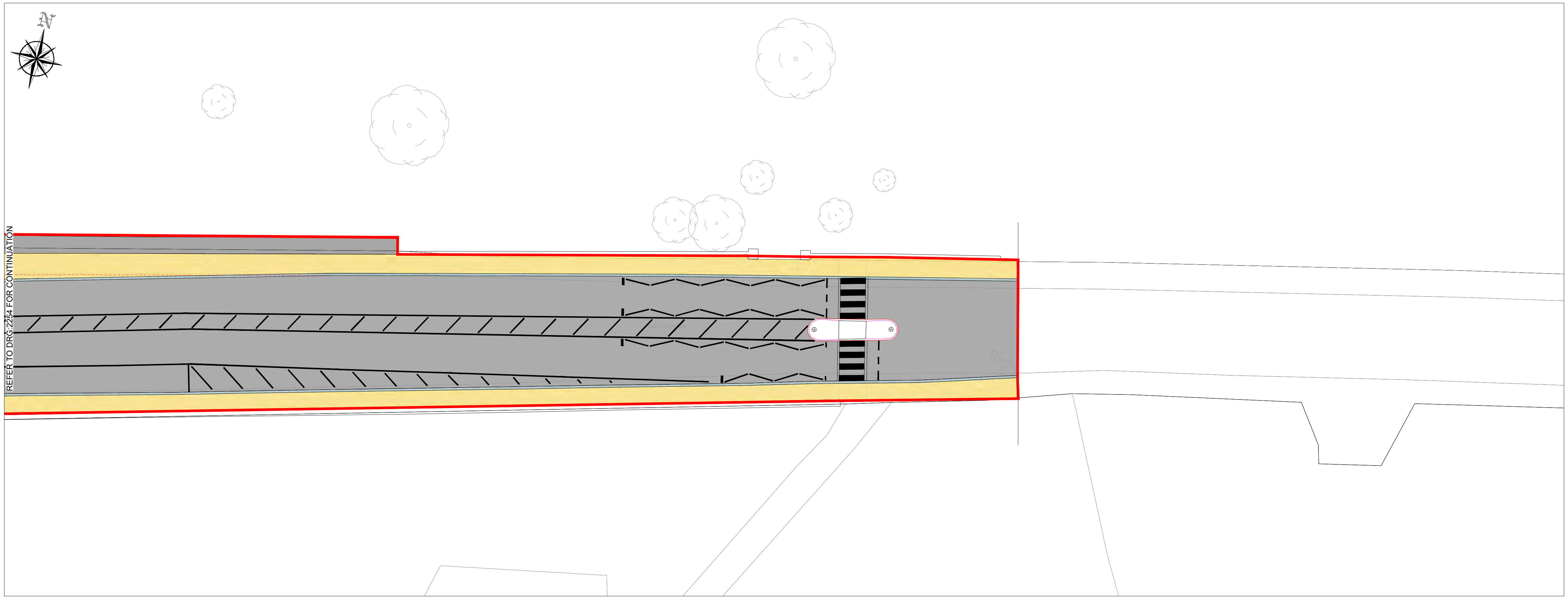
Drawn By	FO	Date	SEPT 2023	CSEA Job No.
Checked By	LP	Scale	1:200@ A1	20_071

Project Code	Originator	Zone/Phase	Level	Type	Role	Dwg. No.
20_071	CSE	00	XX	DR	C	2254

20_071 - CSE - 00 - XX - DR - C - 2254

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 — Project Status: ISSUED FOR PLANNING



DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS

dhbarchitects

ARCHEOLOGISTS

CourtneyDeery

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS

awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

LEGEND :

- SITE BOUNDARY
- PEDESTRIAN BRIDGES - STEEL STRUCTURE - BUSH - HAMMERED CONCRETE FINISH LAID ON A WATERPROOF SURFACE
- VARIOUS SIZES OF STONE PAVING TO FOOTPATH (LIGHT GREY GRANITE AND / OR SANDSTONE)
- STONE AGGREGATE PAVING TO FOOTPATH (SILVER / SANDSTONE)
- ASPHALT FINISH TO ROAD & SHARED SURFACE
- STONE AGGREGATE FINISH TO THE SHARED SURFACE FOR PEDESTRIANS AND BICYCLES (BEIGE/WHITE/LIGHT GREY)
- EXPOSED STONE AGGREGATE FINISH TO STEPS AND RAMP (BEIGE/WHITE/LIGHT GREY)
- GRASSED AND PLANTED AREAS
- TACTILE SURFACE TO PEDESTRIAN CROSSINGS
- STONE KERBS TO FOOTPATH
- STONE KERBS TO PLANTER BED
- EXISTING PATH LINE
- BL SELECTED BOLLARD
- PROPOSED PLANTING (SHRUBS / WILDFLOWER)
- PROPOSED TREE:
  BIG TREE-SALIX ALBA / SWEETGUM / RED MAPLE
  MEDIUM TREE-RIVER BIRCH / ALNUS GLUTINOSA / BETULA PUBESCENS CARPINUS BETULUS **SMALL TREE**-CRATAEGUS
- EXISTING TREE

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23
Rev	Description	Drawn	Checked	Date

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 SOUTH ARRIVAL PLAN SHEET 04 OF 04

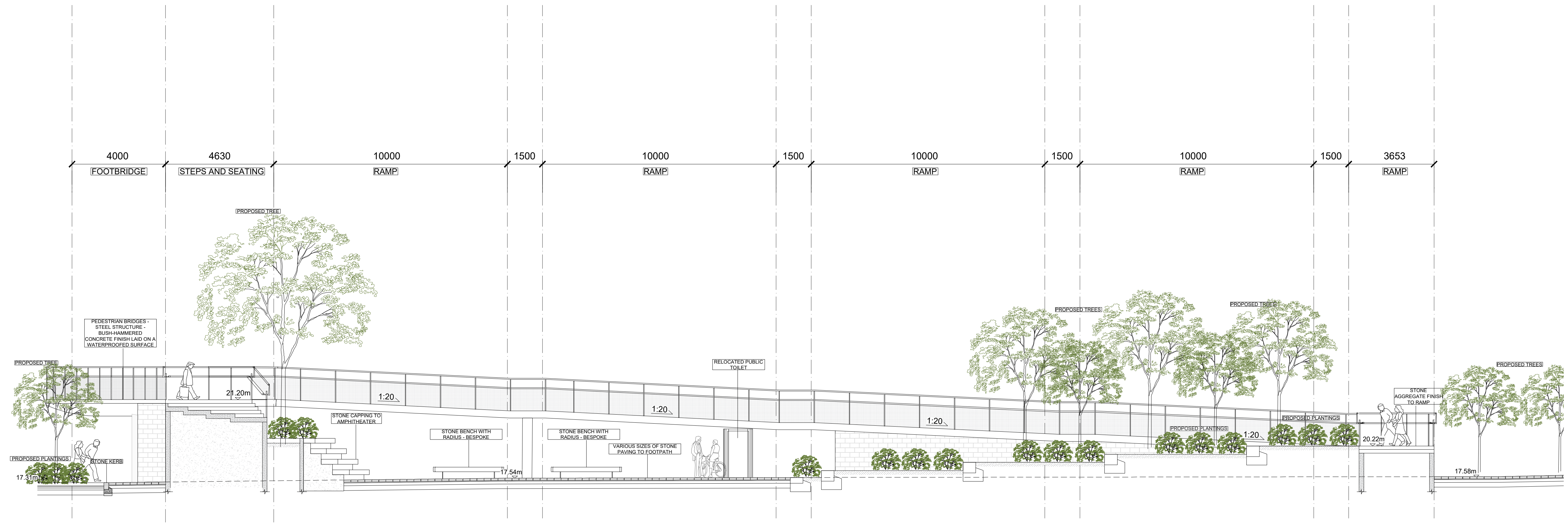
Drawn By: FO	Date: SEPT 2023	20_071	
Checked By: LP	Scale: 1:200@ A1	CSEA Job No.	

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	00	XX	DR	C	2255

20_071 - CSE - 00 - XX - DR - C - 2255

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

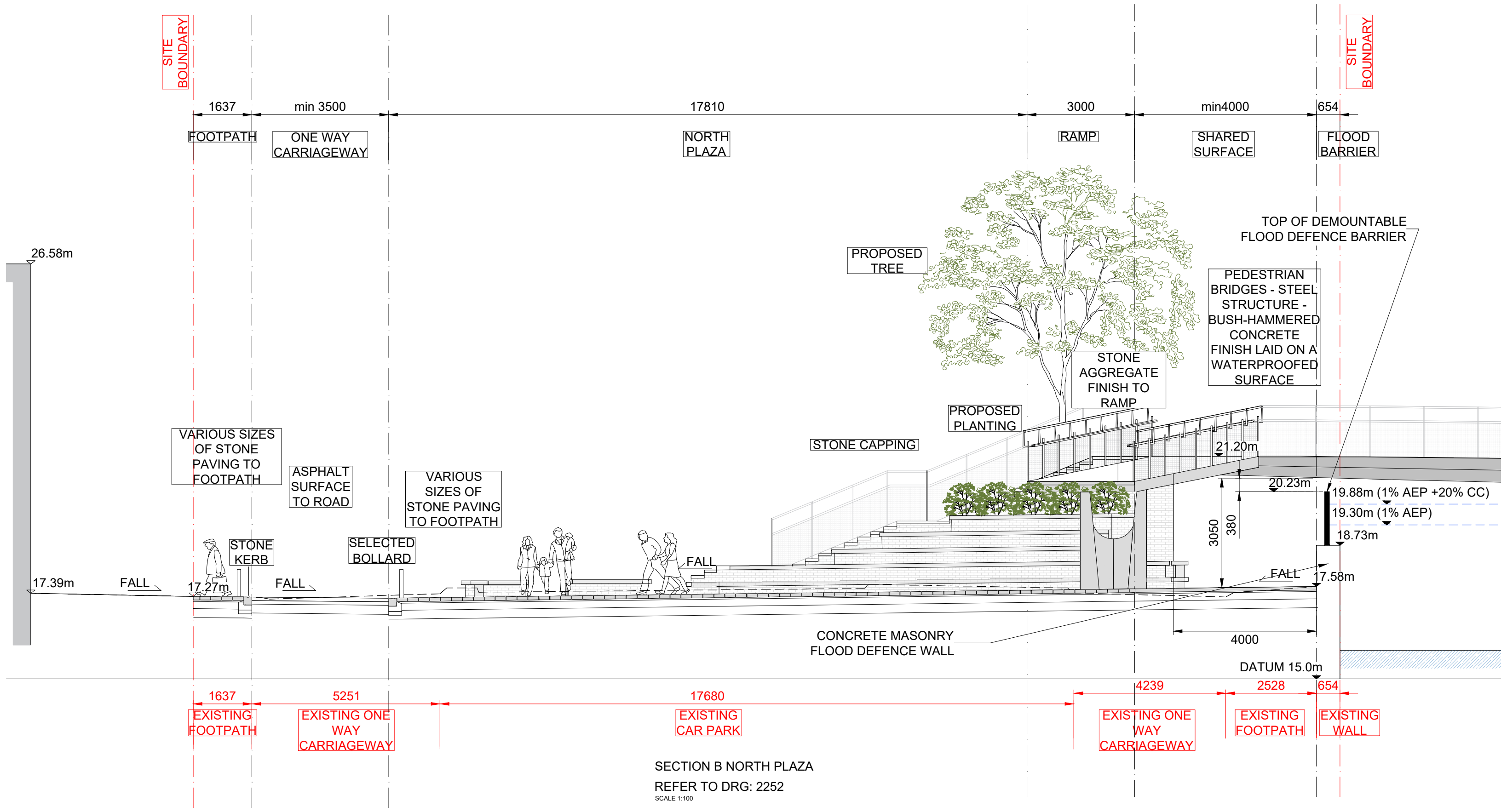
Revision: PL01 — Project Status: ISSUED FOR PLANNING



SECTION A NORTH PLAZA

REFER TO DRG: 2252

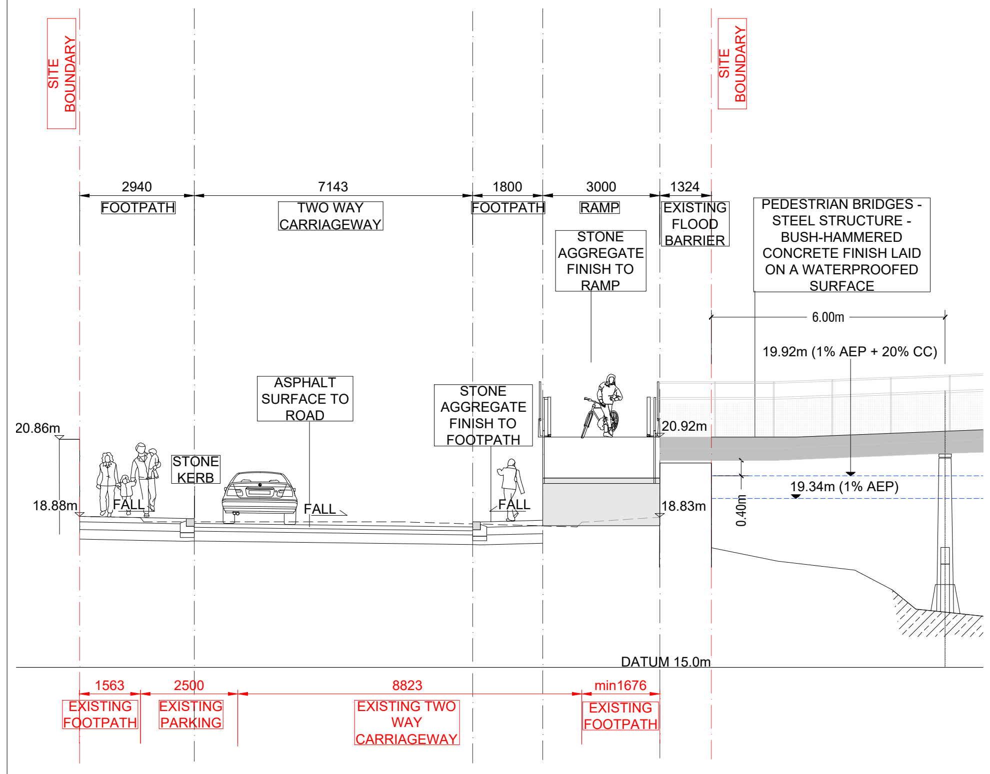
SCALE 1:100



SECTION B NORTH PLAZA

REFER TO DRG: 2252

SCALE 1:100



SECTION C RAHEEN ROAD ARRIVAL POINT

REFER TO DRG: 2255

SCALE 1:100

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS

dhbarchitects

ARCHEOLOGISTS

CourtneyDeery

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS

awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

Rev	Description	Drawn	Checked	Date
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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 TYPICAL SECTIONS A, B & C

Drawn By: FO | Date: SEPT 2023 | 20_071

Checked By: LP | Scale: 1:100@ A1 | CSEA Job No.

Project Code - Originator - Zone/Phase - Level - Type - Role - Dwg. No.

20_071 - CSE - GEN - XX - DR - C - 2256

Status Code: S2 | Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 | Project Status: ISSUED FOR PLANNING

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

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dhbarchitects

ARCHEOLOGISTS

CourtneyDeery

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

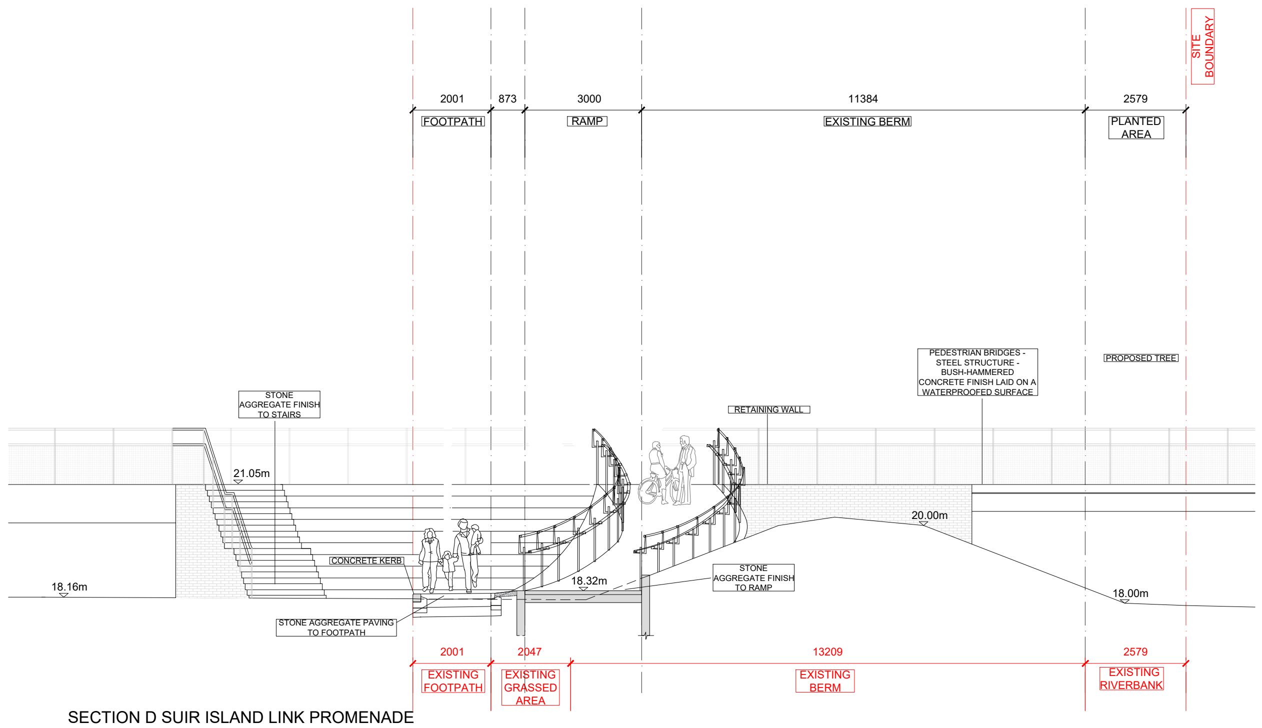
Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS

awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS

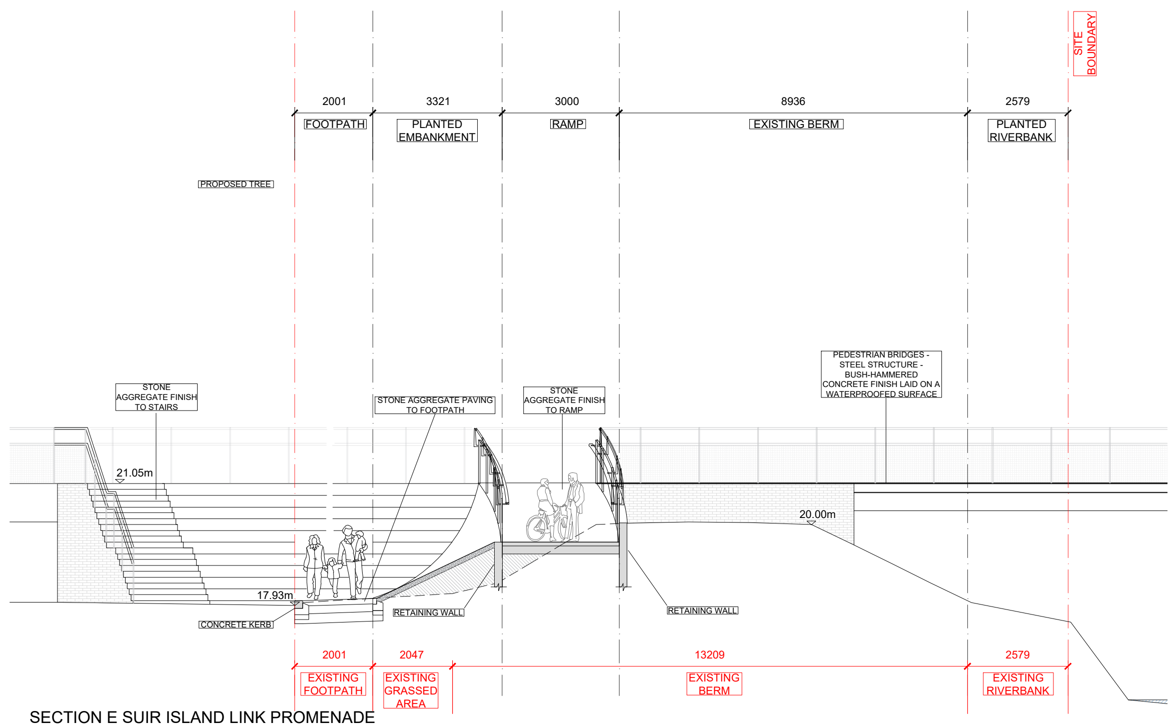
Douglas Carroll
Consulting Engineers



SECTION D SUIR ISLAND LINK PROMENADE

REFER TO DRG: 2254

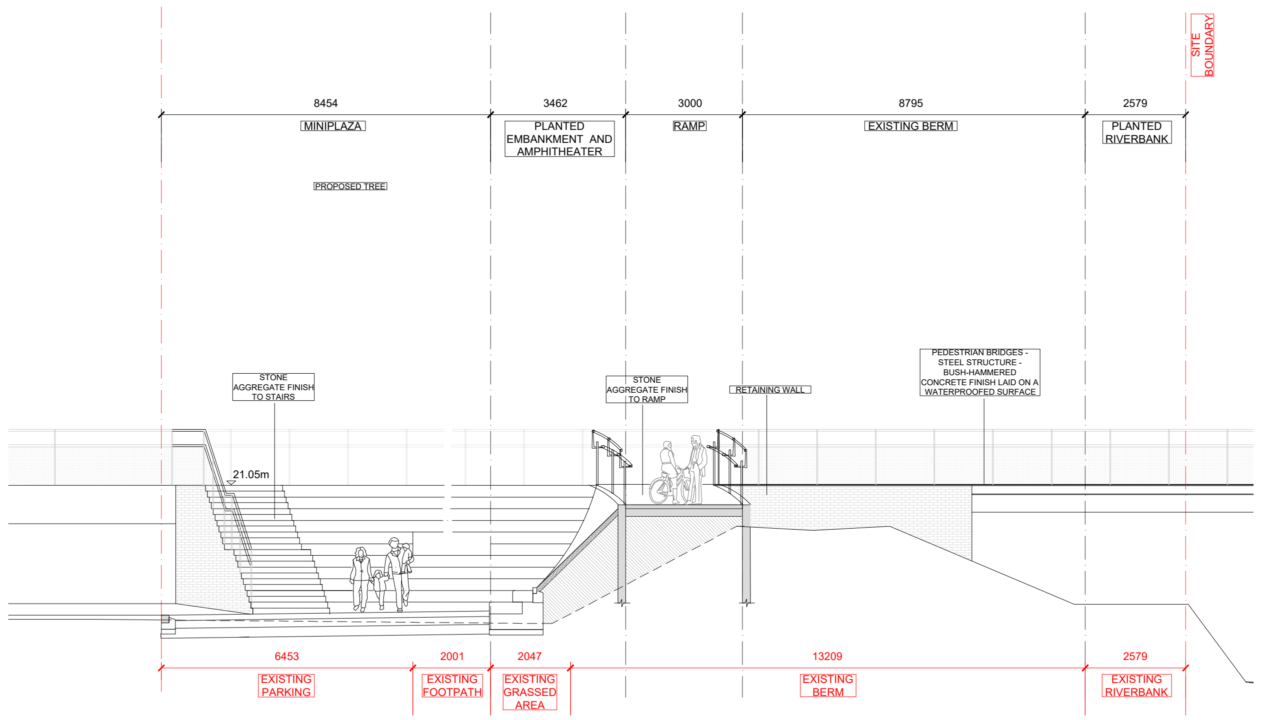
SCALE 1:100



SECTION E SUIR ISLAND LINK PROMENADE

REFER TO DRG: 2254

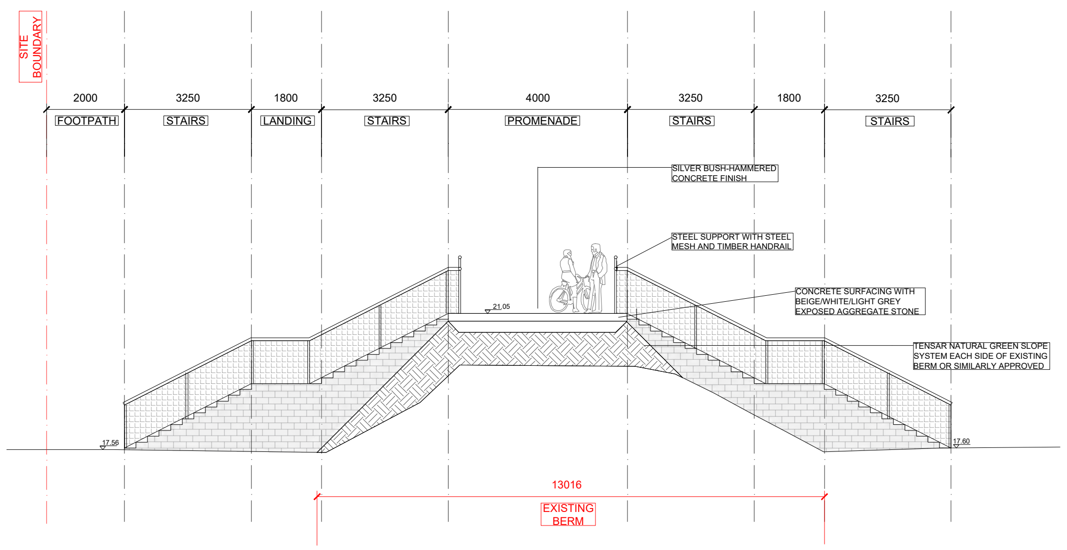
SCALE 1:100



SECTION F SUIR ISLAND LINK PROMENADE

REFER TO DRG: 2254

SCALE 1:100



SECTION G SUIR ISLAND LINK PROMENADE

REFER TO DRG: 2254

SCALE 1:100

Rev	Description	Drawn	Checked	Date

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 TYPICAL SECTIONS D, E, F & G

Drawn By: FO	Date: SEPT 2023		20_071
Checked By: LP	Scale: 1:100@ A1		CSEA Job No.

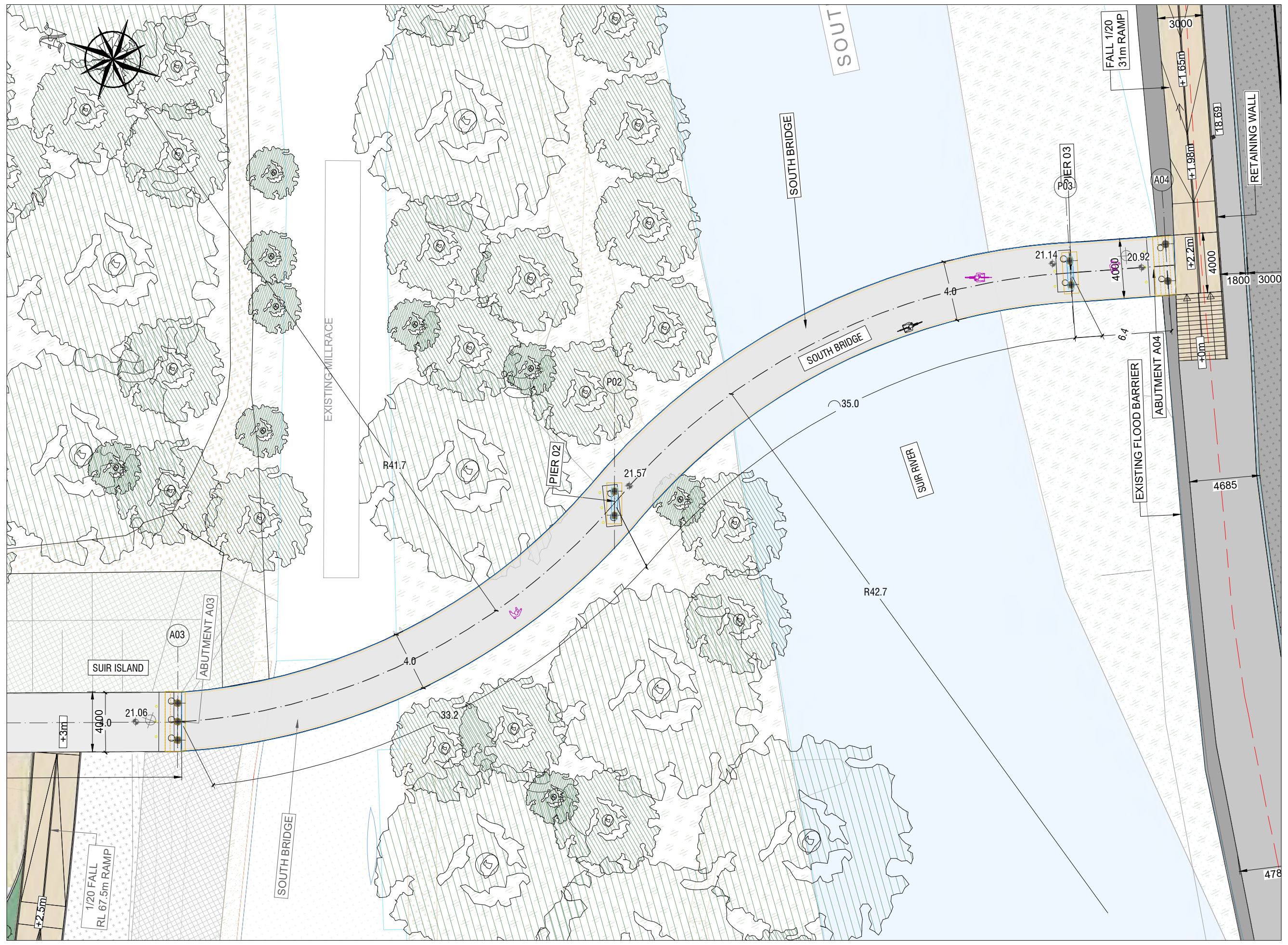
Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2257

20_071 - CSE - GEN - XX - DR - C - 2257

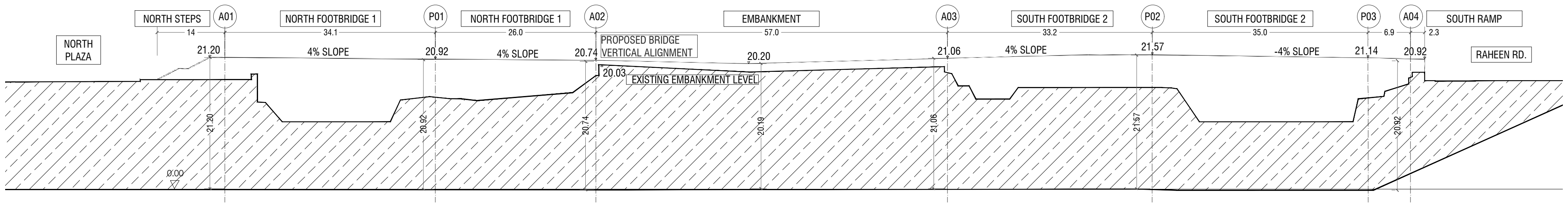
Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 — Project Status: ISSUED FOR PLANNING

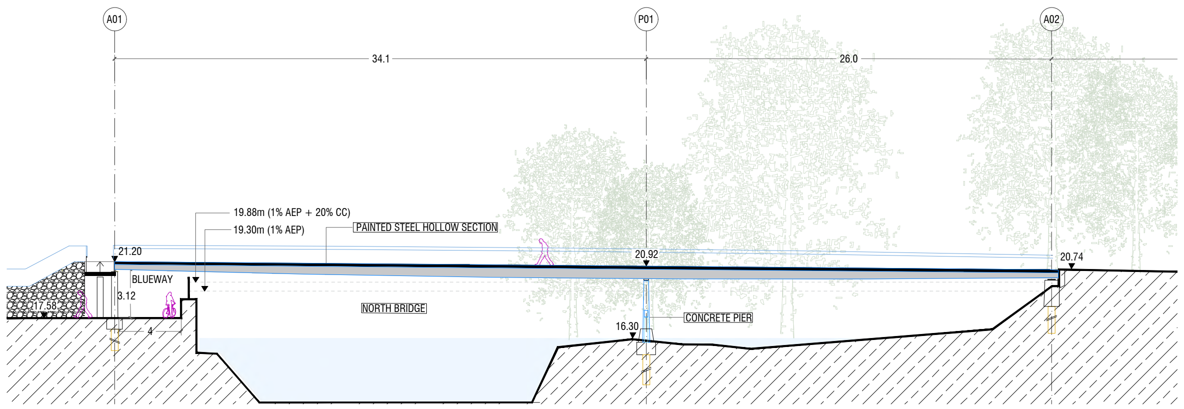
SITE PLAN NORTH BRIDGE 1/250



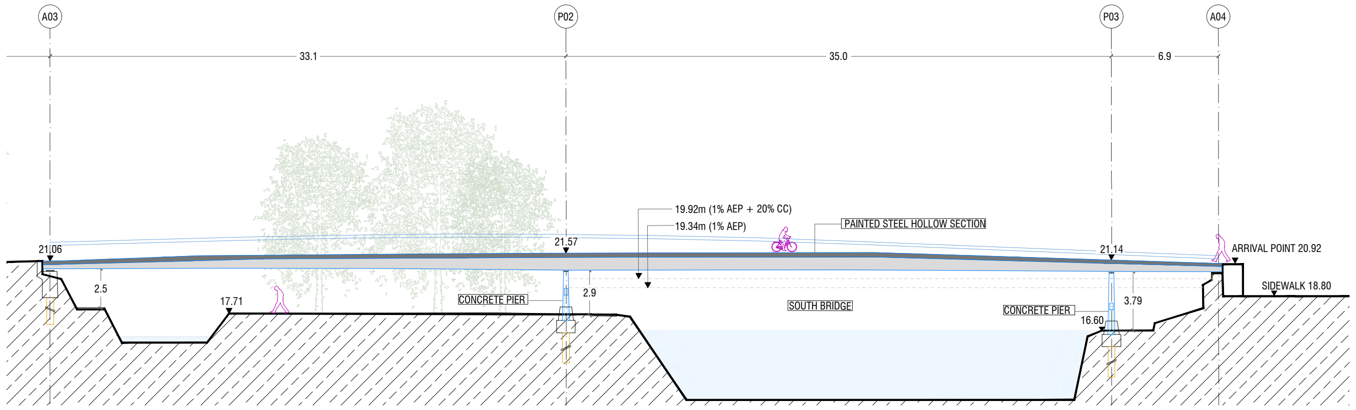
SITE PLAN SOUTH BRIDGE 1/250



VERTICAL ALIGNMENT 1/500



ELEVATION NORTH BRIDGE 1/250



ELEVATION SOUTH BRIDGE 1/250

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

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dhbarchitects

ARCHEOLOGISTS

CourtneyDeery

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

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ENVIRONMENTAL CONSULTANTS

awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

NOTES:

A0X = ABUTMENT FOUNDATION NUMBER X
P0X = PIER FOUNDATION NUMBER X

Rev	Description	Drawn	Checked	Date
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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

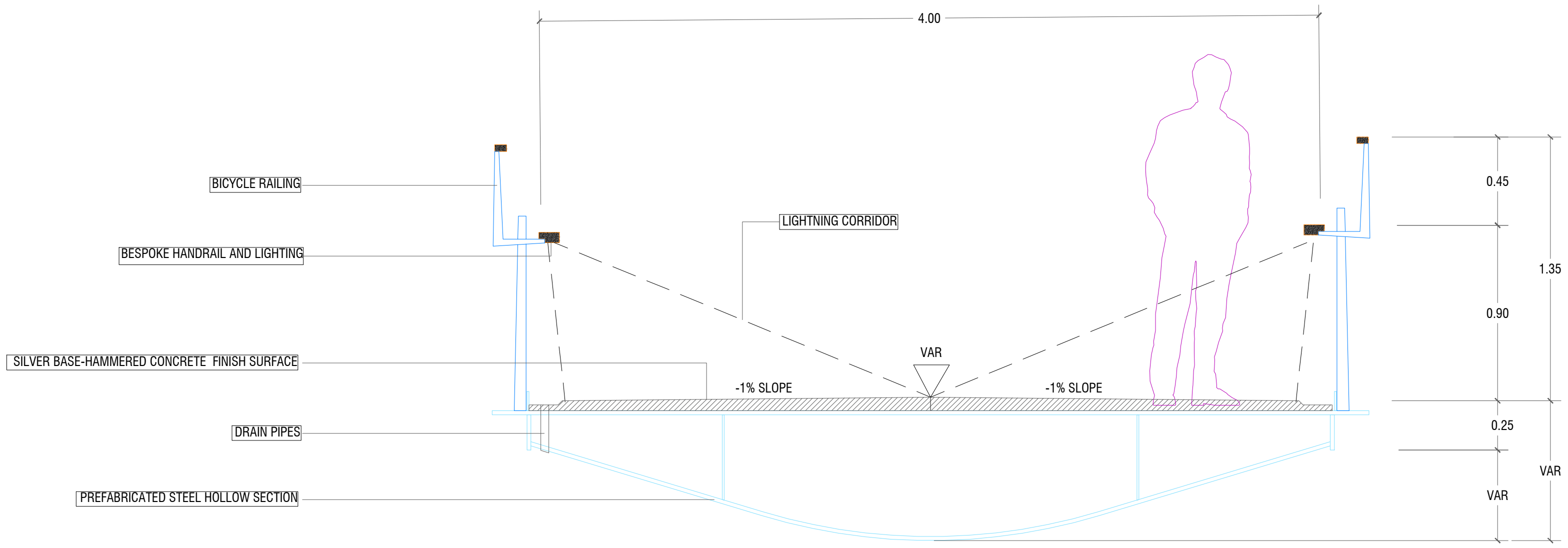
Dwg. Title: PREFERRED OPTION 01 BRIDGE PLAN & ELEVATIONS

Drawn By: FO
Date: SEPT 2023
Checked By: LP
Scale: AS INDICATED @ A1
CSEA Job No.: 20_071

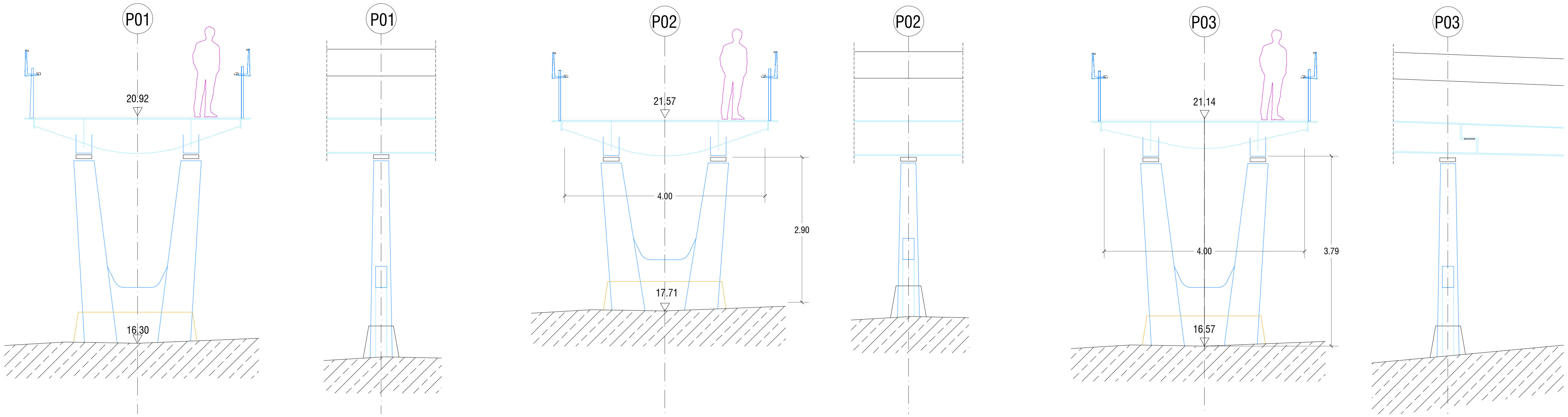
Project Code	Originator	Zone/Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2260

Status Code: S2
Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01
Project Status: ISSUED FOR PLANNING



TYPICAL BRIDE SUPERSTRUCTURE CROSS SECTION 1/20



TYPICAL SUPPORT PIER CROSS SECTIONS 1/50

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS

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ARCHEOLOGISTS

CourtneyDeery

BRIDGES

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ENGINEERS

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ENVIRONMENTAL CONSULTANTS

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A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

NOTES:

A0X = ABUTMENT FOUNDATION NUMBER X
P0X = PIER FOUNDATION NUMBER X

Rev	Description	Drawn	Checked	Date

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

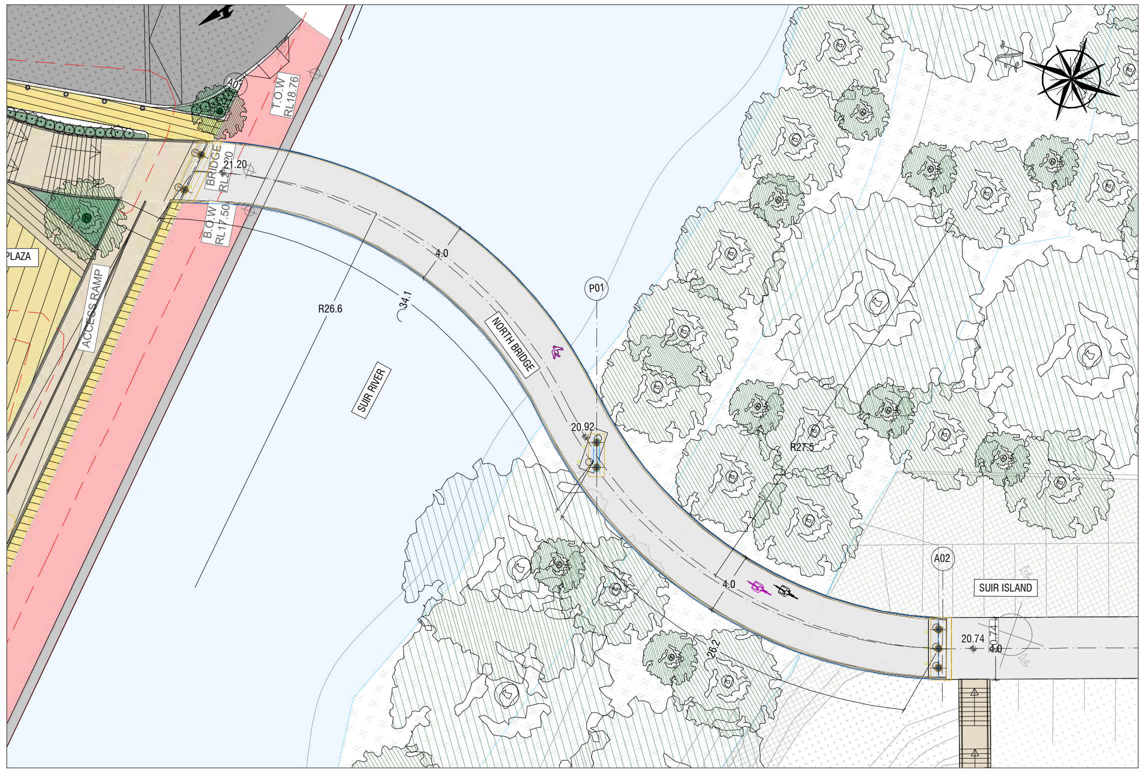
Dwg. Title: PREFERRED OPTION 01 BRIDGE SECTIONS

Drawn By: FO
Date: SEP 2023
Checked By: LP
Scale: AS INDICATED@ A1
CSEA Job No.: 20_071

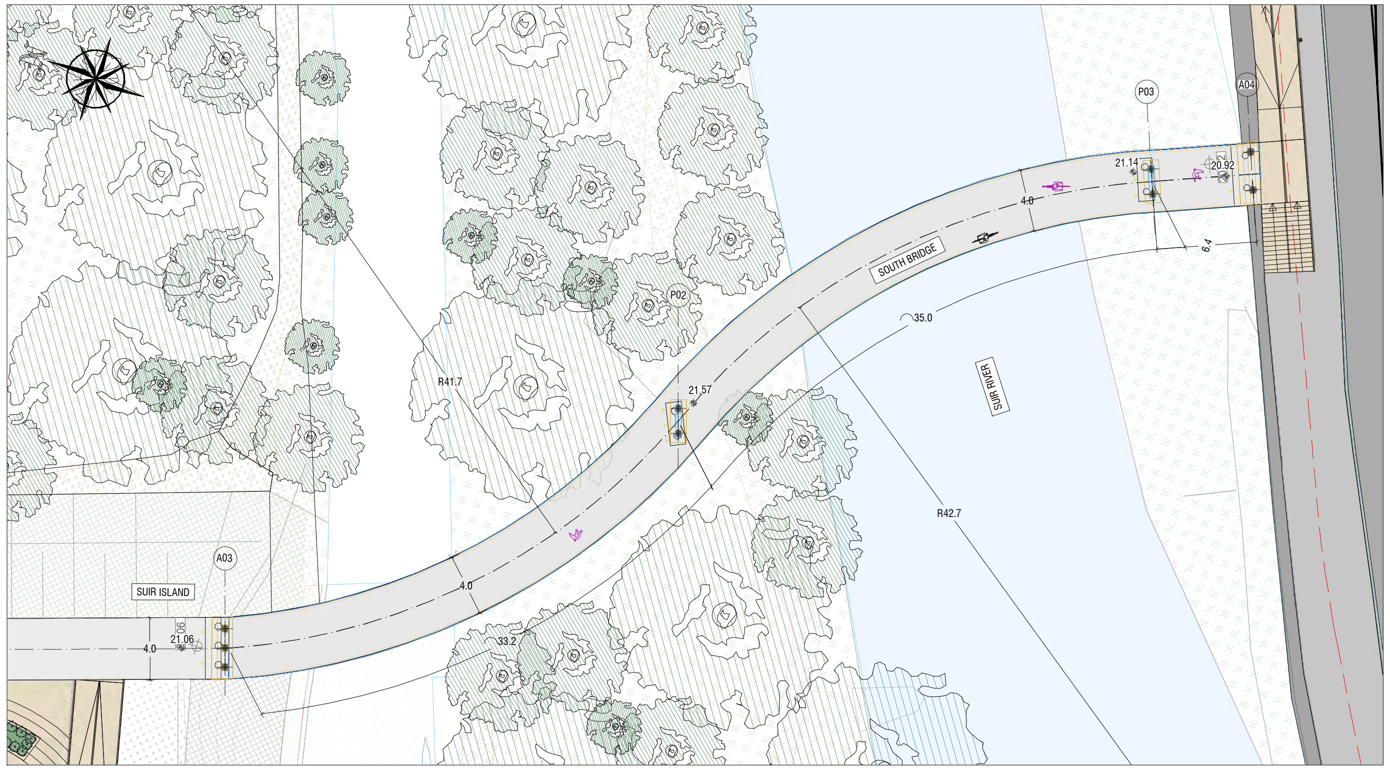
Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2261

Status Code: S2
Suitability Description: SUITABLE FOR INFORMATION

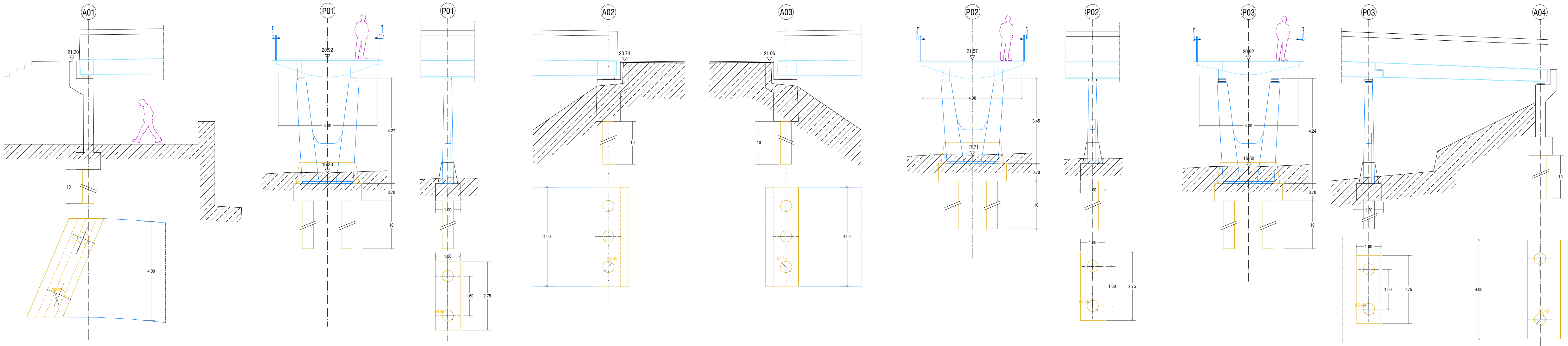
Revision: PL01
Project Status: ISSUED FOR PLANNING



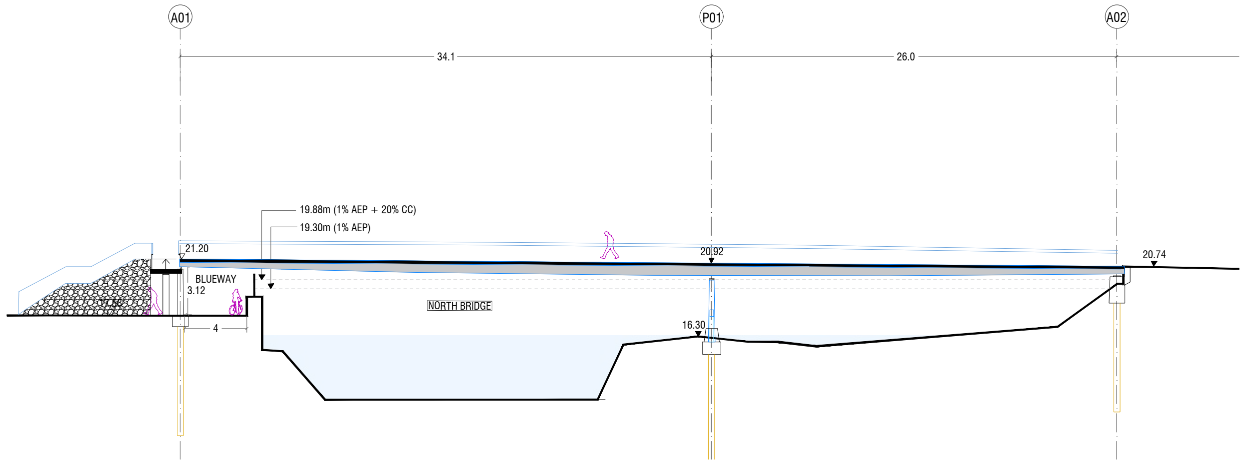
SITE PLAN NORTH BRIDGE 1/250



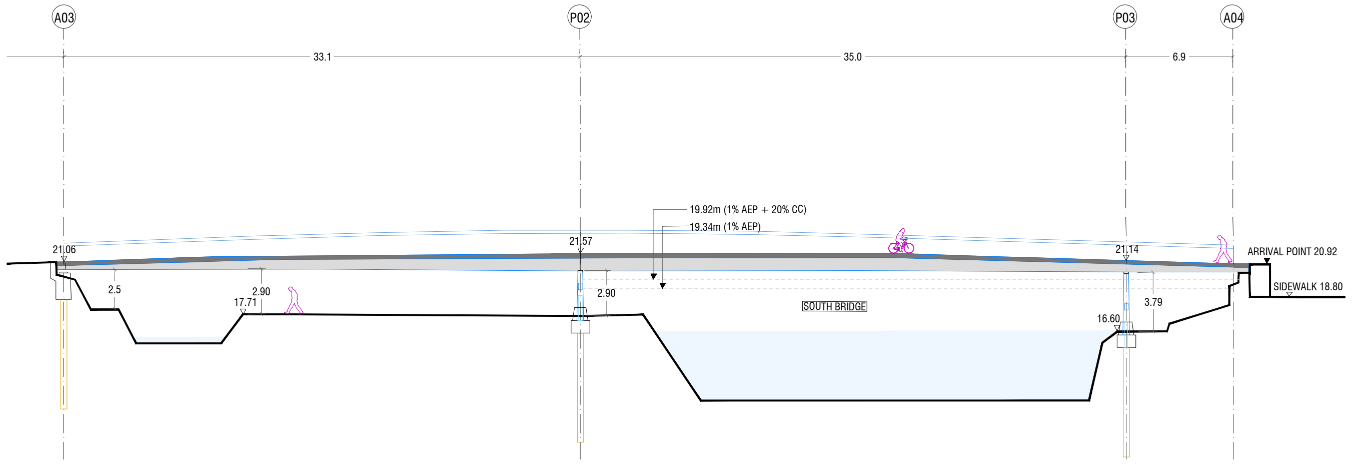
SITE PLAN SOUTH BRIDGE 1/250



FOUNDATIONS PIERS AND ABUTMENTS 1/100 TYPICAL SKETCHES



ELEVATION NORTH BRIDGE 1/250



ELEVATION SOUTH BRIDGE 1/250

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS — dhbarchitects

ARCHEOLOGISTS — CourtneyDeery

BRIDGES — MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS — Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS — awnconsulting

LIGHTING CONSULTANTS — Douglas Carroll

NOTES:

A0X = ABUTMENT FOUNDATION NUMBER X
P0X = PIER FOUNDATION NUMBER X

Rev	Description	Drawn	Checked	Date
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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PREFERRED OPTION 01 BRIDGE DETAILS

Drawn By: FO | Date: SEPT 2023 | CSEA Job No.: 20_071

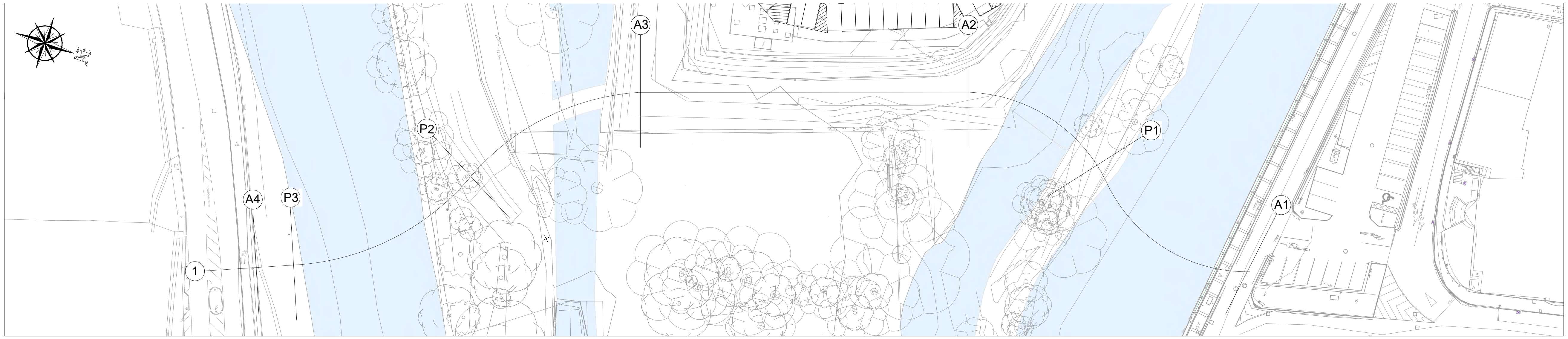
Checked By: LP | Scale: AS INDICATED @ A1

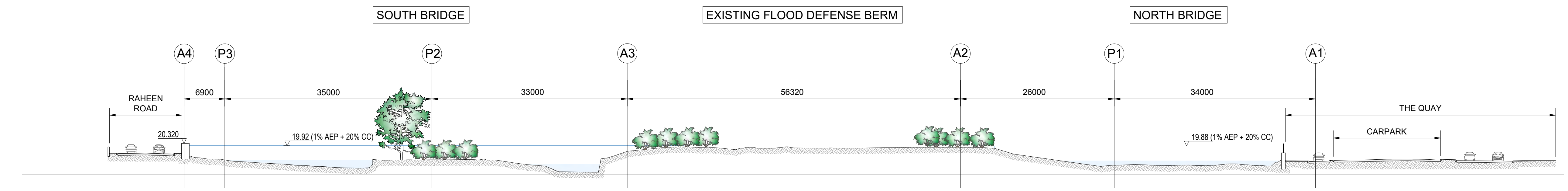
Project Code - Originator - Zone/Phase - Level - Type - Role - Dwg. No.

20_071 - CSE - GEN - XX - DR - C - 2262

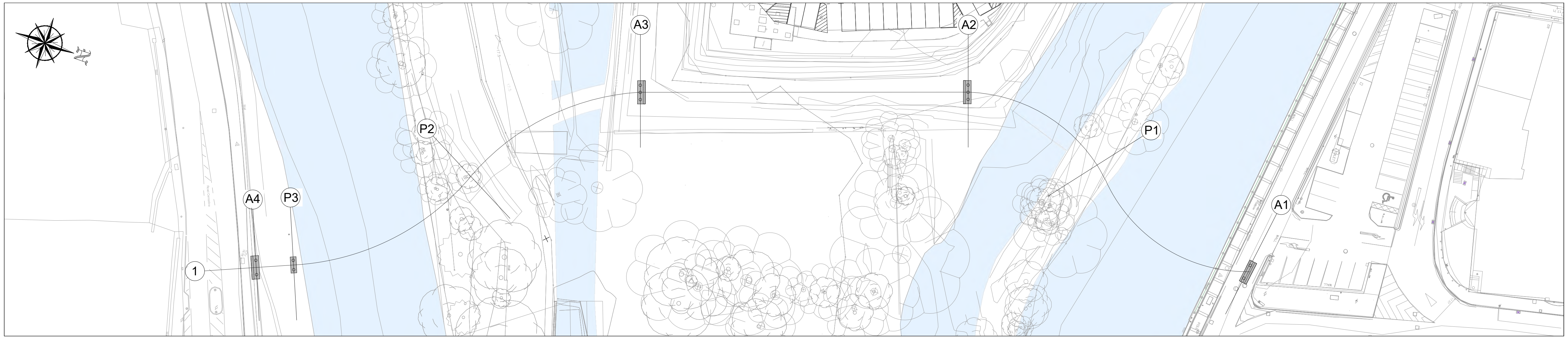
Status Code: S2 | Suitability Description: SUITABLE FOR INFORMATION

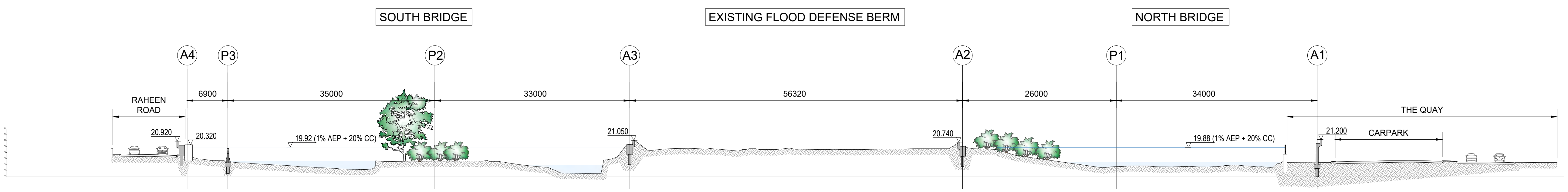
Revision: PL01 | Project Status: ISSUED FOR PLANNING





STAGE 1 - SITE SETUP AND CLEARANCE





STAGE 2 - ABUTMENTS AND PILE FOUNDATION WORKS

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS

dhbarchitects

ARCHEOLOGISTS

CourtneyDeery

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS

awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

NOTE:

- CONSTRUCTION COMPOUND / SITE SETUP IN THE SUIR ISLAND CARPARK TO FACILITATE BOTH BRIDGES NORTH AND SOUTH CONSTRUCTION.

Rev	Description	Drawn	Checked	Date

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: INDICTATIVE CONSTRUCTION SEQUENCE - SHEET 1

Drawn By: FO | Date: SEPT 2023

Checked By: LP | Scale: 1:400@ A1

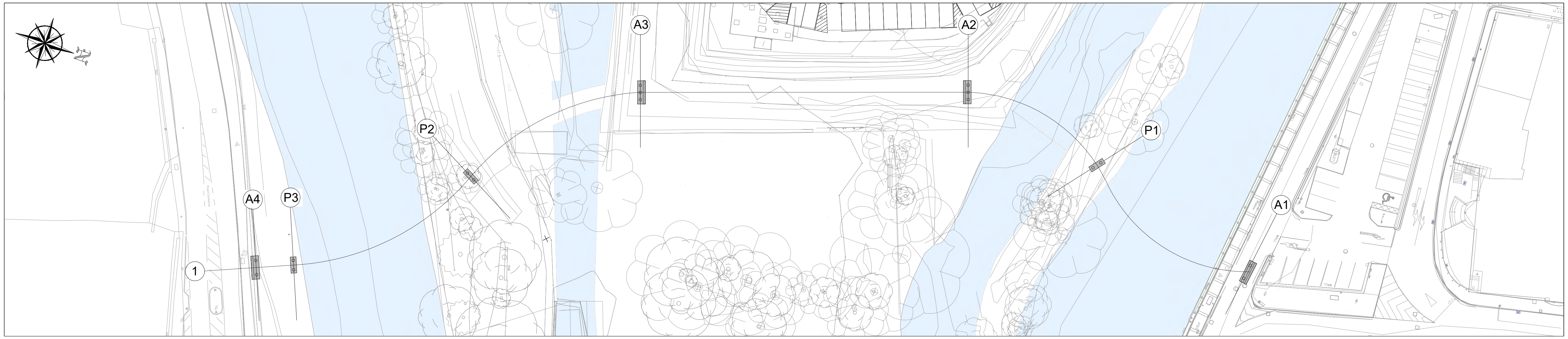
CSEA Job No.: 20_071

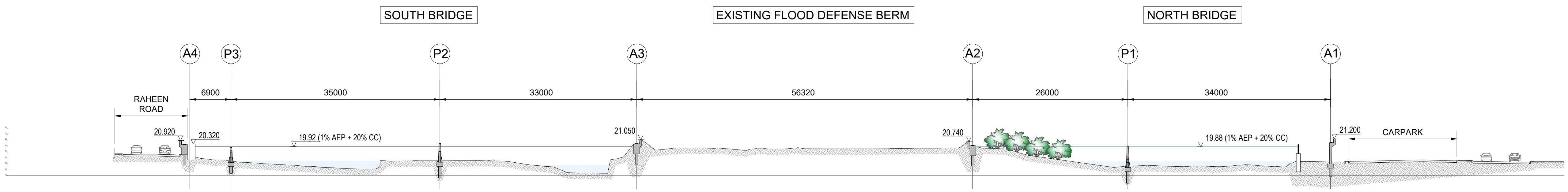
Project Code	Originator	Zone/Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2450

20_071 - CSE - GEN - XX - DR - C - 2450

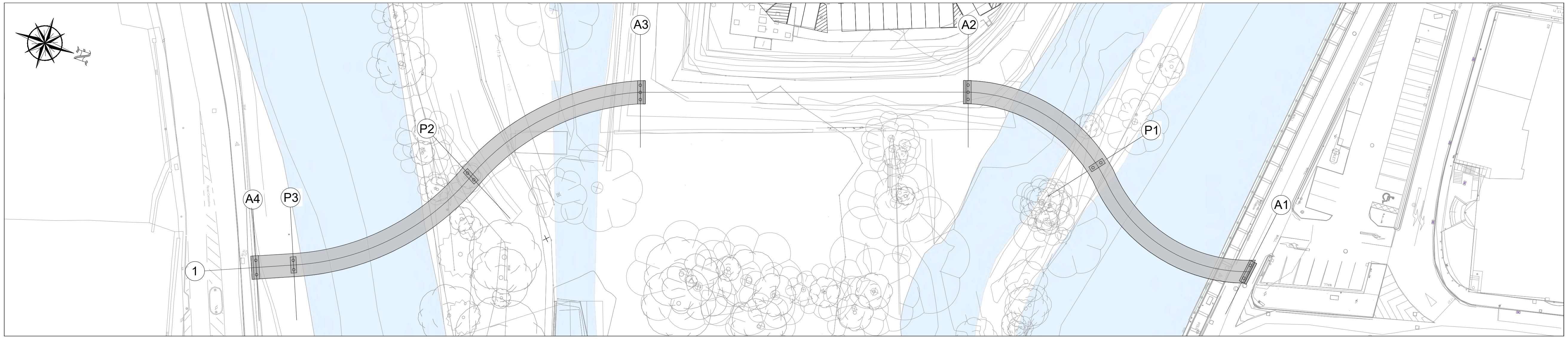
Status Code: S2 | Suitability Description: SUITABLE FOR INFORMATION

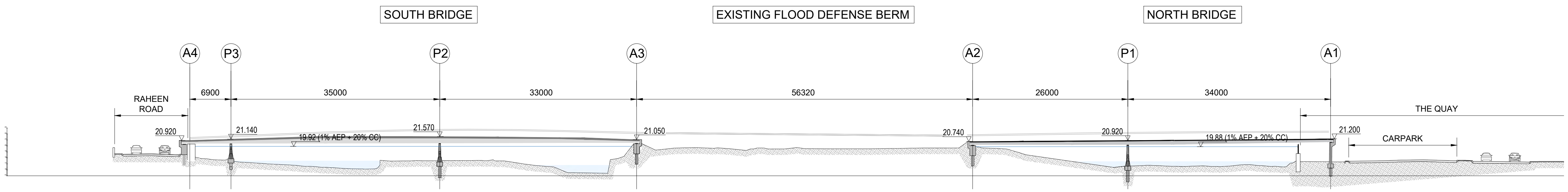
Revision: PL01 | Project Status: ISSUED FOR PLANNING





STAGE 3 - INSTALLATION OF CENTRAL PILE FOUNDATION WORKS





STAGE 4 - INSTALLATION OF FIRST PLATFORMS

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

Comhairle Contae Thiobraid Árann
Tipperary County Council

ARCHITECTS

dhbarchitects

ARCHEOLOGISTS

CourtneyDeery
ARCHAEOLOGY & CULTURAL HERITAGE

BRIDGES

MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS

Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS

awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

NOTE:

- CONSTRUCTION COMPOUND / SITE SETUP IN THE SUIR ISLAND CARPARK TO FACILITATE BOTH BRIDGES NORTH AND SOUTH CONSTRUCTION.

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23
Rev	Description	Drawn	Checked	Date

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

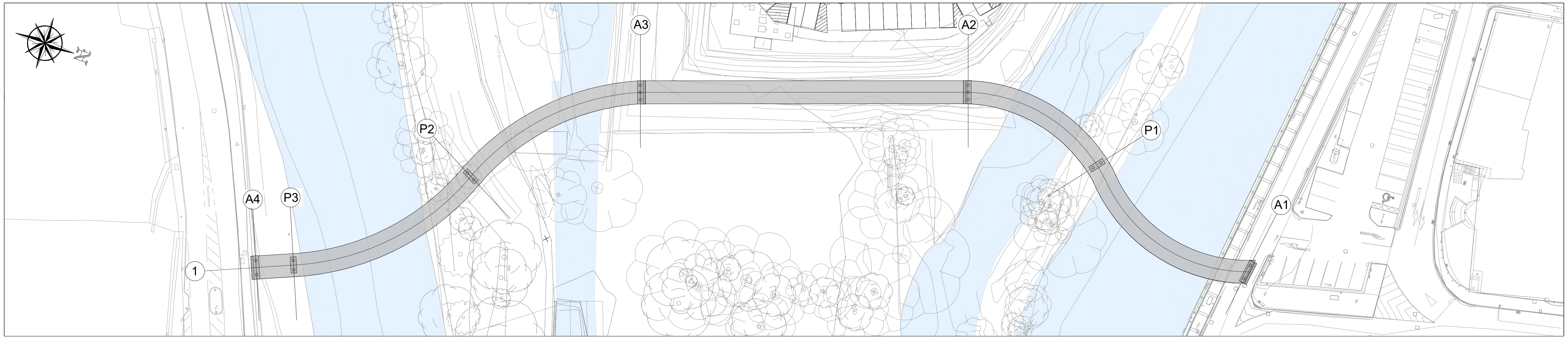
Dwg. Title: INDICATIVE CONSTRUCTION SEQUENCE - SHEET 2

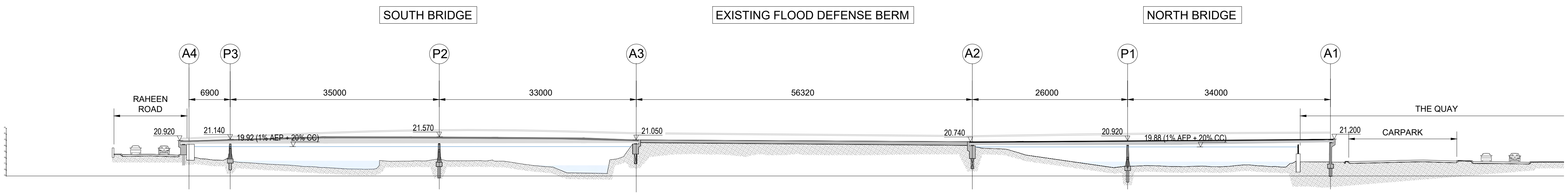
Drawn By: FO	Date: SEPT 2023	20_071	
Checked By: LP	Scale: 1:400@ A1	CSEA Job No.	

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2451

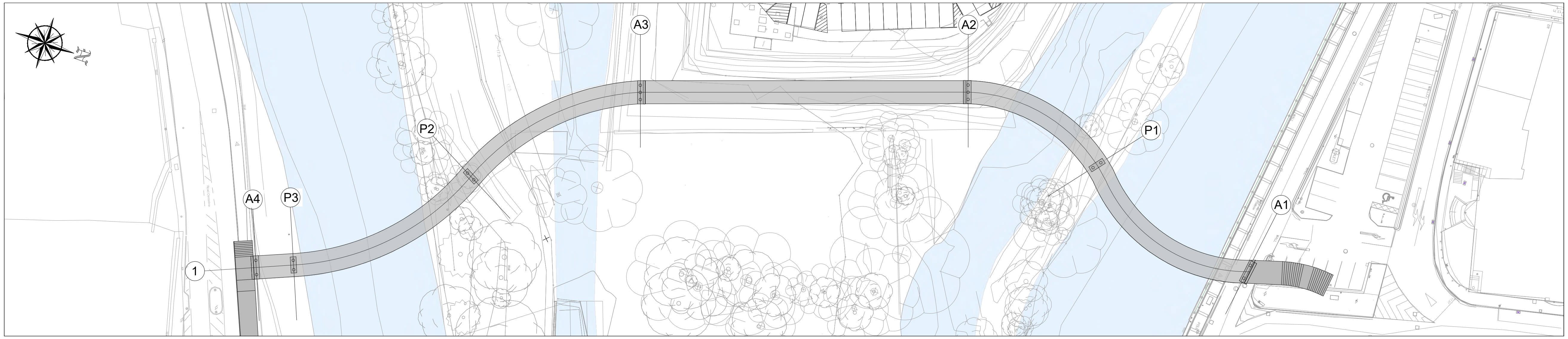
S2 — Status Code
SUITABLE FOR INFORMATION — Suitability Description

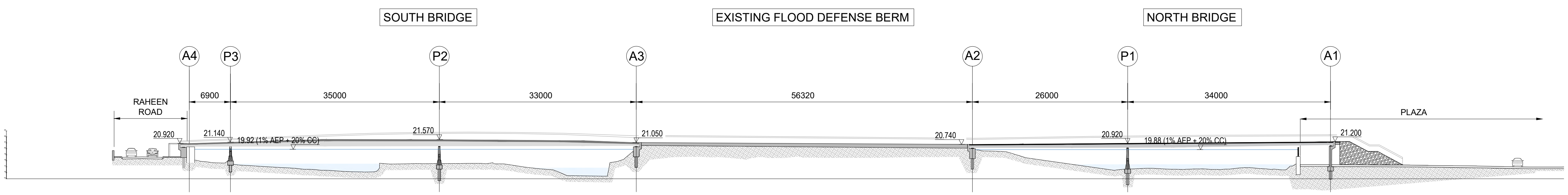
PL01 — Revision
ISSUED FOR PLANNING — Project Status





STAGE 5 - INSTALLATION OF PROMENADE





STAGE 6 - INSTALLATION OF STEPS

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

CLIENT

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ENVIRONMENTAL CONSULTANTS

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A Trinity Consultants Company

LIGHTING CONSULTANTS

Douglas Carroll
Consulting Engineers

NOTE:

- CONSTRUCTION COMPOUND / SITE SETUP IN THE SUIR ISLAND CARPARK TO FACILITATE BOTH BRIDGES NORTH AND SOUTH CONSTRUCTION.

Rev	Description	Drawn	Checked	Date

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PL01	ISSUED FOR PLANNING	FO	LP	22.09.23

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: INDICATIVE CONSTRUCTION SEQUENCE - SHEET 3

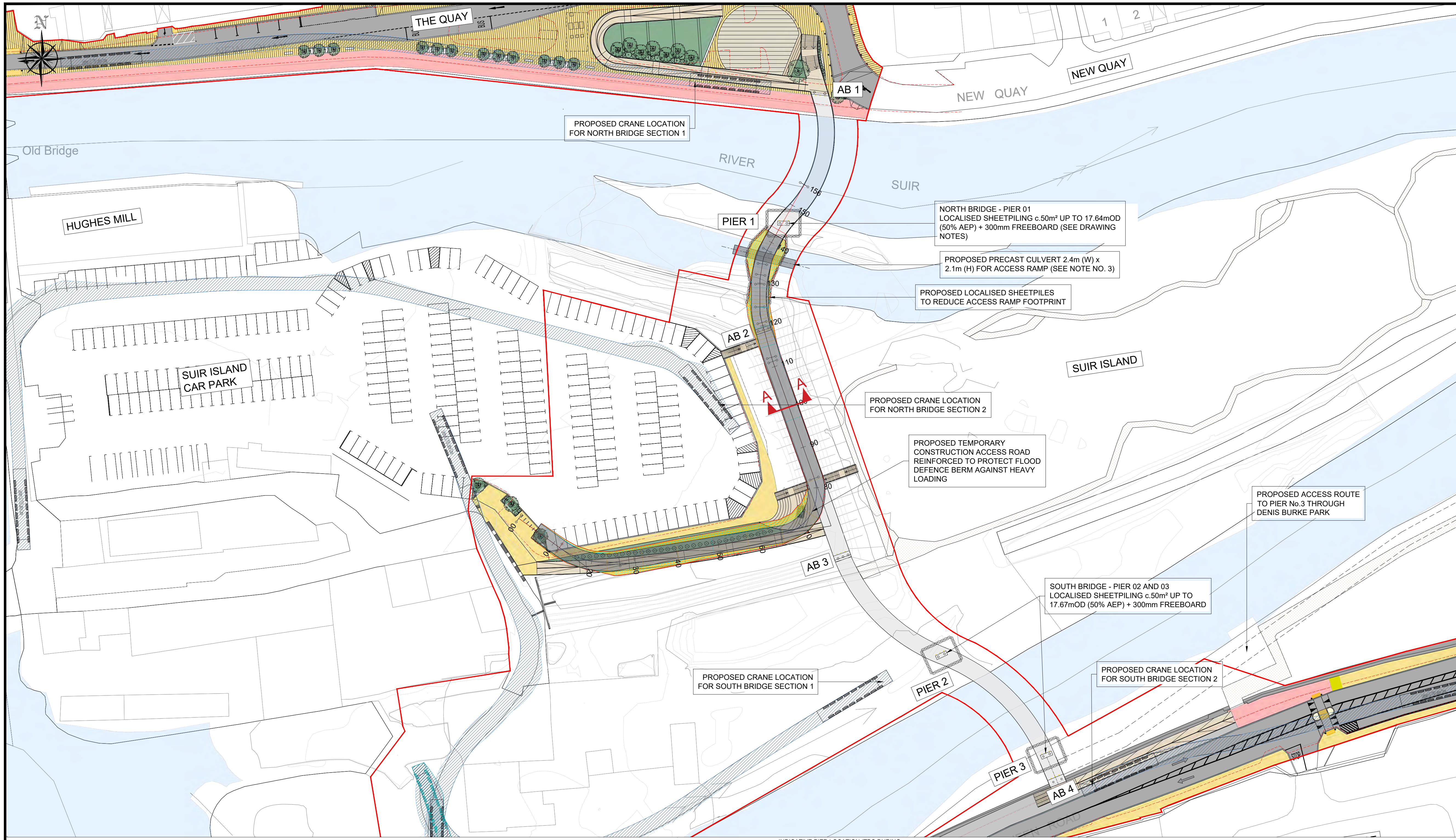
Drawn By: FO
Date: SEPT 2023
Checked By: LP
Scale: 1:400@ A1
CSEA Job No.: 20_071

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	GEN	XX	DR	C	2452

20_071 - CSE - GEN - XX - DR - C - 2452

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 — Project Status: ISSUED FOR PLANNING



DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

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ENGINEERS
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ENVIRONMENTAL CONSULTANTS
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LIGHTING CONSULTANTS
Douglas Carroll

NOTES:

1. PRIOR TO THE COMMENCEMENT OF WORKS FOR PIER NO. 1, THE WORKS AREA WITHIN THE CHANNEL WILL BE SANDBAGGED AND INLAND FISHERIES IRELAND (IFI) WILL CARRY OUT ELECTROFISHING.
2. WORKS FOR PIER NO. 1 SHALL ONLY BE PERMITTED DURING THE MONTHS OF JULY TO SEPTEMBER AS PER DISCUSSIONS HELD WITH IFI.
3. PIER NO. 1 TO BE SET BELOW CHANNEL INVERT AND COVERED WITH 300mm EXCAVATED RIVERBED MATERIAL.
4. WORKS FOR PIER NO. 2-3 SHALL ONLY BE PERMITTED DURING THE MONTHS OF JULY TO SEPTEMBER.

Rev	Description	Drawn	Checked	Date
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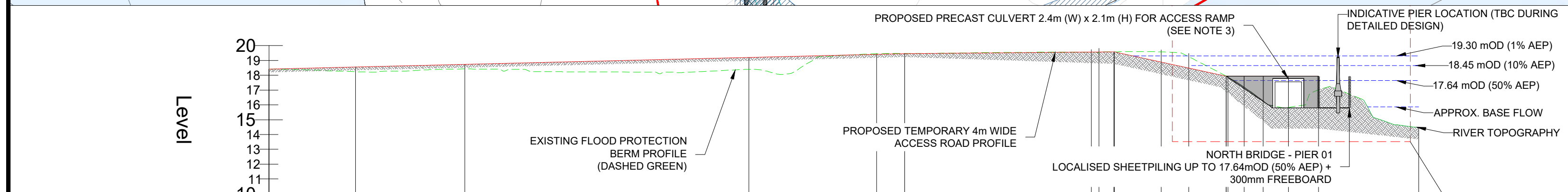
PL01	ISSUED FOR PLANNING	FO	LP	22.09.23



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Proposed Levels	18.417	18.273	18.328	18.411	18.233	18.210	18.284	18.078	19.408	19.475	19.539	19.554	19.588	17.800	15.984		
Proposed Levels		18.537	18.657	18.777	18.897	19.017	19.137	19.257	19.377	19.468	19.514	19.560	18.969	17.937	17.937		

ALIGNMENT - BERM ACCESS RAMP - LONGSECTION
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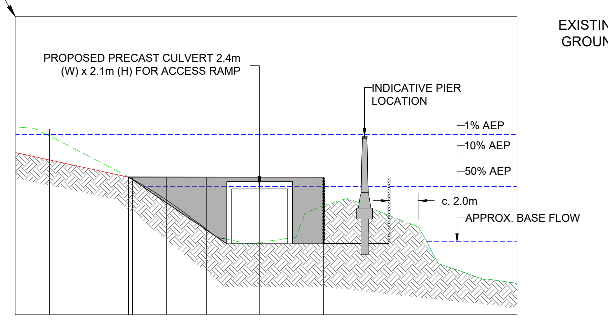

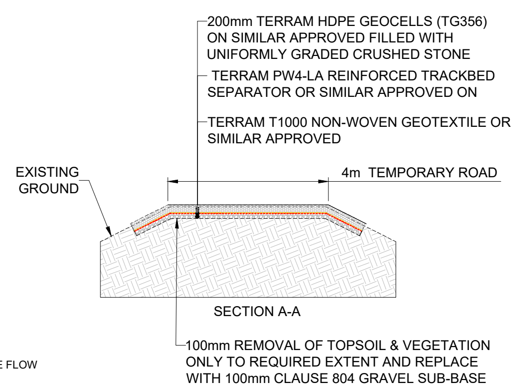

SECTION A-A

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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: PROPOSED TEMPORARY WORKS PIER CONSTRUCTION

Drawn By	FO	Date	SEPT 2023	CSEA Job No.
Checked By	LP	Scale	AS INDICATED @ A1	20_071

Project Code - Originator - Zone/Phase - Level - Type - Role - Dwg. No.
20_071 - CSE - 00 - XX - DR - C - 2460

Status Code: S2 — Suitability Description: SUITABLE FOR INFORMATION

Revision: PL01 — Project Status: ISSUED FOR PLANNING

APPENDIX B – PHOTOGRAPHS

Photo No.	Description
Figure 1	Aerial view with proposed bridge crossings and photograph locations
Photo 1	North Plaza existing parking area and proposed landing of Bridge 1 crossing, looking in downstream direction
Photo 2	North Plaza existing flood protection wall and sidewalk, looking in upstream direction
Photo 3	View of North Plaza from Old Bridge walkway looking downstream
Photo 4	Suir River northern reach looking downstream
Photo 5	Bridge 2 crossing of southern reach view from Suir Island looking in Raheen Road direction
Photo 6	Bridge 2 crossing of southern reach looking from Raheen Road to Suir Island
Photo 7	Upstream view of Suir River southern river reach
Photo 8	Upstream view of Suir Island and confluence of northern and southern river reaches taken from Old Waterford Gashouse Bridge
Photo 9	View of Old Bridge Road northern river reach crossing looking upstream
Photo 10	Bridge 2 crossing looking from Raheen Road to Suir Island
Photo 11	Old Waterford Gashouse Bridge looking in downstream direction

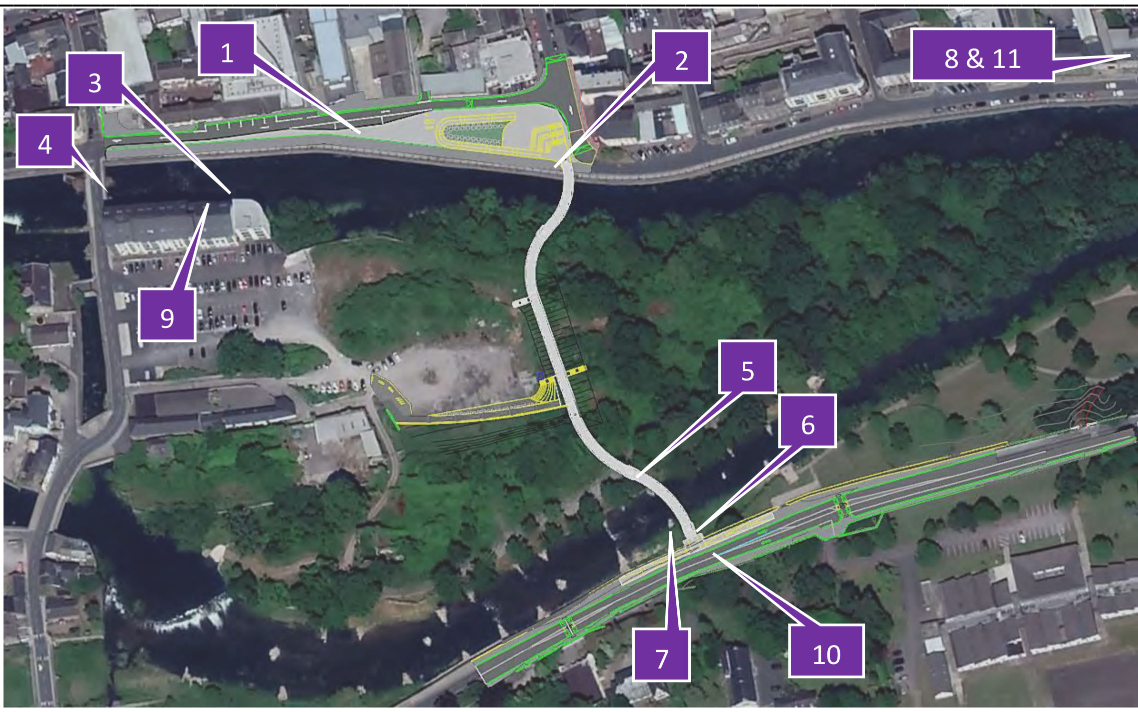

Figure 1: Aerial view with proposed bridge crossings and photograph locations

Photo 1: North Plaza existing parking area and proposed landing of Bridge 1 crossing, looking in downstream direction

Photo 2: North Plaza existing flood protection wall and sidewalk, looking in upstream direction

Photo 3: View of North Plaza from Old Bridge walkway looking downstream

Photo 4: Suir River northern reach looking downstream

Photo 5: Bridge 2 crossing of southern reach view from Suir Island looking in Raheen Road direction

Photo 6: Bridge 2 crossing of southern reach looking from Raheen Road to Suir Island

Photo 7: Upstream view of Suir River southern river reach

Photo 8: Upstream view of Suir Island and confluence of northern and southern river reaches taken from Old Waterford Gashouse Bridge

Photo 9: View of Old Bridge Road northern river reach crossing looking upstream

Photo 10: Bridge 2 crossing looking from Raheen Road to Suir Island

Photo 11: Old Waterford Gashouse Bridge looking in downstream direction

APPENDIX C – HYDRAULIC MODELLING REPORT

REFER TO EIAR CHAPTER 7 APPENDIX 7.3

APPENDIX D – SUPPLEMENTARY SECTION 50 REPORT

Clifton Scannell Emerson Associates

Supplementary Section 50 Report

Suir Island Infrastructure Links

Comhairle Contae Thiobraid Árann
Tipperary County Council

Client: Tipperary County Council

Date: May 2023

Job Number: 20_071

CONSULTING ENGINEERS

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Document Control Sheet

Project Name:	Suir Island Infrastructure Links
Project Number:	20_071
Report Title:	Supplementary Section 50 Report
Filename:	RPT-20_071-069

Issue No.	Issue Status	Date	Prepared by	Checked by
1st	Draft	21/02/2023	HB	LP
2nd	Draft	17/04/2023	HB	LP
3rd	Final	22/05/2023	HB	LP

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 *Commissioning*

Tipperary County Council (TCC) appointed Clifton Scannell Emerson Associates (CSEA) to prepare this Supplementary Section 50 Report as part of the planning application for the Suir Island Infrastructure Links proposed development, located in Clonmel, County Tipperary.

1.2 *Project and Section 50 Application Background*

This section of the report provides a brief overview of relevant correspondence and meetings held between CSEA and the Office of Public Works (OPW) in relation to the Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010 for the proposed bridge crossings over the Suir River. Relevant meeting minutes and responses are included in **Appendix B** of this report.

The first introductory meeting was held on 6th October 2020 in which the various scheme options, potential risks and deliverables for the application were discussed. The outcomes of the meeting included the requirement of the design team to submit a Section 50 Application accompanied by a hydraulic modelling analysis of the proposed bridges to determine the effects on the flood water levels within the river Suir. Refer to meeting minutes (MTG-20_071-001) included in **Appendix B.**

CSEA submitted the OPW Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010 on 30th May 2022 for review. The OPW responded on 21st September 2022 noting that the Section 50 could not be granted due to the following concerns with regard to temporary and permanent impacts on the Clonmel Flood Defence Scheme:

- How will the flood protection be maintained throughout the construction works?
- How will the instream columns of the North and South bridges be constructed? Have the temporary works been considered for this and what effect will it have on flood levels?
- What methodology will be used to install the piles on the Suir Island flood embankment?
- Will the integrity of the embankment be compromised at any stage of the works?
- How are the demountable barriers lifted into position along the North Quay where the proposed bridge spans over the demountable barriers?
- What is the tie-in detail at the Raheen Road flood defence wall?

CSEA addressed the above queries in a letter (LTR-20_071-014) dated 4th October 2022 and subsequently held a meeting (MTG-20_071-030) with the OPW to further discuss any additional concerns on 10th October 2022. The requirement to compile this Supplementary Section 50 Report to address the risks involved during the various phases of the proposed development was discussed during the meeting. The aforementioned letter and meeting minutes are included in **Appendix B**.

Following the draft submission of this Supplementary Report in February 2023, the OPW confirmed that the proposed Suir Island Bridges should be designed to allow for a minimum of 300mm dry-freeboard between the bridge soffit levels and the 1-100-year recurrence interval or 1% Annual Exceedance Probability (AEP) plus a 20% Climate Change (CC) flood water level. The 1% AEP plus an addition 20% CC factor is referred to as the Mid-Range Future Scenario (MRFS) as delineated by the OPW Climate Change Sectoral Adaptation Plan.

1.3 *Purpose of the Report*

This report sets out to address the specific project risks involved in relation to the proposed development and the various interfaces with the Clonmel Flood Defence Scheme infrastructure during the different project phases including design, construction and operation.

The report is structured as follows:

- **Section 1** underlines the project background, pertinent correspondence and highlights the purpose of the report;
- **Section 2** provides an overview of the project and proposed bridge crossings; and
- **Section 3** delivers a summary of interfaces between the proposed development and the Clonmel Flood Defence Scheme infrastructure; highlights risks identified by the OPW and provides mitigation measures during the various project phases; and
- **Section 4** concludes and summarises the findings of the report and makes recommendations on further engagement requirements with the Office of Public Works.

This report should be read in conjunction with the following detailed engineering reports summarised in Table 1-1, which form part of the planning application suite of documents. These documents are available on request.

Table 1-1: Relevant engineering reports

Report No.	Title
RPT-20_071-058	Flood Risk Assessment Stage 1 & 2
RPT-20_071-055	Flood Risk Assessment Suir Island Hydraulic Modelling Report
RPT-20_071-019	OPW Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010
S.I. Ltd Contract No: 5931 Rev 1	Suir Island Infrastructure Links, Site Investigation Report

2 The Proposed Development

2.1 Project Description

The proposed development will consist of:

- Two pedestrian bridges, the first bridge linking the proposed North Plaza on The Quay/Quay St/Sarsfield St Junction to Suir Island, and the second bridge connecting Suir Island to Raheen Road.
- Provision of a new public open space called the North Plaza which will be aligned with Sarsfield Street. The steps and ramp will be visible from O'Connell Street creating a new landmark in the town of Clonmel and will encourage pedestrian movement towards the River Suir. The bicycle access ramp is designed to be as transparent as possible so as not to block the view of Suir Island from Sarsfield Street. This plaza is an ideal setting for impromptu performances and social gathering.
- Modification of traffic direction and carriageway width around the North Plaza and The Quay and Quay St.
- Provision of a bus stop on the western side of the North Plaza located on Quay Street with five benches providing comfortable facilities for public transport users.
- Upgrading of the existing 2-metre-wide sidewalk along Quay Street into a 4-metre-wide shared pedestrian/cycle path which will provide unencumbered access to the proposed plaza area underneath the elevated access ramp.
- Provision of a sloping landscaped terrace with public seating, located inside the hairpin-shaped access ramp leading up to the northern bridge crossing, offering unencumbered views of the plaza area.

- Provision of three benches and a 9-metre-long stepped promenade seating area integrated into the circular-shaped plaza, offering exceptional views of the proposed development.
- Planting of various native tree species around the North Plaza to integrate the proposed development with the existing scenery of Suir Island and complement the visual experience of users.
- Installation of a 4-metre-wide curved pedestrian bridge, which allow users to discover the island 'from up high' by walking seamlessly between the trees while linking the project elements (Sarsfield Street, the berm embankment, and the south riverbank) along one sinuous route. The first bridge follows the geometry of Sarsfield Street and arrives on the island following the line of the berm embankment, which then links onto the second bridge facilitating a link to Denis Burke Park on Raheen Road, creating a direct connection for pedestrians/cyclists between the park and the Town Centre.
- Provision of a pedestrian path or promenade along the existing berm embankment across Suir Island linking the two pedestrian bridges, to facilitate access between Denis Burke Park on Raheen Road and the proposed North Plaza on The Quay.
- Construction of a pedestrian/bicycle ramp from the link promenade onto Suir Island Carpark. The ramp is fully integrated into the landscape by using the existing slope of the berm.
- Construction of three sets of steps connecting the link promenade to Suir Island carpark and the eastern end of Suir Island.
- Provision of a mini public space within Suir Island Carpark at the entrance to the proposed Suir Island Gardens.
- Provision of a south arrival point for the second bridge connecting Suir Island to the Raheen Road. The South Arrival Point will consist of one access ramp to the east and one set of steps to the west, integrated with the bridge landing level and running parallel to the footpath. These elements will be located outside the existing flood barrier.
- Road improvements for the safety of pedestrians/cyclists at the South Arrival Point, including the footpaths being widened and the road narrowed to accommodate 3.0-metre-wide lanes. Removal of three carparking spaces from the southern edge of the road to allow for wider footpaths.
- Installation of two uncontrolled pedestrian crossings positioned at either ends of the proposed access ramp and flight of steps to provide traffic calming at the South Arrival Point. This bridge arrival point will be located close to the school entrance of Raheen College, providing safe and convenient access for the schoolchildren.
- Access ramps and steps are located behind the flood barriers to allow access even during flood events.
- Construction of a new foul pumping station to be located within Suir Island car park which will facilitate future Irish Water connections. Wastewater will be pumped 0.1km approx. via rising main along the proposed bridge linking Suir Island to the proposed North Plaza where it will connect into the existing public network along The Quay.
- Ancillary site development works to include, but not limited to, surface water drainage, lighting and associated electrical works, hard and soft landscaping, road works to include surfacing and line marking, landscaping and installation of street furniture.
- All associated site works.

The proposed development and site location is shown on Figure 2-1.

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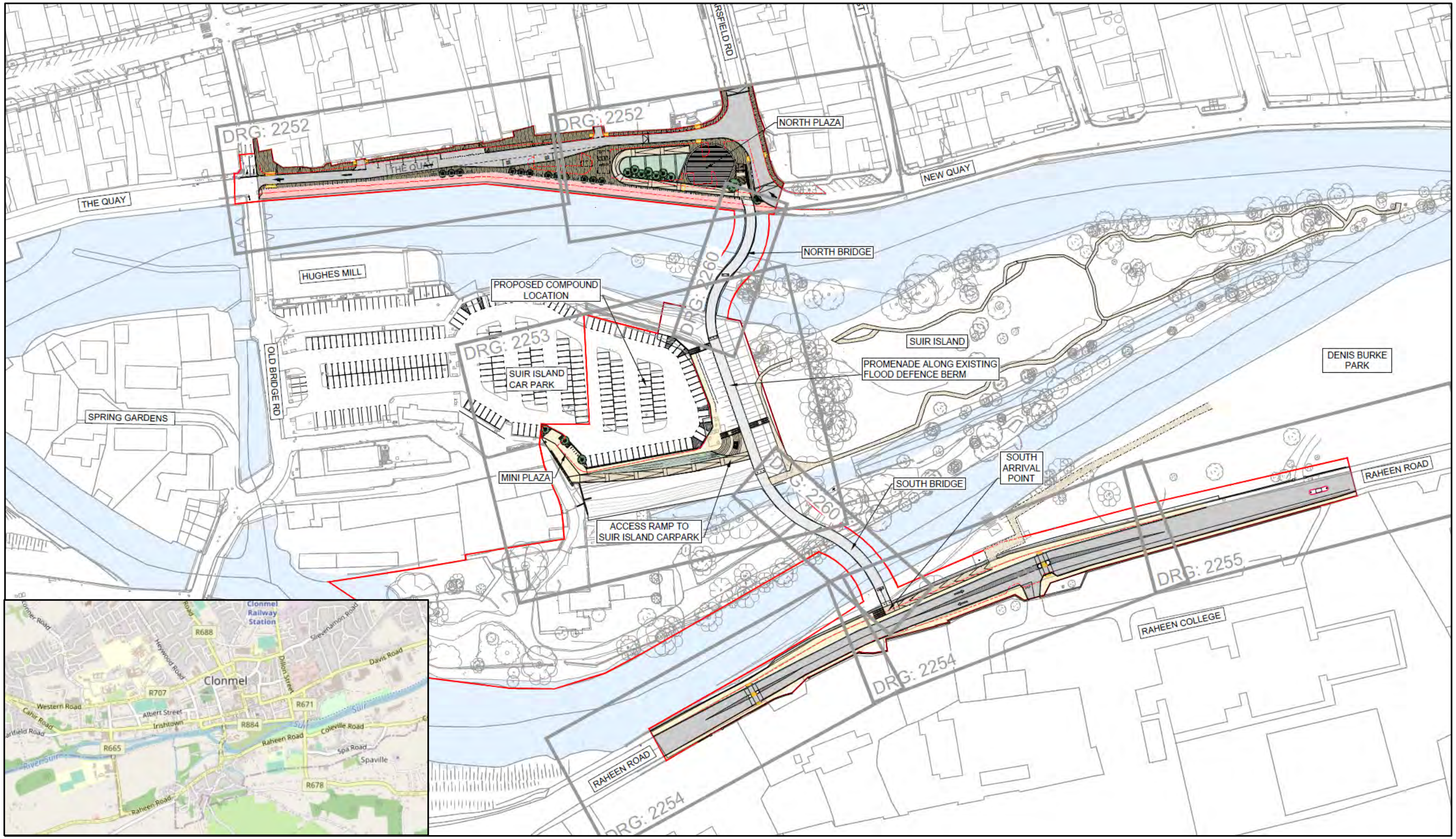

Figure 2-1: Plan layout of the Proposed Development

3 Interfaces with Clonmel Flood Defence Scheme

This section of the report underlines how the design of proposed development interfaces with the existing flood defence scheme infrastructure and highlights the construction and operational phase risks involved at each of the key areas. **Section 3.2** and **3.3** summarises the mitigation measures which will be incorporated throughout the project phases to ensure that the operation of the flood defences are not undermined during the works and access is not restricted during emergency scenarios or regular maintenance periods.

3.1 Design of Interfaces and Risk Identification

The proposed development design interacts with the following key components/structures of the Clonmel Flood Defence Scheme as shown on drawings included in **Appendix A**:

- North Plaza: The northern bridge crossing will span over the concrete masonry flood defence wall running along The Quay Road. The masonry defence wall can further be raised by the installation of demountable barriers which provides further flood protection up to the 1-in-100-year recurrence interval flood plus an additional 20% climate change scenario;
- Suir Island: The abutments of both the northern and southern bridge crossings will be constructed through the flood defence berm at either end and the shared surface promenade will be constructed on top of the berm which will connect the two bridge crossings and also provide a link to the Suir Island carpark ramp, steps and mini-plaza; and
- Raheen Road: The southern bridge will span over the existing concrete masonry flood defence wall with a vertical clearance of approximately 100mm. A pier support will be constructed on either side of the flood defence wall to ensure that no loading is applied to the existing wall from the proposed bridge crossing.

The above interactions with the flood defence infrastructure does have the potential to limit or impede on the operation of the scheme on a temporary basis during the construction phase or on a permanent basis during the operational phase. The sections below highlights these potential risks and underlines the mitigation measures included in the design and highlights constraints which will be included in the contract documentation during the construction phase to ensure that these interactions do not impede on the operation of the flood defences.

3.1.1 North Plaza (The Quays)

The Northern Bridge crossing, connecting the North Plaza to Suir Island, will span over the northern Suir River reach for a total distance of 60-metres. The northern bridge abutment, access ramp and steps will be constructed behind the existing flood protection wall as shown on Figure 3-1 and 3-2.

A minimum vertical clearance of 380mm has been allowed for above the demountable flood protection barriers and the soffit level of bridge superstructure as shown on the extrapolated detail shown on Figure 3-2. The demountable barrier provides flood protection for the 1% Annual Exceedance Probability (AEP) event plus a 20% Climate Change allowance. The northern bridge abutment on Suir Island will be constructed on top of the existing flood protection berm. Refer to Drawings 20_071-CSE-GEN-XX-DR-C-2252 and 2256 included in **Appendix A** for the plan layout and sections of the development proposals located in the North Plaza.

Additional bridge parameters are summarised in Table 3-1, with dimensions measured from the North Plaza abutment to Pier No. 1 and then to the abutment constructed on top of the existing flood protection berm located on Suir Island. The table summarises the dry-freeboard along the bridge length between the bridge soffit levels and the MRFS as highlighted in **Section 1.2**.

The proposal to span over the existing flood defence wall and 1.5-metre-high demountable barrier system has the potential to impede the installation of the barriers during the construction phase, with access being constrained by the contractor's operations and during the operational phase if the proposals limit accessibility for vehicles or the vertical clearance of the bridge above the barriers are insufficient. The risk to the installation of the barriers is addressed in **Section 3.3.1**.

Table 3-1: North Bridge parameters

Parameter	Value
Bridge deck top walkway width	4m
Span (total)	60.0m
Span between supports	34.1m and 26.0m
Bridge deck levels (top)	21.20mOD, 20.92mOD, 20.74mOD
Bridge deck levels (soffit)	20.70mOD, 20.23mOD, 20.25mOD
Freeboard to MRFS (1% AEP + 20% CC)	0.66m, 0.36m, 0.37m
Bridge deck to river channel invert	5.93m (max) and 3.14m (min)
Bridge deck soffit clearance above flood protection structure	Min. 300mm to demountable barrier installed on top of permanent flood defence wall

As summarised in the table above, the northern bridge crossing has been raised to comply with the minimum freeboard requirement of 300mm between bridge soffit levels and the MRFS. The minimum freeboard of 360mm for the northern bridge will be located at the support pier, where the thickness of the bridge superstructure will be at its maximum. Refer to Figure 3-2 below for a detailed section of the proposed interface on the North Plaza, where the bridge will span over the demountable barrier system.

Figure 3-1: Architectural view of the proposed North Plaza

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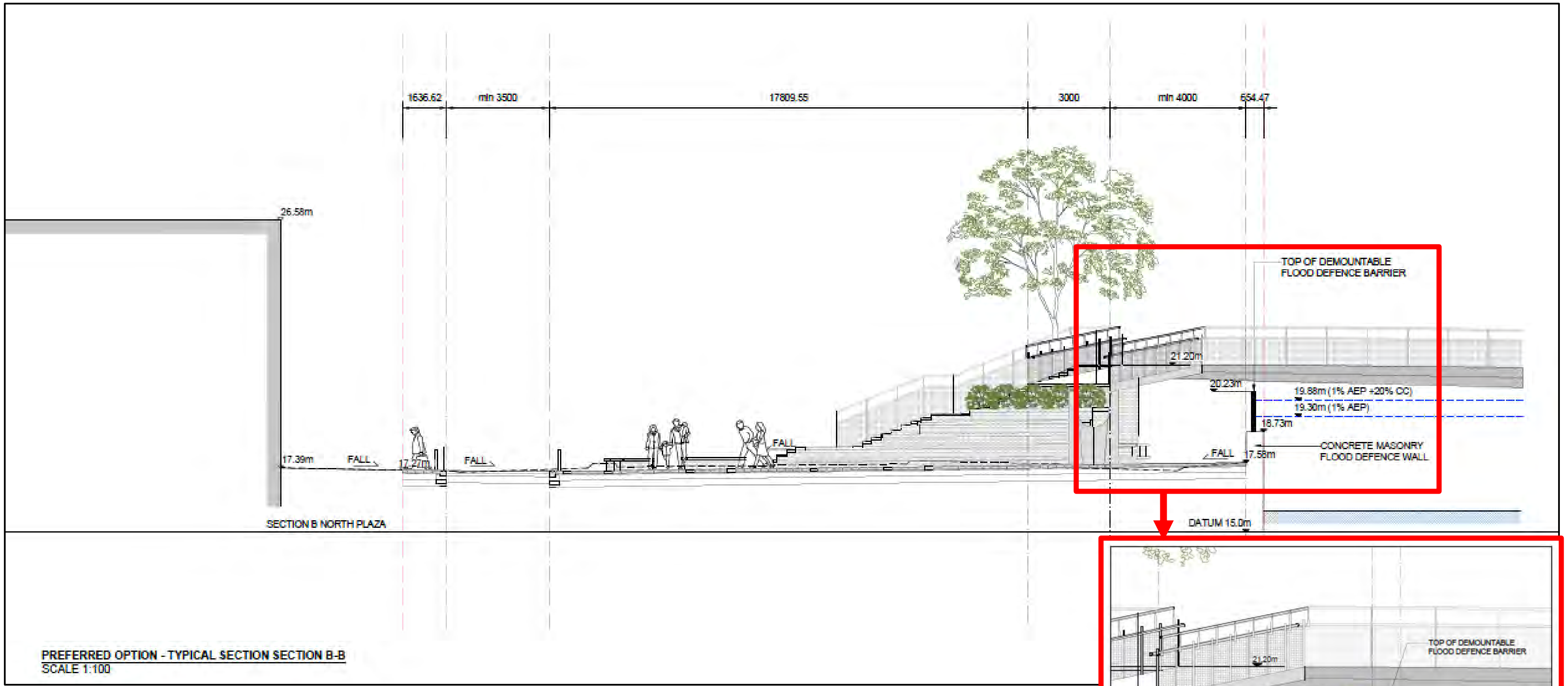


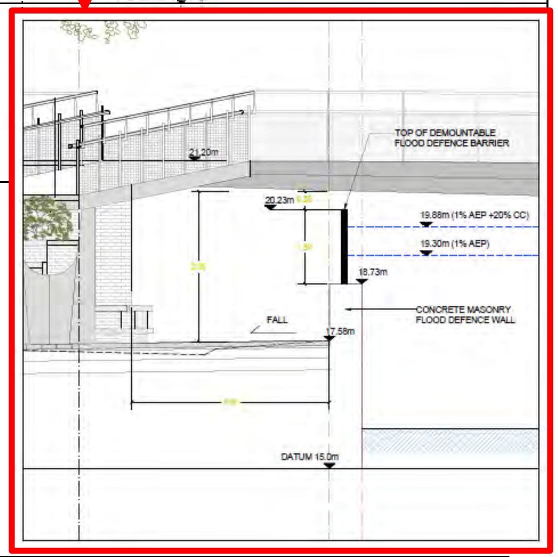


Figure 3-2: Elevation section through North Plaza

Refer to Drawing 20_071-CSE-00-XX-DR-C-1012 for the above detailed sections and Drawing 20_071-CSE-00-XX-DR-C-1014 for an elevation section of the entire northern bridge included in **Appendix A**.

3.1.2 Suir Island

The existing flood defence embankment located on Suir Island will be utilised as the pedestrian link promenade between the northern and southern bridge crossings and will provide access to and from the Suir Island car park and eastern side of Suir Island via the proposed access ramp and three sets of steps. Refer to Drawing 20_071-CSE-GEN-XX-DR-C-2253 and 2257 in **Appendix A** for the plan layout and sections of the development proposals located on Suir Island.

The embankment crest levels will be raised with a filler clay and granular materials to tie into the proposed bridges walkway levels. As shown in Figure 3-3, the raising of the embankment will utilise slope stability systems such as TensarTech® NaturalGreen™ Slope System or a similarly approved system. The walkway surfacing and layer build-up shall be confirmed during the detailed design stage. Currently it is envisaged that this will consist of a cellular confinement system filled with uniformly graded crushed stone to minimise settlement potential and a flexible surface type such asphalt-cement or brick paving.

The flood protection berm will be utilised as a platform to construct the shared path link promenade and will also be used as a construction traffic route to access the single northern bridge pier. The bridge foundations, consisting of end-bearing pile and pile cap structures will also be constructed at either end of the embankment, with piling operations going through the embankment and subsequently localised excavations will be required for the construction of the reinforced concrete pile caps. The above has the potential to impede or undermine the operation of the berm during the construction phase temporarily and the proposed development could impede on access for OPW maintenance staff and vehicles. These risks are addressed in **Section 3.2.1 and 3.3.2**.

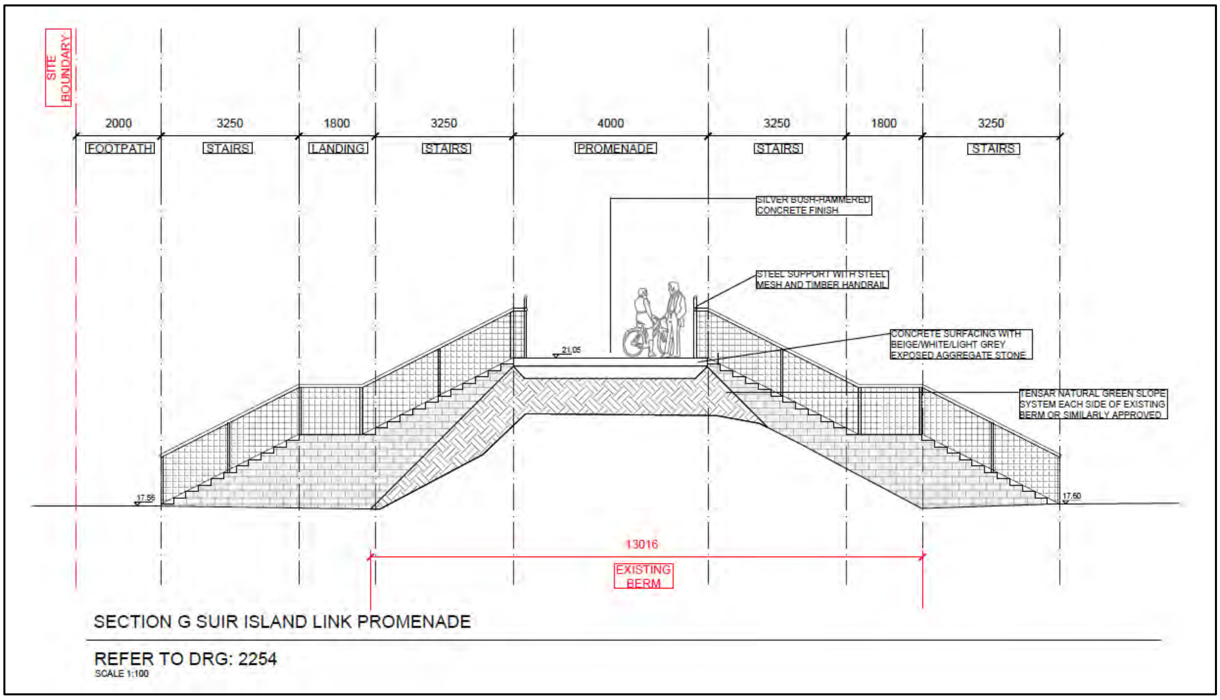


Figure 3-3: Raising methodology of the flood defence berm

3.1.3 Raheen Road

The southern bridge crossing, connecting Suir Island to Raheen Road and Denis Burke Park, will span the Suir River Slalom Course and Millrace for a total distance of 75-metres as shown on Figure 3-4. The Suir Island abutment will be constructed on top of the flood protection berm and the Raheen Road abutment will be constructed on the existing pedestrian path located behind the existing concrete masonry flood defence wall running along Raheen Road as shown on Figure 3-5. Refer to Drawing 20_071-CSE-GEN-XX-DR-C-2254, 2255 and 3901 in **Appendix A** for the plan layout and sections of the development proposals located in Raheen Road.

Figure 3-4: Southern bridge crossing the Slalom Course

Refer to Drawing 20_071-CSE-00-XX-DR-C-1013 for the above detailed sections and Drawing 20_071-CSE-00-XX-DR-C-1014 for an elevation section of the entire southern bridge included in **Appendix A**.

The 2 No. support piers will be located on both banks of the Slalom Course. Table 3-2 summarises additional parameters for the South Bridge, with dimensions measured from the Suir Island abutment to Pier 1 to Pier 2 and to the Raheen Road abutment.

As summarised in the table below and shown on Figures 3-5 and 3-6, the southern bridge landing has been raised by approximately 700mm to provide sufficient freeboard above the bridge soffit levels and the MRFS flood water levels. The freeboard at the Raheen Road masonry flood defence wall is equal to 400mm between the bridge soffit levels and MRFS. This negates the requirement to make any alterations to the existing flood defence wall running along Raheen Road. The vertical clearance between the bridge soffit levels and the Raheen Road flood defence wall is currently 100mm. The support piers will be constructed on either side of the flood defence wall, which will ensure that the proposed bridge does not impose an additional loading on the defence wall foundations.

Table 3-2: South Bridge parameters

Parameter	Value
Bridge deck top walkway width	4m
Span (total)	75.0m
Span between supports	33.1m, 35.0m, 6.9m
Bridge deck levels (top)	21.06mOD, 21.57mOD, 21.14mOD, 20.92mOD
Bridge deck levels (soffit)	20.55mOD, 20.54mOD, 20.38mOD, 20.32mOD
Freeboard to MRFS (1% AEP + 20% CC)	0.65m, 0.62m, 0.46m, 0.4m
Bridge deck to river channel invert	6.97m (max) and 3.01m (min)
Bridge deck soffit clearance above flood protection structure	Bridge deck level to tie into top of existing concrete flood protection wall

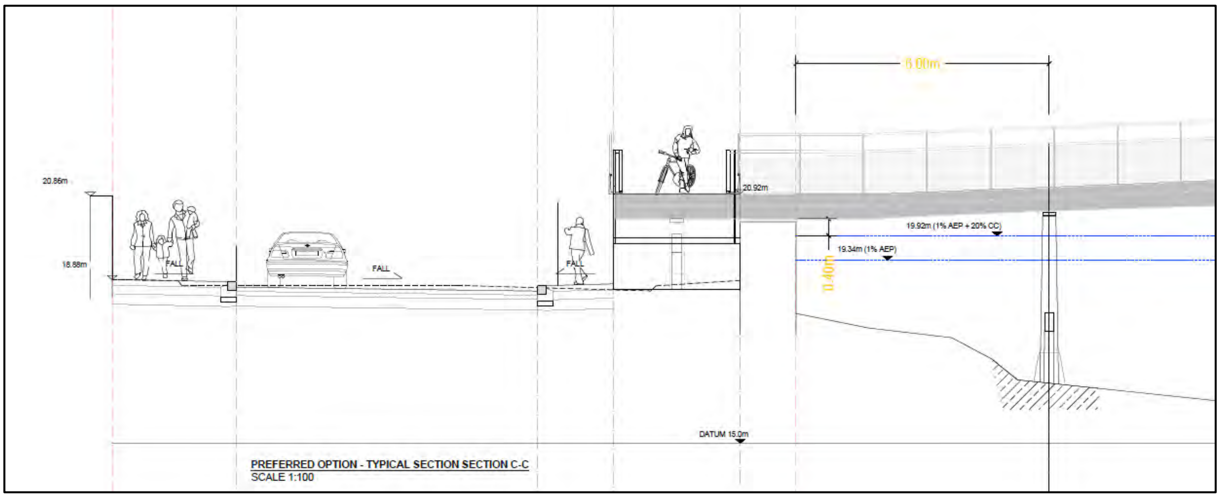


Figure 3-5: Southern bridge crossing landing in Raheen Road elevation

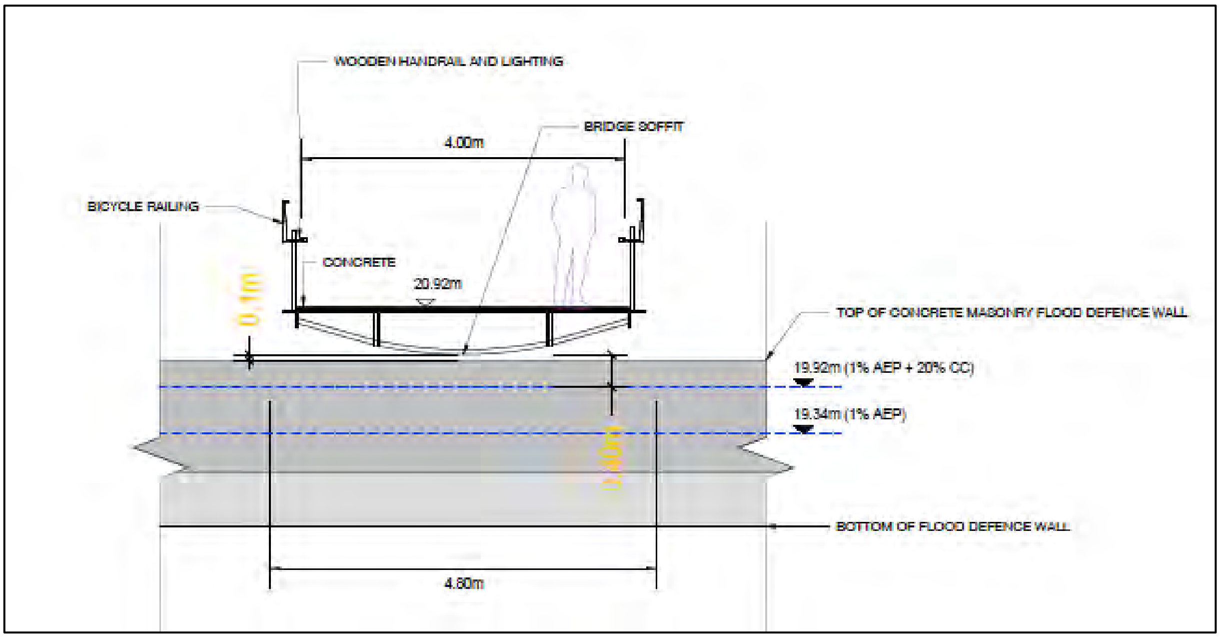


Figure 3-6: Southern bridge landing in Raheen Road section

3.2 Construction Phase Mitigation Measures

This section of the report sets out the specific mitigation or control measures which have been and/or will be included in the construction phase contract documentation to ensure that the construction phase risks to the operation or maintenance of the flood defence scheme is allayed appropriately.

3.2.1 Outline Construction Methodology and Sequencing

The construction of the bridges will follow the high-level sequence summarised below:

- Construction of encased bored end-bearing piles at six locations for the abutments and piers which will be founded on competent bedrock. If sufficient rock is not available, the use of friction piles shall be evaluated.
- Insitu concrete poured pile caps and piers will be constructed during dry-weather periods to allow access to the work areas. Localised sheet-piling around the works areas will be utilised to provide protection for up to the 50% Annual Exceedance Probability or 1-in-2-year recurrence interval summer flood events plus 300-mm freeboard.
- Provision of haul roads on the island for accessibility of machinery for pile construction and installation of bridges.
- Reinforced concrete piers will be constructed up to the soffit levels of the proposed bridges.
- The superstructures for the bridges will consist of prefabricated steel sections, which will be transported to site by exceptional road convoys which will require appropriate licensing and approval.
- The prefabricated steel sections will be assembled at 3 No. locations, namely the North Plaza, Suir Island Carpark site compound and a temporary assembly platform within Denis Burke Park.
- The bridge sections shall be installed by heavy-duty cranes in approx. 30m length sections which will place the sections on top of the completed abutment and pier structures.
- For the northern bridge, a crane will lift half of the footbridge from the North Plaza along the northern river bank while another crane will lift the other half of the footbridge from the Suir Island Carpark.
- For the southern footbridge, a crane will lift half of the footbridge from the temporary assembly platform located within Denis Burke Park along the southern river bank, while another crane lifts the other half of the footbridge from Suir Island.

An indicative construction phasing/sequencing programme is shown on Drawings 20_071-CSE-00-XX-DR-C-2450 to 2453 included in **Appendix A**.

3.2.2 Operation of Flood Defence Scheme during the Works

As highlighted in **Section 3.1** above, the proposed development will interact with the Clonmel flood defence scheme infrastructure on three key areas, namely; The North Plaza, Suir Island and Raheen Road. To prevent the construction works from undermining the operation of the defence scheme, the following constraints/mitigation measures are proposed.

The North Plaza (The Quays):

- The primary concern relates to maintaining accessibility for Tipperary County Council staff for accessing the section of flood defences between Old Bridge Road and New Quay for the installation of the demountable barrier systems. The preliminary layout of the construction works and site hoarding is shown on Figure 3-7 below. For this section it has been assumed that the bridge sections have not been landed on the supports and that the barriers can be installed as per normal conditions. Refer to **Section 3.3.1** for the installation of the demountable barriers following the completion of the bridge landings. The following mitigation measures are proposed to ensure access is maintained during the works:

- The developer recommends that the demountable barrier pillars be installed prior to construction commencement and remain in place for the duration of the works thus minimising the amount and time of works to be completed to install the barrier systems;
- Under the contract documentation (Siteworks Specification) Appendix 1/7 – Site Extent and Limitations to use, the developer will include limitations which states that access will be maintained throughout the works for TCC staff to access the 4-metre-wide section adjacent to the flood defences and that no materials, equipment or obstructions shall be permitted within this zone unless during the time that the 4-metre-wide path is under construction; and
- Further to the above, should the construction of the 4-metre-wide shared path impact on access to the demountable barrier system, the contractor's staff and equipment may be utilised to assist with the installation of the barriers under the direction of competent TCC staff and a corresponding payment item will be included in the works specification and bill of quantities.

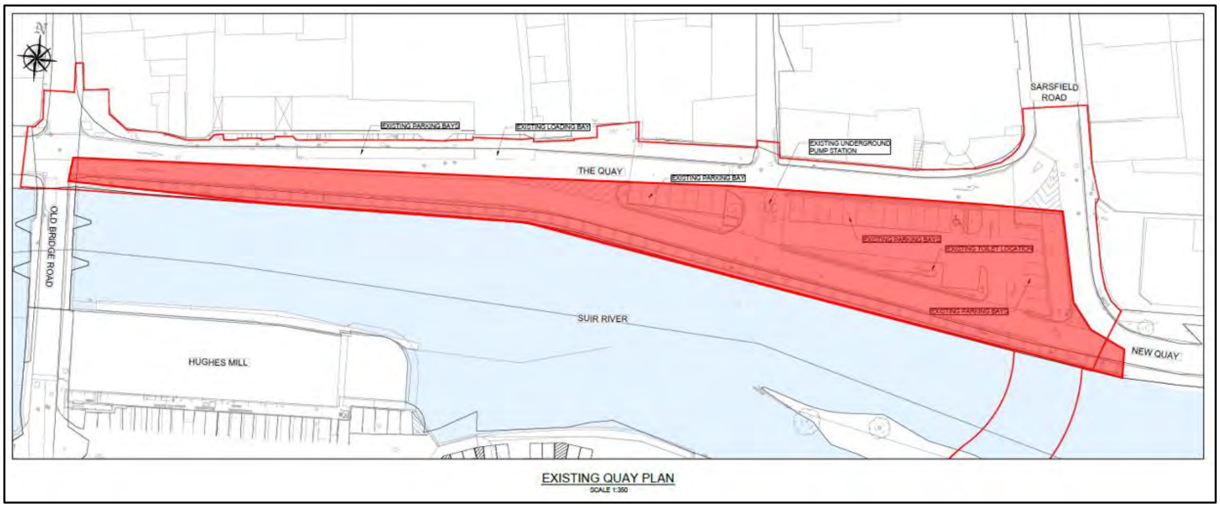


Figure 3-7: Preliminary construction hoarding enclosure

<u>Suir Island Flood Defence Berm:</u>

As noted in **Section 3.1.2**, the works interfaces with the existing earthfill berm located around the Suir Island carpark. To maintain the operation of the flood defence berm during the works, the following operations needs to be carefully planned to ensure that the structural integrity of the defence berm is not undermined:

- Utilising the flood defence berm as an access route for heavy tonnage equipment to access the northern bridge pier;
- Utilising the northern and southern corners of the embankment as platforms to construct the bridge abutments consisting of end-bearing piles and reinforced concrete pile caps where localised excavations will be required;

The following mitigation measures are proposed to ensure that the structural integrity of earthfill embankment is not undermined:

- A clause will be included in the contract specification (Appendix 1/7 Site Extent and Limitations of Use) which will restrict the contractor from removing any existing vegetation from the berm which is not part of the works proposals;
- A temporary works design requirement shall be included in the scope of works under Appendix 1/10 Structures to be Designed by the Contractor. The contractor shall be requested to provide

a Construction Method Statement specific to the works and access on the berm of which shall be approved by the Client's Representative and the Office of Public Works;

- The following design mitigation measures have been incorporated into the works to ensure the flood defence berm is not undermined during the construction works:
  - The works proposed to utilise the berm as a link promenade and shared path between the northern and southern bridges as well as the Suir Island carpark will require the embankment crest to be raised by c. 500mm;
  - As requested by the Office of Public Works, all proposed trees and larger root-ball vegetation landscaping has been removed from the work proposals;
  - Less intrusive pile construction techniques will be considered during the detailed design stage such as driven piles;
  - End-bearing piles are proposed to minimise the number of and subsequently minimise the disturbance area of constructing the bridge abutments on the berm compared to other piling methodologies such as friction-piles;
  - During piling operations, no excavations will be permitted on the berm with only raised platforms being permitted. Piling operations can commence with piles being driven through the embankment. Following the completion of the piles, only localised excavations will be permitted to cut the piles to the correct level and to construct the reinforced concrete pile caps;
  - Where the embankment crest will be raised (Figure 3-3) it is proposed to utilise TensarTech® NaturalGreen™ Slope System or a similarly approved system which will ensure the stability of the embankment, minimise future maintenance requirements and vegetation growth on top of the slope will greatly reduce erosion damage; and

As shown on Drawing 20_071-CSE-GEN-XX-DR-C-2286 included in **Appendix A**, the main contractor's compound has been proposed in the Suir Island carpark. Similarly to the North Plaza, access can be provided for OPW/TCC staff in the event that emergency access is required to maintain the flood defence berm. It should be noted that the berm will be included on the Lands Made Available for the contractor and that maintaining the operation of the berm will be the sole responsibility of the contractor for the duration of the works. The developer thus recommends that the OPW are consulted on a regular basis throughout the works and that the OPW approve all construction method statements which will be provided by the appointed contractor.

Geotechnical site investigations have been carried out in the form of Dynamic Cone Penetrometer testing and boreholes on the existing berm to ensure that that the temporary works design can account for the weight of the equipment in relation to the bearing capacity of the embankment material. It is envisaged that soil stabilising membranes such as Tensar Geogrids with imported granular materials will be utilised to increase the bearing capacity of soils for access routes and working platforms located on the berm. Refer to Figure 3-8 below showing the locations of the site investigations carried out on the Suir Island flood defence berm.

The Borehole (BH) logs from BH03 and BH04, shows that the existing flood defence berm consists of brown sandy gravely silty clay with medium cobbles and boulders. Standard penetration testing was carried out at a depth of c. 3m depth in both boreholes. For BH03, the SPT-N value recorded at this depth was 26, which classifies the material as "compact" (Meyerhoff 1956). At a depth of 6m the SPT-N value increases to 35 to 40 which classifies the soil packing as "dense". For BH04, the SPT-N values range between 12 and 28 for 3m and 6m depths, respectively, which classifies the soil packing of "compact".

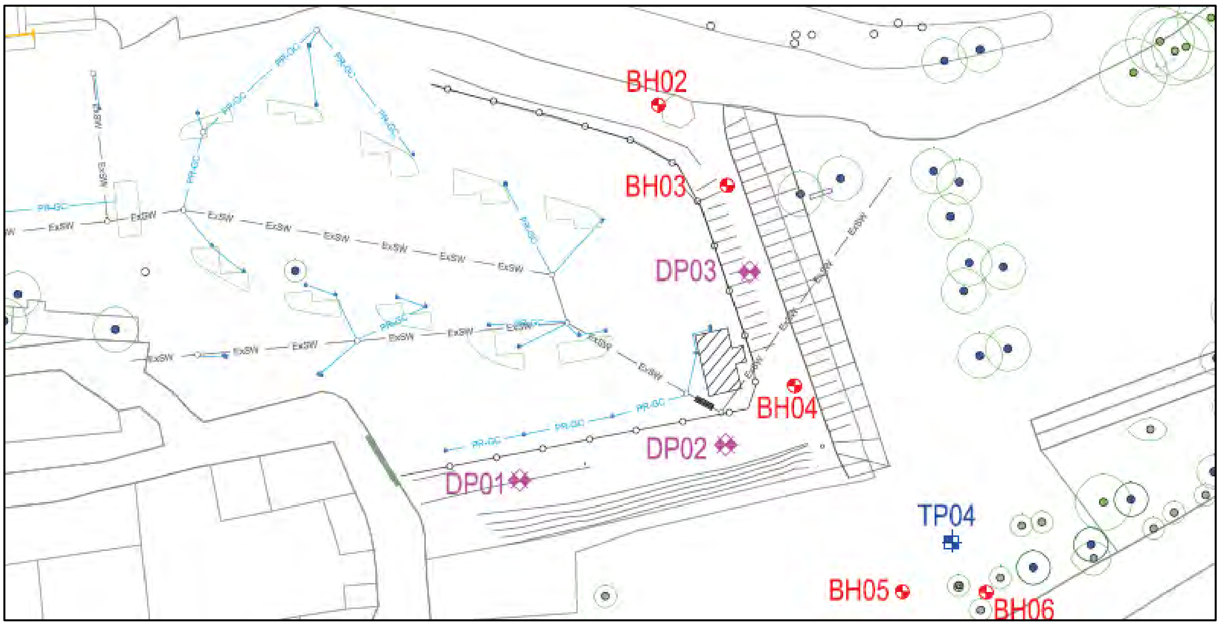


Figure 3-8: Location of site investigations on the Suir Island flood defence berm

The 3 No. Dynamic Penetrometer (DP) tests carried out on ground level of the flood defence berm represent similar results to the above borehole SPT values, with higher blow counts recorded at a depths exceeding 3m. DP03 recorded number of blows below 5 up to depth of 5m below ground level. From the above results, the subsurface conditions of the embankment is considered acceptably stable not to fail catastrophically from increase vehicular loading during the piling works.

Although the embankment is considered stable, the upper strata of the embankment is soft and could potential deform under increased loading arising from the construction works. The proposal to protect the existing flood defence berm from vehicular rutting and deformation is shown on Figure 3-9 below.

As shown below, the upper 100mm-150mm topsoil containing organic material will be removed and stockpiled on site for rehabilitation for other works areas, which will be replaced by Clause 804 base material. To improve the shear resistance of the berm/construction access road, geotextile and trackbed separator layers will be installed below a 200mm high HDPE geocells layer filled with uniformly crushed rock. The reinforced Geocomposite trackbed separates the HDPE geocells from weak sub-grades thus stiffening the geocells laid over weak ground and improving its load bearing capacity. The use of geocells is widely used method to increase the shear resistance of access roads by distributing loads laterally across the cells and thus reducing the downward point loading on subsoils. Following the completion of the works, the flood protection berm will be reinstated in areas where the proposed development does not encompass areas of the berm.

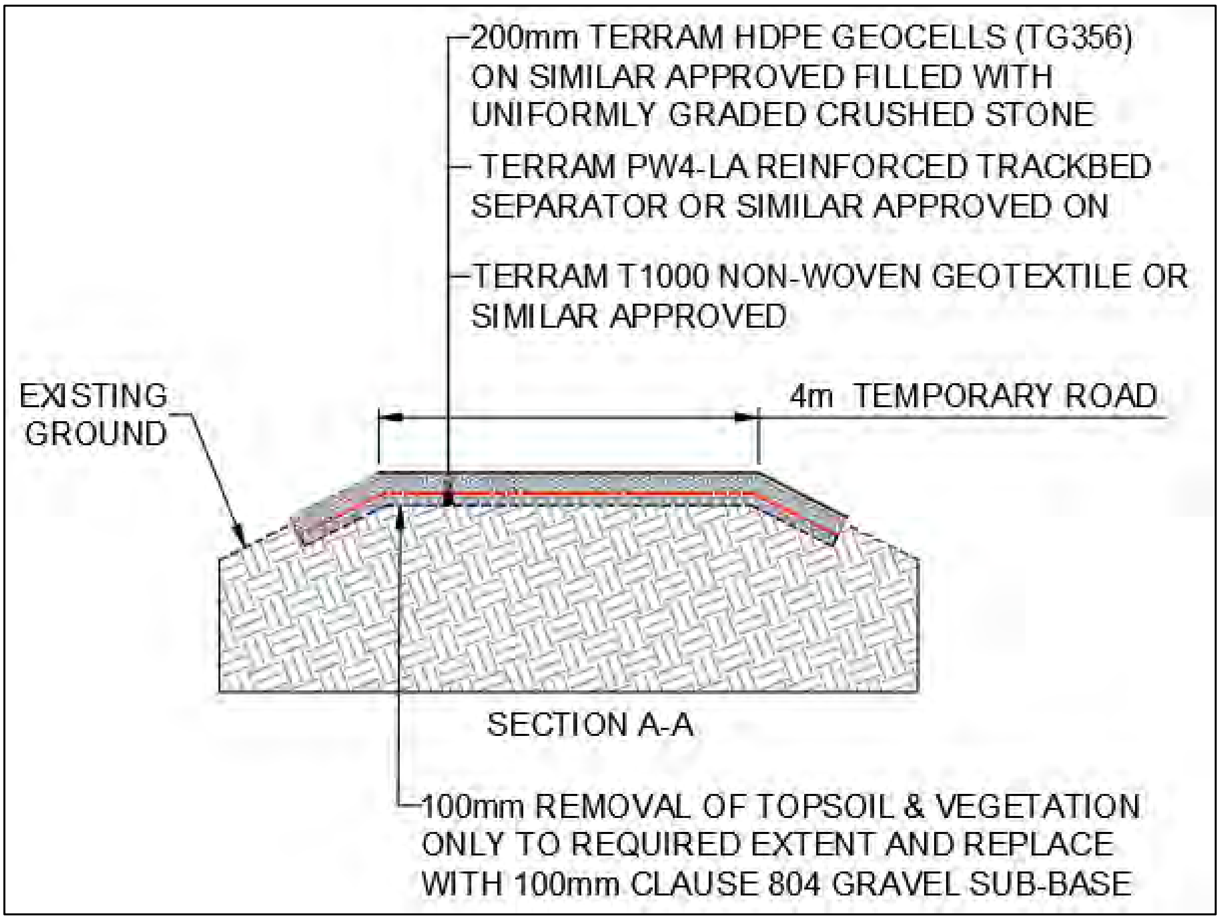


Figure 3-9: Proposed temporary soils reinforcement on Suir Island flood protection berm

3.2.3 Temporary/Enabling Works and Accessing the Northern Pier

The temporary works sheet piling around the 3 No. piers is shown on Drawing 20_071-CSE-00-XX-DR-C-2460 included in **Appendix A**. For the proposed access route over the existing flood defence berm on Suir Island, a precast concrete culvert and localised sheet piling will be utilised to span the old millrace channel to reduce the footprint of the access route and maintain ecological water requirement flows through this sensitive area.

The sheet piling will be localised around each pier (c. 50m^2) with access routes as shown on the drawing. The main purpose of the localised sheet piling is to:

- Provide protection against rising river water levels up to the 50% AEP levels plus an additional 300mm freeboard; and
- To minimise the ingress of groundwater into the works area and to reduce the volume of groundwater to be pumped, filtered and discharged during the construction phase.

The 50% AEP levels plus 300mm freeboard scenario was selected based on the inundation extents of more extreme events. For the 20% AEP event, the access routes to the pier locations will be inundated for all piers, which would require large-scale sheet piling and/or protection berms to be constructed. The foundation works in the floodplains shall only be permitted during summer months.

The effect of the proposed temporary structures (Drawing 20_071-CSE-00-XX-DR-C-2460) on the existing flood water surface elevations (WSE) has been determined in the Hec-Ras model and analyses the worst-case scenario, i.e. all three temporary works areas in place at the same time.

For both the northern and southern river reaches, there is little to no variations in WSE when comparing the existing scenario (baseline) and the temporary works scenario (temp), but with the reduction in flow area, the flow velocities increased by circa 14% to 18% and 5% to 11% for the northern and southern reaches, respectively. Refer to Section 4.2 of the Section 50 Application Report (RPT-20_071-019) for more information.

3.3 Operational Phase Mitigation Measures

The sections of the report aims to address the major concerns in terms of how the proposed development will impact on the operation of the flood defence scheme i.e. the installation of the demountable barrier system in the North Plaza and the maintenance of the flood protection berm located on Suir Island.

3.3.1 Installation of Demountable Barriers (The Quays)

As shown on Drawing 20_071-CSE-GEN-XX-DR-C-2256 (Section B) included in **Appendix A**, the proposed top of bridge design level is 21.20 mOD compared to the top of the flood defence wall of 18.73 mOD with the bridge superstructure consisting of a depth measurement of 0.67 metres. This equates to a vertical clearance of 1.8 metres between the bridge soffit level and top of wall, 1.5 metres of which is allocated for the demountable barrier system leaving 380mm clearance for the installation of the demountable barrier plates which are c. 150mm high per panel as shown on Figure 3-11. As per the meeting minutes (MTG-20_071-030) included in **Appendix B**, Tipperary County Council confirmed that the installation of the barriers would be possible considering the above vertical clearances.

The proposed development also allows for the construction of a 4-metre-wide shared surface along the flood defence wall from Old Bridge Road to New Quay Road, with one-way traffic diverted around the proposed North Plaza. The vertical clearance between the bridge soffit level and top of shared path equates to 2.95 metres, which would allow TCC maintenance vehicles (transporting demountable barriers) to pass unhindered underneath the bridge. Refer to Figure 3-2 or Drawing 20_071-CSE-GEN-XX-DR-C-1012 included in **Appendix A** for more dimensions.

Based on the above, it is evident that the proposed bridge will not impact on the installation methodology of the demountable barrier system. An architectural rendering of the completed bridge structure spanning over the flood defence wall is shown on Figure 3-12 for reference.

Figure 3-10: The Quays demountable barrier system

Figure 3-11: Architectural rendering of the completed northern bridge

3.3.2 Maintenance of Suir Island Flood Defence Berm

As shown on Drawing 20_071-CSE-GEN-XX-DR-C-2253 included in **Appendix A**, the proposed development aims to utilise the upstream slope of the southern embankment flank for the access ramp and the crest of the main embankment as the shared path link promenade with 3 sets of steps included on the embankment slopes.

The southern upstream flank will be filled to achieve the require ramp grades, again making use of slope stability systems such as TensarTech® NaturalGreen™ Slope and geogrids. These systems provide slope stability whilst promoting vegetation growth to establish, which protects the slopes from erosion, thus minimising future maintenance requirements.

The central main embankment will be raised similarly, as outlined above, on both the upstream and downstream slopes. The use of these systems in unison together with using well compacted granular materials will minimise future settlement rates and reduce maintenance requirements. The shared surface path will be constructed from flexible pavement types, which can accommodate settlement in comparison to rigid pavement layers such as concrete. As shown on the South Bridge Elevation (Drawing 20_071-CSE-00-XX-DR-C-2260), the southern bridge will provide sufficient vertical clearance to allow maintenance vehicles to pass underneath the bridge via the Suir Island Gardens to access the eastern section of Suir Island during maintenance operations.

As agreed with the Office of Public Works, no large diameter root-ball trees or shrubs will be introduced on the embankment, thus removing the risk of roots undermining the stability of the earthfill embankment.

Based on the above, it is the view of the developer that the proposed development will not increase the maintenance requirements of the flood protection berm. Following the completion of the construction phase, an Operations and Maintenance Manual will be compiled to ensure that the regular inspection and maintenance be carried out on the proposed development to ensure that the operation of the flood protection berm is not undermined.

4 Conclusion and Recommendations

This report sets out to address the specific project risks relating to the proposed development and the various interfaces with the Clonmel Flood Defence Scheme infrastructure during the different project phases including design, construction and operation.

This supplementary report underlines how the design of proposed development interfaces with the existing flood defence scheme infrastructure and highlights the construction and operational phase risks involved at each of the key areas. **Section 3.2** and **3.3** summarises the mitigation and control measures which will be incorporated throughout the project phases to ensure that the operation of the flood defences are not undermined and access is not restricted during emergency scenarios or regular maintenance periods.

The report acknowledges that the proposed development interfaces with critical Clonmel Flood Defence Scheme infrastructure and aims to address these risks involved during the construction and operational phases of the project. It should be noted that the project is still in preliminary design stage and that the risks will be further scrutinised during the detailed design stage.

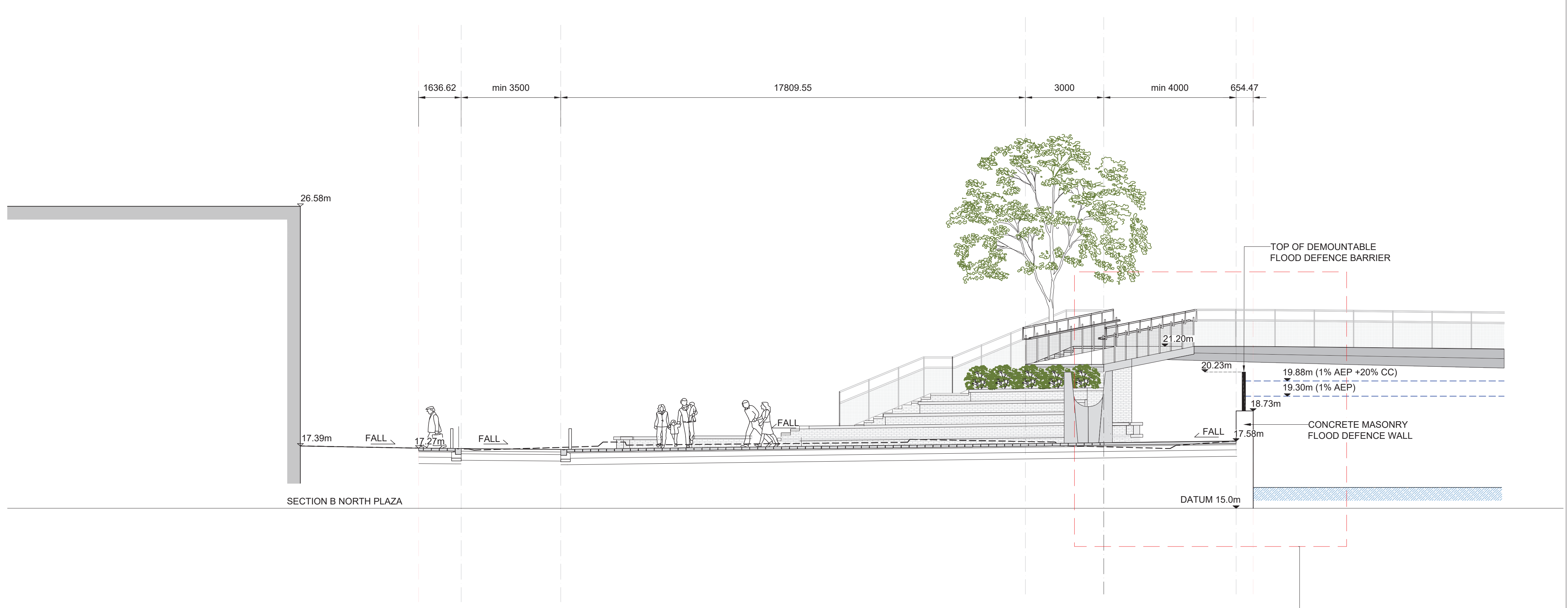
Based on the above information and relevant reports, it is the view of the developer that sufficient evidence has been provided to address the relevant concerns raised about the proposed development for the approval of the Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU Regulations SI 122 of 2010 based on the following:

- The proposed development will not adversely impact on the flood water levels either upstream or downstream of the development as noted in Section 4.1 of the Section 50 Application Report (RPT-20_071-019);
- During the construction phase, the temporary works will not adversely impact on flood water levels upstream or downstream of the development as noted in Section 4.2 of the Section 50 Application Report (RPT-20_071-019);
- The completed development will not impact on the installation of the demountable barrier systems on the North Plaza (The Quays) as noted in Section 3.3.1 of this report;
- The construction phase will not undermine the operation of the flood defence berm located on Suir Island as noted in Section 3.2.2;
- The proposed development will not adversely affect the maintenance requirements of the Suir Island flood defence berm; and
- The proposed development will not impact on the operation of the concrete masonry flood defence wall located along Raheen Road.
- The vertical alignment of the proposed bridge crossings provide sufficient dry-freeboard between the bridge soffit levels and the 1% AEP and 20% AEP Climate Change (MRFS) flood water levels as requested by the Office of Public Works.

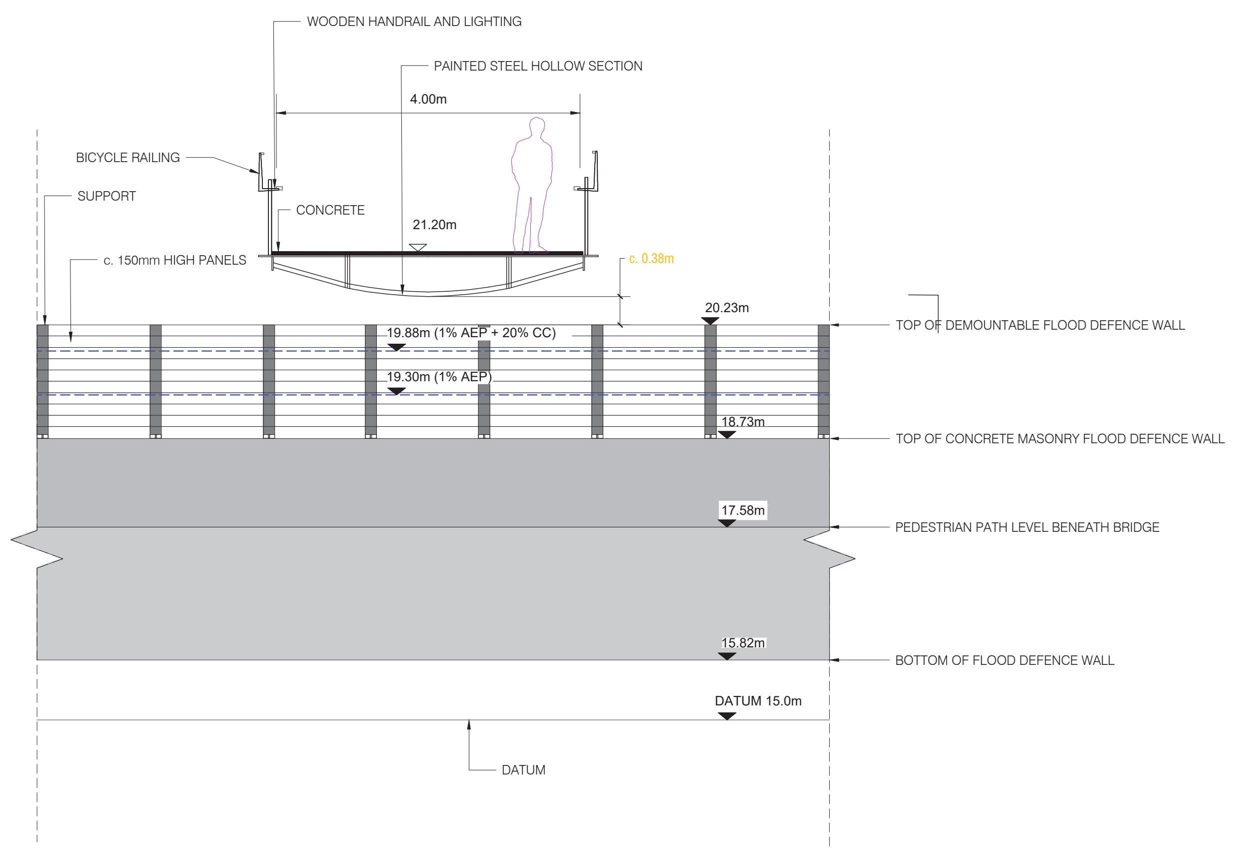
It should be noted that continuous engagement with the Office of Public Works will be sought by the developer to ensure that all risks are addressed for the detailed design, procurement and implementation phases of the project. Further to the above, prior to any commencement of works on site, a Section 9 of the Arterial Drainage (Amendment) Act, 1995 Modification or Relocation of Watercourse, Embankment or Other Works Application will be lodged with the OPW Regional Office for approval.

Appendix A – Development Drawings

Drawing No.	Drawing Title
Sketches	
20_071-CSE-GEN-XX-DR-C-1012	North Plaza Interfaces Typical Sections
20_071-CSE-GEN-XX-DR-C-1013	Raheen Road Interfaces Typical Sections
20_071-CSE-GEN-XX-DR-C-1014	Bridge Longsections and Flood Water Levels
Planning Drawings - **REFER TO EIAR VOLUME C**	
20_071-CSE-GEN-XX-DR-C-2001	Site Location Map
20_071-CSE-GEN-XX-DR-C-2251	Preferred Option 01 Overall Plan
20_071-CSE-GEN-XX-DR-C-2252	Preferred Option 01 North Plaza Plan Sheet 01 of 04
20_071-CSE-GEN-XX-DR-C-2253	Preferred Option 01 Carpark Plan Sheet 02 of 04
20_071-CSE-GEN-XX-DR-C-2254	Preferred Option 01 South Arrival Plan Sheet 03 of 04
20_071-CSE-GEN-XX-DR-C-2255	Preferred Option 01 South Arrival Plan Sheet 04 of 04
20_071-CSE-GEN-XX-DR-C-2256	Preferred Option 01 Typical Sections A, B & C
20_071-CSE-GEN-XX-DR-C-2257	Preferred Option 01 Typical Sections D, E, F & G
20_071-CSE-GEN-XX-DR-C-2260	Preferred Option 01 Bridge Plan & Elevations
20_071-CSE-GEN-XX-DR-C-2261	Preferred Option 01 Bridge Sections
20_071-CSE-GEN-XX-DR-C-2262	Preferred Option 01 Bridge Details
0_071-CSE-GEN-XX-DR-C-2286	Proposed Site Compound Plan
20_071-CSE-GEN-XX-DR-C-2460	Proposed Temporary Works for Pier Construction



PREFERRED OPTION - TYPICAL SECTION SECTION B-B
SCALE 1:100



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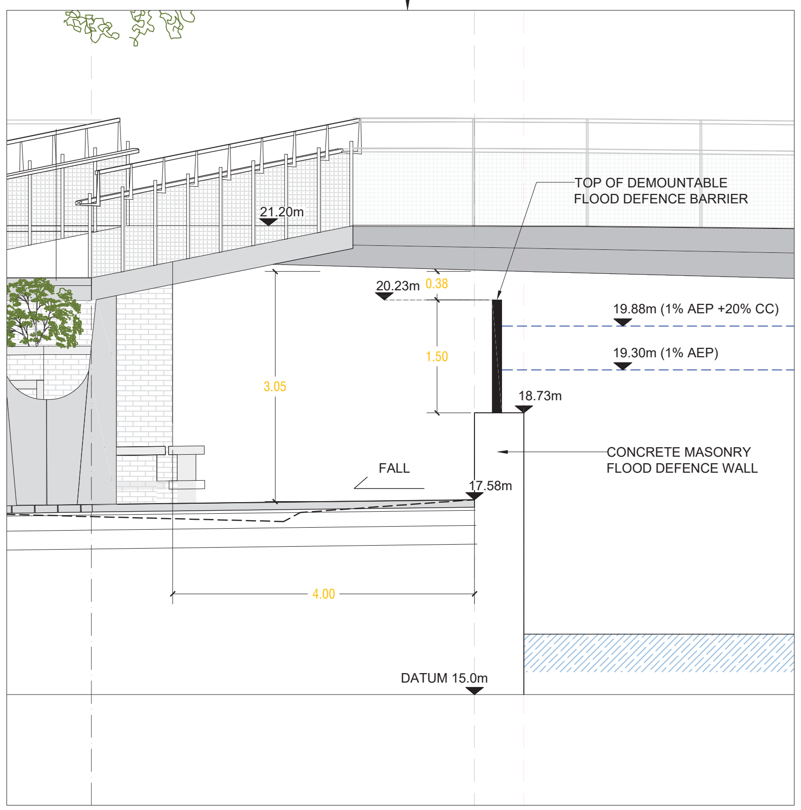

PREFERRED OPTION - INTERFACE WITH FLOOD DEFENCE INFRASTRUCTURE
SCALE 1:50

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1

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P01	FOR INFORMATION	HB	LP	11.04.23
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Project: SUIR ISLAND INFRASTRUCTURE LINKS
Dwg. Title: NORTH PLAZA INTERFACES TYPICAL SECTIONS

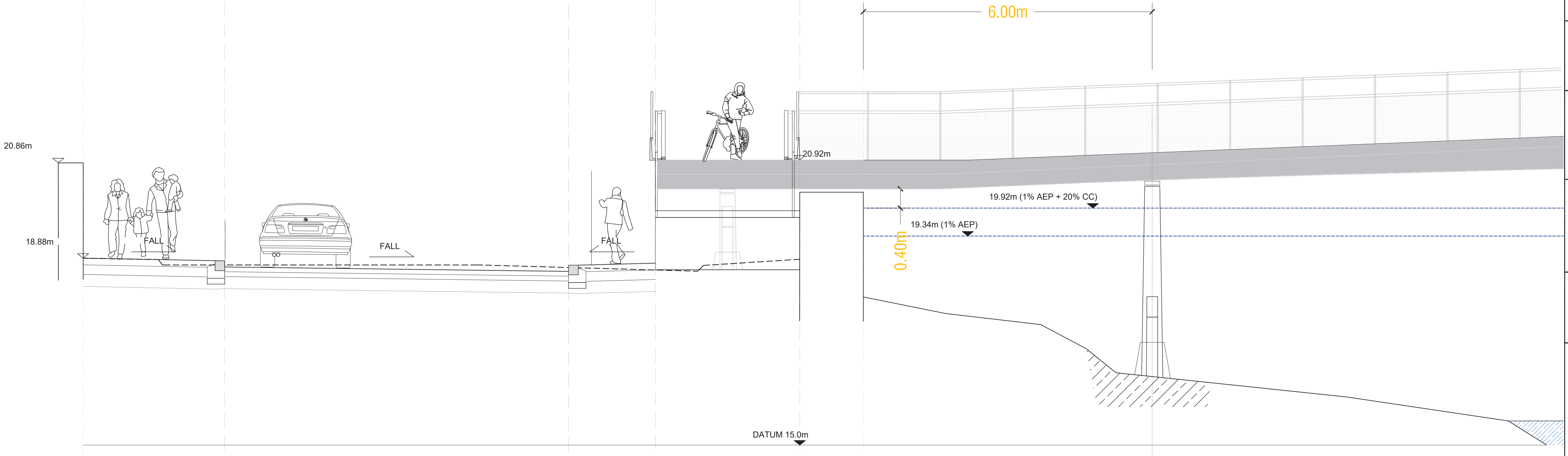
Drawn By: HB
Date: APR 2023
Checked By: LP
Scale: AS SHOWN@ A1
CSEA Job No.: 20_071

Project Code	Originator	Zone/ Phase	Level	Type	Role	Dwg. No.
20_071	CSE	00	XX	DR	C	1012

Status Code: S2
Suitability Description: FOR INFORMATION
Revision: P01
Project Status: PRELIMINARY

DRAWING IS PRODUCED USING THE IRISH TRANSVERSE MERCATOR (ITM) GEOGRAPHIC COORDINATE SYSTEM

A1



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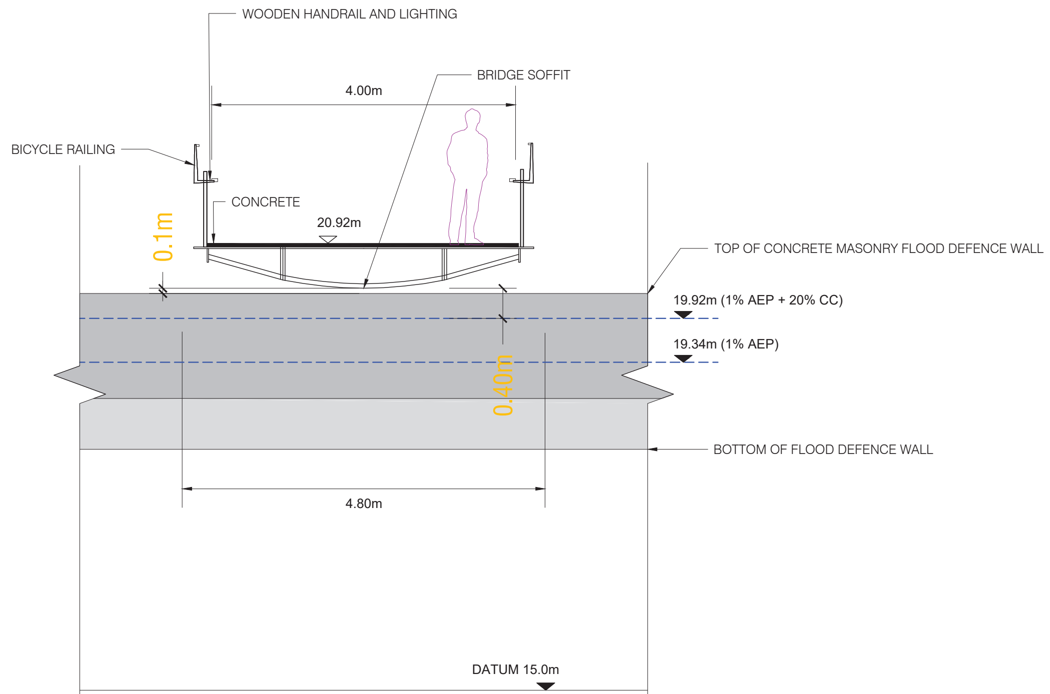

PREFERRED OPTION - TYPICAL FLOOD DEFENCE INTERFACE RAHEEN ROAD
SCALE 1:50

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P01	FOR INFORMATION	HB	LP	11.04.23
P01	FOR INFORMATION	FO	LP	28.03.23

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Dwg. Title: RAHEEN ROAD INTERFACES TYPICAL SECTIONS

Drawn By: HB
Date: APR 2023
Checked By: LP
Scale: AS SHOWN @ A1
CSEA Job No.: 20_071

Project Code	Originator	Zone/Phase	Level	Type	Role	Dwg. No.
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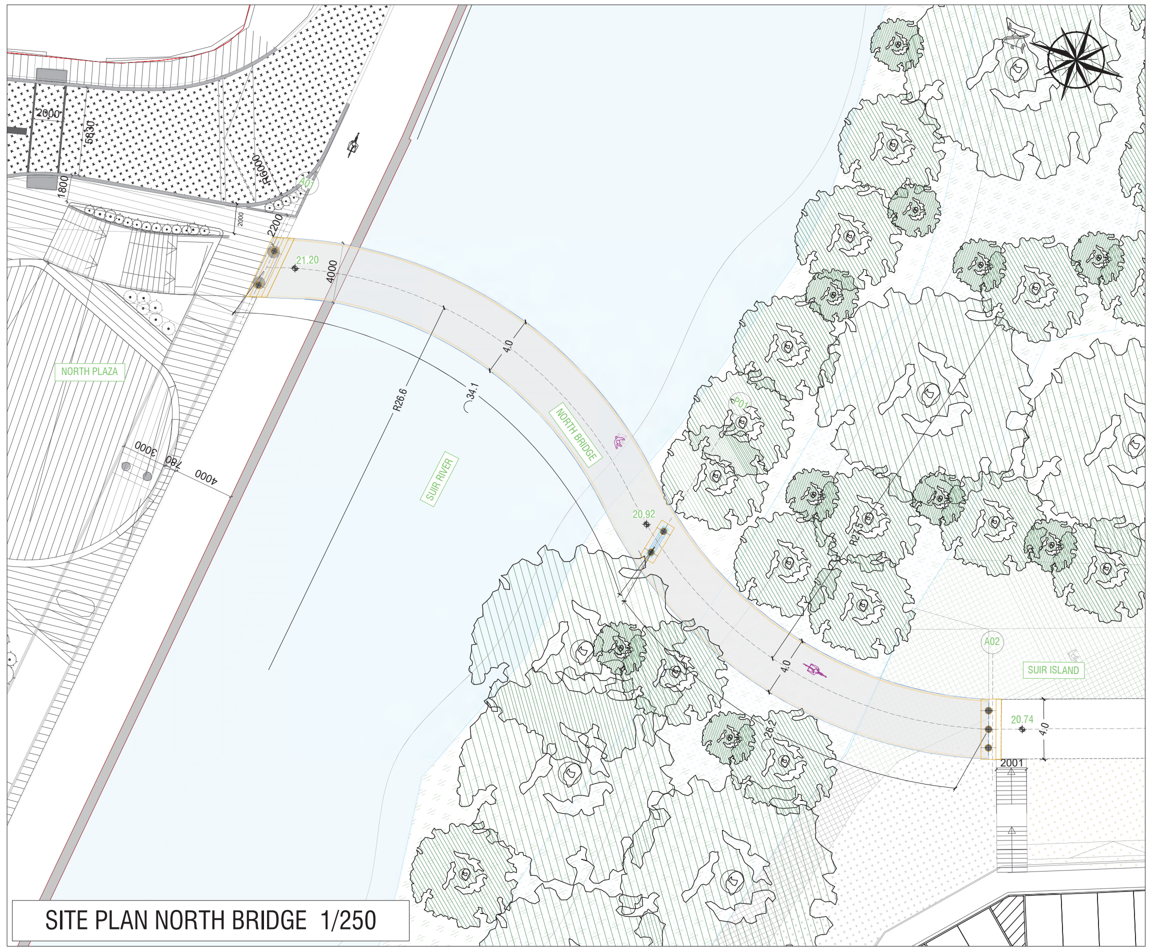
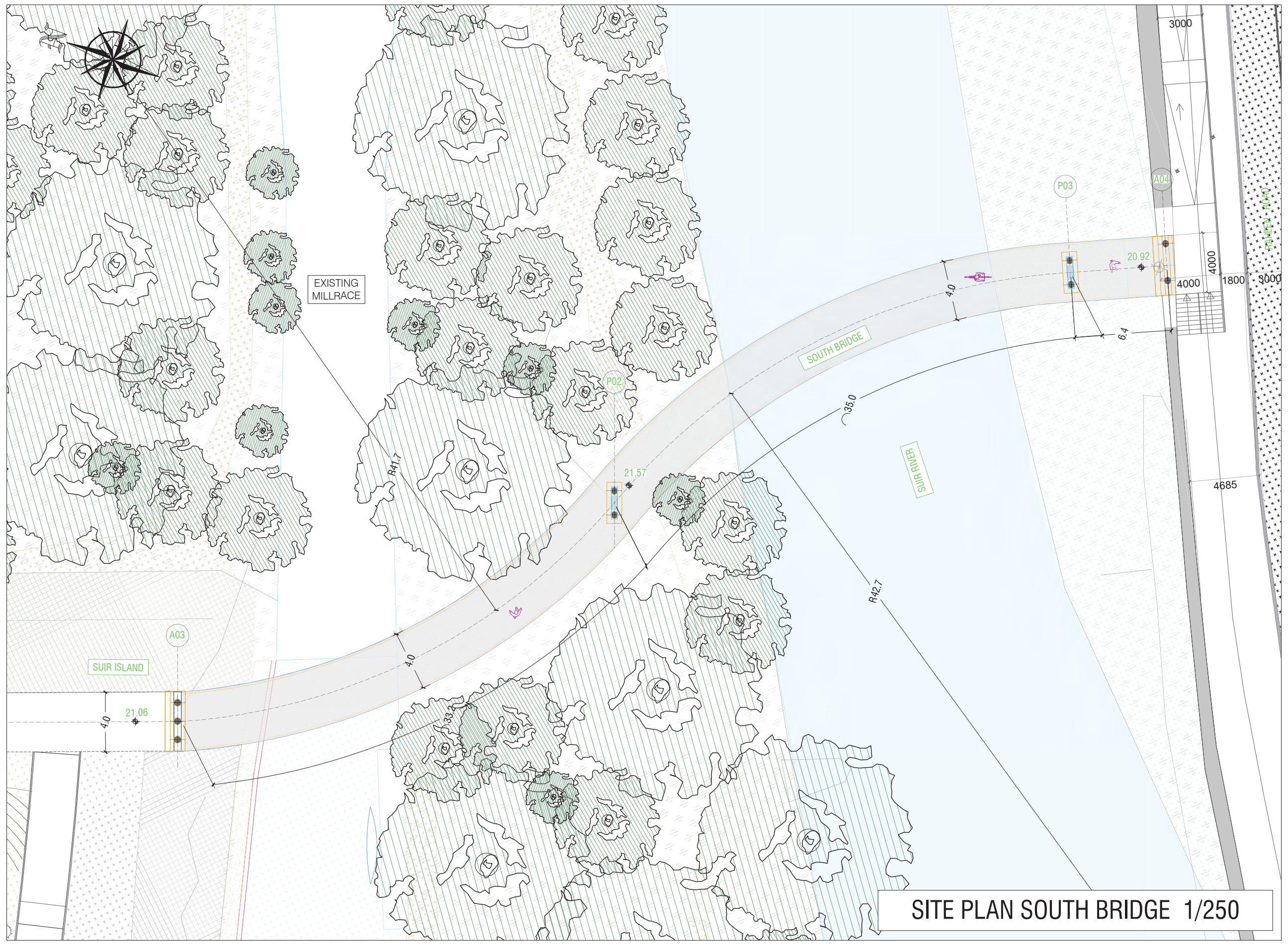
Status Code: S2
Suitability Description: FOR INFORMATION

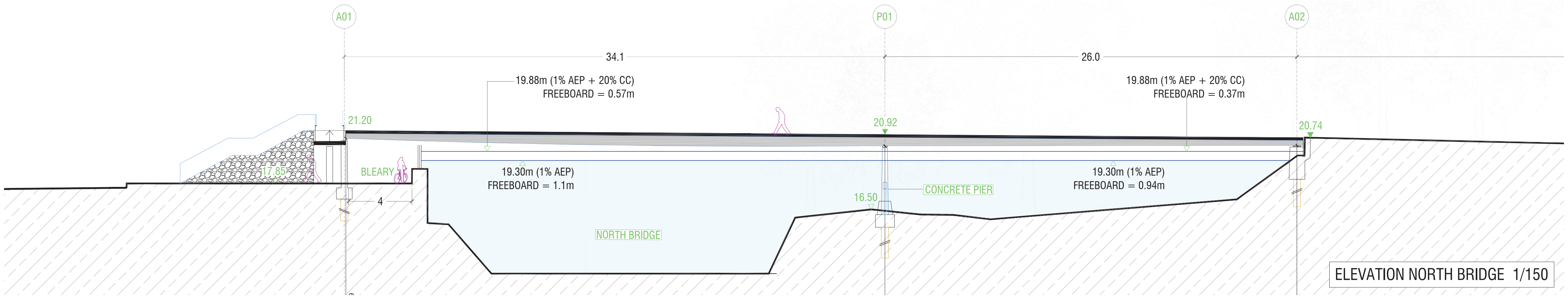
Revision: P01
Project Status: PRELIMINARY



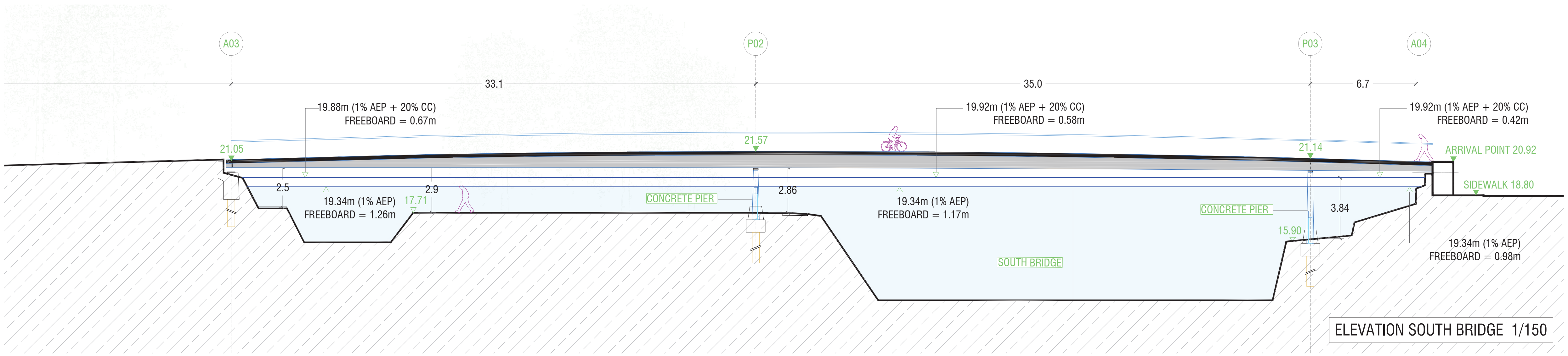
SITE PLAN NORTH BRIDGE 1/250



SITE PLAN SOUTH BRIDGE 1/250



ELEVATION NORTH BRIDGE 1/150



ELEVATION SOUTH BRIDGE 1/150

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A1

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Comhairle Contae Thiobraid Árann
Tipperary County Council

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dhbarchitects

ARCHEOLOGISTS
CourtneyDeery

BRIDGES
MARC MIMRAM ARCHITECTURE INGÉNIERIE

ENGINEERS
Clifton Scannell Emerson Associates

ENVIRONMENTAL CONSULTANTS
awnconsulting
A Trinity Consultants Company

LIGHTING CONSULTANTS
Douglas Carroll
Consulting Engineers

Rev	Description	Drawn	Checked	Date
P01	FOR INFORMATION	HB	LP	28/03/23

Clifton Scannell Emerson Associates

Clifton Scannell Emerson Associates Limited
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Client: TIPPERARY COUNTY COUNCIL

Project: SUIR ISLAND INFRASTRUCTURE LINKS

Dwg. Title: BRIDGE LONGSECTIONS AND FLOOD WATER LEVELS

Drawn By: HB
Date: MAR 2023
Checked By: LP
Scale: AS INDICATED@ A1
CSEA Job No.: 20_071

Project Code - Originator - Zone/Phase - Level - Type - Role - Dwg. No.

20_071 - CSE - 00 - XX - DR - C - 1014

Status Code: S2
Suitability Description: FOR INFORMATION

Revision: P01
Project Status: PRELIMINARY

Appendix B – Previous Meeting Minutes and Correspondence

Document No.	Document Title
MTG-20_071-001	Office of Public Works Kick-off meeting
LTR-20_071-014	Section 50 Application Response
MTG-20_071-030	Office of Public Works Section 50 Application Review Meeting

Clifton Scannell Emerson Associates

MINUTES OF MEETING

PROJECT:	20_071 – Suir Island Infrastructure Links	**Date:**	06/10/2020
Situated at:	Clonmel Tipperary	**Time:**	11:00am
For:	Clifton Scannell Emerson Associates	**Ref:**	MTG-20_071-001
Location:	Microsoft Teams		
Title:	OWP Meeting		
Subject:	OPW Meeting No.1		
Next meeting:	TBC		

Attendance:

Name	Organisation	
James Fitzgerald	OPW	JF
Ronan Geoghegan	CSEA	RG
David Wall	CSEA	DW
Siddig Elshareef	CSEA	SE
Kevin Crowley	CSEA	KC

Apologies:		
Name	Organisation	
Gillian Flynn	TCC	GF

Points Discussed		Action by
1	**Overview of the scheme**	
1.1	RG opened the meeting to JF with an introduction to the CSEA team in attendance stating CSEA are the lead designers and set up this meeting with OPW to discuss the scheme.	Note
1.2	RG discussed in detail all route options with JF, the first option discussed was the do nothing option, then the do something option and 5 varying bridge options	Note
1.3	RG discussed the options and implications of the 5 varying route and bridge proposals and the traffic implications on the Quay street with the connection to the Public Realm	Note
1.4	RG pointed out the project constraints which includ ecology, trees, flooding fluvial and defence walls of each route option to JF	Note
1.5	JF mentioned that CSEA will need to review how the options effect the defence berms on Suir Island.	Note
1.6	JF notes he was not part of the design team that carried out the flood design for Clonmel.	Note
2	**Flood Levels**	
2.1	As Built information - KC to ask GF for top of defence barrier level information & Cross sections through the barriers.	CSEA

2.2	Bridge Design levels to have the soffit of bridge above the flood defences. JF noted that it would be the OPW's preference to not impact on the flood defences in any way as this could result in a full redesign of the defence system.	Note
2.3	JF said the OPW flood design is based on achieving 1in100 plus 20% Climate change Impact on flood planes	Note
2.4	It was discussed that the top level of the flood defence to the bridge is to have at least 300mm freeboard	Note
2.5	JF noted that CSEA talk to GF for the flood barrier levels. JF also suggested that CSEA should discuss the project with the TCC team responsible for the installation of the flood defences to determine installation methodologies and access relative to the bridge designs.	CSEA
2.6	The impact on the flood plains should be identified by a HECRAS Model. CSEA noted that they intend on developing the river profile using Civil 3D and then transfer this information into a HECRAS model which will indicate flood levels.	CSEA
2.7	JF to seek flood modal information from the hydraulic design team. CSEA to formally request this model from the OPW through JF.	JF/CSEA
2.8	JF noted that the OPW technical team may not be inclined to issue their model data but he would investigate.	JF
2.9	The OPW HECRAS model is out of date and needs to be updated, JF acknowledged to SE that this can be done via Civil3D also.	CSEA
2.10	Question asked if OPW have any Flood water pump stations CSEA should know about aside from what's on the flood map and to send on information if they do.	JF
2.11	JF noted that a Section 50 application will be necessary for the bridges. CSEA will prepare this application and will review with JF prior to submission. When the Section 50 is officially submitted OPW still retain their review period as the application will be distributed to all relevant departments within the OPW who will review independently of these advanced discussions. The Section 50 application will be submitted in advance of the Planning Application. The flood model information will be necessary to accompany this application.	Note
2.12	JF noted that if the existing defences are altered in the final design then in addition to Section 50 consent, approval under Section 9 of the 1995 Arterial Drainage Amendment Act may be required.	Note
3	**Suir Island**	
3.1	RG noted that it was TCC's intention to open the millrace through the island and that this is likely to have positive effects on the flood levels and conveyance of water.	Note
3.2	JF noted that pollarding of the trees on Suir Island is likely to be required.	Note

3.3	JF suggested leaving the flood defence berm alone if possible. JF suggested that CSEA investigate the maintenance regime of this berm with TCC prior to considering it as part of the bridge design. CSEA were investigating placing a 4m wide path on top of the berm which could form part of the Suir Blueway.	CSEA
3.4	RG noted that the bridge foundations are likely to be a pile design and suggested that the piles extend through the berm with a pile cap sitting at top of berm level or above top of berm level. JF suggested that this may be acceptable to the OPW, however exact details would have to be worked out.	Note
3.5	JF noted that the Pump stations, the bridge and overall design shouldn’t have an impact on the flood design	Note
4	**AOB**	Note
4.1	No date arranged for next meeting	Note

Our Ref: LTR-20_071-014

Date: 4th October 2022

Mr. James Fitzgerald
Office of Public Works,
Newtown,
Trim,
Co. Meath
C15 K8V0

Re: 20_071 Suir Island Infrastructure Links

Subject: Section 50 Application Response

Dear Mr. Fitzgerald,

In response to your email dated 21st September 2022 in relation to the Suir Island Infrastructure Links proposed development and the Section 50 Applications, Clifton Scannell Emerson Associates wishes to address the following concerns raised by the Office of Public Works as enclosed in this correspondence.

We look forward to further discussion with regard to this.

Yours sincerely,

Laura Peare

Laura Peare
Clifton Scannell Emerson Associates

Enc.

Drawing No. 20_071-CSE-00-XX-DR-C-2251
Drawing No. 20_071-CSE-00-XX-DR-C-2252
Drawing No. 20_071-CSE-00-XX-DR-C-2253
Drawing No. 20_071-CSE-00-XX-DR-C-2254
Drawing No. 20_071-CSE-00-XX-DR-C-2255
Drawing No. 20_071-CSE-00-XX-DR-C-2256
Drawing No. 20_071-CSE-00-XX-DR-C-2257
Drawing No. 20_071-CSE-00-XX-DR-C-2260
Drawing No. 20_071-CSE-00-XX-DR-C-2261
Drawing No. 20_071-CSE-00-XX-DR-C-2262
Drawing No. 20_071-CSE-00-XX-DR-C-2286
Drawing No. 20_071-CSE-00-XX-DR-C-2450
Drawing No. 20_071-CSE-00-XX-DR-C-2451
Drawing No. 20_071-CSE-00-XX-DR-C-2452
Drawing No. 20_071-CSE-00-XX-DR-C-2460

c.c.

James Fitzgerald (james.fitzgerald@opw.ie),
Denis Delaney (denise.delaney@opw.ie),
Roger Noonan (roger.noonan@tipperarycoco.ie),
Ronan Geoghegan (ronan.geoghegan@csea.ie),
Henk Botha (henk.botha@csea.ie)

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1 Maintaining the Operation of the Flood Protection Infrastructure during the Construction Phase and Raheen Road Tie-in:

Flood Protection on The Quays

The construction phase of the proposed North Plaza will have no impact on the existing flood defences along The Quays, up to the point where the northern bridge superstructure will be landed on the support structures. As shown on Drawing 20_071-CSE-00-XX-DR-C-2256 (Section B), sufficient clearance is allowed between the bridge soffit levels and the existing flood defence wall with the demountable barrier system. The operational concern raised by the OPW in relation to the installation of the demountable barriers underneath this crossing is addressed in **Section 4** below.

Flood Protection on Suir Island

During the construction phase, it is envisaged that the existing flood defence berm located around the Suir Island carpark will be utilised as the access route to construct the northern bridge pier located adjacent to the main river channel. A preliminary access route is shown on Drawing 20_071-CSE-00-XX-DR-C-2460. To maintain the functionality of the flood defence berm during the construction phase the following constraints will be incorporated into the contract documentation:

1. No vegetation shall be cleared on the existing berm slopes, except on the route as indicated on the aforementioned drawing, to prevent any erosion or undermining from occurring on the berm during flooding events;
2. The access route shall be constructed by raising the existing embankment levels with Clause 804 sub base and existing levels shall not be lowered below the 1% AEP + 20% CC water surface elevations;

Flood Protection along Raheen Road and Tie-in

As shown on Drawing 20_071-CSE-00-XX-DR-C-2256 (Section C), we propose to integrate the bridge superstructure through the existing flood defence wall located along Raheen Road. This will be achieved by cutting a key through the existing masonry wall to land the southern bridge on the supporting structures located behind the flood defence wall and piers located on either bank of the Slalom Course. This will prevent any loading to be distributed onto the existing flood defence wall. The construction of the key through the existing wall will only occur prior to the landing of the bridge superstructure and will be temporarily closed at all times with plates bolted to the masonry wall prior to the landing. The approximate dimensions of the key will be 4.25m (wide) by 1.25m (depth) to allow the bridge superstructure to span through the wall. Following the completion of the landing, a bespoke plate and rubber gasket system will be manufactured to seal the narrow gap between the bridge and existing flood defence wall to prevent flood waters from spilling onto Raheen Road.

2 Construction of Support Structures in the River Suir Floodplain and Temporary Works:

The temporary works sheet piling around the 3 No. piers is shown on Drawing 20_071-CSE-00-XX-DR-C-2460. For the proposed access route over the existing flood defence berm on Suir Island, a precast concrete culvert and sheet piling will be utilised to span the old millrace channel to reduce the footprint of the access route and maintain flows through this ecological sensitive area.

The sheet piling will be localised around each pier (c. 50m^2) with access routes as shown. The main purpose of the localised sheet piling is to:

- Provide protection against rising river water levels up to the 50% AEP levels plus an additional 300mm freeboard; and
- To minimise the ingress of groundwater into the works area and to reduce the volume of groundwater to be pumped, filtered and discharged during the construction phase.

The 50% AEP levels plus 300mm freeboard scenario was selected based on the inundation extents of more extreme events. For the 20% AEP event, the access routes to the pier locations will be inundated for all piers, which would require large-scale sheetpiling and/or protection berms to be constructed. The foundation works in the floodplains shall only be permitted during summer months.

The effect of the proposed temporary structures (Drawing 20_071-CSE-00-XX-DR-C-2460) on the existing water surface elevations (WSEL) has been determined in the Hec-Ras model and is summarised below.

For both the northern and southern river reaches, there is little to no variations in WSEL when comparing the pre-construction scenario and the temporary works scenario, but with the reduction in flow area the flow velocities increased by circa 14% to 18% and 5% to 11% for the northern and southern reaches, respectively.

Northern River Reach

Flood AEP	WSEL (Base)	V (Base) (m/s)	WSEL (Temp)	V (Temp) (m/s)
50% AEP	17.64	1.47	17.60	1.67
20% AEP	18.14	1.51	18.10	1.78
10% AEP	18.45	1.53	18.40	1.79
1% AEP	19.30	1.52	19.27	1.75

Southern River Reach

Flood AEP	WSEL (Base)	V (Base) (m/s)	WSEL (Temp)	V (Temp) (m/s)
50% AEP	17.67	1.12	17.66	1.24
20% AEP	18.15	1.14	18.15	1.23
10% AEP	18.45	1.16	18.45	1.24
1% AEP	19.32	1.26	19.32	1.32

3 Pile Construction Methodology on the Suir Island Flood Defence Berm:

The piling and pile cap construction methodology on the Suir Island flood defence berm will be as follows:

- Prepare access route as shown Drawing 20_071-CSE-00-XX-DR-C-2460 with suitable sub base materials;
- Move piling plant to abutment locations;
- The provisional piling type envisaged for the project consists of end bearing type piles, either bored and cast in-situ or driven and cast in-situ. Friction and aggregate pile types will be evaluated during the detailed geotechnical and structural design phase;

- Provisionally, 3 No. end bearing piles will be required at each of the abutment locations on the berm;
- To prevent the undermining of the flood defence berm and maintain the functionality of the berm, the piling will commence from a ordnance level higher than the 1% AEP flood event;
- Following the completion of the piling, a localised excavation through the embankment will be required to the designed depth and dimensions of the pile cap;
- In the event that the above excavations undermines the functionality of the flood defence berm, temporary flood defences will be erected around the excavations consisting of either demountable barriers or sheet piling;
- The pile caps and abutment wing walls will be constructed from reinforced cast in-situ concrete;
- Following the completion of the pile caps and wing walls, the flood defence berm shall be reinstated to the required levels as shown on the vertical alignment section shown on Drawing No. 20_071-CSE-00-XX-DR-C-2260.

Please refer to the Indicative Construction Sequence Drawing No. 20_071-CSE-00-XX-DR-C-2450 to 2452.

4 Installation Methodology of Demountable Barriers on The Quays:

As shown on Drawing 20_071-CSE-00-XX-DR-C-2256 (Section B), the northern bridge is so designed to span over the demountable barrier system (Figure 1) with a minimum clearance of 300mm (refer to Figure 2 & 3). Various options are available to install the demountable barriers during the bridge operation phase such as:

- Manufacturing bespoke barriers not exceeding 100mm in height which can be easily installed by hand through the 300mm gap between the bridge soffit level and top of demountable barrier pillars;
- Incorporating a permanent translucent barrier underneath the bridge crossing which will not impact on the visual experience of users;
- Incorporating a folding demountable barrier underneath the bridge crossing which can be lowered into place to provide sufficient space to install larger panels. This can be achieved by incorporating a bracket on the soffit of the bridge for a demountable electric winch.

Figure 1: Demountable barrier system

Figure 2: North Plaza 3D view

Figure 3: Northern bridge crossing 3D view

Appendices: Drawings

Drawing No.	Drawing Title
Planning Drawings - REFER TO EIAR VOLUME C	
20_071-CSE-GEN-XX-DR-C-2001	Site Location Map
20_071-CSE-GEN-XX-DR-C-2251	Preferred Option 01 Overall Plan
20_071-CSE-GEN-XX-DR-C-2252	Preferred Option 01 North Plaza Plan Sheet 01 of 04
20_071-CSE-GEN-XX-DR-C-2253	Preferred Option 01 Carpark Plan Sheet 02 of 04
20_071-CSE-GEN-XX-DR-C-2254	Preferred Option 01 South Arrival Plan Sheet 03 of 04
20_071-CSE-GEN-XX-DR-C-2255	Preferred Option 01 South Arrival Plan Sheet 04 of 04
20_071-CSE-GEN-XX-DR-C-2256	Preferred Option 01 Typical Sections A, B & C
20_071-CSE-GEN-XX-DR-C-2257	Preferred Option 01 Typical Sections D, E, F & G
20_071-CSE-GEN-XX-DR-C-2260	Preferred Option 01 Bridge Plan & Elevations
20_071-CSE-GEN-XX-DR-C-2261	Preferred Option 01 Bridge Sections
20_071-CSE-GEN-XX-DR-C-2262	Preferred Option 01 Bridge Details
0_071-CSE-GEN-XX-DR-C-2286	Proposed Site Compound Plan
20_071-CSE-GEN-XX-DR-C-2460	Proposed Temporary Works for Pier Construction

Clifton Scannell Emerson Associates

MINUTES OF MEETING

PROJECT:	20_071 – Suir Island Infrastructure Links	**Date:**	10th October 2022
Situated at:	Clonmel, Co. Tipperary	**Time:**	10.00am
For:	Clifton Scannell Emerson Associates	**Ref:**	MTG-20_071-030
Location:	Online (Zoom)		
Title:	Suir Island - Section 50 Application Review		
Next meeting:	TBC		

Attendance:

James Fitzgerald (JF)	Office of Public Works (OPW)
Roger Noonan (RN)	Tipperary County Council (TCC)
Ronan Geoghegan (RG)	Clifton Scannell Emerson Associates (CSEA)
Laura Peare (LP)	Clifton Scannell Emerson Associates (CSEA)
Henk Botha (HB)	Clifton Scannell Emerson Associates (CSEA)

Apologies:

Denise Delaney (DD)	Office of Public Works (OPW)

	Points Discussed	Action by
0	**Background:**	
0.1	CSEA submitted the Section 50 Application on the 24th June 2022. OPW responded on 21st September 2022 with a list of concerns which was addressed in a response letter issued on 4th October 2022.	Meeting Note
1	**Introduction:**	
1.1	JF noted that the Section 50 Application for Suir Island Infrastructure Links development provided all the necessary information but the OPW have a few concerns regarding the proposed construction works and bridge crossings, specifically how the development interacts/interfaces with the existing flood defence infrastructure.	Note
1.2	JF highlighted Section 9 of the Arterial Drainage Act 1995, As Amended, where Commissioners may consent to alteration to existing watercourses or structures in Drainage Schemes if the proposed works would not increase the risk of flooding or have a negative impact on drainage of land. JF noted that the concerns need to be addressed prior to the OPW giving consent for the Section 50 application.	Note
1.3	JF noted the response letter provided covered all the concerns and further concerns shall be discussed during the meeting	Note
2	**Concerns – Maintaining flood protection throughout the works, temporary works and interface with existing flood defences:**	
2.1	LP provided an overview of the bridge interface on the proposed North Plaza where the bridge will span over the existing flood defences and demountable barriers.	Note
2.2	JF noted that OPW would not consider installing permanently fixed barriers underneath the bridge. JF requested CSEA/TCC to provide a clear statement to confirm that the demountable barriers can be installed following the completion of the bridge. LP noted the barriers are c. 100mm high per panel.	CSEA
2.3	RN highlighted previous discussions with TCC personnel responsible for the installation of barriers which confirmed the 300mm freeboard between the bridge and barrier would be sufficient to install the barriers.	Note
2.4	LP provided an overview of the works proposed on and around the Suir Island flood defence berm noting the embankment will be raised, no vegetation to be removed	Note

	unless necessary and the access routes. LP noted southern piers will be accessed via Suir Island Gardens and not across the flood defence berm.	
2.5	JF noted construction traffic will cross the embankment and CSEA to ensure bearing capacity of berm to be considered. Temporary works design to be completed.	CSEA
2.6	RN noted that the pile foundations would minimise the impact on the embankments. JF agreed but CSEA to take cognisance of the weight of drilling rigs.	Note
2.7	JF noted that less intrusive pile types should be considered such a driven. RG noted that this will be considered during design stage.	Note
2.8	JF noted clear control measures to be included in contract documents for the works on the berms which clearly states that flood protection needs to be maintained throughout the works.	CSEA
2.9	JF enquired if the temporary works impact has been considered for the pier constructions. HB noted this has been considered in the response letter, with water levels not significantly impacted but flow velocities increased. JF requested CSEA to update the Section 50 application with a paragraph included.	CSEA
2.10	LP highlighted the proposal of integrating the south arrival point through the flood defence wall along Raheen Road.	Note
2.11	JF enquired if Pier No. 3 (situated close to flood defence wall) is required. LP noted this has been raised previously, currently the bridge spans are quite long but will be reviewed during the detailed design phase.	CSEA
3	**Additional Concerns:**	
3.1	JF noted that the drawings show landscaping (trees and shrubbery) in and around the existing flood defence berm located on Suir Island. JF noted this will not be permitted. CSEA to remove trees and shrubbery on the berm. JF noted the OPW are in the progress of preparing a Natura Impact Statement for the regular maintenance of the berm.	CSEA
3.2	JF noted the contract documents should state that access to be maintained during the construction stage for TCC personnel to install flood defences as well as for maintenance activities.	CSEA
4	**Progressing with the Section 50 Application:**	
4.1	JF requested CSEA to provide a supplementary document to the Section 50 Application report, which covers the following: 1. Background of the project and overview of the development proposals; 2. Summary of interfaces/alterations to existing infrastructure including risks to existing flood defence scheme and mitigation measures; 3. Statements on the above in relation to the design stage, construction stage and operational phases of the development; 4. Statement on the above that the proposed works will not impact on the existing flood defence scheme operation;	CSEA
4.2	CSEA to provide the aforementioned supplementary statement/report for OPW's review and comment to further progress with the Section 50 application.	CSEA
4.3	CSEA confirmed that interactions with OPW can be arranged during detail design stage, procurement and construction phases.	Note

APPENDIX E – SECTION 50 APPLICATION CONSENT

OPW Oifig na nOibreacha Poiblí Office of Public Works

Our Ref: 276-2022,

Clifton Scannell Emerson Associates Limited,

Civil & Structural Consulting Engineers,

3rd Floor,The Highline,

Bakers Point, Pottery Road,

Dun Laoghaire,Co. Dublin.

A96 KW29

Henk.Botha@csea.ie

Re:Section 50: Proposed Suir Island Bridge, Clonmel

Dear Mr. Botha,

I refer to your above named recent Section 50 Application. The application and supporting documentation have been compiled and submitted by Clifton Scannell Emerson Associates, 3rd Floor, The Highline, Bakers Point, Pottery Road, Dun Laoghaire, Co. Dublin, A96 KW29. The application has been submitted on behalf of Tipperary County Council, Civic Offices, Emmet Street, Clonmel, E91 N512.

The documentation submitted has been examined and I am to confirm that the consent of the Commissioners of Public Works under Section 50 of the Arterial Drainage Act, 1945 is given to the proposed bridge as follows;

The documentation submitted has been examined and I can confirm that the consent of the Commissioners of Public Works under Section 50 of the Arterial Drainage Act 1945 is given for the proposed bridge works as detailed in the drawings referenced below (which are located in the Supplementary Section 50 Report Suir Island Infrastructure Link, dated May 2023).

20_071-CSE-GEN-XX-DR-C-1014 Bridge Long sections and Flood Water Levels
20_071-CSE-GEN-XX-DR-C-1013 Raheen Road Interfaces Typical Sections
20_071-CSE-GEN-XX-DR-C-1012 North Plaza Interfaces Typical Sections

The consent is also based on the following criteria being met: i.e.
All relevant stakeholders and Local Authorities are to be informed of the proposed bridge works and all relevant approvals and permissions are in place.

It should be noted that the consent is given only for the purpose of Section 50 and does not absolve the recipient of responsibility for any adverse effects caused by this installation to any third party.

The Commissioners of Public Works are not responsible and accept no liability for any loss or damage whatsoever caused as a result of this development.

Yours sincerely,

Nora Carey

Nora Carey

Flood Project Management

May 22nd 2023.

.....

Clifton Scannell Emerson Associates Limited, Civil & Structural Consulting Engineers

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