FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

Engineering Technical Report to Accompany Planning Application

JUNE 2022

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Document Verification

Client:	Cork Co Co
Project Name:	Fermoy Weir Remediation And Fish Bypass Channel
Project Ref:	19011
Document Title:	Engineering Technical Report
File Name:	19011-TJOC-PL-XX-PD-C-3709_Engineering_Technical_Report

Revision Code	Status Code	Description of Revision	Prepared By	Checked By	Approved By	Date of Issue
C01	AP	Planning Issue	DC	MV	EF	08.06.2022

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1. INTRODUCTION

1.1. Background

The weir on the river Blackwater at Fermoy has suffered a number of breaches in recent years, particularly at its eastern end where the weir is entirely breached. The effects of the breaches are that the normal flow in the river no longer flows over the weir but instead is funnelled through the southernmost arches of the bridge towards the Mill Race channel in front of O'Neill Crowley Quay where it then flows through the breaches in the weir.

The volume of water in the river Blackwater in most flow conditions are such that velocities in this channel and at the breaches in the weir are not conducive to the free passage of fish.

The weir on the river Blackwater at Fermoy and adjacent limestone quay wall at O'Neill Crowley Quay are included in the Fermoy Record of Protected Structures in the Fermoy Development Plan (2010-2016). Cork Co Co is the owner of the weir.

Works that materially alter a protected structure require planning approval, irrespective of any applicable exemptions, if the works would affect the character of the structure or any element of the structure that contributes to its special interest.

The present weir and Mill Race were completed in 1802 according to Dan Noonan in his Archaeological Assessment Report for Fermoy South Drainage Scheme. The Mill Race powered a flour mill that was constructed at the same time. The weir is an integral part of the heritage of Fermoy and has provided the basis for the development of many of the town's sporting and leisure activities.

The weir is located in the river Blackwater at Fermoy and is situated within the Munster Blackwater Special Area of Conservation (SAC). The catchment area upstream of the weir is approximately 1,767km^2.

The Fermoy Weir is included in the Record of Protected Structures in the Fermoy Development Plan (2010-2016). The adjacent limestone quay wall at O'Neill Crowley Quay was delisted in a variation to the Fermoy Development Plan. A new quay wall was constructed in front of the existing quay wall as part of the Fermoy South Drainage Scheme flood defence works. The section of the original quay wall which was below the original road level was not demolished and remains buried under the footpath at O'Neill Crowley Quay.

1.2. Purpose of the Report

This Engineering Technical Report has been prepared to accompany an application by Cork County Council to An Bord Pleanála for planning permission for a development at Fermoy, Co. Cork comprising

- The remediation of Fermoy Weir, a protected structure, upstream and downstream of Fermoy Bridge, Remediation works to include removal of existing concrete screed, placement of rockfill at base of weir as stabilisation, reinstatement of cobbled surfaces to top of weir embankment along with associated filling of eroded

sections of embankment, stabilisation of existing weir walls through grouting, pointing of masonry, masonry inserts with concrete and replacement of capping stones on weir walls, reconstruction of collapsed and breached sections of weir walls with masonry and reinforced concrete and ancillary works to tie into the north and south banks of the River Blackwater and to the pier of Fermoy Bridge.

- Construction of a rough pool bypass Channel for fish passage on the north bank of the river Blackwater, channel to have a minimum width of 28m between internal faces of sidewalls, channel to include rock ramps, perturbation boulder, masonry faced side walls, safety fencing, maintenance access, hard and soft landscaping, and all associated development works above and below ground.

This report provides

- details of the applicant and consents required;
- a description of the proposed development;
- a summary of the options considered;
- the engineering basis for the design of the proposed works;
- the benefits of the development;
- a summary of the detailed investigations, studies and reviews carried out to support the design of the proposed scheme;
- references to the Outline Construction Management Plan (OCMP) and the Construction Environmental Management Plan (CEMP); and
- details of consultations with stakeholders at both a local and national level.

1.3. Reason for the Proposed Works

Cork County Council recognises the significant impact that exists at the Fermoy Weir in its current condition, whereby the existing weir, which is a protected structure, has fallen into disrepair. In order to complete any remediation of the weir it is necessary to provide for passage of fish in the River Blackwater consistent with the Water Framework Directive River Basin Management Plan and the conservation objectives of the Munster Blackwater Special Area of Conservation. Any modifications to the weir should not negatively affect natural fish migration and preferably should improve such migration.

Fermoy Town Council received Notice under Section 116 of the Fisheries (Consolidation) Act 1959 from the Department of Communications, Energy and Natural Resources (hereafter referred to as DCCAE). The Notice advised of the need for the Town Council to undertake immediate repairs to the fish ladder on the weir in Fermoy in order to reduce the barrier effect of the weir on migratory fish species.

Before these works could be completed, issues arose as to whether such works should be subject to appropriate assessment and if the reinstatement of the existing fish ladder on its own sufficiently satisfied the requirement to provide for passage of all fish.

In 2016 a breach appeared in the weir wall section of the weir, downstream of Fermoy bridge arising from the collapse of a section of wall. In the period since then, this breach has increased in size. The net effect of the continued breach of the weir wall has been that all normal flows are directed through the breach and there is no flow over the weir apart

from in flood events. However, this situation is not advantageous to the movement of fish. The effect of funnelling the entire flow of the Blackwater River down from a width of 55m upstream of the weir into a channel width of less than 10meters immediately upstream of the breach results in velocities likely to be in excess of 2m/s in all normal flow conditions for a distance of over 40m.

The velocity of flow in the vicinity of the breach was such as to cause significant bed and bank erosion in a short period of time. The OPW, who are responsible for the Fermoy Drainage Scheme and associated flood defence walls, were concerned that continued bed and bank erosion could undermine the flood defences. In the autumn of 2020 the OPW, exercising its powers under the Arterial Drainage Act, completed bed and bank stabilisation works. This entailed placing rockfill in the river bed upstream of the weir to reduce the risk of further bed erosion. These works, which were completed in accordance with mitigation measures identified through an Appropriate Assessment and Natura Impact Statement, were not intended to not significantly alter the velocities in the river and did not improve the conditions for the passage of fish.

Cork County Council as owner of a protected structure has an obligation to ensure the continued preservation of the structure. The weir at Fermoy has been a central feature of life in for well over two hundred years. In fact, there is evidence of a weir at Fermoy dating back to the reign of Henry VIII.

Works to remediate and reinstate the weir can only be progressed if the issue of passage of fish is also addressed. The Fish Bypass channel is proposed as the best way of providing for passage of all fish while retaining the protected structure that is the weir.

Other options were considered, both in technical terms and in the context of a public consultations process. The scheme as now proposed was identified as being the preferred technical solution.

2. APPLICANT DETAILS

2.1. Cork County Council

This application is being made by Cork County Council, the owner of Fermoy Weir, which is a protected Structure The application is being made to An Bord Pleanala in respect of a local authority development under section177AE (relating to Appropriate Assessment (AA)) of the Planning and Development Act, 2000, as amended.

2.2. Consent of Land Owners

The proposed Fish Bypass on the north bank of the river will be partially located in lands (folio Ref CK 24179L) which are owned by Sherwood Oak Ltd. (C.R.O. Reference 554484) of Raffeen House, Ringaskiddy, County Cork. Nancy Horan, Martin Horan & David Horan are the directors of Sherwood Oak Ltd. This land acquisition will include the acquisition of temporary and permanent wayleaves to facilitate access to and around the bypass structure during the construction and operational phases.

A letter of consent from Nancy Horan, Martin Horan & David Horan in respect of the making of this application is included with the submission documentation.

2.3. Other Consents

The OPW has been consulted in respect of the proposed scheme in the context of any consents required under the Arterial Drainage Act. The relevant sections of the Arterial Drainage Act are Section 9, Section 47 and Section 50 as follows;

1. Section 9 (channel) of the Arterial Drainage (Amendment) Act 1995 provides that the Commissioners of the OPW may consent to alterations 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 the drainage of land. The OPW have confirmed that section 9 consent may be required given that location of the weir and fish Bypass within the Fermoy Drainage Scheme. A Flood Risk Assessment is included at Appendix D of this report which demonstrates that the proposed development does not increase the risk of flooding and has no impact on the trigger levels for the erection of flood barriers.
2. Section 47 (weir) of the Arterial Drainage Act 1945 provides that any person planning to erect or alter a weir must first get consent from the Commissioners of the OPW or all the affected landowners. The Commissioners may grant consent only where the applicant meets stringent requirements. The OPW are of the view that the remediation of an existing weir does not constitute the erection of a weir or the alteration of a weir.
3. Section 50 (bridge) of the Arterial Drainage Act 1945 and the EU (Assessment and Management of Flood Risks) Regulations, SI 122 of 2010, which states that the consent of the Commissioners of the OPW is required by bodies and persons proposing to carry out construction/alteration works on bridges and culverts. The modification or remediation of the weir in the vicinity of the piers has a negligible impact on the Bridge (as demonstrated in the assessment of scour velocities in the CFD modelling report included at Appendix C of this report) and as such a Section 50 application to the OPW is not required.

3. DESCRIPTION OF THE DEVELOPMENT SITE

The proposed development site is located in the townlands of Fermoy and Carrignagroghera in Fermoy, Co. Cork. The site comprises three elements:

1. Lands on the north bank of the river Blackwater between the west end flood embankment and the river, including access points to the river;
2. Fermoy weir and adjacent riverbed extending from the north bank at Town Park to the south bank at Mill Island; and
3. Lands at Mill Island carpark, including lands within the council's public carpark and undefended lands on the banks and within the bed of the river

The site is shown at Drg 19011-TJOC-XX-XX-DR-C-0051 as included in the planning drawings and reproduced at Appendix A.

3.1. Existing Infrastructure

Existing Services in the vicinity of the proposed development are shown at Drg 19011-TJOC-XX-XX-DR-C-0082, included in the planning drawings and reproduced at Appendix A. There are no new utility provisions required to service the proposed development and there are no diversions of existing services required as a consequence of the proposed development.

3.2. Details of the Proposed Development

The proposed project comprises the remediation of the existing weir, including reconstruction of the breached sections of the weir, and the construction of a rough channel pool bypass to provide for fish passage around the weir. A plan of the proposed works is illustrated on drawing No. 19011-TJOC-PL-XX-DR-C-0052 is included in the planning drawings and reproduced at Appendix A.

The weir remediation works can be divided into two different elements which comprise the remediation of the upstream section of the weir, including the existing fish ladder incorporated in the weir, and the downstream section of the weir. The weir is categorised as a rubble embankment type weir upstream of the bridge and extending for a distance of 37m east of Fermoy bridge. The remaining section of the weir, extending eastwards, is a gravity wall type weir (Mill Race section). It is this section that has been breached in the approx. locations as shown on the Existing Site Layout Plan drawing 19011-TJOC-PL-XX-DR-C-0051 included in the planning drawings and reproduced at Appendix A. These breaches are also visible in Figure 3-1.

Figure 3-1: Mill Race Section of Weir & Breaches – June 2021 (Looking Downstream)

A plan of the proposed remediated weir is shown at Drawing 19011-TJOC-PL-XX-DR-C-0060. Proposed remedial details to the existing fish pass are included on Drawing No. 19011-TJOC-PL-XX-DR-C-0081. Both of these drawings are included in the planning drawings and reproduced at Appendix A.

3.2.1. Weir remediation - Embankment Section

The remediation of the embankment (crump) section of the weir will involve the removal of the existing concrete apron and resetting of the limestone setts with the addition of random rubble fill (similar to the existing) where required. A high tensile geotextile will be incorporated to assist in reducing wash out of the fill in the embankment. At both the upstream heel and downstream toe of the crump weir section, the undercut / missing stonework will be reset on concrete heel and toe footings along with the addition of rock armour on both the upstream and downstream sides to prevent undercurrents undermining the embankment, in particular on the downstream section in the future.

The crest of the crump weir will be reinstated to a level corresponding to the historic level of the weir as evident from the historic photographs of the weir. A level of 21.45mOD is proposed for this section on the remediated weir.

Cross-sections through the embankment section of the weir, showing the proposed remediation works, are shown at Drawing No.'s 19011-TJOC-PL-XX-DR-C-0061 and 19011-TJOC-PL-XX-DR-C-0062 included in the planning drawings and reproduced at Appendix A.

3.2.2. Weir Remediation – Mill Race Weir Wall

The remediation of the Mill Race section of the weir, east of the Bridge, will involve reconstructing the breached sections with existing or new stonework to closely resemble the existing masonry. Given the nature of this section of the weir, it is proposed to inject natural cement (also referred to as Prompt) into the fill sections and place mass concrete in the core of the new section of the weir. The stonework facing will then be pointed in natural cement and the downstream face of the weir protected by adding rock armour. The capping of the Mill Race wall will be removed, the wall raised and the capping reset to a remediated level higher than the adjacent Crump weir, with a level of 21.55mOD proposed.

Cross-sections through the Mill race weir walt section of the weir, showing the proposed remediation works, are shown at Drawing No. 19011-TJOC-PL-XX-DR-C-0063 included in the planning drawings and reproduced at Appendix A.

3.2.3. Proposed Fish Bypass

In order to provide for the required level of fish passage, a 28m wide rock ramp type bypass channel, with a crest level of 21.20mOD at the upstream end, is proposed to be constructed in the northern bank of the river.

The proposed bypass consists of constructing a curved rock (rough channel pool) ramp type of bypass in the northern bank of the river Blackwater, west of Fermoy bridge. The rock ramp will provide a ladder for fish migrating upstream and resting pools would be created by the varying levels of rock weir walls.

The Bypass Channel will have sheet piled masonry faced side walls, The bed of the channel will comprise a gravel bed on rockfill. Armourstone, pitched vertically, will create the intermediate pools (12 No in total) and steps in the bypass channel.

It is proposed to minimise the height of vertical walls on the sides of the curved bypass channel and grade the bypass channel into the existing landscape.

The construction of the Bypass channel will require the removal of a number of riverbank trees. Planting of willow into the embankment of the fish pass will screen views of the development. A riparian enhancement planting scheme and wildflower meadow is proposed for the riverbank area to the north of the fish pass site (See Doyle O'Troithigh Landscape Plan LP-01-PP accompanying the application).

The proposed fish bypass channel is presented on Drawing No. 19011-TJOC-PL-XX-DR-C-0053 included in the planning drawings and reproduced at Appendix A.

3.3. Benefits of the Proposed Development

The remediation of the weir and the provision of a fish bypass channel at Fermoy will have a number of benefits:

- Facilitate the achievement of the objectives of the Water Framework Directive by facilitating fish passage on the River Blackwater;
- Assist in the achievement of conservation objectives for the Munster Blackwater Special Area of Conservation;
- Support the policies and objectives of the Cork County Development Plan 2014-2022, Fermoy Town Plan 2009-2015 and Fermoy Municipal District Local Area Plan.

It is an objective of the Fermoy Town Plan to protect Fisheries including those listed in Annex II of the Habitats Directive and other protected species such as salmon, lamprey species (Brook Lamprey, River Lamprey and Sea Lamprey) and freshwater pearl mussel. This proposal supports that objective

It is also an objective of the Fermoy Town Plan to promote the well-being and life-cycle of protected aquatic species within its area of control. The construction of the Fish Bypass will support that objective.

It shall be an objective, subject to safety considerations to preserve specimen trees in the town council area and environs and examining the possibility of conserving the visually and/or ecologically important ones by means of Tree Preservation Order.

The remediation of the Weir is consistent with Objective 4.1.6 of the Fermoy Town Plan which sets an objective of vigorously pursuing sites and buildings that are allowed to fall into a derelict and neglected condition with a view to enhancing the visual amenities of the town.

The remediation of the weir, a protected structure, will be consistent with the development management objectives of the Fermoy Town Plan which require:

Development management objective 4.5.9. of the Town Plan states that Development proposals for sites identified as a Protected Structure will be required to incorporate measures to protect, conserve and enhance the character and appearance of the structure(s).

Consistent with development management objective 4.5.10. of the Town Plan, the proposals for the remediation of the weir and the construction of a fish bypass channel alongside the weir structure will be compatible with and will not detract from the special character of the structure and its setting and will complement and reflect the design and character of contiguous buildings and the surrounding area.

Also consistent with development management objective 4.5.10. of the Town Plan, features of architectural or historic interest, including the salmon leap, will be retained. The historic form and structural integrity of the weir structure will also be retained

3.4. Construction Phase

An Outline Construction Management Plan (OCMP) and a Parent Construction Environmental Management Plan (PCEMP) has been prepared to accompany this planning application. The OCM and CEMP will be further developed by the contractors who will undertake the actual construction works.

The OCMP sets out, on a preliminary basis, a framework of measures to address the implications of the construction works.

The PCEMP identifies environmental objectives and targets for the proposed development and sets out mitigation measures which will be required to be implemented during the construction and operational phases of the development.

The PCEMP includes supplementary plans as listed below:

1. Environmental Monitoring Plan
2. Environmental Incident Response Plan
3. Traffic Management Plan
4. Waste Management Plan
5. Invasive Species Management Plan

The hours of construction work and site deliveries, unless otherwise amended by the Planning Authority, will be restricted to the following:

- Monday to Friday 0700hrs to 1900hrs
- Saturday 0700hrs to 1400hrs
- Sunday and Bank Holidays Works prohibited
- Deliveries (of materials, plant or machinery) 0800hrs to 1900hrs

There may be occasions where it is necessary to make certain deliveries outside these times, for example, where large loads are limited to road usage outside peak times. However, the Contractor responsible will be obliged to provide justification and obtain prior approval for such a situation.

The construction works will be undertaken within and adjacent to the Munster Blackwater Special Area of Conservation and must comply with any mitigations identified in the Natura Impact Statement and in the PCEMP.

The Outline Construction Management Plan (OCMP) describes the sequence of construction which, after initial mobilisation and site set up, will comprise three stages. These stages will comprise:

1. the remediation of the weir upstream (west) of Fermoy Bridge initially
2. followed by (or possibly concurrent with) the construction of the fish bypass channel on the north bank of the river.
3. On completion of the bypass channel works, flow from the river will be directed through the bypass channel, at which stage to flow to the Mill race will be dammed at the southernmost arches of Fermoy bridge facilitation the remediation and reinstatement of the weir downstream (east) of the bridge.

These stages are shown at Drawing 19011-TJOC- PL-XX-DR-C-0087 and are described in the Outline Construction Management Plan (OCMP) included with this application. Construction works during Stages 1 and 2 will be accessed and serviced from the compound at the north side of the river. Works for Stage 3 will be accessed and serviced from a satellite compound at the Mill Island carpark.

3.5. Options Considered

Options for fish passage have been considered as part of the feasibility stage for the project. These options were identified in discussions with key stakeholders including Inland Fisheries Ireland, the Development Application Unit and the National Parks and Wildlife Service. High level information was provided in the consultation material for each option, describing what each option involves and what the implications for the weir and for fish passage would be if the option were pursued. Following on from a feasibility study, two options for the remediation of the weir are being considered and nine for the fish passage.

Before commencing preparation of a planning application and associated environmental studies and assessments for the scheme to provide for the remediation of Fermoy Weir along with the provision of a Fish Bypass Channel at Fermoy, the views and opinions of the public and relevant stakeholders were invited through a consultation process.

9 No. options were identified for the fish bypass element of the works and these options were presented for public consultation in November 2020. The public consultation process produced another option for the fish pass when a Chester Weir type arrangement was proposed in a number of submissions.

Not all of these options were considered viable as some would be contrary to legal obligations arising under Habitats Directive and planning legislation.

The options that were considered for providing for fish passage were as follows

1. Do-nothing;
2. Do-nothing except for stabilising the existing weir;
3. Remediate the existing fish pass;
4. Remove the weir in its entirety;
5. Construct an in-river rock ramp;
6. Construct a rock ramp in the existing breach;
7. Construct a near natural bypass channel.
8. Bypass the river around the weir
9. Construct a rough channel pool bypass.
10. Chester type weir arrangement

Preliminary drawings and sketches, based on material included in the Public Consultation process and illustrating the proposals for the above options, are included in Appendix F.

The Options that were considered for remediating the remediation of the weir comprised:

1. Mitigation by design, i.e. reconstruction using original materials.
2. Mitigation by record, i.e. record and replace with new.

As stated above the proposed provision for fish passage comprises Option 9 – rough channel pool bypass constructed around the weir in the lands adjacent to the north bank of the river. The construction of the bypass channel provides for the passage of fish and allows the remediation of the weir which is a protected structure. The weir remediation is proposed to be undertaken, where possible, through mitigation by design as opposed to mitigation by record.

3.5.1. Option 1 – Do Nothing Scenario

The do-nothing option, as the name suggests, involves leaving the existing situation as is. This will not facilitate free passage of fish species listed as qualifying interests for the Blackwater River SAC. Current speeds are too fast to facilitate upstream movement of qualifying interest fish species and is unable to meet the requirements of IFI in terms of providing fish passage for fish of all species. Similarly, the greater part of the flow range in the river would continue to be funnelled into the Mill Race Channel with resultant high velocities and turbulence acting as a barrier to fish passage.

This option would also not be acceptable from an architectural conservation perspective as the weir, which is a protected structure, would continue to deteriorate. Cork County Council, as the owner of the protected structure, is legally required to make sure that the structure does not become endangered through neglect, decay, damage or harm. This option would, in effect, involve Cork Co Co ignoring its obligations under Part IV of the Planning and development Act, 2000.

3.5.2. Option 2 – Stabilise Remaining Section of Existing Weir

This option is similar to the do-nothing scenario described in Option 1, except that it would involve works to stabilise the existing weir to prevent further deterioration, while leaving the breach in the weir.

This option would meet the conservation objectives of the SAC only if it is able to provide for free passage to fish species listed as qualifying interests for the Blackwater SAC. Similar to Option 1, the greater part of the flow range in the river would continue to be funnelled into the Mill Race Channel with resultant high velocities and turbulence acting as a barrier to fish passage. This would give rise to continued erosion of the river bed and banks.

This option would not meet the architectural conservation objectives for the protected weir. The approach envisaged in this option would not allow the “restoration of character” of the weir. It would also negatively impact the established leisure and amenity uses upstream of the weir. Rowing regattas have had to be cancelled since the breach formed in the weir due to inadequate depth of water upstream of the weir.

3.5.3. Option 3 – Remediate Existing Fish Pass

This option consists of repairing the existing fish pass. The existing fish pass is a technical type fish pass, comprising a masonry stepped structure located within the weir structure close to the midpoint of the river. The fish pass crosses the weir on a diagonal to decrease the gradient and increase the number of steps in the structure. Damage to the lower part of the structure was repaired in 2013. Since then, further damage has occurred and part of the side wall of the pass, on the downstream facing side of the structure, has been breached.

Figure 3-1: Existing Fish Pass at Fermoy Weir - November 2019

It had been proposed to retain the upper section of the fish pass structure and demolish and replace the lower section with a new in-situ concrete structure. A new channel was proposed to be created in the river bed to create an attraction flow in the river at the entrance to the fish pass.

IFI have advised that the location of the existing fish pass is contrary to basic fish pass design guidance. Guidance advises that the entrance should be located where migrating fish naturally congregate which is generally as far upstream along a weir structure as possible. The existing fish pass entrance is halfway along the weir and is too far downstream to be found by all migrating fish. In addition to this, the entrance will not ensure the free run of all fish at all periods of the year.

Furthermore, the orientation of the fish pass is also unsuitable and does not conform to basic fish pass design guidance which states it should be perpendicular to the weir and parallel to the water flow on the weir.

IFI advised that the fish pass is required to provide passage for all fish species listed as Annex II species within the Habitats Directive which, for the river Blackwater, consist of Atlantic Salmon, sea, river and Brook Lamprey and Twaite shad. IFI also advised that the fish pass is also required to provide passage at all times, to the above species, irrespective of flow conditions. This would not be achievable with an upgrade of the existing fish pass. In addition to this, remediating the existing fish pass would not satisfy the relevant requirements of the Fisheries Consolidation Act, the Water Framework Directive or the Habitats Directive.

3.5.4. Option 4 – Complete Removal of Existing Weir

This option provides for the complete removal of the existing weir. While this option would satisfy the conservation objectives of the SAC, and would also provide for the passage of all fish due to the elimination of the barrier, it would not be acceptable from an architectural conservation objective as the existing weir is a protected structure.

As previously stated, Cork County Council, as the owner of the protected structure, is legally required to make sure that the structure does not become endangered through neglect, decay, damage or harm. This option would, in effect, involve Cork Co Co ignoring or reneging on its obligations under Part IV of the Planning and Development Act, 2000.

This option would result in a significant lowering of water levels in the reach of the river upstream of where the weir is situated which would extend for several kilometres upstream.

Riverbank habitats could be permanently affected by the lowering of the water level if the weir was removed. Construction impacts could include the requirement for instream works to remove the rubble and masonry structure resulting in the risk of silt generation and disturbance of adjacent instream habitats. There is also a risk that silt, accumulated over many years at the upstream side of the weir, could be released downstream during the demolition and removal of the weir structure. This could impact on aquatic species listed as qualifying interests for the Blackwater River SAC including Freshwater Pearl Mussel which are particularly susceptible to increased silt levels. Whilst it is noted that the complete removal of weir would facilitate movement of fish listed as qualifying species for the Blackwater River SAC, such movement of fish can be facilitated by the engineered solutions discussed above.

The complete removal of the existing weir would significantly impact on the amenity uses of the river upstream of Fermoy Bridge and would negatively impact the existing amenity uses for that stretch of the river. Rowing activities in particular would suffer adversely due to the permanent lowering of water in this reach of the river.

3.5.5. Option 5 – Construct an In-River Rock Ramp

This proposal comprises constructing a rock ramp, approx. 62m long x 30m wide in the river Blackwater on the western side of Fermoy bridge alongside the north bank of the river. This option also involves raising the weir crest level to form a height of 21.50mOD throughout. Dredging of an area of the river bed of approx. 350m^2, downstream of the weir, would also be required as part of this option. The rock ramp would be integrated directly in the weir construction.

The bed of the ramp would comprise rockfill in which large boulders or boulder sills would be arranged to form cascades providing the water depths and flow velocities required to allow upstream migration of fish. These boulders and sills would also serve to create shelters, deep zones and resting pools along the length of the ramp. A bed slope of 1 in 30 approximately was proposed to satisfy these requirements. The ramp would have to be separated from the retained section of weir by a vertical dividing wall.

The proximity of Fermoy Bridge to the weir dictates that the rock ramp would have to be largely located upstream of the existing weir. If the ramp extended downstream it would interfere with the bridge pier.

The development of a rock ramp would facilitate movement of migratory fish species listed as qualifying interests for the Blackwater River SAC (Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon and downstream movement of Brook Lamprey). However, the proposed location of the new rock ramp would require removal of a significant section of the weir which is a Protected Structure.

3.5.6. Option 6 – Construct Fish Ramp (Rock Ramp) in Existing Breach

This option proposed by NPWS consists of constructing the new fish ramp in the existing breach in the weir. However, it would not be ideally situated for fish passage because the breach is located at the downstream end of the weir. Ideally, fish passage should be provided for at the furthest upstream point on the obstruction.

In the case of Fermoy weir, the furthest upstream point is located alongside the north bank. The breach in the weir is located alongside the south bank at the furthest downstream point meaning the new fish ramp would not be ideally located for fish passage.

3.5.7. Option 7 – Construct a Near Natural Bypass Channel

This option consists of constructing a meandering, near natural, bypass channel which would be situated in the northern bank of the river Blackwater, west of Fermoy bridge. This option would have the added benefit of being able to construct the bypass predominantly from land which would significantly reduce the extent of instream works and the subsequent impact on the SAC.

The term ‘bypass channel’ is used for fish passes that bypass an obstacle and that are in the form of a natural-looking channel that mimics a natural river. This proposal would require no structural alterations to the weir structure itself other than those required for the remediation of the weir. Only a portion of the flow would be diverted through the bypass channel.

A near natural bypass channel as proposed for Fermoy would receive approximately 15% of the upstream flow and would have an average longitudinal gradient of 1:30 approximately and a channel width varying between 8 and 12 metres.

Resting pools are incorporated for fish at two locations in this option.

Inland Fisheries Ireland (IFI) expressed concern that a near natural fish bypass channel would not satisfy the requirement for passage of migratory fish species listed as qualifying interests for the Blackwater River SAC and does not meet the IFI requirement for conveyance 50% of the mean flow.

3.5.8. Option 8 – Bypass River around weir

A variation of Option 7 was also considered, which consists of utilising the proposed bypass channel to divert all of the flow around the existing weir. This alternative option would eliminate the need for a rock ramp. Although this option would be substantially cheaper, it would still require significant land acquisition, bank protection measures on the new

channel and would not avoid the costs associated with the remediation of the weir. However, the water level in the reach of the river upstream of the weir would be reduced if this option was implemented.

When the weir was intact there was a 2.2m difference in water levels either side of the weir. Allowing all flow to bypass the weir structure without controls would result in a drop in water level on the upstream side of the weir in the range 1.0m to 1.5m. The impact of this drop in water level would continue to be experienced several kilometres upstream. This would have a negative effect on the conservation objectives of the SAC such as alluvial woodland and would not be considered acceptable by the NPWS.

This option would not accommodate the requirements of Fermoy rowing club as it would significantly impact on their rowing interests due to the decreased water levels in the river. The weir would also become permanently dry with this option as all of the flow would be diverted through the new bypass channel.

3.5.9. Option 9 – Construct a Rough Channel Pool Bypass

Option 9 consists of constructing a curved rock (rough channel pool) ramp type of bypass in the northern bank of the river Blackwater, west of Fermoy bridge. The rock ramp would provide a ladder for fish migrating upstream and resting pools would be created by the varying levels of rock weir walls.

The Fish Passes Design, Dimensions, Monitoring Guideline published by the FAO and DVWK (2002) describes a rough-channel pool pass as a combination of a technical fish pass and a fish ramp, in which the pool cross-walls are substituted by columnar rocks set on edge. This arrangement allows appreciably greater water depths to be obtained and a steeper slope (up to maximum 1:10, although 1 in 35 is proposed for Fermoy) to be used than with conventional fish ramps. A decisive feature in this case is that the differences in water level between the pools must not exceed h = 0.2 m, to maintain the maximum permissible flow velocities of v_{max} = 2.0 m/s.

Large, slender boulders (quarry-stones), embedded in the bottom rockfill layer of the pass, will be used to build the transverse bars as shown in Figure 4.2. The boulders will be embedded in approximately 0.4 m in the rockfill bottom. The boulders must be embedded in such a way that water only flows around them, and not over them. The clear width of the opening between the boulders should not be less than 0.20m, to enable larger fish to ascend and to reduce the risk of clogging with debris.

The boulders must be offset in both the longitudinal and the transverse directions to allow the discharge to better fan-out and for better dissipation of energy in the pools. The discharge jets should always impinge on a boulder of the next transverse bar downstream and should not shoot through the next bar in order not to form a short-circuit current.

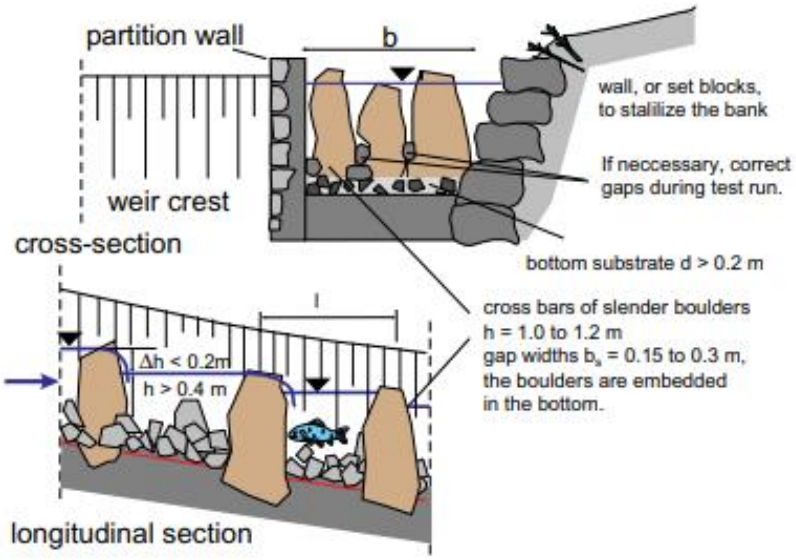

Figure 3-2: Rough Channel Pool Pass Details

This option will facilitate free movement of migratory fish species listed as qualifying interests for the Blackwater River SAC (Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon and movement of Brook Lamprey).

3.5.10. Chester Weir

A number of local Stakeholders proposed an alternative option to the fish bypass, recommended by their own retained experts, suggesting that a ramp arrangement similar to that at Chester Weir on the River Dee in the UK could provide for fish Passage. They stated that they believed that *"this type of fish pass may suit Fermoy weir, a Chester type weir and fish could be adapted to work in Fermoy, we would hope that this proposal is not thrown out the window without giving it serious consideration. We believe this could have minimum impact and would work well for fish migration, the environment and our clubs and amenities on the river."*

Research papers in relation to the Chester weir were reviewed when this option was put forward by Fermoy stakeholder groups. These research papers noted that the Chester weir is located on the tidal estuary of the River Dee and incorporates holding pools where fish wait for tides to rise to enable them to swim upstream. The River Blackwater is not tidal at Fermoy. Also, the arrangement as proposed would have to be constructed against the weir in Fermoy, which is designated as a protected structure, and which would present issues with regards to planning and construction due to the protected nature of the weir under planning legislation. It would also involve instream construction in the area immediately upstream of the bridge and could introduce a risk of increased scour of the river bed at the bridge piers

Inland Fisheries Ireland, who are the governing body responsible for approving the design of any fish passes, also reviewed the Chester weir and advised that the Chester weir option is essentially a rock ramp that would be too small to meet the necessary flow requirements, i.e., the larger of 12.5% of the long-term mean flow or 50% of the flow upstream of the weir. They also advised that in higher flows the fish would find it difficult to locate the entrance

to the pass and so would be substantially delayed in migrating, could get injured or could lose eggs when attempting to jump the weir.

In view of the above, the Chester type weir is not considered a viable option for the scheme.

4. DESIGN BASIS

The basis for the design of the fish bypass channel is in the publication "Guidelines on the Construction & Operation of Small-Scale Hydro-Electric Schemes and Fisheries", Central and Regional Fisheries Boards and Engineering Division, Dept of Communications, Marine & Natural Resources, 2006. Inland Fisheries Ireland and the Dept of Housing Local Government and Heritage have advised that these guidelines should be applied to the design of the fish bypass (see Section 4.2 below).

4.1. Munster Backwater Fermoy Drainage Scheme

In the past, Fermoy was severely affected by flooding from the River Blackwater. The OPW delivered the Munster Blackwater Fermoy Drainage scheme in two contracts between 2009 and 2014. In these contracts, flood defence works were completed on both the north and south banks of the river.

Extensive hydrological studies were commissioned by the OPW to inform the design of the Fermoy Flood Defence Scheme. Flood estimates were derived for Fermoy for the eight historical events between 1980 and 2002 using a model which routed flows measured at Killavullen (Babtie 2003). These flood estimates were reviewed in 2011 by Jacobs and DHV to take account of discrepancies that were identified between observed and predicted flood levels in Fermoy.

Following the construction of the Fermoy North and South Drainage Schemes, the OPW undertook some model calibration surveys. However, the hydraulic model was not updated to reflect post construction conditions. The original model included pre-and post-construction scenarios.

Further modelling has been undertaken using Hec Ras 2D modelling software to consider the flood implications of the diversion of flows to the Bypass and the minor alterations to the weir level. Furthermore, the deterioration and subsequent breach of parts of the weir in recent years has led to the flow regime being altered. As a consequence of this, the flow is now concentrated at Mill Race which has resulted in significant erosion which required emergency works undertaken by the OPW in the autumn of 2020 to avoid undermining of the flood defence structures. The current flow regime and its consequences has also been assessed in the modelling which is included in the Site Specific Flood Risk Assessment At Appendix E.

The OPW also commissioned a 1-D Hydraulic model of the Blackwater at Fermoy for the South West CFRAMS Study. As stated above, a 2D model (Hec Ras 2D) has been developed, incorporating elements of the 1 D model in respect of cross-sections upstream and downstream of the immediate vicinity of the weir and bridge. This Hec Ras 2D model has been developed to consider the implications of the detailed layout of the proposed weir remediation and fish bypass channel. The OPW requires that any proposed modification to the weir and any works within the flood plain will not result in any increased flood risk at Fermoy and the conclusions of the Site Specific Flood Risk Assessment confirm this.

4.2. Design Flows

The South West CFRAMS unit of Management 18 Hydrology report (2016) provides design flows for the river Blackwater downstream of Fermoy Bridge which were used for the production of the CFRAMS flood maps. These design flows or a range of different flood events are shown in Table 4-1 below.

Table 4-1:UoM18 Design Peak Flood Flows at Fermoy

HEP ID	Gauge/ Ungauged Location	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	0.5% AEP	0.1% AEP
18_1158_5	Fermoy Bridge Downstream 18107	370 m^3/s	499 m^3/s	585 m^3/s	667 m^3/s	773 m^3/s	853 m^3/s	933 m^3/s	1117 m^3/s

The OPW maintains a number of staff gauges in the vicinity of Fermoy Weir. These gauges are referenced at Table 4-2 below;

Table 4-2: River Level Gauges at Fermoy

Gauge reference	Location
18124	Fermoy U/S Rowing Club
18106	Fermoy Bridge U/S
18107	Fermoy Bridge D/S
18117	Fermoy Mill

The catchment area upstream of gauge 18107, Fermoy Bridge D/S is 1,750km^2. The OPW's Hydrodata website records statistics for gauge 18107 are reproduced at Table 4-3 below.

Table 4-3: Flow Duration Statistics for Station 18107 at Fermoy

DURATION PERCENTILES								
Flows equalled or exceeded for the given percentage of time (m3/s) (Data derived for the period 2001 to 2019)								
1%	5%	10%	25%	50%	75%	90%	95%	99%
254.273	146.374	96.979	46.773	22.284	13.725	9.857	8.579	6.125
Levels equalled or exceeded for the given percentage of time (mAOD Poolbeg) (Data derived for the period 2001 to 2019)								
1%	5%	10%	25%	50%	75%	90%	95%	99%
24.45	23.626	23.168	22.63	22.283	22.134	22.061	22.023	21.968

Inland Fisheries Ireland have directed that, in accordance with the Guidelines on the Planning, Design, Construction & Operation of Small-Scale Hydro-Electric Schemes and Fisheries, DCENR, 2007, the flow that must be available to the fish for passage etc. is *"Compensation flow provision of 12.5% of the long term mean flow (Q_m) or 50% of the available flow upstream of the intake point, whichever is the greater".*

The long-term average flow for the River Blackwater is not recorded for any gauge at Fermoy. However, the Department of Housing has previously advised that the long term mean flow Q_m at Fermoy was 47.4m^3/s. The 95%ile flow is recorded above as 8.579m^3/s. 12.5% of Q_m corresponds to 5.925m^3/s.

Table 4-4 below provides estimates of flow and depth at the upstream inlet to the Bypass Channel for a range of flow conditions. These estimates are based on an assumption of flow over a broad crested weir for both sections of the weir and for bypass channel.

This analysis confirms that 100% of the flow approaching the weir structure will be directed to the bypass channel for river flow conditions up to the 95%ile flow in the river Blackwater at Fermoy. For the long term mean annual flow of 47.7m^3/s, 44% of the flow approaching the weir will be diverted to the bypass channel. While this does not satisfy the requirement for 50% of the available flow upstream of the inlet to the bypass channel, the flow into the bypass channel remains substantial in this scenario given the scale flow in the river.

Table 4-4: Flow Estimates over Weir and Bypass for a Range of River Flow Conditions

	Depth H over Ramp Weir	Flow at Bypass U/S inlet Weir	Total Flow over Weir and Bypass	Upstream Water level	% Flow in By pass
	m	m^3/s	m3/s	mOD	
0.075AADF	0.0705	0.799	3.56	21.2705	100%
12.5% of Q_m	0.1558	2.625	5.93	21.3558	100%
0.15AADF	0.1913	3.571	7.11	21.3913	100%
95%ile Flow	0.2318	4.764	8.58	21.4318	100%
0.3AADF	0.3134	7.489	14.22	21.5134	84%
0.7AADF	0.4363	12.301	33.19	21.6363	53%
1.0AADF	0.4979	14.997	47.40	21.6979	44%
1.3AADF	0.5519	17.501	61.63	21.7519	38%
1.5AADF	0.5851	19.104	71.11	21.7851	36%
2.0AADF	0.6614	22.960	94.81	21.8614	32%
Q10	1.4000	70.708	426.99	22.6000	20%
Q100	1.6705	92.161	585.00	22.8705	19%

The configuration and layout of the Rough Channel Pool Bypass proposed at the weir in Fermoy has been designed to provide for the passage of all fish species present in the river Blackwater at Fermoy. Of particular relevance are the fish species which are qualifying interests for the Blackwater SAC, namely Atlantic salmon, brook lamprey, river lamprey,

sea lamprey, twaite shad, allis shad and freshwater crayfish. Also of interest are eels and trout which are also present in the river.

The fish bypass channel design and weir remediation proposals have been prepared in accordance with the recommendations of

- Fish Passes – Design, Dimensions and Monitoring, FAO and DVWK, 2002.

The design also has regard for the recommendations and guidance in:

- River Weirs – Good Practice Guide, Environment Agency, R&D Publication W5B-023/HQP, 2003
- Environment Agency Fish Pass Manual, UK Environment Agency, Document GEHO 0910 BTBP-E-E, UK Environment Agency, 2010;
- Weir removal, lowering and modification: A review of best practice, Environment Agency, Report SC070024, 2013;
- Manual on Scour at bridges and other hydraulic Structures, 2nd Edition, CIRIA C742, 2015;
- Rivers Weirs – Design, Maintenance Modification and Removal, CIRIA C763, 2016;

4.3. Surveys Undertaken

To assist with the preparation of this application, the following surveys and investigations were completed:

i. Topographical surveys of the Fermoy Weir (Murphy Surveys MSL27232 Aug 2018), included with the drawings accompanying the application;
ii. Topographical survey of the site at the north bank of the river and bathymetric survey of the river bed downstream of the weir in (Geodata 20423, May 2020), included with the drawings accompanying the application
iii. Topographical and bathymetric survey of the breach in the weir and the adjacent river bed including the downstream gravel banks (Murphy Surveys MSL37760 Aug 2020), included with the drawings accompanying the application;
iv. Photographic surveys of the weir completed on the 13th July 2016, 12th July 2018, 6th June 2019, 2nd July 2019, 5th December 2019, 30th Jan 2020, 25th May 2020, 3rd June 2020, 7th and 9th Nov 2020, 19th March 2021 and 8th June 2021.
v. Underwater Archaeology Impact Assessment (Mizen Archaeology, May 2020), included with the application;
vi. Stage 1 Conservation engineering survey and Report (Trevor Wood Consulting Engineers, Nov 2020), included at Appendix B of this report;
vii. Assessment of the stability of cut slopes in the vicinity of the North Fermoy flood protection embankment (AGL Consulting Engineers, April 2020);
viii. Fermoy Fish Pass – Hydraulic Design Review (RHDHV, October 2021), included at Appendix C of this report;
ix. Fermoy Fish Bypass – Computational Fluid Dynamic (CFD) Modelling report (RHDHV, Oct 2021), included at Appendix D of this report;
x. Site Specific Flood Risk Assessment, (TJ O'Connor & Associates, April 2022), included at Appendix E of this report

xi. Aquatic baseline report for Fermoy Weir, Fermoy, Co. Cork (Triturus Environmental Ltd., May 2021), appended to the Ecological Impact Assessment included with the application.
xii. Survey of The Freshwater Pearl Mussel (*Margaritifera margaritifera*) at Fermoy Bridge on the Munster Blackwater River, Co. Cork (Sweeney Consultancy, 2021) appended to the Ecological Impact Assessment included with the application.
xiii. Tree survey and arboricultural impact assessment Fermoy Weir Development, (Mark Donnelly, July 2021), appended to the Ecological Impact Assessment included with the application.
xiv. Habitat and ecological surveys as detailed in the Natura Impact Statement and Ecological Impact Assessment (Dixon Brosnan, 2020,2021);
xv. Invasive Species Survey (Dixon Brosnan, 2021), included at Appendix B of this report

5. REPORTS PREPARED

5.1. Conservation Engineer's report

The Fermoy Weir is included in the Record of Protected Structures in the Fermoy Development Plan (2010-2016). The adjacent limestone quay wall at O'Neill Crowley Quay was delisted in a variation to the Fermoy Development Plan. A new quay wall was constructed in front of the existing quay wall as part of the Fermoy South Drainage Scheme flood defence works. The section of the original quay wall which was below the original road level was not demolished and remains buried under the footpath at O'Neill Crowley Quay.

Inspections of the weir structure were undertaken on the 30th January 2020 and 20th May 2020 by Trevor Wood Consulting Engineers, who were engaged by T.J. O'Connor & Associates as Conservation Engineers for the project. This inspection involved an inspection on the extent of the breach and the condition of the remaining section of the weir. The assessment also referenced the inspection of the weir previously undertaken in August 2018 by Infrastruct which had concluded that the concrete apron placed on the embankment section of the weir in the 1970's had effectively failed structurally.

The conservation engineer's report also referenced the underwater archaeology survey complete by Mizen Archaeology in May 2020, which identified numerous timber stakes and pinning evident on exposed sections at the base of the embankment (crump) weir.

The conservation engineer states in his report that best conservation practice should be adopted in terms of any remedial works to the protected structure, retaining as much existing fabric as possible and keeping interventions to a minimum. The conservation engineer's recommendations for remedial works are incorporated in the propose scheme. The key elements of these works comprise

- the removal of concrete aprons placed on the surface of the weir in the 1970's which had the effect of increasing the speed of flow over the weir resulting in bed erosion at the toe of the weir;
- reinstatement of cobble setts/ facing stonework on the surface of the embankment section of the weir;
- Stabilise the toe and heel of the embankment section of the weir to protect the toes of the two slopes and reduce the risk from undercurrents undermining the downstream side in the future;
- Retain and restore the structure of the existing fish pass (salmon leap) while ensuring that the reinstated structure does not generate white water which would attract fish;
- Reconstruction of the breached section of the Mill Race Weir Wall with original stone recovered from the river bed, supplemented by locally quarried limestone and red sandstone.

The conservation engineer's report is reproduced at Appendix B of this report.

5.2. Fish Pass Hydraulic Design Review

The design of the fish pass was reviewed by Dr Peter Brunner, Senior fish habitat specialist, RHDHV. The review included an assessment of the generic swim speeds and swim depths of the key fish species and their migration windows. The review also included observations on the proposed design against key criteria for a fish pass, concluding that the proposed fish pass design at Fermoy will provide suitable hydraulic conditions for passage of a range of target fish species.

The review also highlights the DVWK guidance which suggests that the characteristics of an irregular rough-channel pool pass such as that proposed for Fermoy cannot be calculated accurately and that a degree of testing and modification should be allowed for during the construction phase. This is allowed for in the proposal to adjust the position of perturbations boulders, particularly immediately upstream of the inlets to the uppermost weir on the bypass channel, with a view to restricting velocities in these inlets to less than 2m/s.

The review also notes that post construction monitoring of the efficacy of the fish pass for the various target species is also recommended, particularly for shad. This is addressed in the post operational monitoring recommendations in the Natura Impact Statement and in the recommendations contained in the Trex Ecology report on Operational Monitoring which is included as an appendix to the Natura Impact Statement.

The fish pass hydraulic design review is reproduced at Appendix C of this report.

5.3. CFD Modelling Report

The hydraulic design review of the fish bypass channel was supported by a computational fluid dynamic modelling exercise to determine if velocities within the fish pass (bypass channel) comply with the maximum speed requirements for a variety of fish species.

To verify the velocities within the fish pass and water depth over the Fermoy weir, three river flow scenarios were tested in the CFD model. These are: Q95 (flow exceeded 95% of the time and is typical of a dry summer flow), 0.7 annual average daily flow (AADF) and 1 AADF. These conditions were considered to represent the range of flows likely to generate critical flow conditions. Larger flows will result in a greater proportion of the flow spilling over the weir structure on the main channel of the river.

Following the initial model run the hydraulic model, the model of the fish bypass was modified to increase the spacing on three of the five gaps in the upstream weir and to introduce a 1m wide bench or sill immediately upstream of the uppermost fish pass weir.

The CFD Modelling reports notes that the design of the fish pass comprises a bypass channel with a series of 13 weirs, each with 5 staggered gaps to enable fish to swim up the channel. The weirs are spaced by set distance and each consecutive weir dropped in crest level. The review notes that such cascading design is favourable as it allows fish to swim up through the gaps and then rest within the pools in between the weirs.

The CFD Modelling report concludes that, based on the results of the CFD model, the proposed design performs hydraulicly as intended, although compliance with fish

regulations needs to be considered in greater detail to address the velocities within some sections of the bypass channel exceeding threshold set by the DVWK guidance. The modelled maximum velocities are above the 2m.s within two of the five gaps at the first (most upstream) weir in the bypass channel. There are 13 weirs in total along the length of the bypass channel and it is only in the uppermost weir that the velocities in two of the five gaps in the weir may present a challenge for fish passage.

However, the CFD model report notes that the modelled velocities are conservative since a 'smooth' wall was used to represent the fish pass design. Furthermore, such high velocities are limited to no more than two gaps (out of five), whereas in the remaining gaps, the maximum velocities are below 2m/s. Velocities throughout the rest of the bypass channel are well below the 2m/s threshold under all considered flow scenarios.

The CFD modelling report notes that some additional measures could be implemented to improve the design, e.g., perturbance boulders could be added to disrupt the flow and slow velocities in the upper pools in front of gaps at the fish pass weir where the velocities are the highest. This feature has been incorporated in the scheme as proposed. The precise positioning of these perturbation boulders will be determined at the end of the construction stage in conjunction with post construction monitoring as detailed in the Trex Ecology report on operational monitoring which is included as an Appendix to the Natura Impact Statement. This is a not uncommon requirement for fine tuning of the inlet arrangement at rough pool fish bypass channels and is the approach recommended in the FAO/DVWK design guidance document.

The CFD modelling report is reproduced at Appendix D of this report.

5.4. Flood Risk Assessment

A Flood Risk Assessment, in accordance with "The Planning System and Flood Risk Management – Guidelines for Planning Authorities", is required to be submitted to ABP for applications under section 177AE of the Planning and Development Act 2000 as amended.

The flood maps for the area indicate that the development is situated within Flood Zone A, i.e., an area at risk to flooding up to a 1% AEP event. The proposed development, which comprises rehabilitating the existing weir and constructing a new fish bypass channel, are both classified as water compatible development under the above guidelines. These development types are permissible in Flood Zone A without the requirement of a Justification Test.

The OPW require confirmation that the works proposed for the weir remediation and Fish Bypass Channel do not give rise to an increase in flood risk or flood depth within the flood plain of the River Blackwater and the area covered by the Munster Blackwater Fermoy Drainage Order. The OPW also require confirmation that the construction of the works will not increase flood risk at any properties or alter the trigger levels for the erection of the demountable flood defence barriers.

The Site Specific Flood Risk Assessment is reproduced Appendix E of this report. It concludes that the proposed development will not have an impact on flood risk within or adjacent to the site either during construction of once the works are completed.

Other reports prepared for the Public Consultation process held from November 2020 to February 2021are not included in this application.

6. CONSULTATIONS

6.1. Public consultation

Cork County Council undertook a non-statutory public consultation, to elicit the views and opinions of the public, concerned parties and prescribed bodies on the options considered for the Fermoy Weir Remediation and Fish Bypass Channel project along with any other measures considered for implementation.

Before commencing preparation of a planning application and associated environmental studies and assessments for the scheme to provide for the remediation of Fermoy Weir along with the provision of a Fish Bypass Channel at Fermoy, the views and opinions of the public and relevant stakeholders were invited through a consultation process.

Details of the proposed measures were made available on a website created for the consultation, www.fermoyweir.ie, from Friday, November 6th 2020.

The consultation was a non-statutory public consultation, intended to elicit the views and opinions of the public, concerned parties and prescribed bodies on the options considered for the Fermoy Weir Remediation and Fish Bypass Channel project along with any other measures considered for implementation.

The consultation was for an initial period of four weeks from Friday, November 6th until Friday, December 4th 2020. Local stakeholders highlighted the difficulties created by the Covid-19 restrictions in place during the consultation period. The closing date for receipt of submissions was subsequently extended to the 18th December 2020.

A report was prepared summarising the contributions and feedback received from the public. Over 100 submissions were received from the public and from key stakeholders through a combination of the project website and hardcopy submissions sent to Cork County Council. The Public Consultation Summary report was also placed on the www.fermoyweir.ie following review and analysis of the submission received. The Public Consultation Summary report identified the common trends and recurring themes in the submissions and presents responses to the issues and concerns raised.

The submissions received included ones from the following local and national stakeholders

- Fermoy Tourism
- Fermoy Forum
- Fermoy River Youth & Amenity Group (Wheelchair Boat),
- Cork Nature Network
- Fermoy Game Fishing and Fermoy Coarse Anglers
- Blackwater River Trust
- Save Our Weir – Save our Salmon
- Fermoy Rowing Club
- Inland Fisheries Ireland

The Community Water officer also requested that she be provided with further information and updates on the project as it progresses.

Save Our Weir Save Our salmon is an umbrella group representing fourteen clubs and organisations with an involvement or interest in the River Blackwater at Fermoy. These clubs and organisations are:

- Fermoy Rowing Club
- Blackwater Sub Aqua Club
- Blackwater Triathlon Club
- Fermoy Tourism
- Save The Weir Umbrella Group
- Sandycove Island Swim Club
- Fermoy Wheelchair Boat
- Fermoy River Youth Fishing and Amenity
- Fermoy Game Fishing Association
- Fermoy Coarse Anglers Association
- Ballyduff Bridge Salmon Fishery
- Bridgetown Upper Fishery
- Phoenix Kayak Club
- Fermoy Town and District Angling Club

Briefings were held with representatives of the Save the Weir group on 6th Nov and 10th Dec 2020 and on the 3rd March 2022.

Presentations were made to the Councillors of the Fermoy Area Municipal District Committee of Cork Co Co on the 21st Dec 2021.

A copy of the Public Consultation Summary report is included with the documentation supporting this application. This report includes an appendix which summarises responses provided in respect of all comments received in the consultation process.

6.2. Other Stakeholders

Separate meetings were held with Inland Fisheries Ireland and the National Parks and Wildlife Service on the 10th February 2020 in respect of the proposed development.

Information on the scheme was provided to David Horan, a director of Sherwood Oak Ltd., owner of lands affected by the works on the north bank of the river Blackwater in October 2020 and Feb 2022.

APPENDIX A

Scheme Drawings

19011-TJOC-PL-XX-DR-C-0048	Site Location Map 6”
19011-TJOC-PL-XX-DR-C-0049	Site Location Plan
19011-TJOC-PL-XX-DR-C-0050	Aerial View of Existing Site
19011-TJOC-PL-XX-DR-C-0051	Existing Site Layout Plan
19011-TJOC-PL-XX-DR-C-0052	Key Plan –Proposed fish Bypass, Weir and Mill Island plans
19011-TJOC-PL-XX-DR-C-0053	Proposed Fish Bypass Plan
19011-TJOC-PL-XX-DR-C-0054	Fish Bypass Longitudinal Sections
19011-TJOC-PL-XX-DR-C-0055	Fish Bypass Sections
19011-TJOC-PL-XX-DR-C-0058	Plan of Existing Weir
19011-TJOC-PL-XX-DR-C-0059	Proposed Weir Remediation – Existing Sections
19011-TJOC-PL-XX-DR-C-0060	Weir Remediation – Plan of Proposed Weir
19011-TJOC-PL-XX-DR-C-0061	Weir Remediation – Proposed Sections
19011-TJOC-PL-XX-DR-C-0062	Weir Remediation – Proposed Sections
19011-TJOC-PL-XX-DR-C-0063	Weir Remediation – Proposed Sections
19011-TJOC-PL-XX-DR-C-0073	Existing Weir Condition
19011-TJOC-PL-XX-DR-C-0074	Existing Weir Condition - Area 1
19011-TJOC-PL-XX-DR-C-0075	Existing Weir Condition - Area 2
19011-TJOC-PL-XX-DR-C-0076	Existing Weir Condition - Area 3
19011-TJOC-PL-XX-DR-C-0077	Existing Weir Condition - Area 4
19011-TJOC-PL-XX-DR-C-0078	Existing Weir Condition - Area 5
19011-TJOC-PL-XX-DR-C-0079	Existing Fish Ladder Remediation Plan
19011-TJOC-PL-XX-DR-C-0081	Existing Fish Ladder Remediation Details – Sheet 2
19011-TJOC-PL-XX-DR-C-0082	Existing Services
19011-TJOC-PL-XX-DR-C-0083	Tree Protection Plan
19011-TJOC-PL-XX-DR-C-0084	Construction Spoil Management
19011-TJOC-PL-XX-DR-C-0085	Site Compounds
19011-TJOC-PL-XX-DR-C-0086	Instream Works Phasing
19011-TJOC-PL-XX-DR-C-0087	Fermoy Bridge Elevations
21-053 LP01-01-PP	Landscape Plan

N

LEGEND:

PLANNING RED LINE BOUNDARY

PERMANENT WAYLEAVES

SITE NOTICE LOCATION X

0 105.6 211.2 316.8 422.4 633.6 844.8 1056m

1:10560

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS
CORRIG HOUSE, CORRIG ROAD, SANDYFORD, DUBLIN 18.
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PROJECT: FERMOY WEIR REMEDIATION & FISH BYPASS CHANNEL

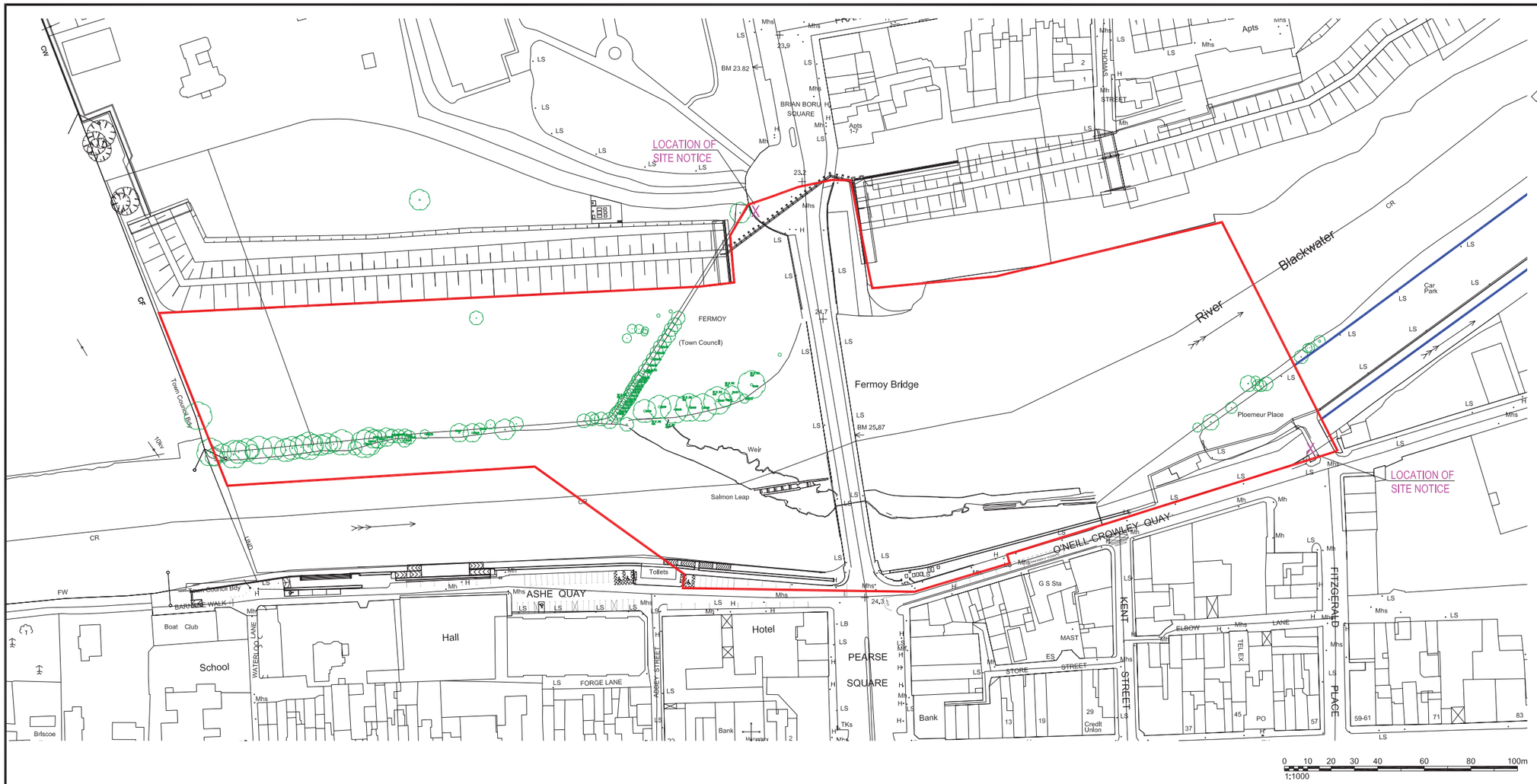
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: SITE LOCATION MAP

SCALE: 1:10560 (A3)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0048

REV: C01



LEGEND:

- PLANNING RED LINE BOUNDARY
- PERMANENT WAYLEAVES
- SITE NOTICE LOCATION X
- OTHER LANDS IN THE CONTROL OF THE APPLICANT

MAP REPRODUCED BY PERMISSION OF ORDNANCE SURVEY IRELAND (CORK CCMA 9802)

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS
CORRIG HOUSE, CORRIG ROAD, SANDYFORD, DUBLIN 18.
Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

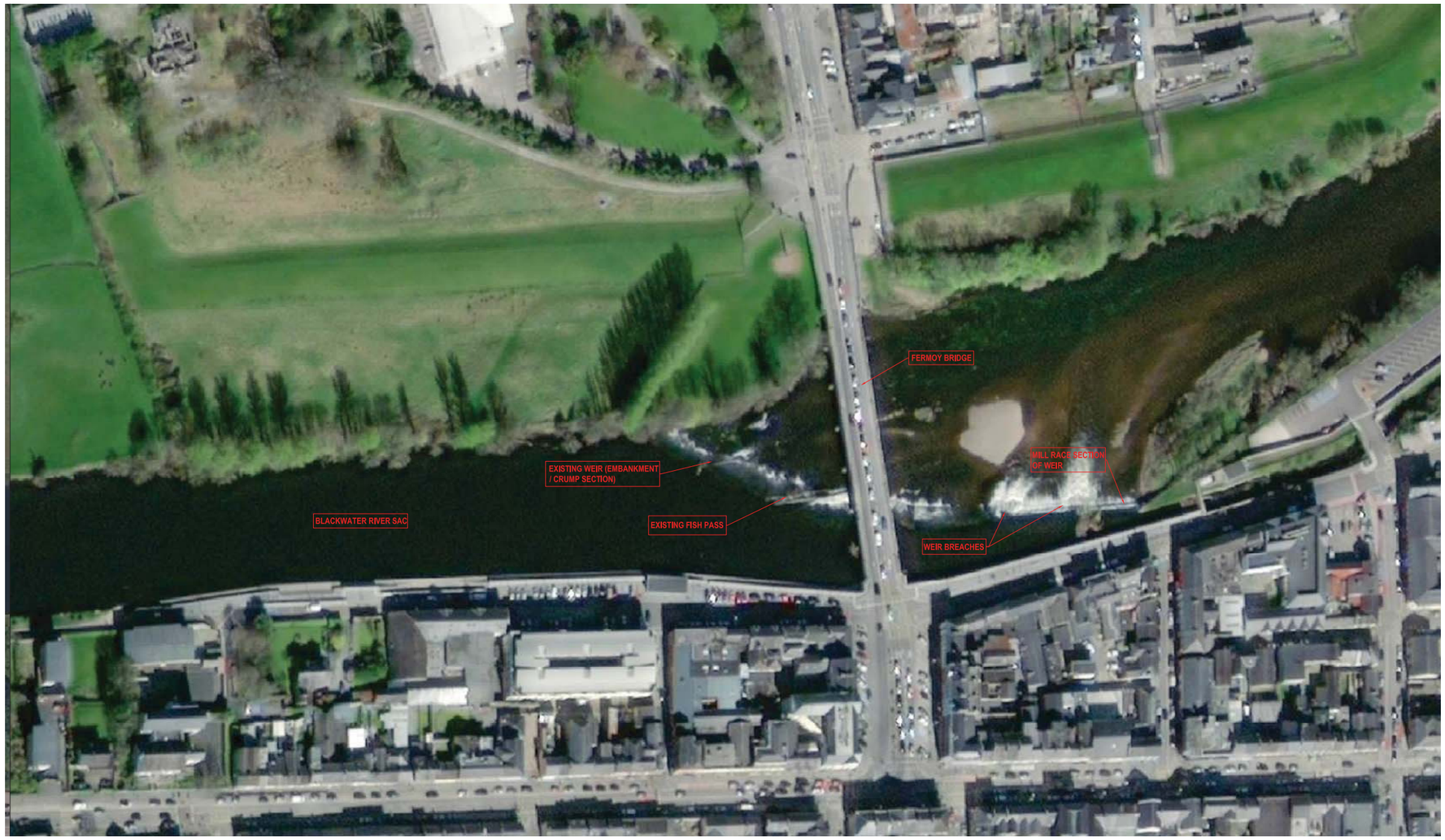
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: SITE LOCATION PLAN

SCALE: 1:1000 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0049

REV: C01



N

0 10 20 30 40 60 80 100m
1:1000

Lidar Survey supplied by
Cork County Council
26th June 2018

C01	AP	ISSUED FOR PLANNING	02.06.2022
REV	STAT	DESCRIPTION	DATE

DRAWING STATUS:
ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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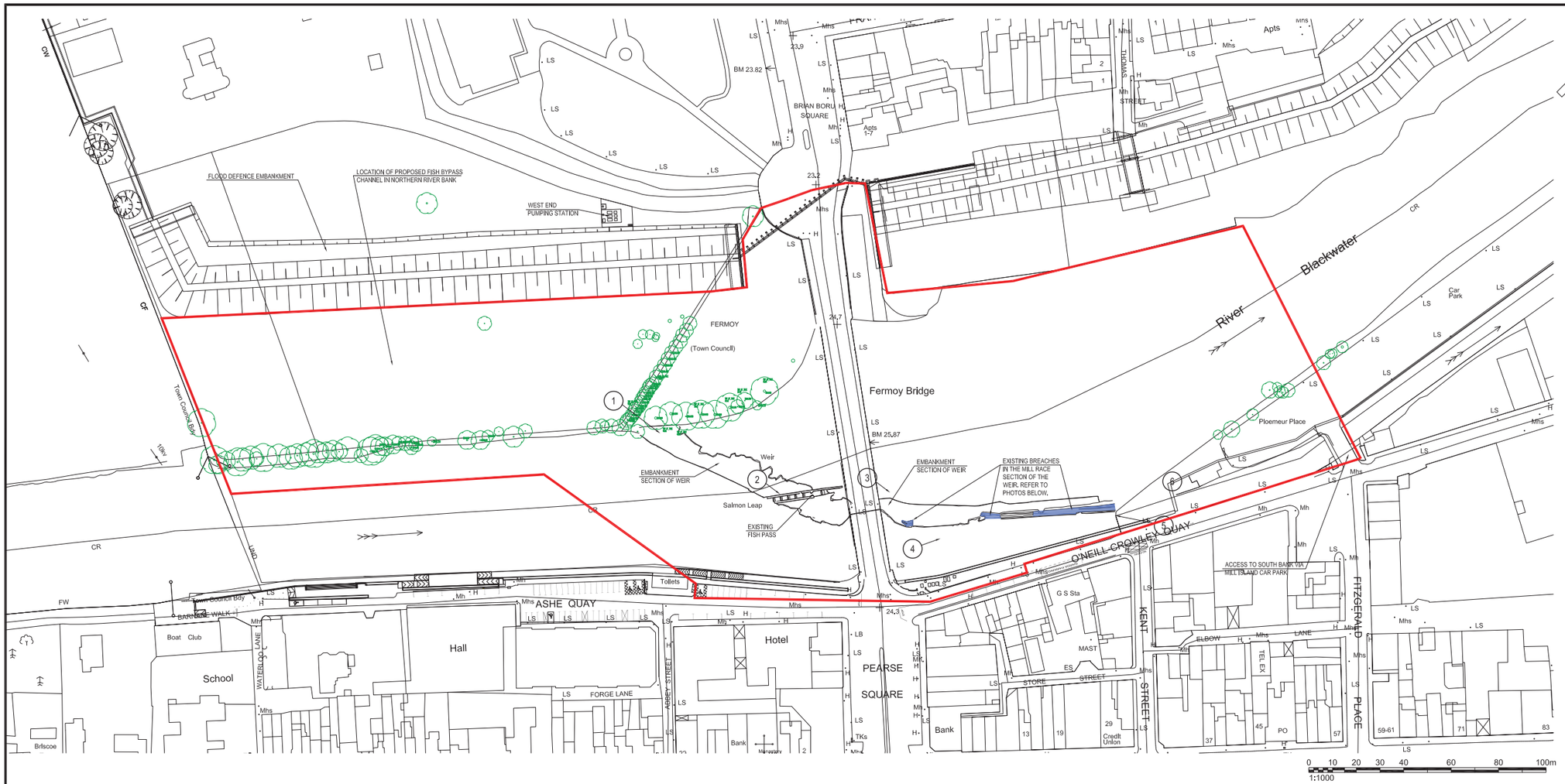
PROJECT:
FERMOY WEIR REMEDIATION AND
FISH BYPASS CHANNEL

CLIENT:
CORK COUNTY COUNCIL

DRAWING TITLE:
FERMOY WEIR
AERIAL VIEW OF EXISTING SITE

SCALE: 1:1000 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER	REV:
19011-TJOC-PL-XX-DR-C-0050	C01



NOTES:

1. TREE INFORMATION SHOWN ON THIS DRAWING IS TAKEN FROM GEODATA SURVEYING LTD. TOPOGRAPHICAL SURVEY OF JUNE 2020.
2. EXISTING WEIR INFORMATION SHOWN ON THIS DRAWING IS TAKEN FROM WEIR SURVEY CARRIED OUT BY MURPHY GEOSPACIAL IN AUGUST 2018. EXTENT OF BREACHES SHOWN ARE AS SURVEYED IN 2018 AND MAY HAVE INCREASED IN THE TIME SINCE THE SURVEY HAD BEEN CARRIED OUT.
3. PHOTOS TAKEN IN MARCH 2021.

LEGEND:

SITE BOUNDARY

EXISTING TREES

PHOTO LOCATION AND DIRECTION (1)

EXISTING BREACHES IN WEIR

PHOTO 1 - EMBANKMENT WEIR

PHOTO 3 - INTERFACE BETWEEN EMBANKMENT AND MILL RACE WEIR

PHOTO 5 -EXISTING BREACHES IN MILL RACE SECTION OF WEIR

PHOTO 2 - EXISTING FISH LADDER

PHOTO 4 - EXISTING BREACHES IN MILL RACE SECTION OF WEIR
(LOOKING DOWNSTREAM)

PHOTO 6 -EXISTING BREACHES IN MILL RACE SECTION OF WEIR
(LOOKING UPSTREAM)

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY: LC | REVIEWED BY: MV | APPROVED BY: DC

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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

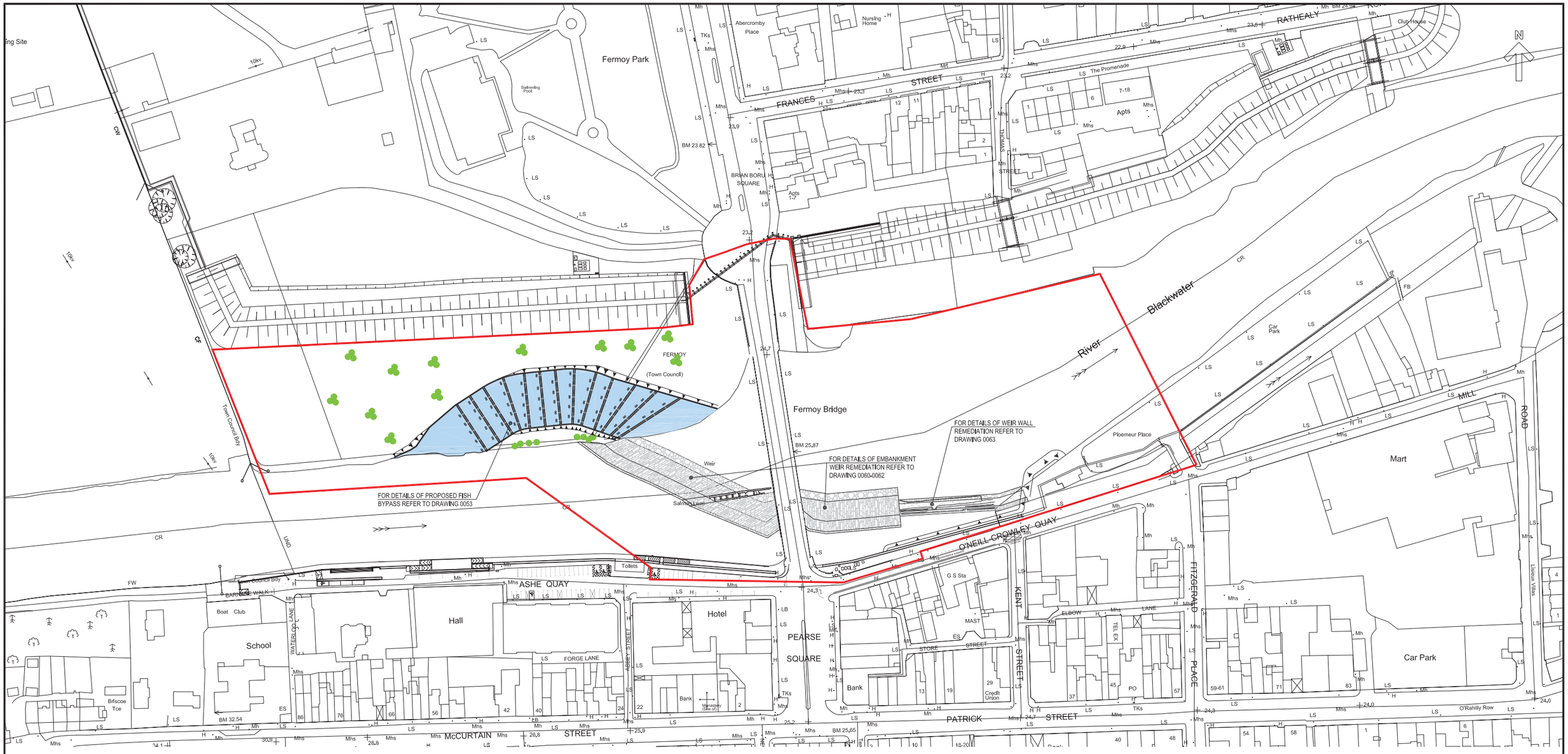
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING SITE LAYOUT PLAN

SCALE: 1:1000 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER: 19011-TJOC-PL-XX-DR-C-0051

REV: C01



0 10 20 30 40 60 80 100m
1:1000

NOTES:

1. FOR DETAILS OF FISH BYPASS REFER TO DRAWING 0053.
2. FOR DETAILS OF REMEDIATION OF EMBANKMENT SECTION OF WEIR REFER TO DRAWINGS 0060-0062.
3. FOR DETAILS OF REMEDIATION TO MILL RACE SECTION OF WEIR REFER TO DRAWINGS 0060 AND 0063.

MAP REPRODUCED BY PERMISSION OF ORDNANCE SURVEY IRELAND (CORK CCMA 9802)

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: KEY PLAN
PROPOSED FISH BYPASS, WEIR AND MILL ISLAND PLAN

SCALE: 1:1000 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0052

REV: C01

FERMOY NORTH FLOOD DEFENCE EMBANKMENT

NEW 4m WIDE ACCESS GATE

EXISTING FENCELINE TO BE RETAINED

EXISTING RAILING AND SEAT TO BE TEMPORARILY REMOVED FOR CONSTRUCTION ACCESS

PERTURBATION BOULDERS, RANDOM PLACEMENT

CONCRETE AND STONE CLADDING

LANDSCAPED 1:4 SLOPE

LANDSCAPED 1:2 SLOPE

PERTURBATION BOULDERS, RANDOM PLACEMENT

FISH POOLS CREATED BY VARYING LEVEL OF ROCK WEIR WALLS

FERMOY (Town Council)

BRIAN BORU SQUARE

Apts 1-7

Fermoy Bridge

FERMOY BRIDGE

Weir

Salmon Leap

EXISTING FISH PASS

BED OF RIVER TO BE DREDGED TO MINIMUM BED LEVEL OF 18.50 AT BRIDGE PIERS AND 19.10 AT OUTLET FROM FISH BYPASS

BM 25.87

ASHE QUAY

FERMOY SOUTH FLOOD DEFENCE WALLS

Toilets

Hotel

Hall

Boat Club

BARNANE WALK

Town Council Bdy

10kv

CF

UND

OR

0 5 10 15 20 30 40 50m
1:500

LEGEND:

EXISTING RIVER BED LEVELS	19,02
PROPOSED LEVELS	19,02
EXISTING TREES	
EXISTING TREES TO BE REMOVED	
PROPOSED PLANTING	

NOTES:

1. REFER TO DRAWINGS 0054 AND 0055 FOR SECTION DETAILS OF PROPOSED FISH BYPASS CHANNEL.
2. ALL LEVELS SHOWN RELATE TO ORDNANCE DATUM MALIN HEAD.

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: PROPOSED FISH BYPASS PLAN

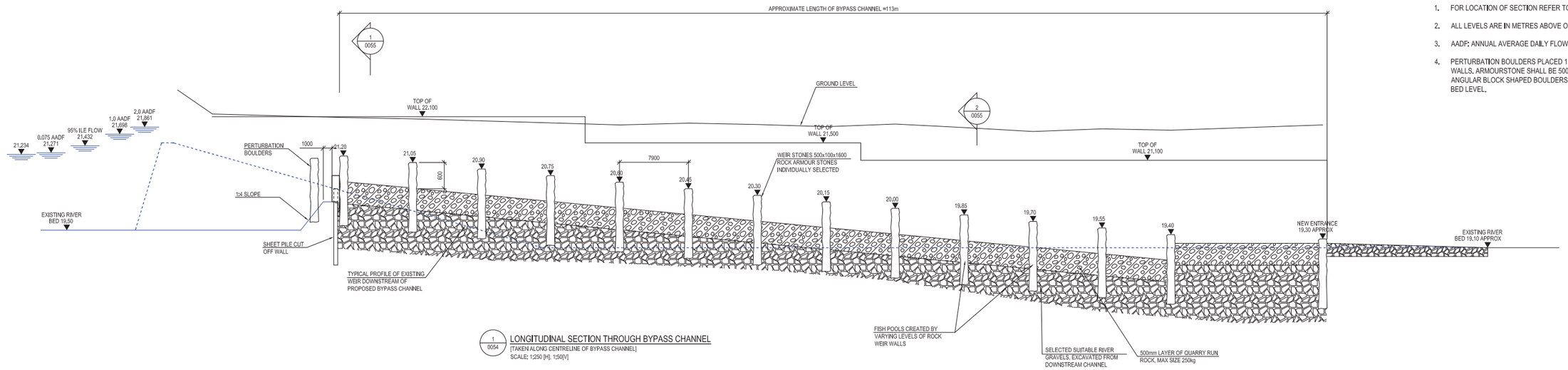
SCALE: 1:500 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-XX-XX-DR-C-0053

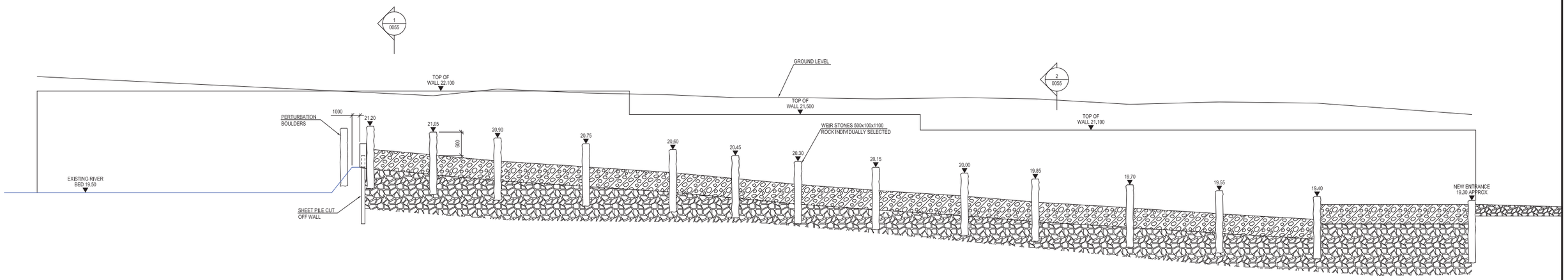
REV: C01

NOTES:

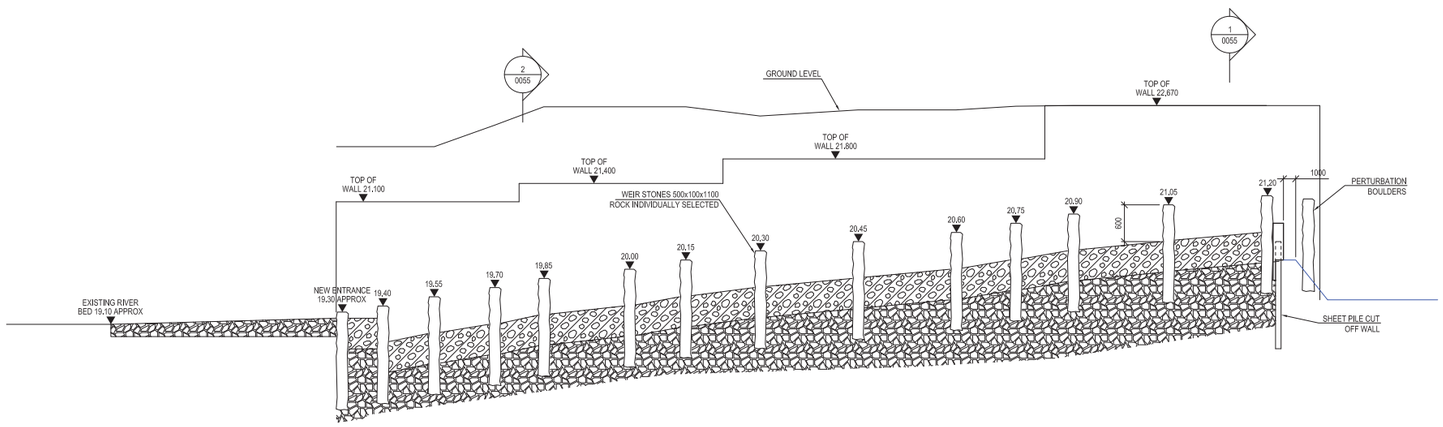
1. FOR LOCATION OF SECTION REFER TO DRAWING 0053.
2. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM MALIN HEAD.
3. AADF: ANNUAL AVERAGE DAILY FLOW
4. PERTURBATION BOULDERS PLACED 1m UPSTREAM OF GAPS IN THE WEIR WALLS. ARMOURSTONE SHALL BE 500x1000x1600 HIGH MIN. DIMENSIONS ANGULAR BLOCK SHAPED BOULDERS PROJECTION 500mm ABOVE THE RAMP BED LEVEL.



1 0054 LONGITUDINAL SECTION THROUGH BYPASS CHANNEL
[TAKEN ALONG CENTRELINE OF BYPASS CHANNEL]
SCALE: 1:250 [H], 1:50[V]



2 0054 ELEVATION OF NORTHERN WALL OF BYPASS CHANNEL
SCALE: 1:250 [H], 1:50[V]



3 0054 ELEVATION OF SOUTHERN WALL OF BYPASS CHANNEL
SCALE: 1:250 [H], 1:50[V]

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

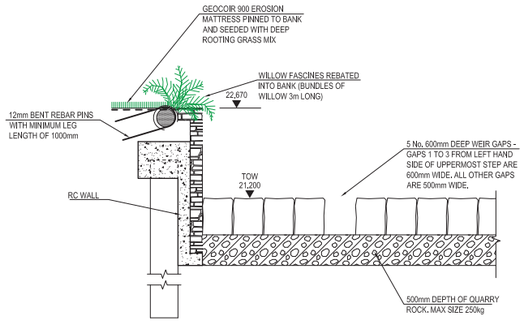
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: PROPOSED FISH BYPASS LONGITUDINAL SECTION

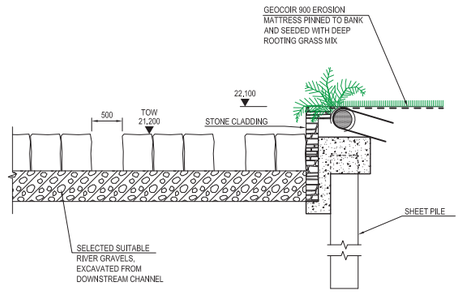
SCALE: 1:250 [H], 1:50 [V] (A1)

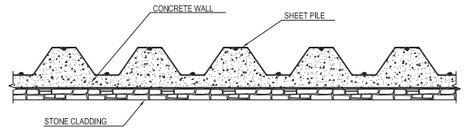
PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER: 19011-TJOC-XX-XX-DR-C-0054

REV: C01



1 / 0055 SECTION
SCALE: 1:50

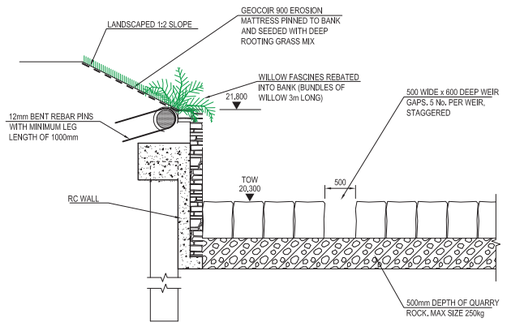




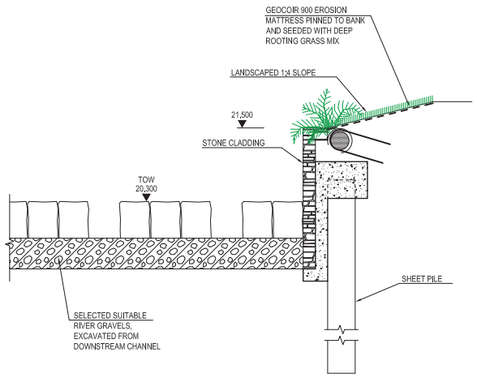
4 / 0055 DETAIL PART PLAN OF SHEET PILE WALL
SCALE: 1:50

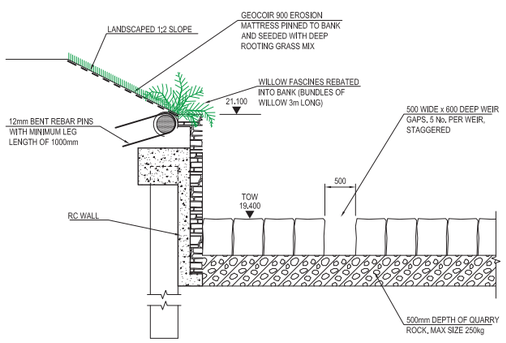
NOTES:

1. FOR LOCATION OF SECTIONS REFER TO DRAWING 0053.
2. ALL LEVELS ARE IN METERS ABOVE ORDNANCE DATUM MALIN HEAD

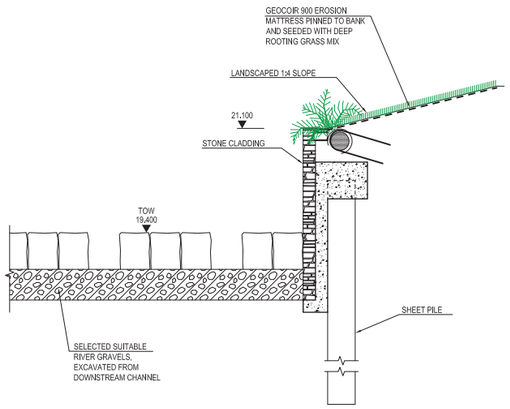


2 / 0055 SECTION
SCALE: 1:50





3 / 0055 SECTION
SCALE: 1:50



REV	STAT	DESCRIPTION	DATE
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DRAWING STATUS: ISSUED FOR PLANNING

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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

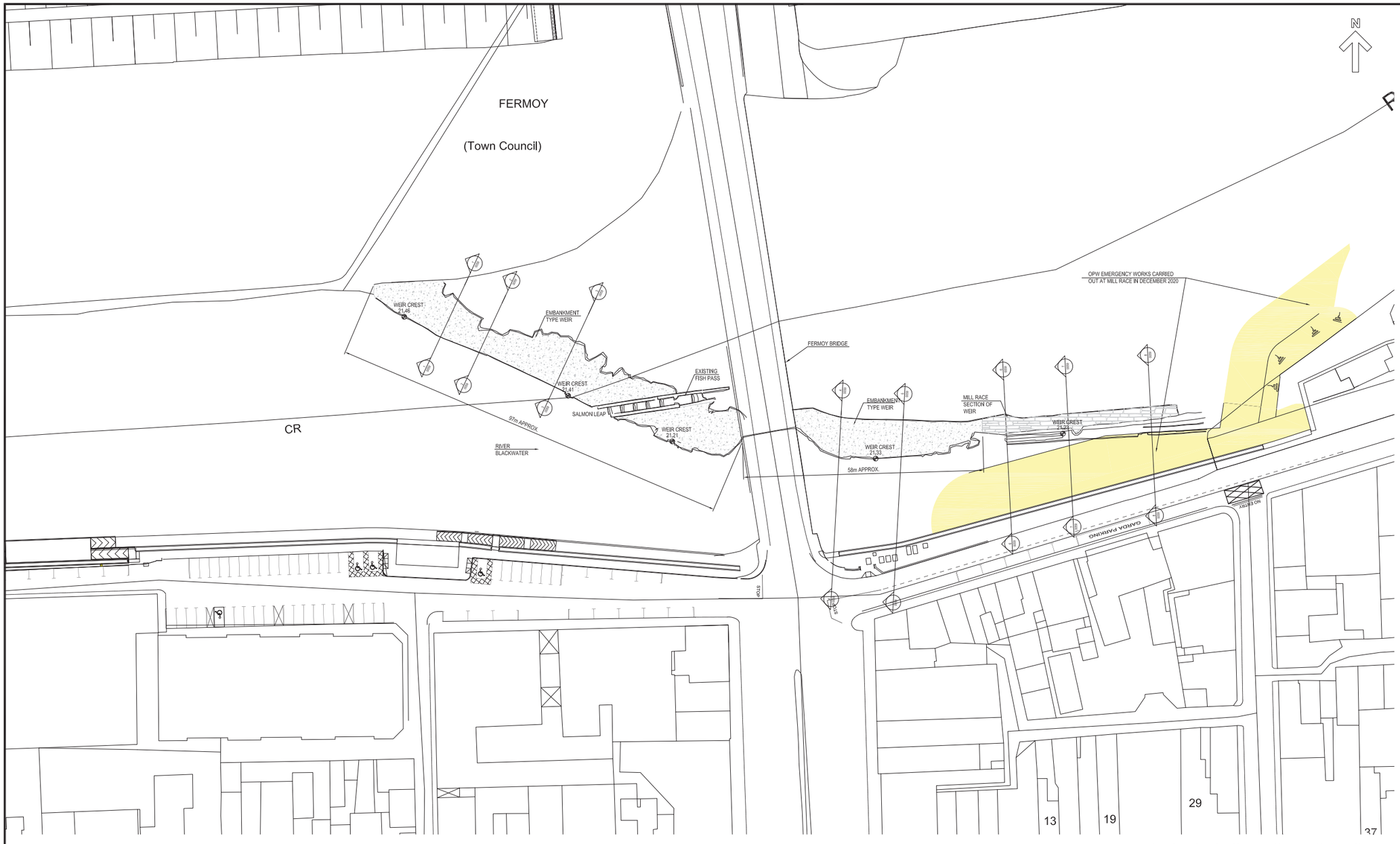
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: FISH BYPASS SECTIONS

SCALE: 1:50 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE -ROLE- NUMBER
19011-TJOC-XX-XX-DR-C-0055

REV: C01



N

NOTES:

1. EXTENT OF EXISTING WEIR BASE ON TOPOGRAPHICAL SURVEY UNDERTAKEN BY MURPHY GEOSPACIAL IN AUGUST 2018.
2. FOR SECTIONS THROUGH EXISTING WEIR REFER TO DRAWING 0059.

APPROXIMATE EXTENT OF BED STABILISATION WORKS UNDERTAKEN BY THE OPW IN 2020

MAP REPRODUCED BY PERMISSION OF ORDNANCE SURVEY IRELAND (CORK CCMA 9802)

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY EMBANKMENT WEIR REMEDIATION AND FISH BYPASS CHANNEL

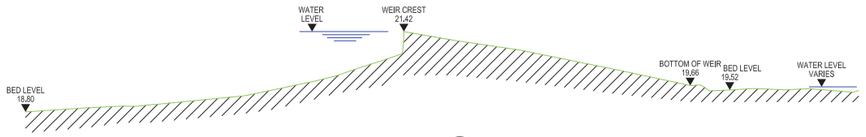
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: WEIR REMEDIATION PLAN OF EXISTING WEIR

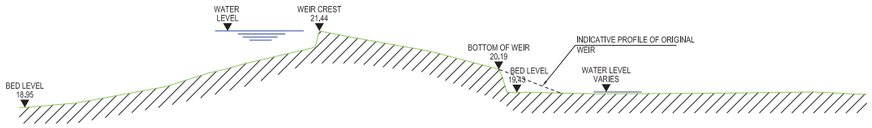
SCALE: 1:500 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE -ROLE- NUMBER
19011-TJOC-PL-XX-DR-C-0058

REV: C01



1 / 0059 EXISTING EMBANKMENT WEIR SECTION
SCALE: 1:100



2 / 0059 EXISTING EMBANKMENT WEIR SECTION
SCALE: 1:100

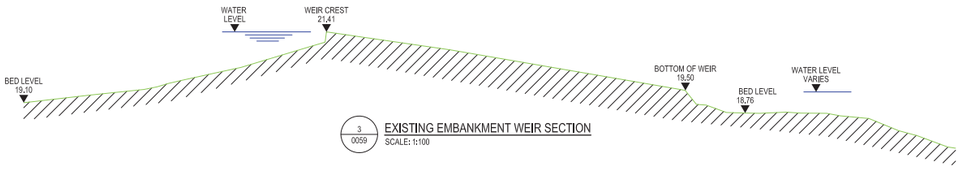
NOTES:

1. FOR LOCATION OF SECTIONS REFER TO DRAWING 0058.
2. ALL LEVELS SHOWN ARE IN METERS ABOVE ORDNANCE DATUM, MALIN HEAD.
3. AUGUST 2018 AND AUGUST 2020 SURVEYS OF THE RIVER BED AND WEIR UNDERTAKEN BY MURPHY GEOSPATIAL AND CARRIED OUT TO ITM.
4. AUG 2018 SURVEY DRAWING REFERENCE 27232 18024_Fermoy_Welr
5. AUG 2020 SURVEY DRAWING REFERENCE MSL37760_01
6. SECTIONS SHOW APPROXIMATE BED PROFILE FOLLOWING WORKS COMPLETED BY OPW IN AUTUMN 2020.

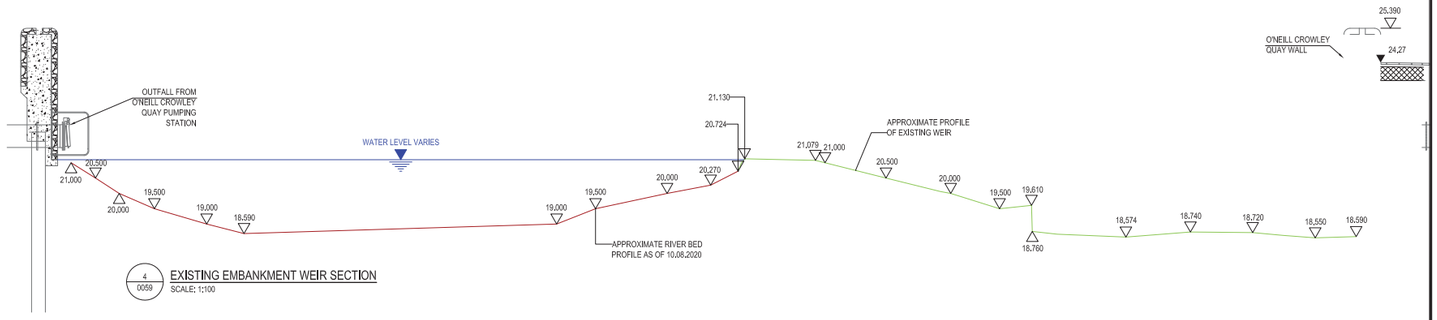
LEGEND:

AUGUST 2018 SURVEY PROFILE

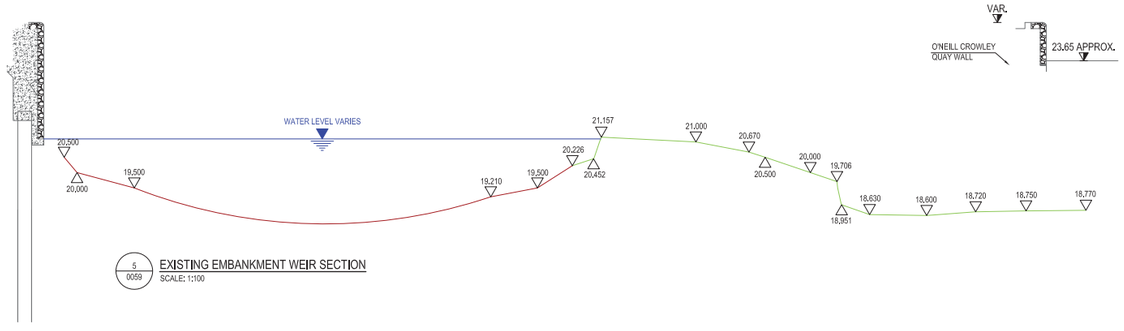
AUGUST 2020 SURVEY BED PROFILE



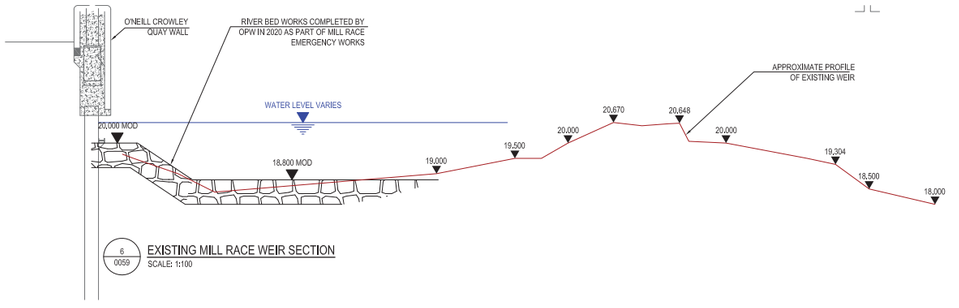
3 / 0059 EXISTING EMBANKMENT WEIR SECTION
SCALE: 1:100



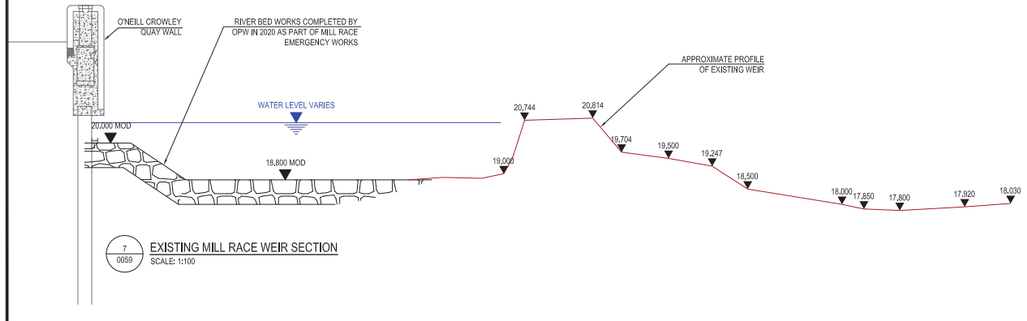
4 / 0059 EXISTING EMBANKMENT WEIR SECTION
SCALE: 1:100



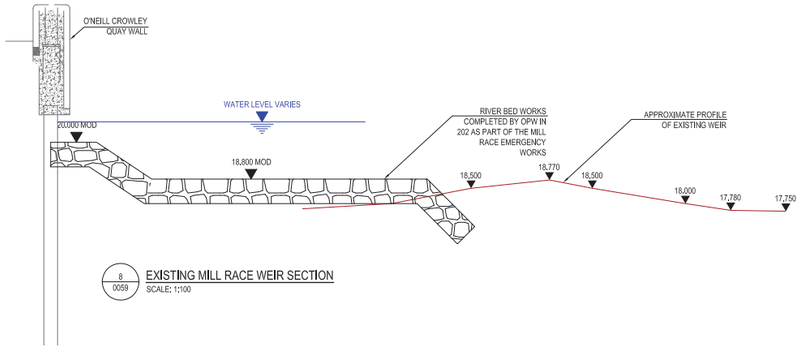
5 / 0059 EXISTING EMBANKMENT WEIR SECTION
SCALE: 1:100



6 / 0059 EXISTING MILL RACE WEIR SECTION
SCALE: 1:100



7 / 0059 EXISTING MILL RACE WEIR SECTION
SCALE: 1:100



8 / 0059 EXISTING MILL RACE WEIR SECTION
SCALE: 1:100

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

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LC	MV	DC

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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

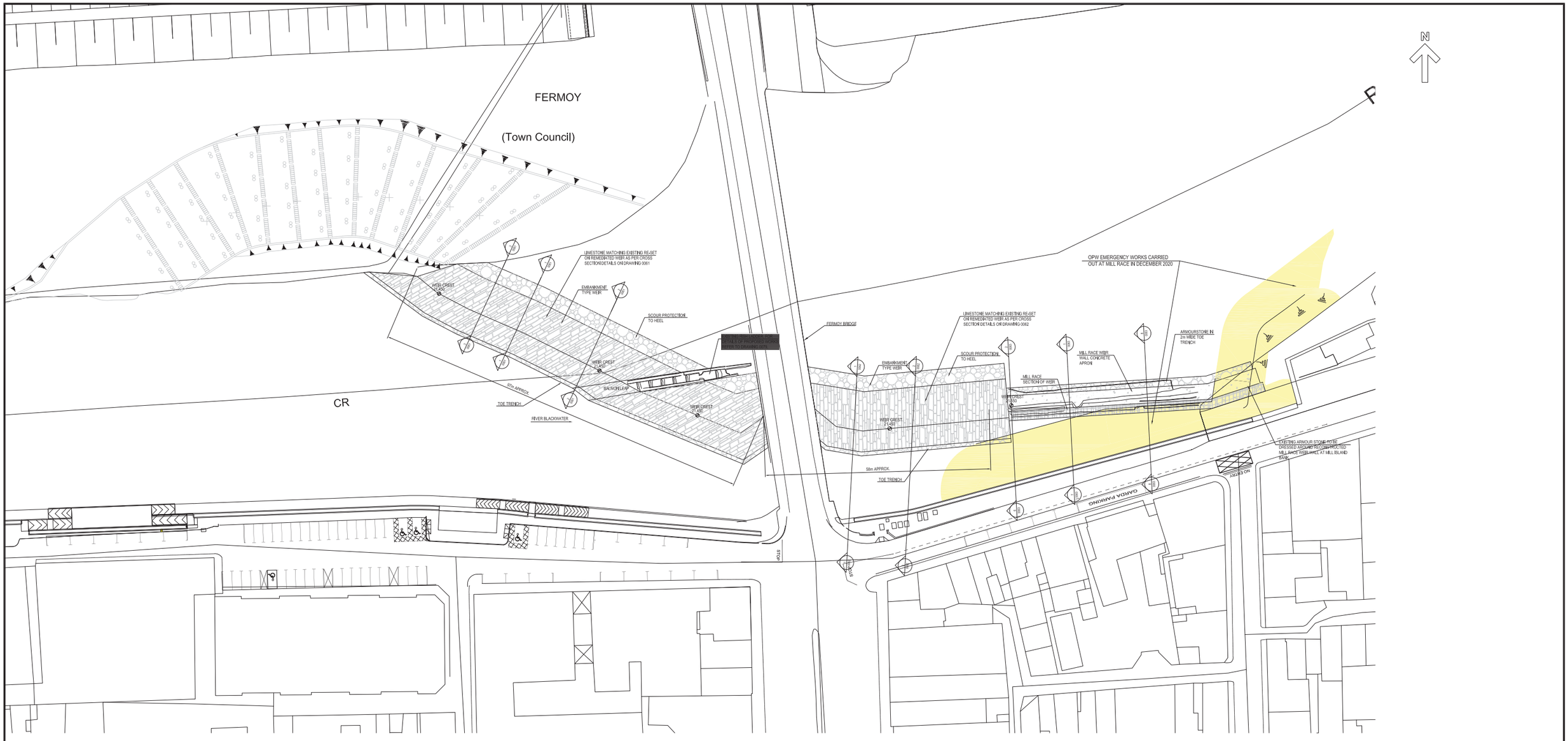
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: PROPOSED WEIR REMEDIATION EXISTING SECTIONS

SCALE: AS SHOWN (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0059

REV: C01



0 5 10 15 20 30 40 50m
1:500

NOTES:

1. FOR SECTIONS THROUGH PROPOSED EMBANKMENT WEIR REFER TO DRAWINGS 0061 AND 0062.
2. FOR SECTIONS THROUGH PROPOSED MILL RACE WEIR REFER TO DRAWING 0063.
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM MALIN HEAD.
4. WEIR REMEDIATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CONSERVATION ENGINEER'S RECOMMENDATIONS.

APPROXIMATE EXTENT OF BED STABILISATION WORKS UNDERTAKEN BY THE OPW IN 2020

MAP REPRODUCED BY PERMISSION OF ORDNANCE SURVEY IRELAND (CORK CCMA 9802)

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

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PROJECT: FERMOY EMBANKMENT WEIR REMEDIATION AND FISH BYPASS CHANNEL

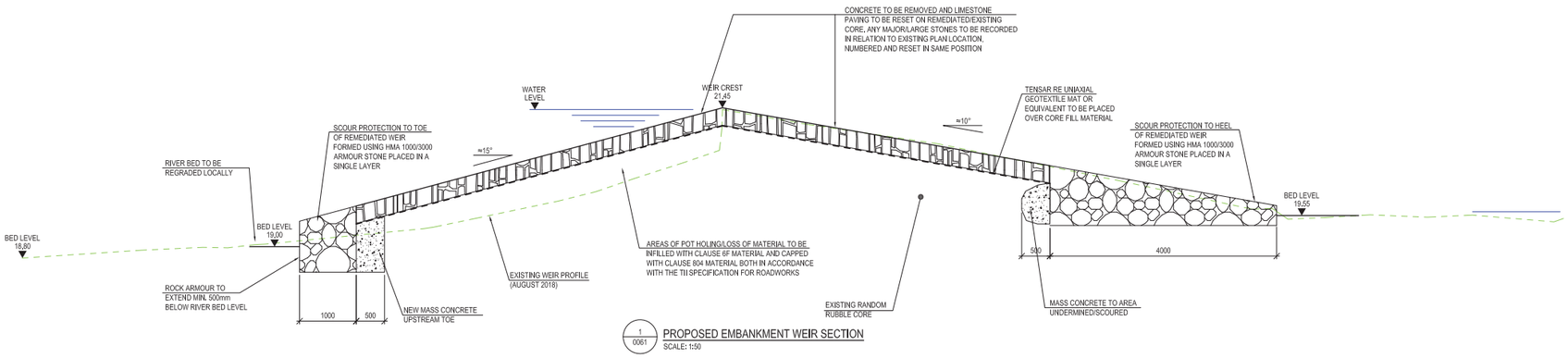
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: WEIR REMEDIATION PLAN OF PROPOSED WEIR

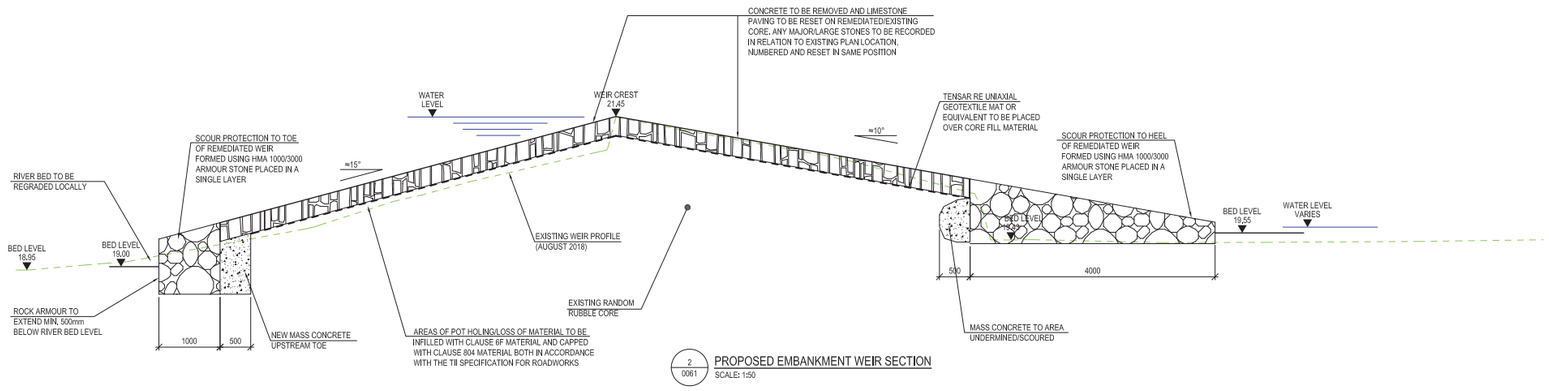
SCALE: 1:500 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0060

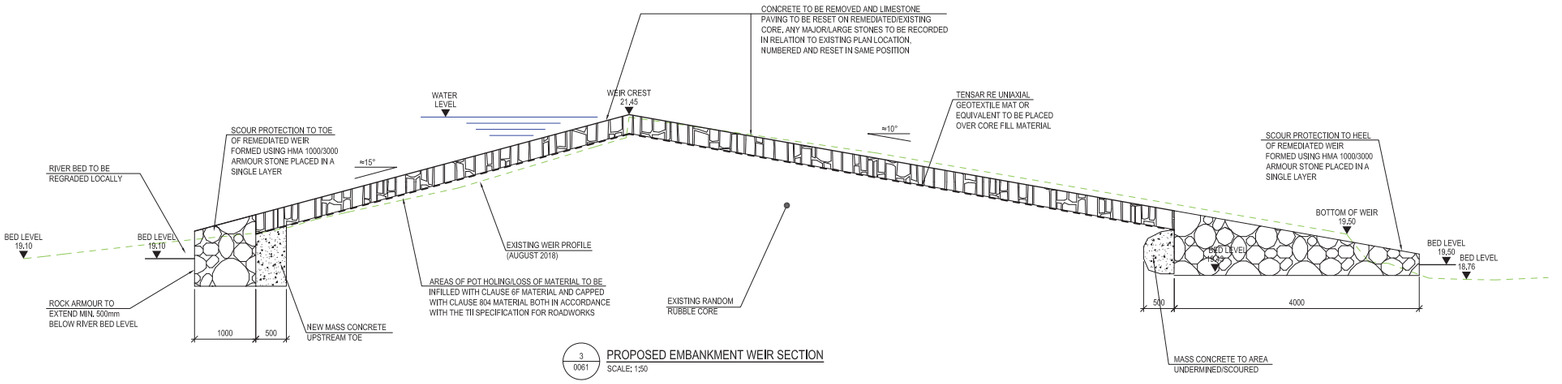
REV: C01



1/0061 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50



2/0061 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50



3/0061 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50

NOTES:

1. ALL LEVELS SHOWN ARE IN METERS ABOVE ORDNANCE DATUM, MALIN HEAD.
2. FOR LOCATIONS OF SECTIONS REFER TO DRAWING 0060.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH SURVEY DRAWINGS OF EXISTING WEIR STRUCTURE AND WITH SECTION DRAWINGS 0062 AND 0063.
4. WEIR REMEDIATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CONSERVATION ENGINEER'S RECOMMENDATIONS.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS
CORRIG HOUSE, CORRIG ROAD, SANDYFORD, DUBLIN 18.
Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

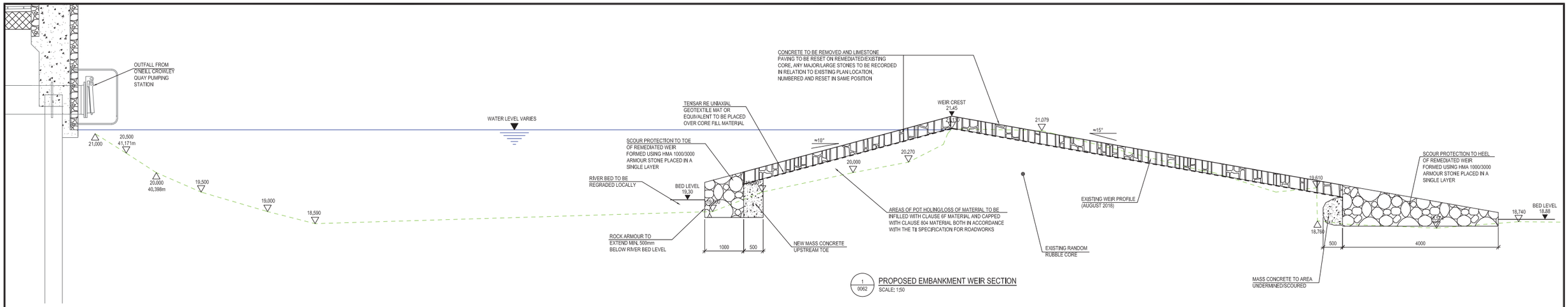
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: WEIR REMEDIATION PROPOSED SECTIONS

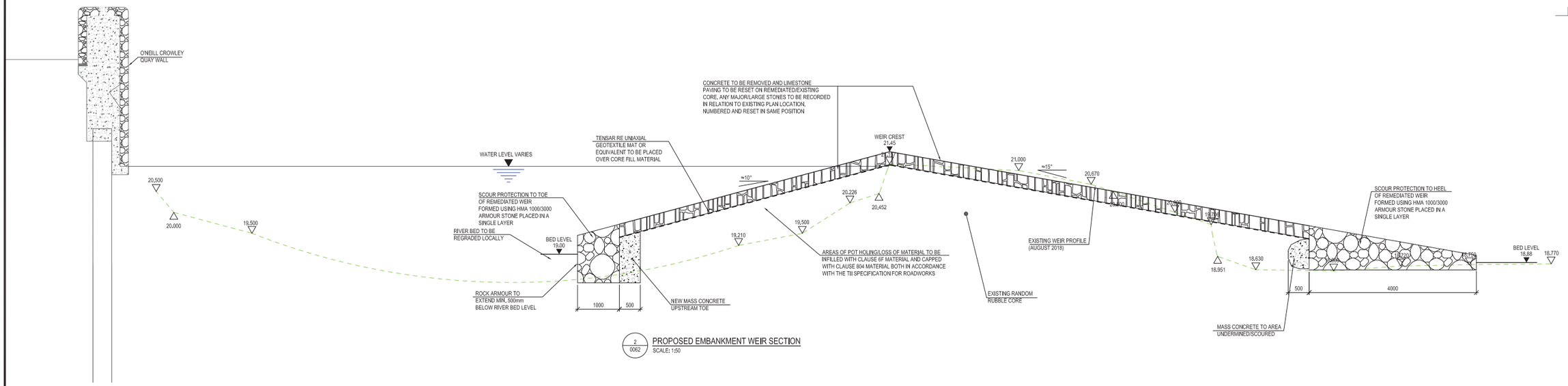
SCALE: AS SHOWN (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0061

REV: C01



1/0062 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50



2/0062 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50

NOTES:

1. ALL LEVELS SHOWN ARE IN METERS ABOVE ORDNANCE DATUM, MALIN HEAD.
2. FOR LOCATIONS OF SECTIONS REFER TO DRAWING 0060.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH SURVEY DRAWINGS OF EXISTING WEIR STRUCTURE AND WITH SECTION DRAWINGS 0061 AND 0063.
4. WEIR REMEDIATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CONSERVATION ENGINEER'S RECOMMENDATIONS.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

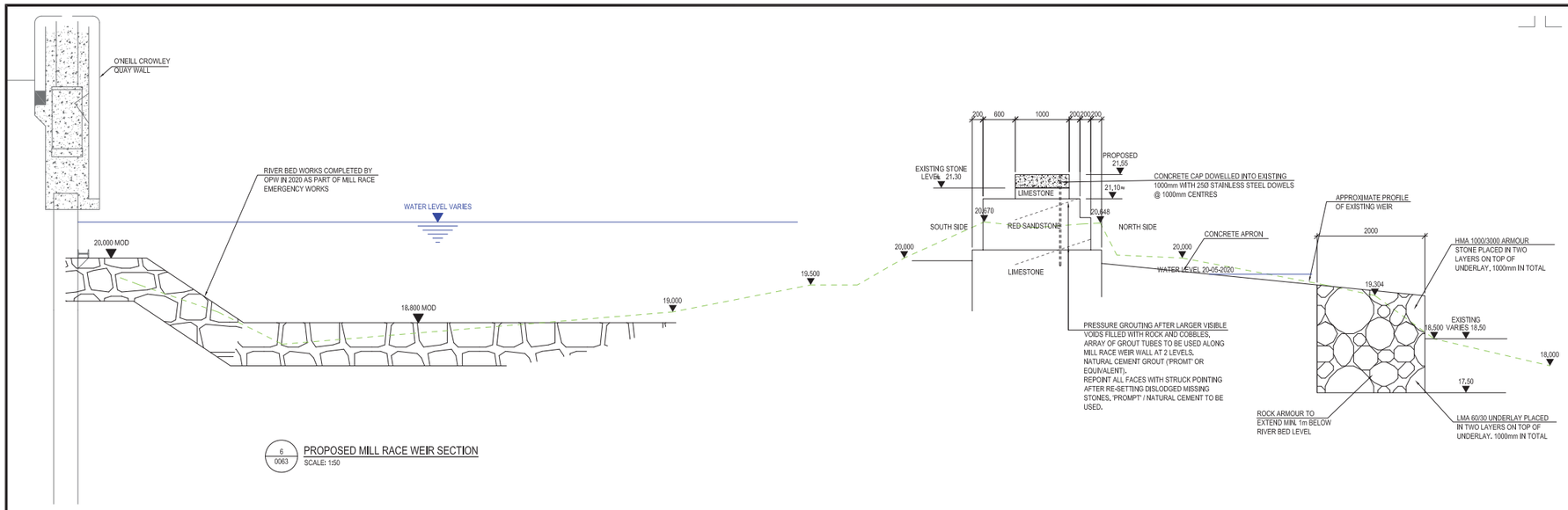
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: WEIR REMEDIATION PROPOSED SECTIONS

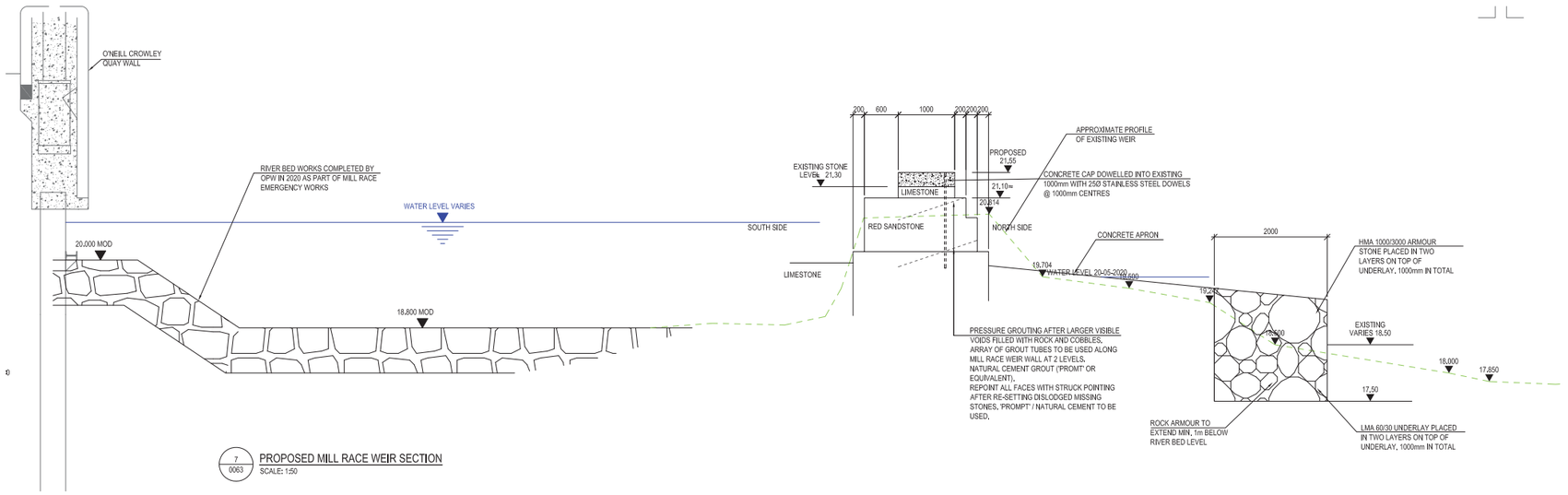
SCALE: AS SHOWN (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER: 19011-TJOC-PL-XX-DR-C-0062

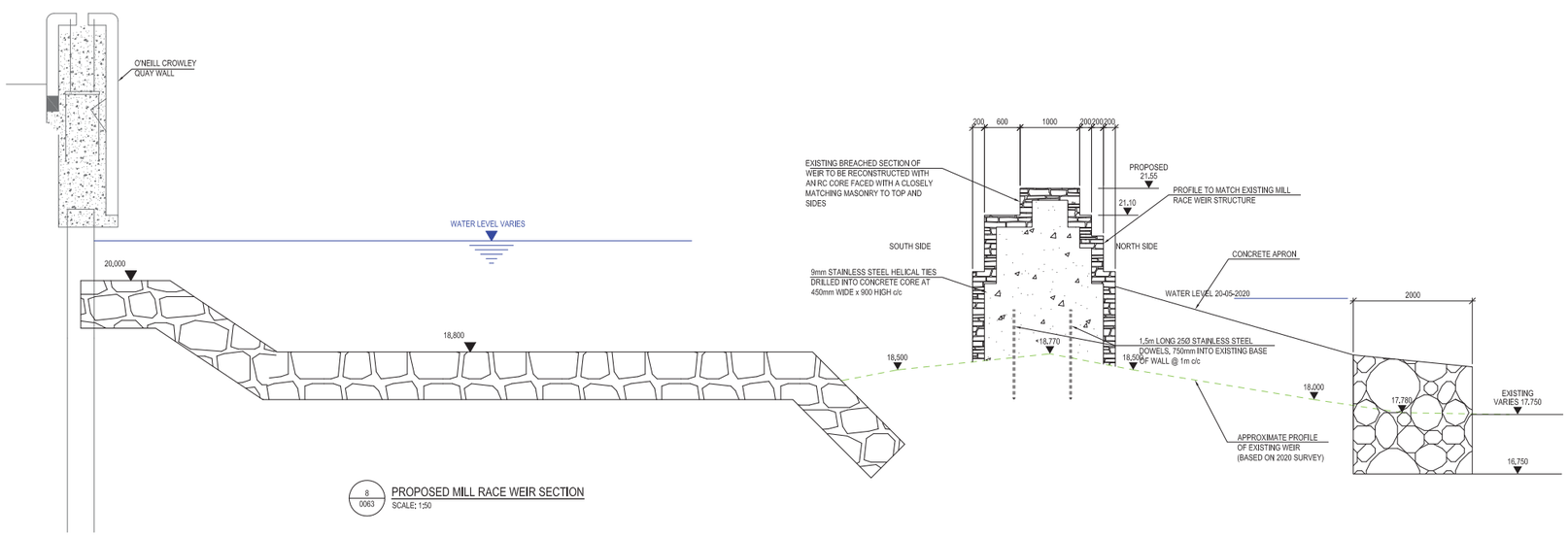
REV: C01



6 / 0063 PROPOSED MILL RACE WEIR SECTION
SCALE: 1:50



7 / 0063 PROPOSED MILL RACE WEIR SECTION
SCALE: 1:50



8 / 0063 PROPOSED MILL RACE WEIR SECTION
SCALE: 1:50

NOTES:

1. ALL LEVELS SHOWN ARE IN METERS ABOVE ORDNANCE DATUM, MALIN HEAD.
2. FOR LOCATIONS OF SECTIONS REFER TO DRAWING 0060.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH SURVEY DRAWINGS OF EXISTING WEIR STRUCTURE AND WITH SECTION DRAWINGS 0061 AND 0062.
4. WEIR REMEDIATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CONSERVATION ENGINEER'S RECOMMENDATIONS.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

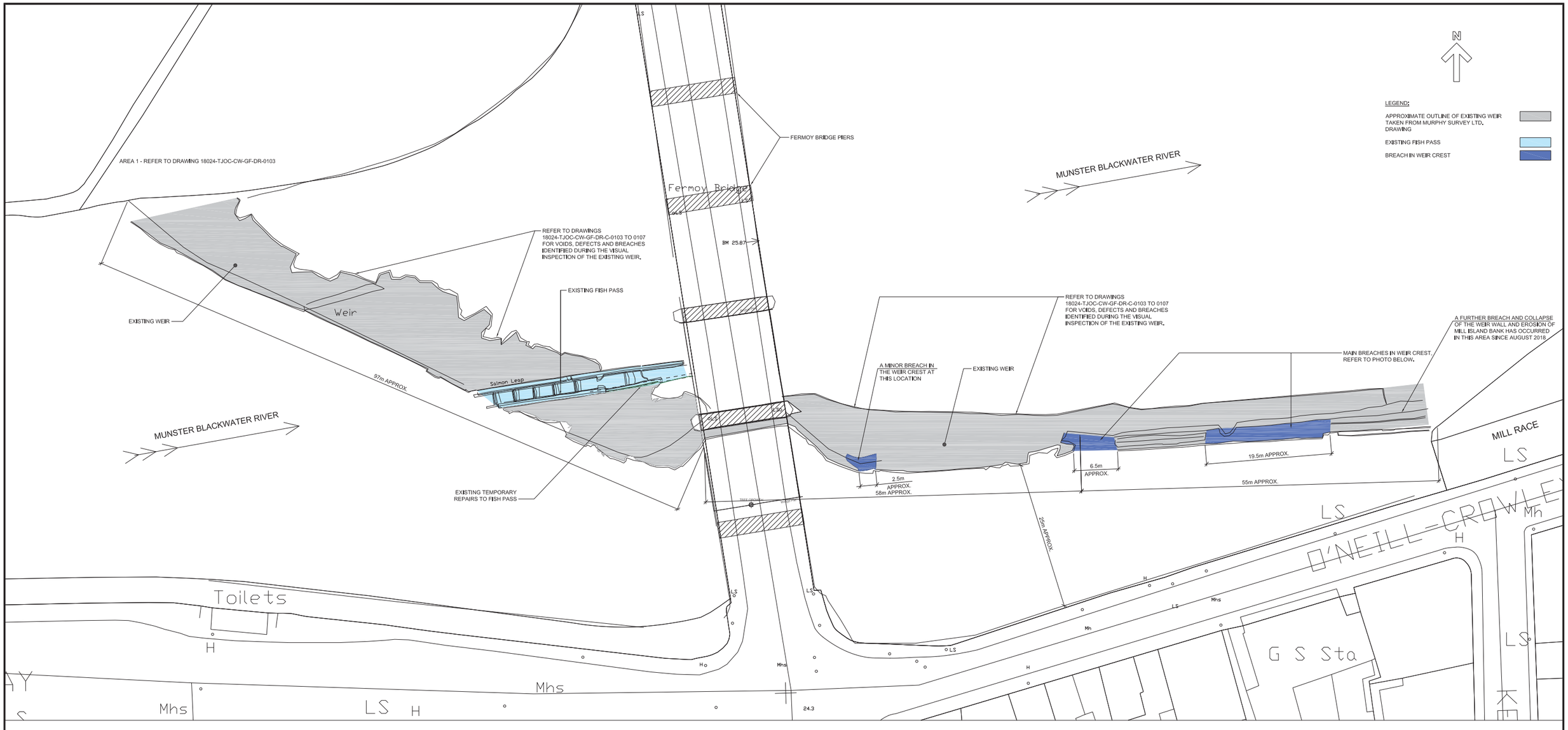
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: WEIR REMEDIATION PROPOSED SECTIONS

SCALE: AS SHOWN (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0063

REV: C01



1 / 0073 EXISTING WEIR LAYOUT
SCALE: 1:300

0 3 6 9 12 18 24 30m
1:300

2 / 0073 PHOTO OF EXISTING WEIR ON EAST SIDE OF FERMOY BRIDGE

3 / 0073 AERIAL PHOTO OF FERMOY WEIR

NOTES:

1. REFER TO DRAWINGS 19011-TJOC-PL-XX-DR-C-0074 TO 0078 FOR FURTHER NOTES AND PHOTOGRAPHS.
2. DIMENSIONS SHOWN ON DRAWING ARE APPROXIMATE ONLY AND ARE BASED ON THE SURVEY UNDERTAKEN BY MURPHY SURVEYS LTD ON 23rd AUGUST 2018.
3. COMMENTS AND PHOTOGRAPHS ON THE CONDITION OF THE WEIR ARE BASED ON A VISUAL INSPECTION OF THE WEIR ON 15th AUGUST 2018, NO OPENING UP WORKS OF ANY KIND WERE UNDERTAKEN DURING THE VISUAL INSPECTION.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION

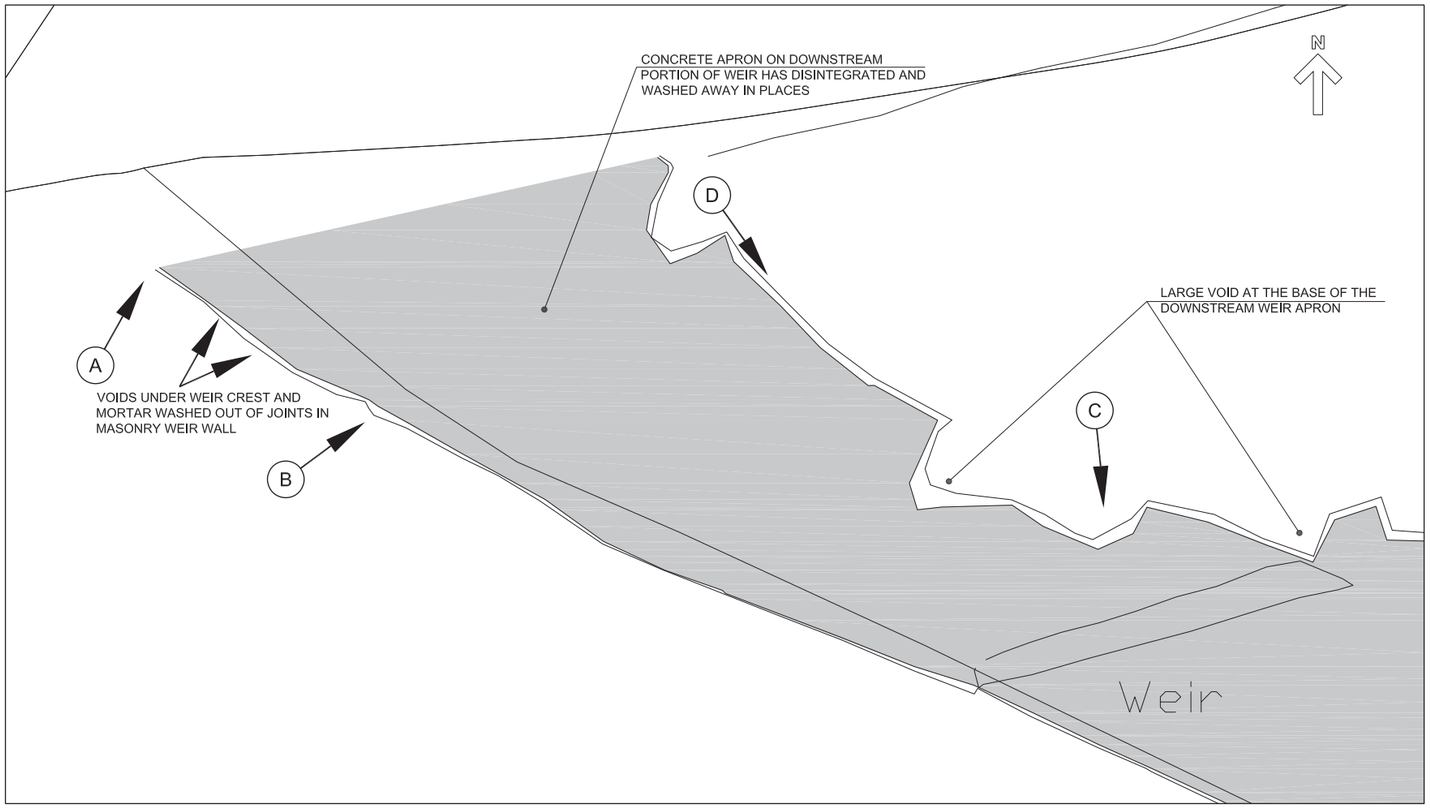
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: SUMMARY OF EXISTING WEIR CONDITION IN 2018

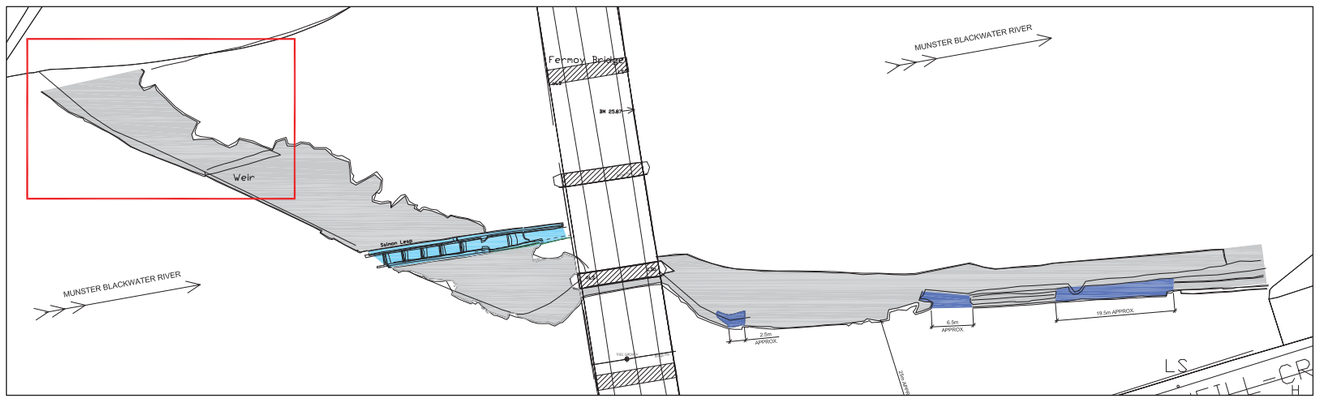
SCALE: 1:300 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0073

REV: C01



1 / 0074 EXISTING WEIR LAYOUT - AREA 1
SCALE: 1:100



2 / 0074 KEYPLAN - AREA 1
SCALE: 1:500

A / 0074 VOIDS UNDER WEIR CREST

B / 0074 MORTAR AND FINES WASHED OUT OF JOINTS IN MASONRY WEIR WALLS

C / 0074 LARGE VOID AT THE BASE OF THE DOWNSTREAM WEIR APRON

D / 0074 CONCRETE APRON OF WEIR HAS DISINTEGRATED AND WASHED AWAY IN PLACES

NOTES:

1. COMMENTS AND PHOTOGRAPHS ON THE CONDITION OF THE WEIR ARE BASED ON A VISUAL INSPECTION OF THE WEIR ON 15th AUGUST 2018. NO OPENING UP WORKS OF ANY KIND WERE UNDERTAKEN DURING THE VISUAL INSPECTION.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

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PROJECT: FERMOY WEIR REMEDIATION

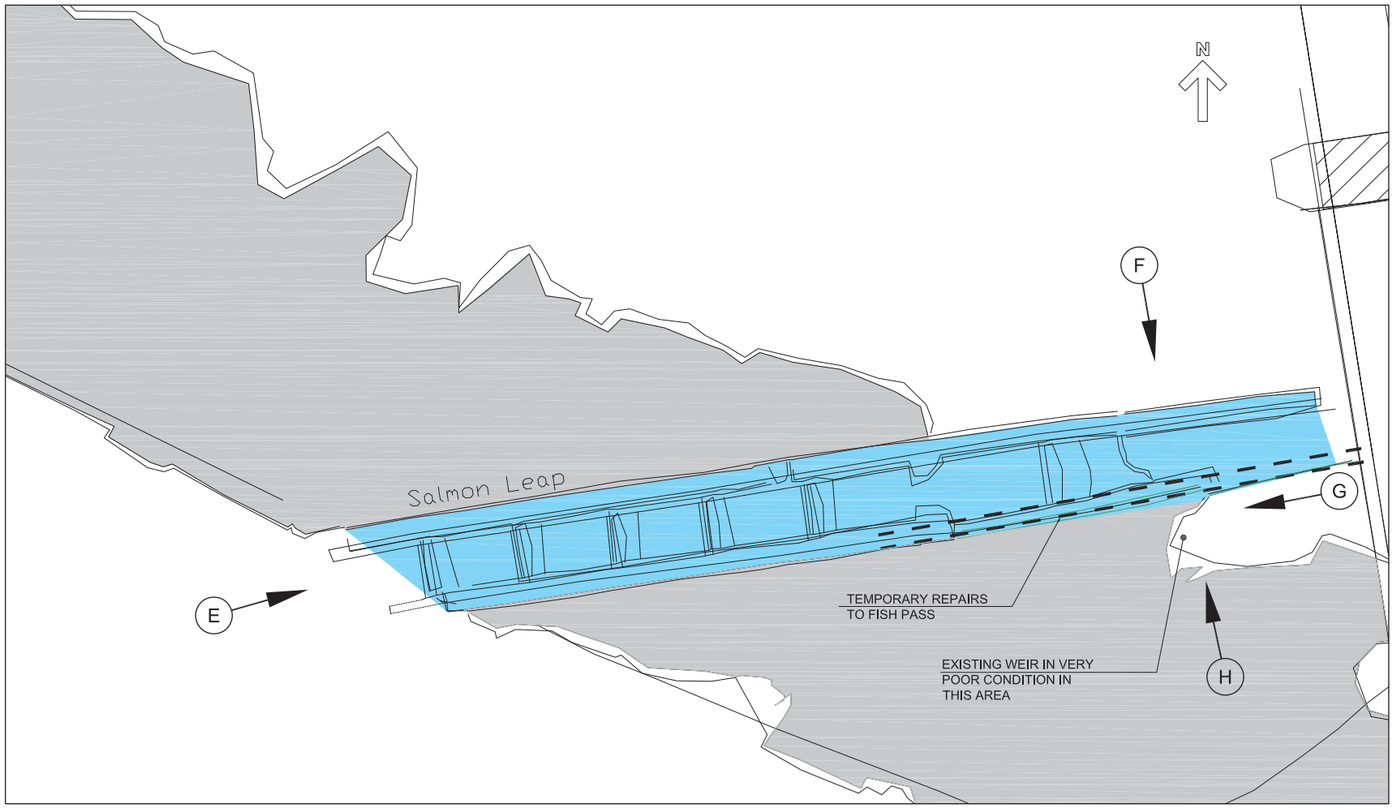
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING WEIR CONDITION AREA 1

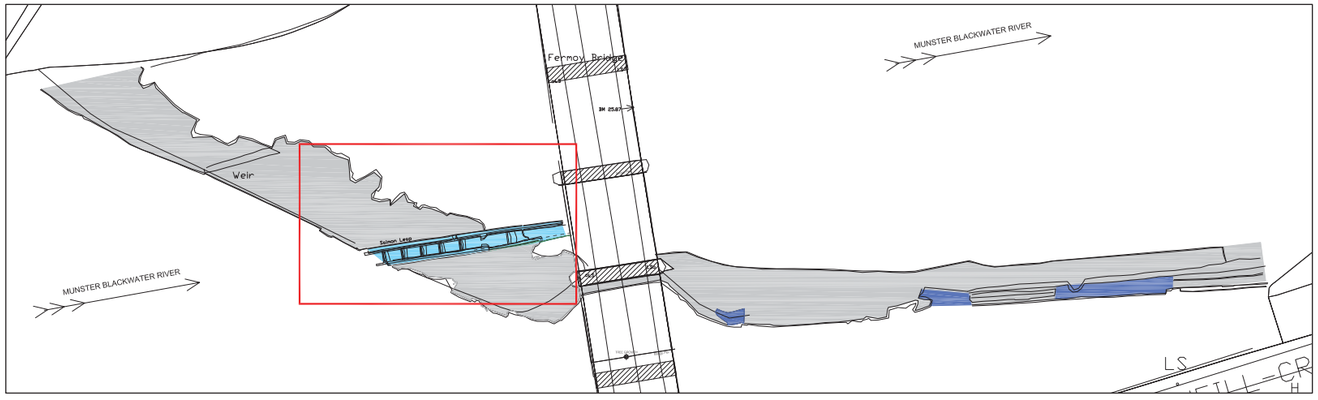
SCALE: 1:100 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0074

REV: C01



1 / 0075 EXISTING WEIR LAYOUT - AREA 2
SCALE: 1:100



2 / 0075 KEYPLAN - AREA 2
SCALE: 1:500

E / 0075 VIEW OF UPSTREAM END OF FISH PASS

F / 0075 VIEW OF DAMAGE TO FISH PASS WALL

G / 0075 WEIR APRON HAS DISINTEGRATED AND WASHED AWAY

H / 0075 VIEW OF TEMPORARY REPAIRS TO FISH PASS AND DISLODGED MATERIAL FROM WEIR

NOTES:

1. COMMENTS AND PHOTOGRAPHS ON THE CONDITION OF THE WEIR ARE BASED ON A VISUAL INSPECTION OF THE WEIR ON 15th AUGUST 2018. NO OPENING UP WORKS OF ANY KIND WERE UNDERTAKEN DURING THE VISUAL INSPECTION.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

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PROJECT: FERMOY WEIR REMEDIATION

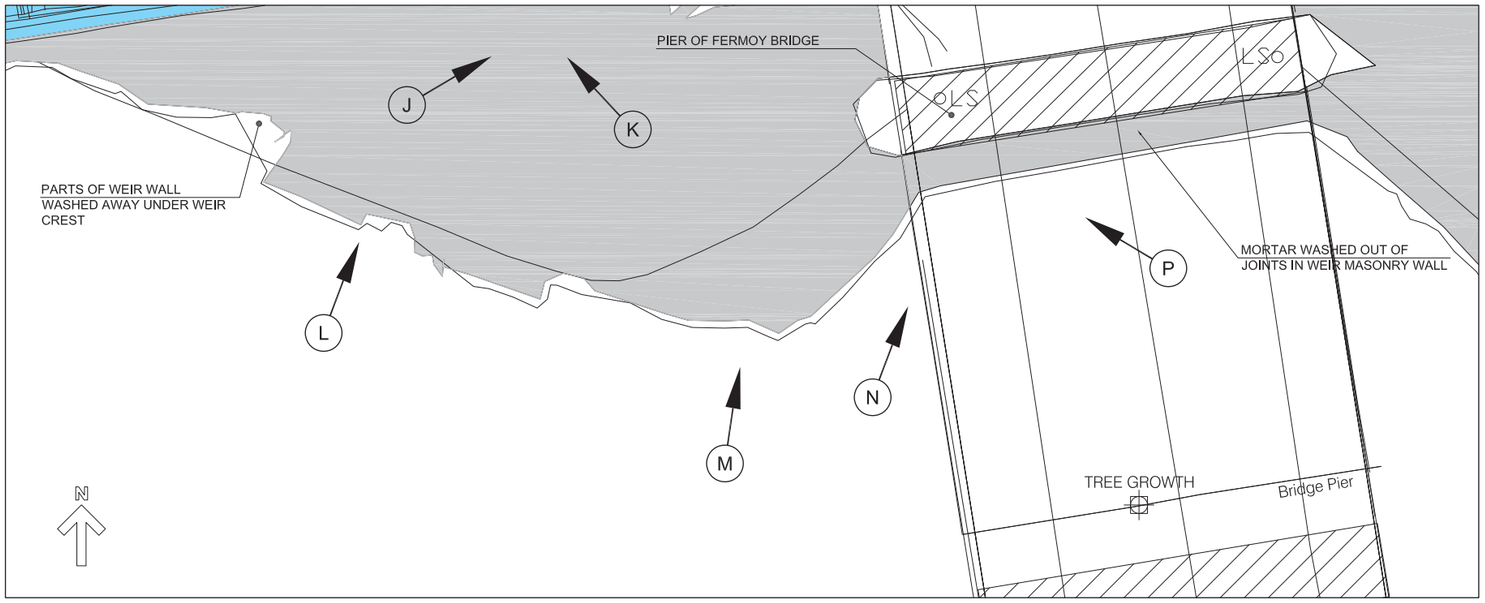
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING WEIR CONDITION
AREA 2

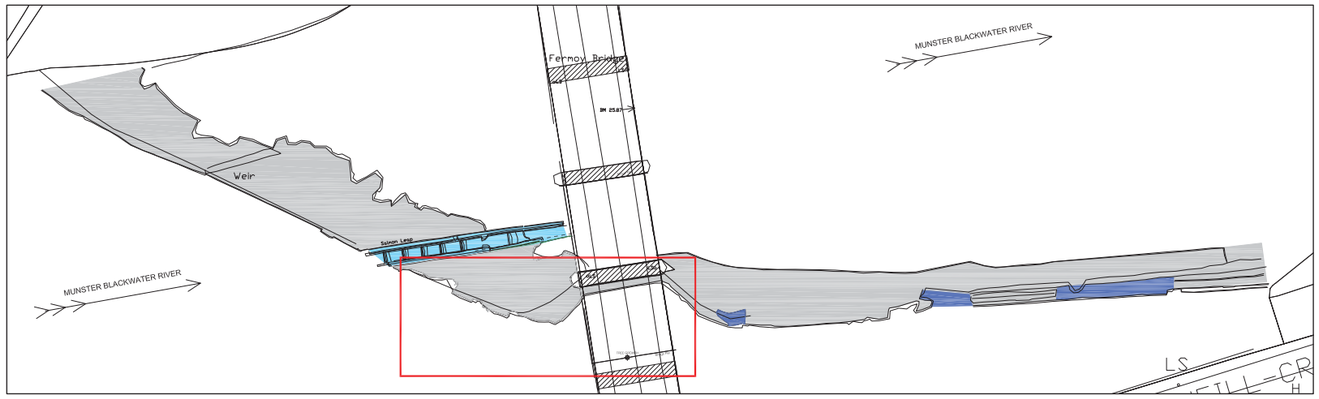
SCALE: 1:100 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0075

REV: C01



1/0076 EXISTING WEIR LAYOUT - AREA 3
SCALE: 1:100



2/0076 KEYPLAN - AREA 3
SCALE: 1:500

M/0076 PART OF WEIR WALL WASHED AWAY UNDER WEIR CREST

N/0076 MORTAR AND FINES WASHED OUT OF MASONRY WEIR WALL ADJACENT TO FERMOY BRIDGE

P/0076 MORTAR AND FINES WASHED OUT OF MASONRY WEIR WALL ADJACENT TO FERMOY BRIDGE

J/0076 WEIR APRON DISINTEGRATED AND WASHED AWAY AT JUNCTION WITH FISH PASS

K/0076 WEIR APRON DISINTEGRATED AND WASHED AWAY AT JUNCTION WITH FISH PASS

L/0076 PART OF WEIR WALL WASHED AWAY UNDER WEIR CREST

NOTES:

1. COMMENTS AND PHOTOGRAPHS ON THE CONDITION OF THE WEIR ARE BASED ON A VISUAL INSPECTION OF THE WEIR ON 15th AUGUST 2018. NO OPENING UP WORKS OF ANY KIND WERE UNDERTAKEN DURING THE VISUAL INSPECTION.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION

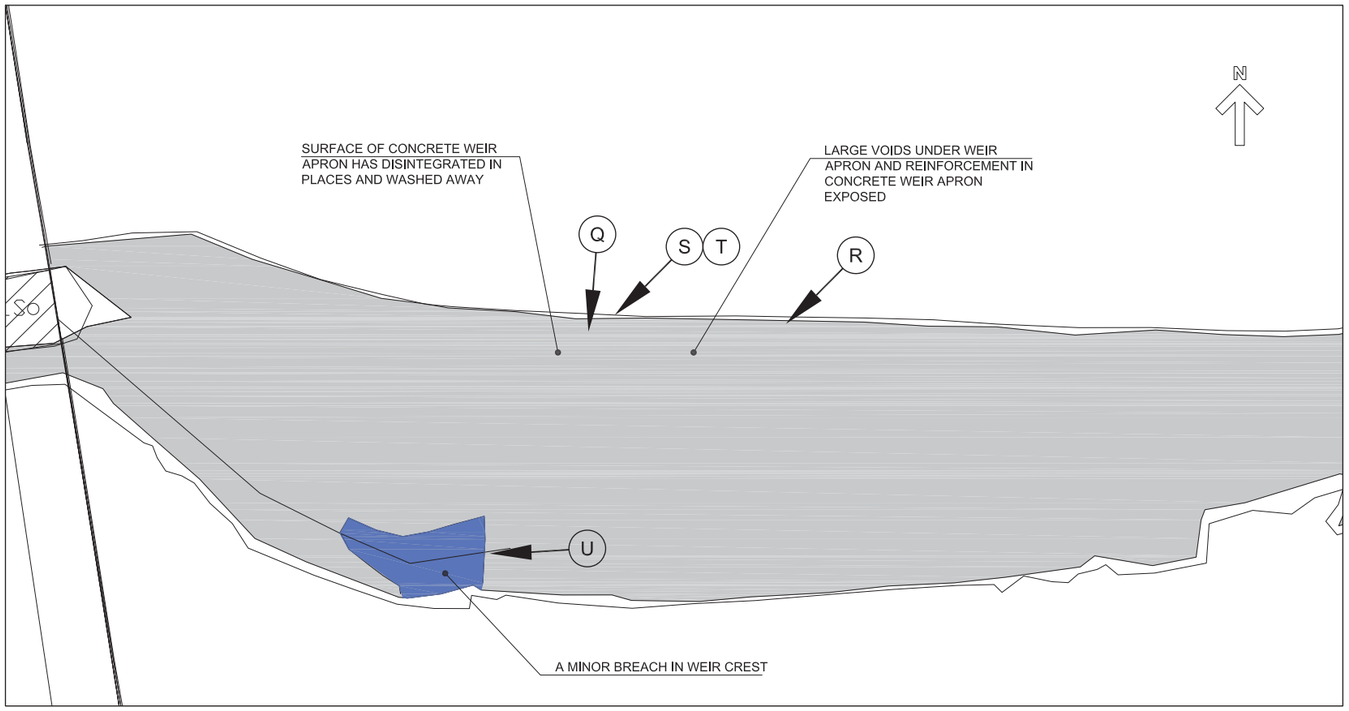
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING WEIR CONDITION AREA 3

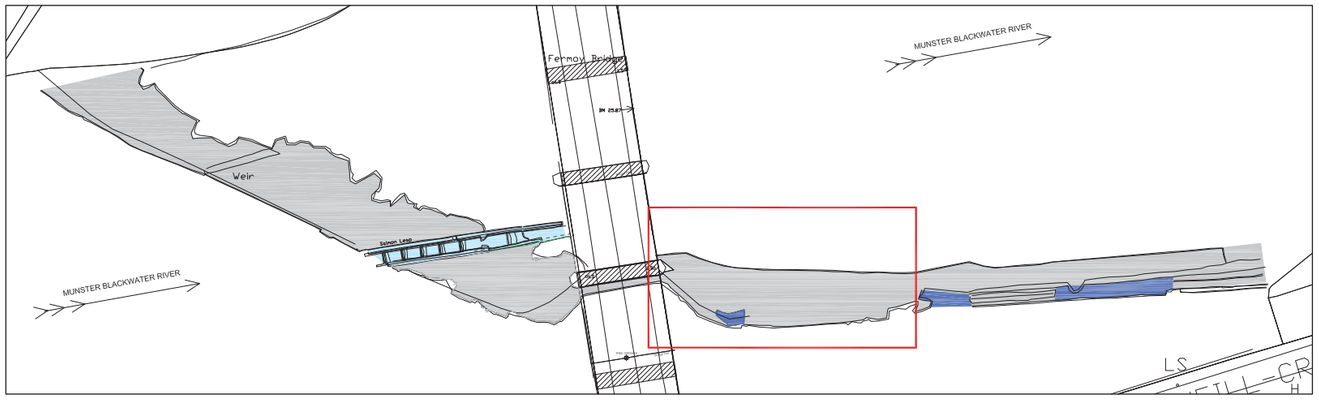
SCALE: 1:100 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0076

REV: C01

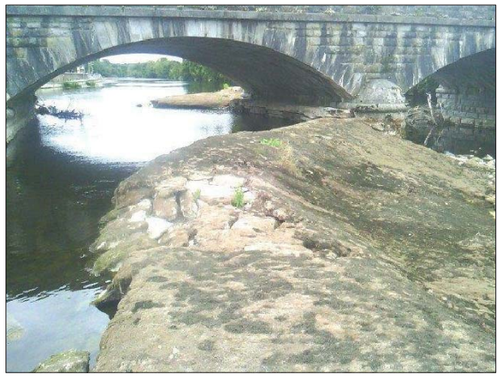


1/0077 EXISTING WEIR LAYOUT - AREA 4
SCALE: 1:100



2/0077 KEYPLAN - AREA 4
SCALE: 1:500

T/0077 LARGE VOIDS UNDER CONCRETE WEIR APRON, REINFORCEMENT EXPOSED AND CORRODED



U/0077 MINOR BREACH IN WEIR CREST

O/0077 SURFACE OF CONCRETE WEIR APRON HAS DISINTEGRATED IN PLACES

R/0077 LARGE VOIDS UNDER CONCRETE WEIR APRON

S/0077 REINFORCEMENT EXPOSED AND CORRODED UNDER WEIR APRON

NOTES:

1. COMMENTS AND PHOTOGRAPHS ON THE CONDITION OF THE WEIR ARE BASED ON A VISUAL INSPECTION OF THE WEIR ON 15th AUGUST 2018. NO OPENING UP WORKS OF ANY KIND WERE UNDERTAKEN DURING THE VISUAL INSPECTION.

REV	SUIT	DESCRIPTION	DATE
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DRAWING STATUS: ISSUED FOR PLANNING

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PROJECT: FERMOY WEIR REMEDIATION

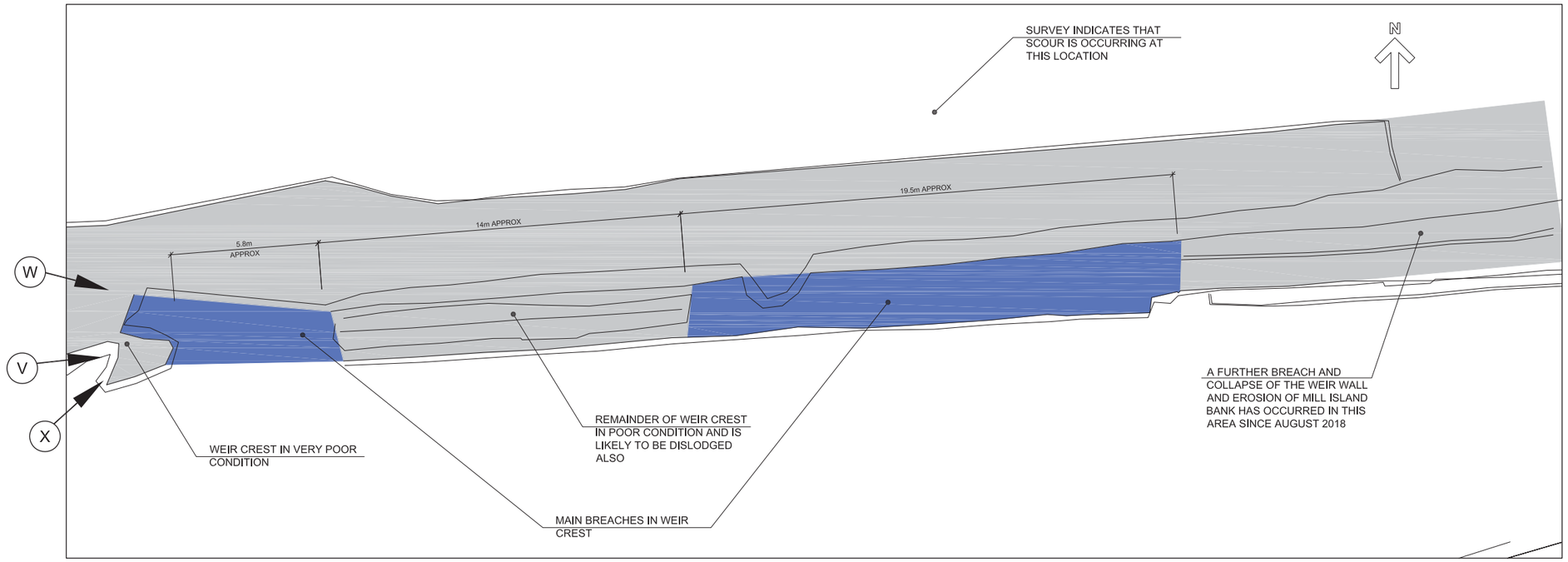
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING WEIR CONDITION AREA 4

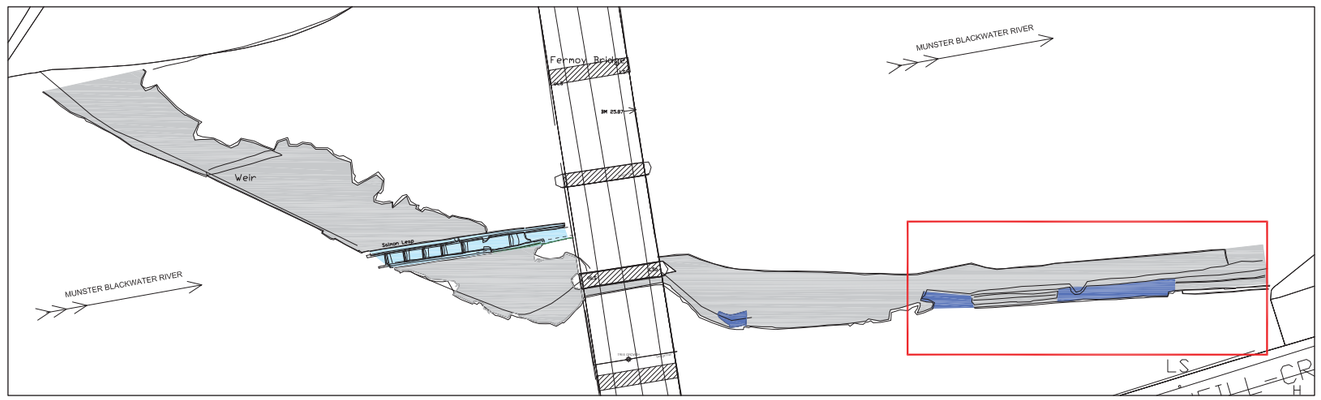
SCALE: 1:100 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE -ROLE- NUMBER
19011-TJOC-PL-XX-DR-C-0077

REV: C01

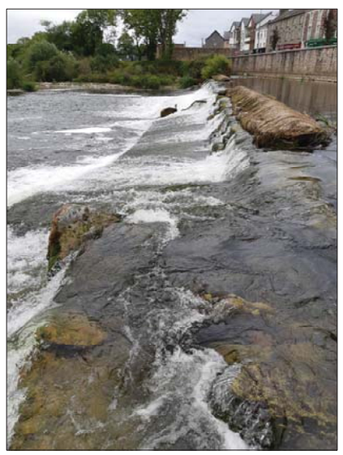


1/0078 EXISTING WEIR LAYOUT - AREA 5
SCALE: 1:100

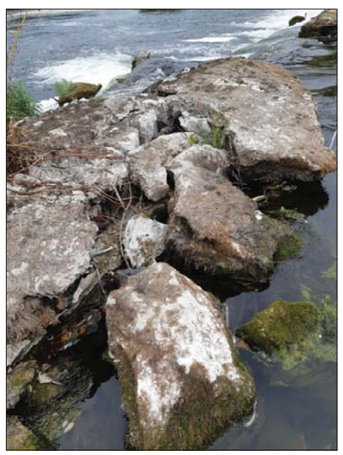


2/0078 KEYPLAN - AREA 5
SCALE: 1:500

V/0078 VIEW OF WEIR CREST



W/0078 VIEW OF WEIR CREST AND DOWNSTREAM APRON



X/0078 VIEW OF WEIR CREST CONDITION

NOTES:

1. COMMENTS AND PHOTOGRAPHS ON THE CONDITION OF THE WEIR ARE BASED ON A VISUAL INSPECTION OF THE WEIR ON 15th AUGUST 2018. NO OPENING UP WORKS OF ANY KIND WERE UNDERTAKEN DURING THE VISUAL INSPECTION.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION

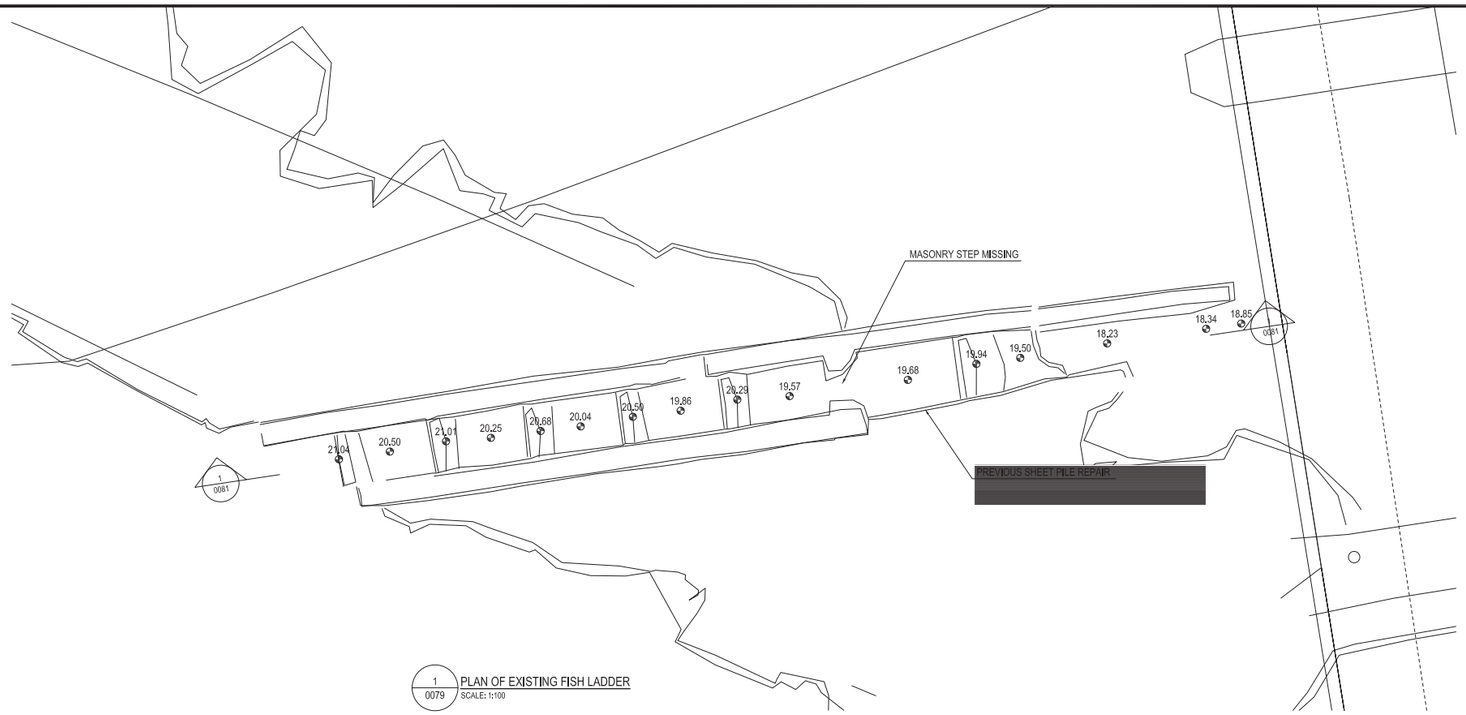
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING WEIR CONDITION AREA 5

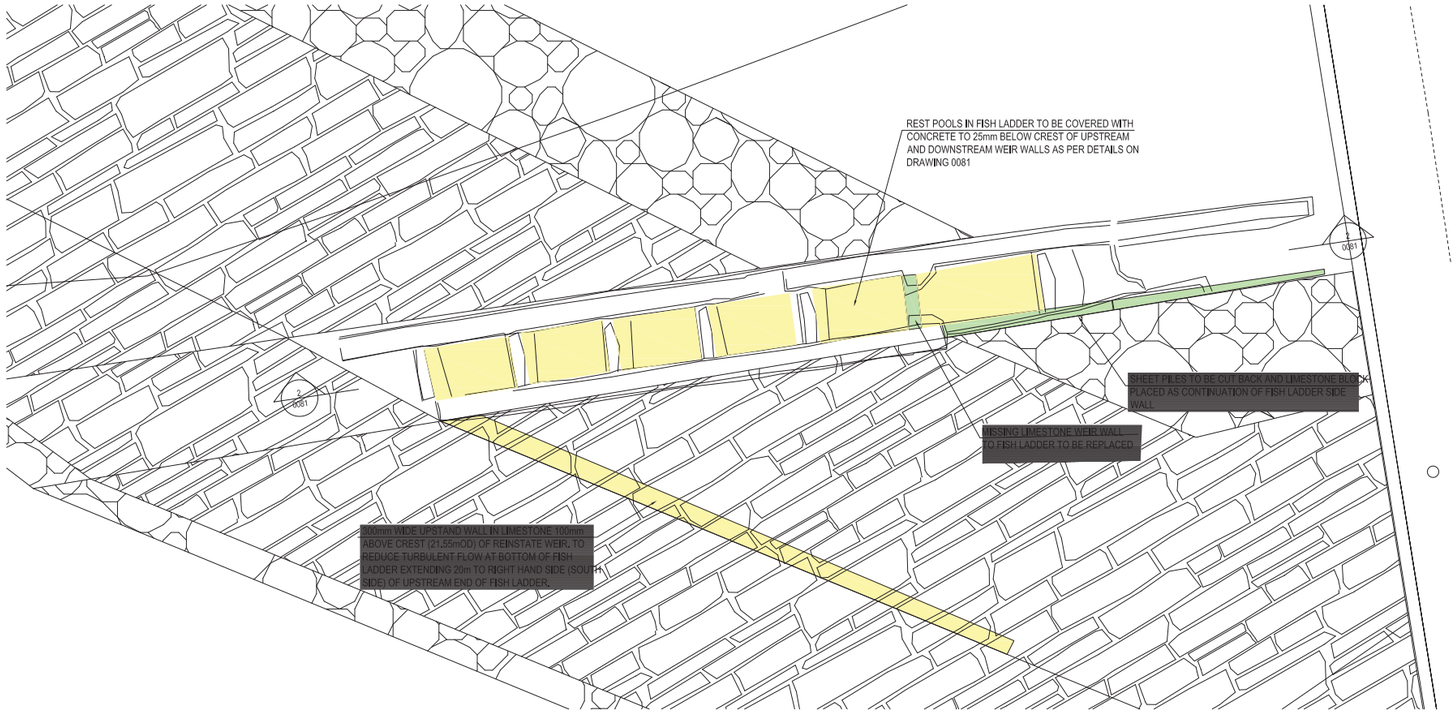
SCALE: 1:100 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0078

REV: C01



1 / 0079 PLAN OF EXISTING FISH LADDER
SCALE: 1:100



2 / 0079 PLAN OF PROPOSED WORKS TO EXISTING FISH LADDER
SCALE: 1:100

NOTES:

1. 1. FISH PASS REMEDIATION WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH CONSERVATION ENGINEER'S RECOMMENDATIONS AND DETAILS SHOWN ON DRAWING 0081.
2. LAYOUT OF EXISTING FISH LADDER BASED ON MURPHY SURVEYS TOPOGRAPHICAL SURVEY COMPLETED AUGUST 2018.

NOTE:
DETAILS AND DIMENSIONS OF PROPOSED WORKS TO FISH PASS ARE TAKEN FROM INFORMATION SUPPLIED BY OTHERS AND ARE SUBJECT TO APPROVAL FROM INLAND FISHERIES IRELAND

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

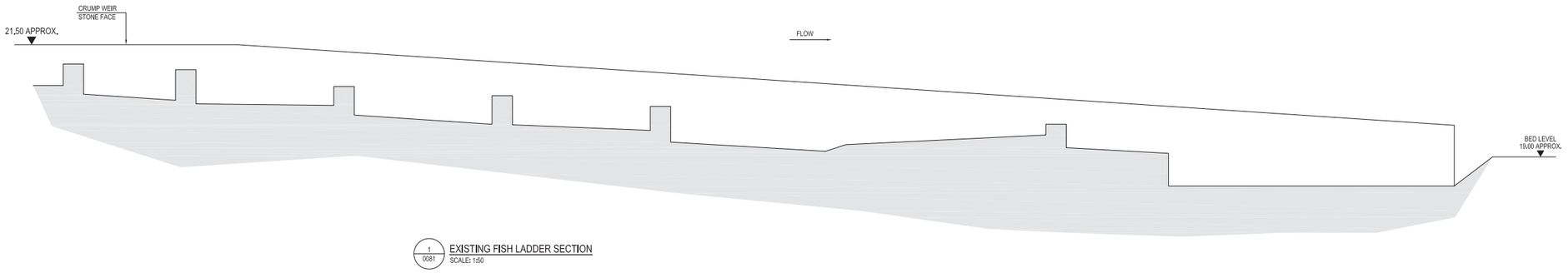
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING FISH LADDER REMEDIATION PLAN

SCALE: 1:100 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE -ROLE- NUMBER
19011-TJOC-PL-XX-DR-C-0079

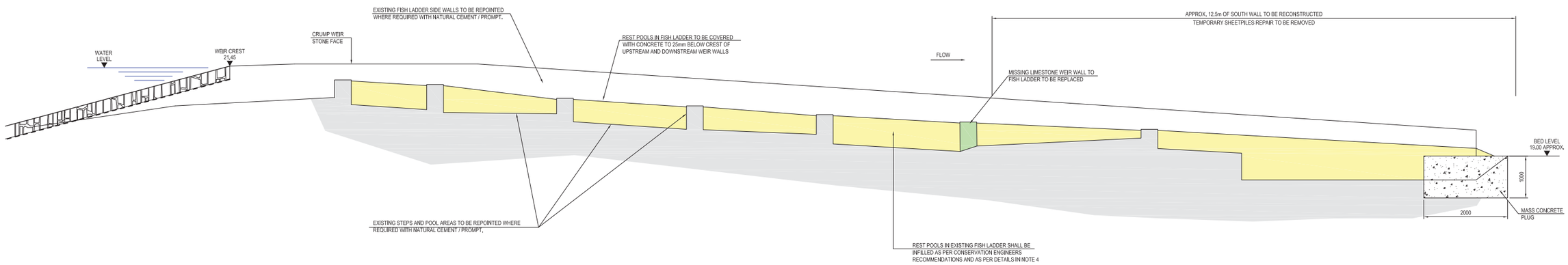
REV: C01



1/0081 EXISTING FISH LADDER SECTION
SCALE: 1:50

NOTES:

1. ALL WORKS CARRIED OUT IN THE RIVER AND TO THE FISH PASS TO BE AGREED WITH INLAND FISHERIES IRELAND PRIOR TO COMMENCEMENT OF THE WORKS.
2. WORKS IN THE RIVER WILL ONLY BE PERMITTED BETWEEN THE BEGINNING OF AUGUST TO MID SEPTEMBER IN ACCORDANCE WITH INLAND FISHERIES IRELAND GUIDELINES.
3. PROPOSED REMEDIAL WORK DETAILS AS PER CONSERVATION ENGINEER, TREVOR WOODS CONSULTING ENGINEERS, DETAILS.
4. COVERING
   DPM 1500 GAUGE TO BE LAID UP PASS INSIDE WALLS OVER BASE AND LAPPED MINIMUM 1m BETWEEN SHEETS / JOINTS.
   TYPE 6F FILL WITHIN 300mm EXISTING CAPPING.
   150mm CLAUSE 804 BLINDED WITH LEAN MIX CONCRETE.
   150mm CONCRETE SLAB (FIBRE MESH POLYPROPYLENE FIBRES)
   SURFACE TO BE STAMPED WITH RANDOM STONE PATTERN.
5. ALL LEVELS AS PER MURPHY SURVEYS 2018 SURVEY OF WEIR STRUCTURE.
6. EXISTING FISH LADDER SHALL BE INFILLED IN ORDER TO AVOID WHITE WATER CREATED BY THE STEPS IN THE LADDER ATTRACTING FISH FROM DOWNSTREAM OF THE WEIR.



2/0081 PROPOSED FISH LADDER SECTION
SCALE: 1:50

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS
CORRIG HOUSE, CORRIG ROAD, SANDYFORD, DUBLIN 18.
Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

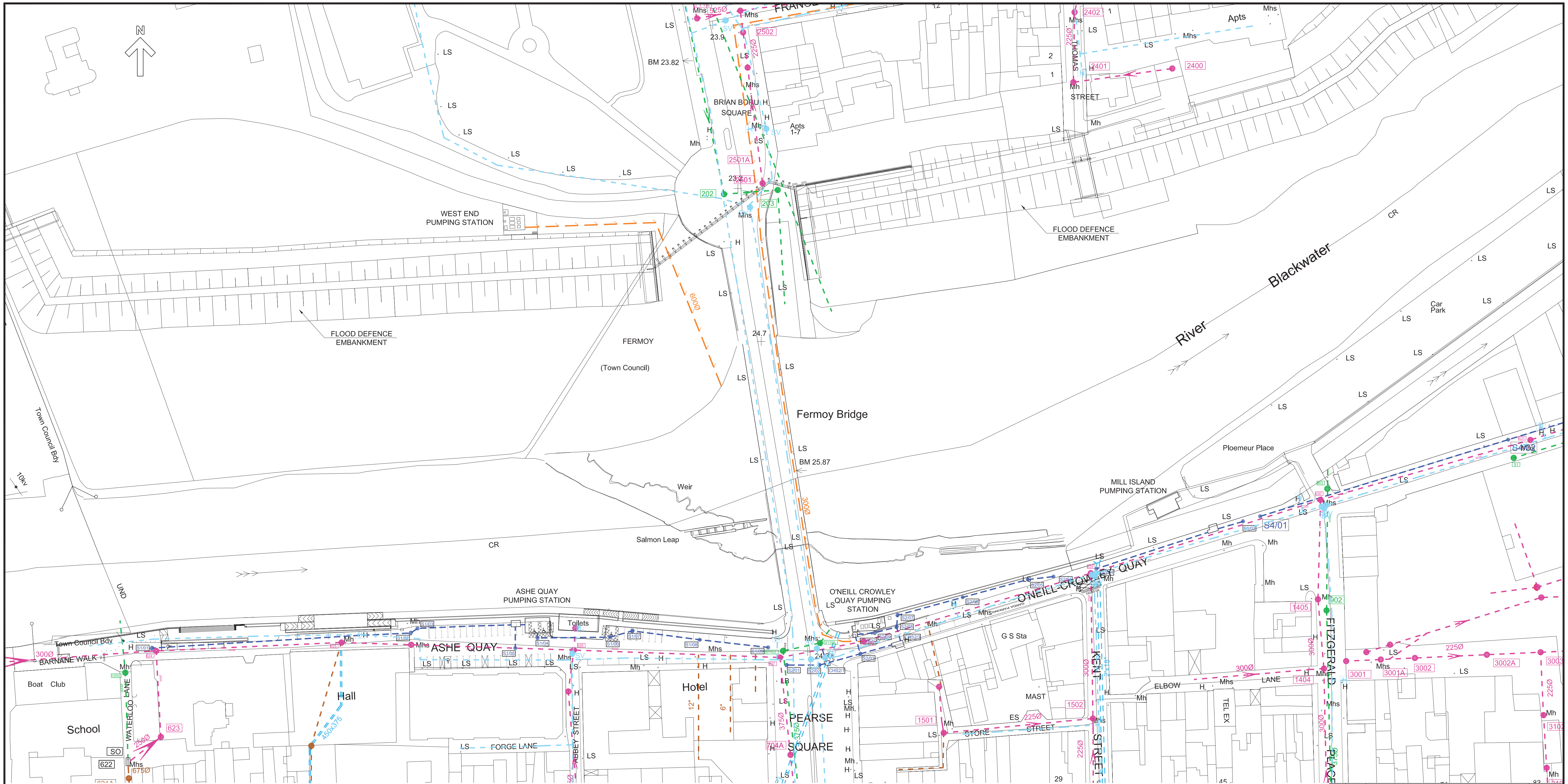
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING FISH LADDER REMEDIATION DETAILS - SHEET 2

SCALE: AS SHOWN (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
190080-TJOC-PL-XX-DR-C-0081

REV: C01



0 7.5 15 22.5 30 45 60 75m
1:750

LEGEND

- FOUL SEWER
- SURFACE WATER SEWER
- COMBINED SEWER
- CULVERT SEWER
- RISING MAIN
- WATERMAIN

MAP REPRODUCED BY PERMISSION OF ORDNANCE SURVEY IRELAND (CORK CCMA 9802)

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR REVIEW AND COMMENT

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS
CORRIG HOUSE, CORRIG ROAD, SANDYFORD, DUBLIN 18.
Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

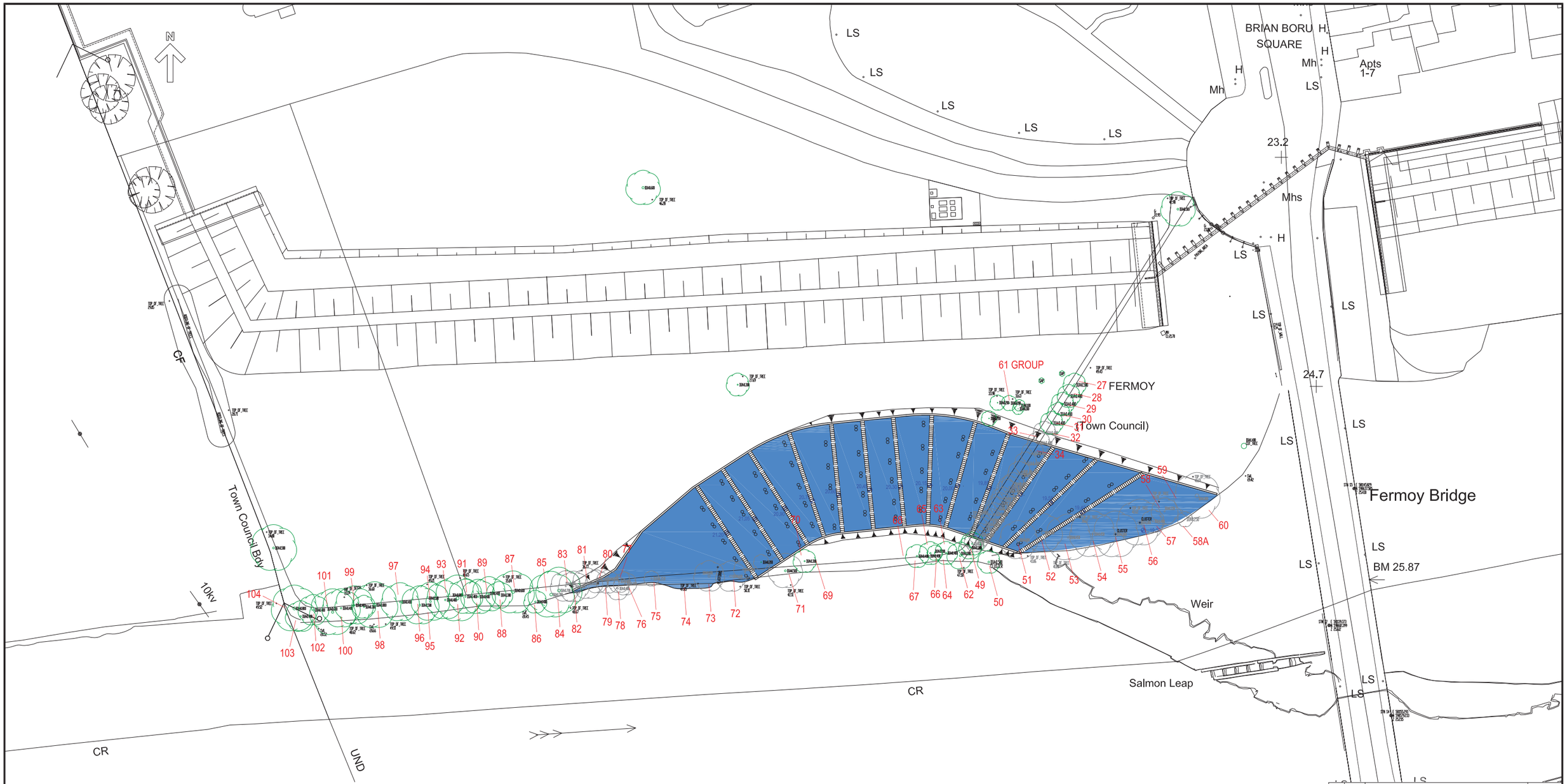
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING SERVICES

SCALE: 1:750 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0082

REV: P01



LEGEND:

- EXISTING TREES
- EXISTING TREES TO BE REMOVED
- ROOT PROTECTION AREA

NOTES:

1. TREES LOCATIONS ARE BASED ON GEODATA 2020 TOPOGRAPHICAL SURVEY
2. DRAWING RECORDS TREES AND GROUPS OF TREES IDENTIFIED IN THE TREE SURVEY UNDERTAKEN BY MARK DONNELLY BSC ARBORIST IN 2021
3. TREE SURVEY DRAWING SHALL BE READ IN CONJUNCITON WITH THE ECOLOGISTS ECOLOGICAL IMPACT ASSESSMENT FOR THE PROJECT.

MAP REPRODUCED BY PERMISSION OF ORDNANCE SURVEY IRELAND (CORK CCMA 9802)

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS
CORRIG HOUSE, CORRIG ROAD, SANDYFORD, DUBLIN 18.
Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

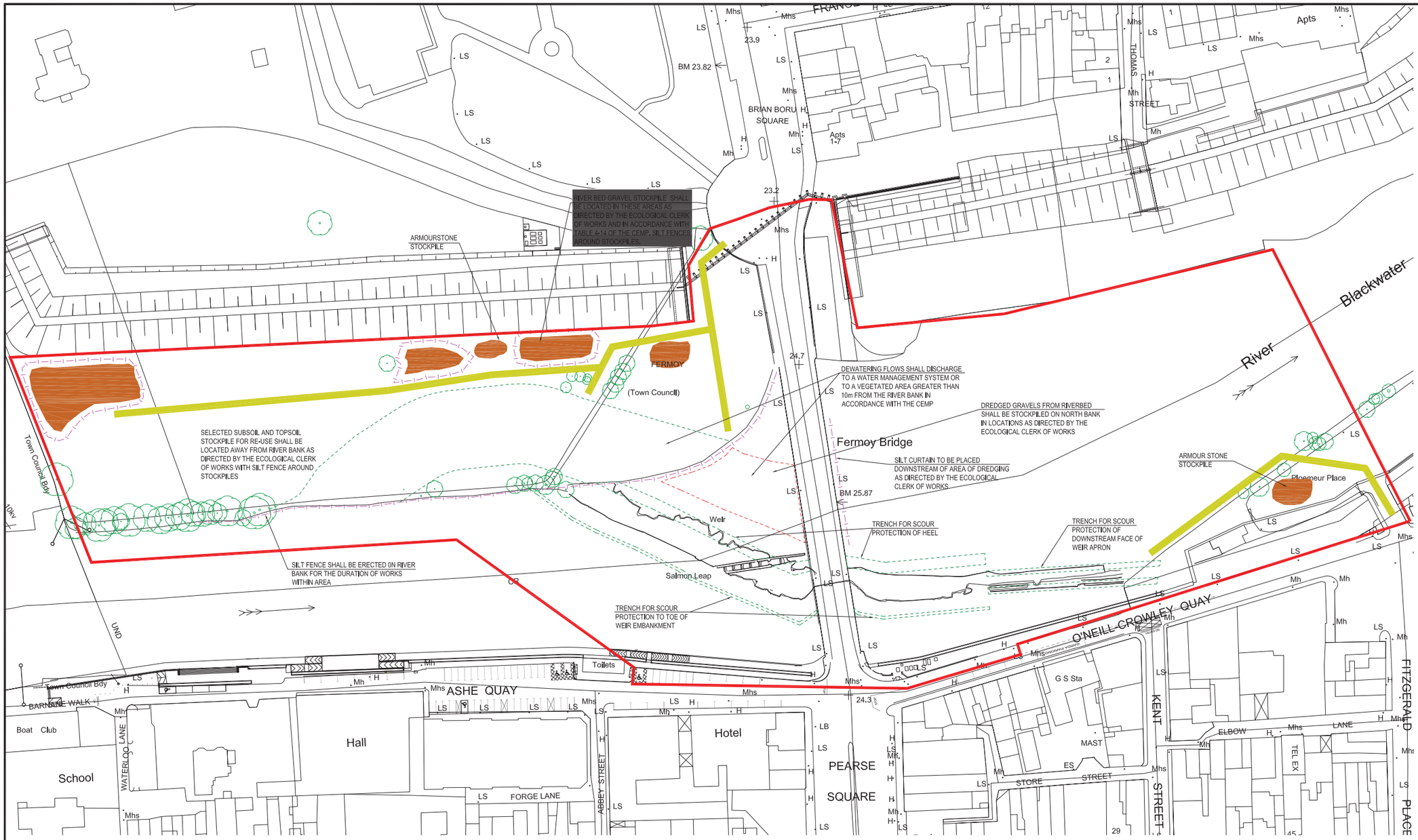
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: TREE PROTECTION PLAN

SCALE: 1:500 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0083

REV: C01



N

NOTES:

1. WHERE FEASIBLE SOIL EXCAVATION SHALL TAKE PLACE DURING DRY PERIODS AND UNDERTAKEN WITH EXCAVATORS AND DUMP TRUCKS.
2. TOP SOIL AND SUBSOIL SHALL NOT BE MIXED TOGETHER.
3. STOCKPILES SHALL BE GRADED TO <1:4 PROFILE. TOPSOIL AND SUBSOIL SHALL BE STOCKPILED SEPARATELY.
4. SURFACE WATER MANAGEMENT SHALL COMPLY WITH MITIGATION MEASURES IDENTIFIED IN TABLE 4-5 OF THE CEMP.
5. SILT FENCES SHALL BE ERECTED AROUND EACH STOCKPILE.
6. RIVERBED GRAVELS SELECTED FOR RE-USE IN THE WORKS SHALL BE STOCKPILED IN A BUNDED AREA AS DIRECTED BY THE ECOLOGICAL CLERK OF WORKS.
7. STOCKPILES SHALL NOT ENCROACH ON ROOT PROTECTION AREAS OF ANY TREES.
8. THE LOCATIONS OF STOCKPILES SHOWN HERE ARE INDICATIVE. THE CONTRACTOR SHALL DEVELOP MATERIALS STORAGE PROPOSALS IN ACCORDANCE WITH THE CEMP AND TO THE SATISFACTION OF THE ECOLOGICAL CLERK OF WORKS.
9. STOCKPILING OF MATERIALS SHALL NOT BE PERMITTED WITHIN THE MAIN CHANNEL OF THE BLACKWATER APART FROM LOCAL STOCKPILES OF MATERIAL REQUIRED FOR THE REMEDIATION OF THE WEIR.

LEGEND:

- PROPOSED SITE BOUNDARY
- OUTLINE OF PROPOSED EXCAVATION
- AREA OF DREDGING
- SILT FENCE
- EXISTING TREES TO BE RETAINED
- CONSTRUCTION ACCESS ROUTES

MAP REPRODUCED BY PERMISSION OF ORDNANCE SURVEY IRELAND (CORK CCMA 9802)

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

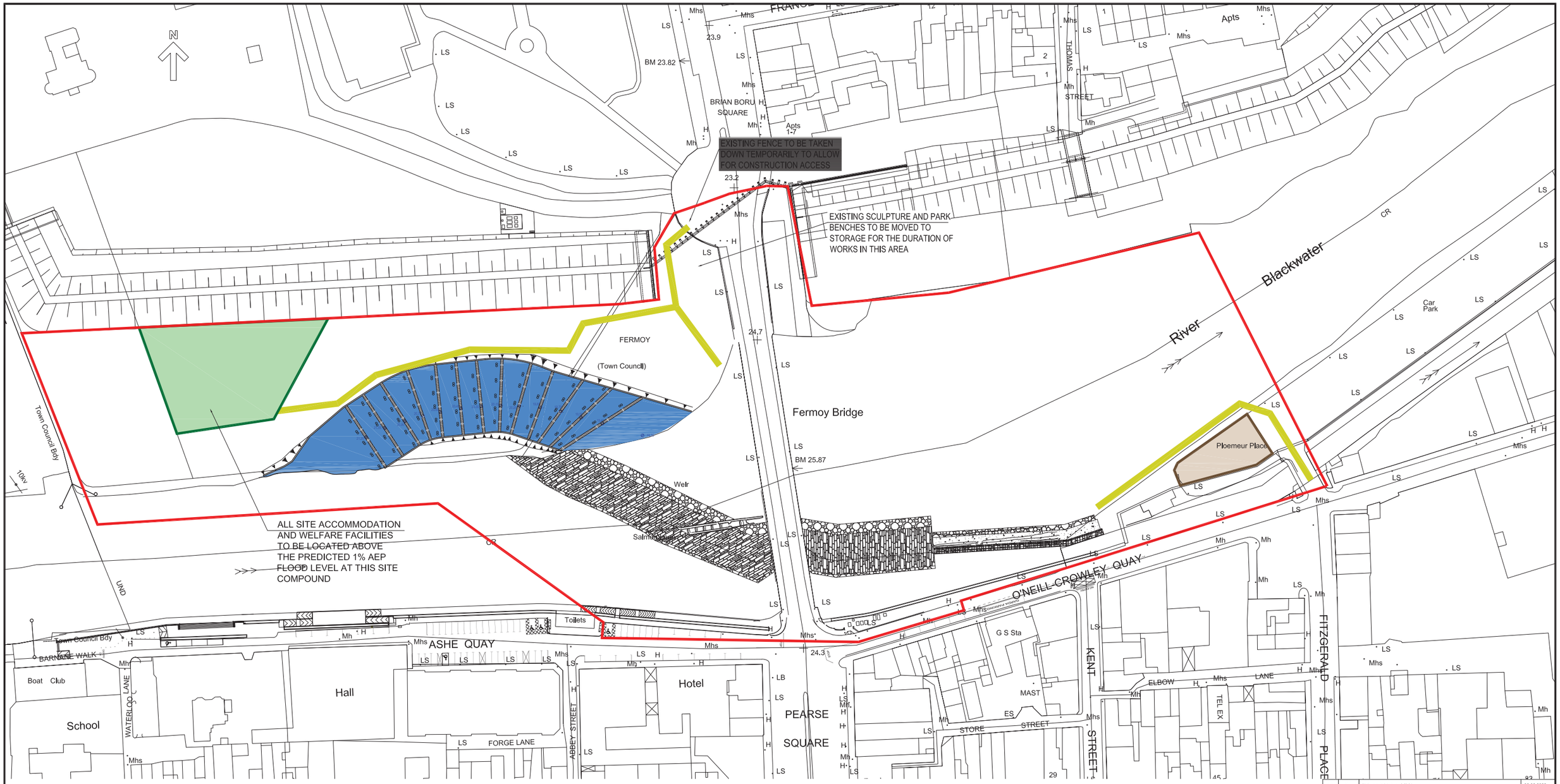
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: CONSTRUCTION SPOIL MANAGEMENT

SCALE: 1:750 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE -ROLE- NUMBER
19011-TJOC-PL-XX-DR-C-0084

REV: C01



LEGEND:

- SITE COMPOUND
- SATELLITE COMPOUND
- SITE BOUNDARY
- CONSTRUCTION ACCESS ROUTES

MAP REPRODUCED BY PERMISSION OF ORDNANCE SURVEY IRELAND (CORK CCMA 9802)

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS
CORRIG HOUSE, CORRIG ROAD, SANDYFORD, DUBLIN 18.
Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: SITE COMPOUNDS

SCALE: 1:750 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER: 19011-TJOC-PL-XX-DR-C-0085

REV: C01

N

EXISTING FENCE TO BE TAKEN DOWN TEMPORARILY TO ALLOW FOR CONSTRUCTION ACCESS

EXISTING SCULPTURE AND PARK BENCHES TO BE MOVED TO STORAGE FOR THE DURATION OF WORKS IN THIS AREA

BRIAN BORU SQUARE

THOMAS STREET

Apts 1-7

Apts

FERMOY

(Town Council)

NORTH BANK ACCESS

BUND AND SILT FENCE DOWNSTREAM OF BRIDGE FOR DURATION OF STAGE 2 WORKS

Fermoy Bridge

River Blackwater

CR

Car Park

Ploemeur Place

SOUTH BANK ACCESS FOR STAGE 3 WORKS

BUND AND SILT FENCE AS DIRECTED BY THE ECOLOGICAL CLERK OF WORKS FOR DURATION OF STAGE 3 WORKS

TEMPORARY STONE ACCESS FOR STAGE 2 WORKS

BM 25.87

BM 23.82

Town Council Bdy

10kV

FISH BYPASS CHANNEL TO BE CONSTRUCTED OFF LINE FROM MAIN CHANNEL OF THE RIVER BLACKWATER IN STAGE 1. RIVER TIE IN WORKS TO BE COMPLETED IN PERIOD JULY - SEPT TO COMPLY WITH IFI GUIDELINES FOR INSTREAM WORKS AFTER STAGE 2 IS COMPLETE.

TEMPORARY SHEET PILE AND SAND BAG PROTECTION TO CREATE DRY WORKING AREA FOR DURATION OF STAGE 2

Weir

Inion Leas

UND

Toilets

O'NEILL CROWLEY QUAY

G S Sta

KENT STREET

FITZGERALD PLACE

ELBOW LANE

TEL EX

MAST

STORE

ES

STREET

Town Council Bdy

BARRACK WALK

Boat Club

School

WATERLOO LANE

Hall

ASHE QUAY

FORGE LANE

ABBEY STREET

CRANE POSITIONED IN CAR PARKING SPACES WHEN REQUIRED

TEMPORARY SHEET PILE AND SAND BAG PROTECTION TO CREATE DRY WORKING AREA FOR DURATION OF STAGE 3 WORKS DOWNSTREAM OF BRIDGE. ONLY TO BE PUT IN PLACE WHEN BYPASS CHANNEL TIE IN IS COMPLETE.

CRANE POSITIONED WHEN REQUIRED TO LIFT MATERIALS

PEARSE SQUARE

0 7.5 15 22.5 30 45 60 75m

1:750

NOTES

1. SEQUENCE OF CONSTRUCTION OPERATIONS SHALL BE AS AGREED WITH IFI AND SHALL BE IN COMPLIANCE WITH THE CEMP
2. INSTREAM WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH FISHERIES IRELAND GUIDELINES FOR INSTREAM WORKS
3. STAGE 1 WORKS ON THE NORTH BANK OF THE RIVER TO CONSTRUCT THE FISH BYPASS CHANNEL SHALL PROCEED AS AN OFF LINE CONSTRUCTION. THE TIES INS OF THE FISH BYPASS CHANNEL TO THE RIVER SHALL BE COMPLETED AFTER THE STAGE 2 WORKS, TO REMEDIATE THE WEIR UPSTREAM OF FERMOY BRIDGE, ARE COMPLETE.
4. 4. STAGE 3 WORKS TO REMEDIATE THE WEIR DOWNSTREAM OF THE BRIDGE SHALL NOT COMMENCE PRIOR TO COMPLETION OF STAGE 2, WEIR REMEDIATION WORKS UPSTREAM OF THE BRIDGE, AND COMPLETION OF FISH BYPASS CHANNEL TIE INS TO RIVER BLACKWATER

LEGEND:

STAGE 1 - WORKS ON NORTH BANK OF RIVER FOR BYPASS CHANNEL

STAGE 2 - IN STREAM WORKS UPSTREAM OF BRIDGE

STAGE 3 - IN STREAM WORKS DOWNSTREAM OF BRIDGE

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS
CORRIG HOUSE, CORRIG ROAD, SANDYFORD, DUBLIN 18.
Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

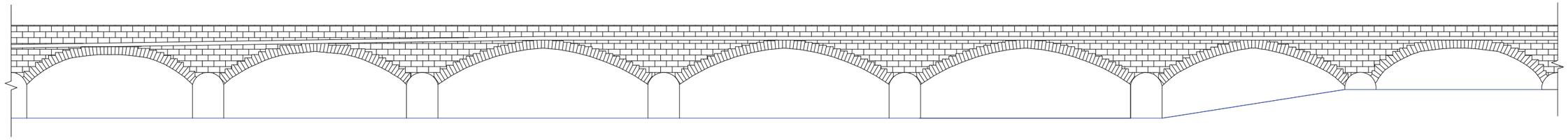
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: INSTREAM WORKS PHASING

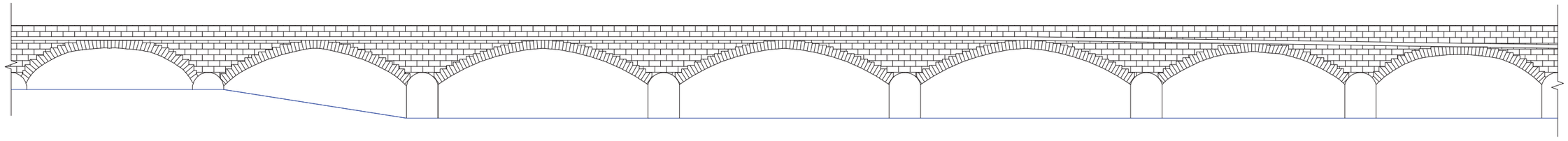
SCALE: 1:750 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0086

REV: C01



1 / 0087 EAST ELEVATION
SCALE: 1:150



2 / 0087 WEST ELEVATION
SCALE: 1:150

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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CONSULTING ENGINEERS
CORRIG HOUSE, CORRIG ROAD, SANDYFORD, DUBLIN 18.
Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION

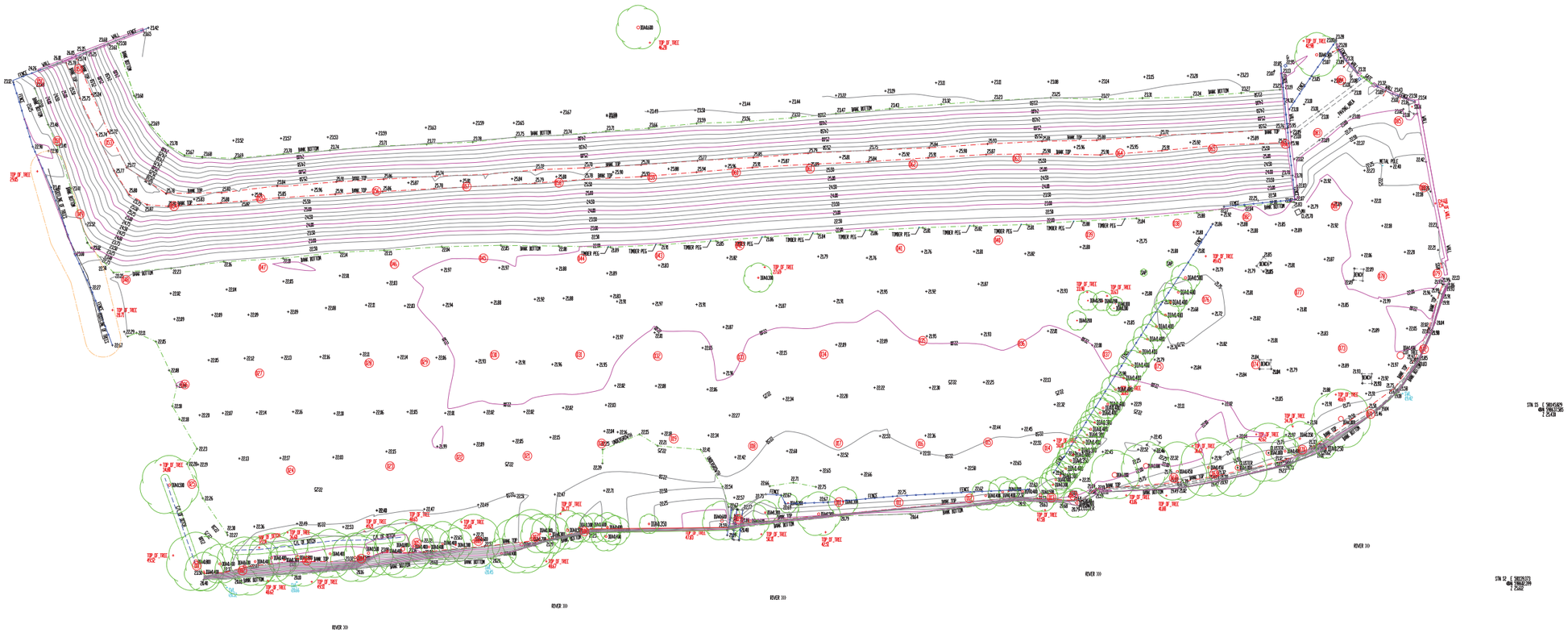
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: FERMOY BRIDGE ELEVATIONS

SCALE: 1:150 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0087

REV: C01



Topographical Survey
Scale 1:500

ITM NORTH

SURVEY NOTES
1. ALL LEVELS ARE RELATED TO MALIN HEAD DATUM (OSGM15)
2. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED.
3. ANY DESCRIPENCIES IN THE SURVEY SHOULD BE REPORED TO GEODATA SURVEYING LTD IMMEDIATELY.
4. DO NOT SCALE, THIS SHALL ONLY BE PERMITTED IN DIGITAL FORM.
5. GRID IS 20m X 20m

0 10m 20m 30m
1:500

SYMBOLS

+0.00	SPOT LEVEL	GY	GULLY	AV	AIR VALVE	AJ	ARMSTRONG JUNCTION		GATE	O/H ESB	OVERHEAD ESB LINE	SIGN	SIGN	UB	SOFFIT BEAM	+RIDGE	RIDGE LEVEL		FOUL SEWER		UNIDENTIFIED EM SIGNAL		TRAFFIC
	CONTROL SURVEY STATION	WM	WATER METER		FIRE HYDRANT	LP	LAMP POST	SW1.00	SURFACE WATER LEVEL	O/H TEL	OVERHEAD TEL LINE	8m	TREE ACTUAL SPREAD	SC CL	SOFFIT CEILING	+EAVES	SOFFIT LEVEL		STORM SEWER		ELECTRICAL CABLE		TRENCH
MH CL	MANHOLE COVER	SV	SLUICE VALVE	TEL	TEL INSP CHAMBER	TP	TELECOM POLE	+BL0.00	BED LEVEL WATERCOURSE	TL	TELECOM POLE	000	TREE TAG NO.	HEAD	HEAD TO FFL	FFL0.00	FINISH FLOOR LEVEL		COMBINED SEWER		PUBLIC LIGHTING		COMBINED SEWER
UL	UTILITY INSP CHAMBER	SC	STOP COCK	MP	MINE PILLAR	EP	ESB POLE	+IL	INVERT LEVEL	+TOP	TOP TAG	BL	BOLLARD	WB	WINDOW BOARD TO FFL	+200	PEG REF NUMBER	ESB	ESB BOX		UNIDENTIFIED GPR	ESB	ESB BOX

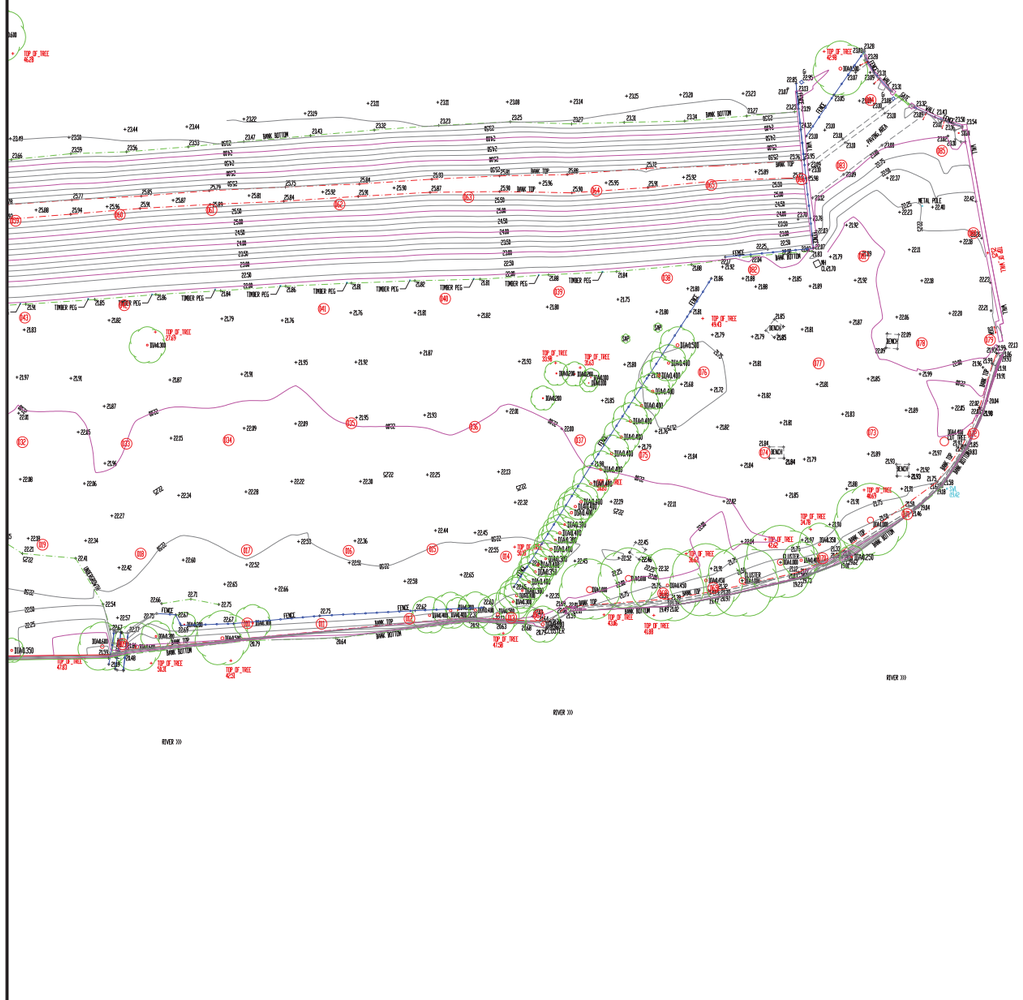
COORDINATE SYSTEM
ITM-Irish Transverse Mercator

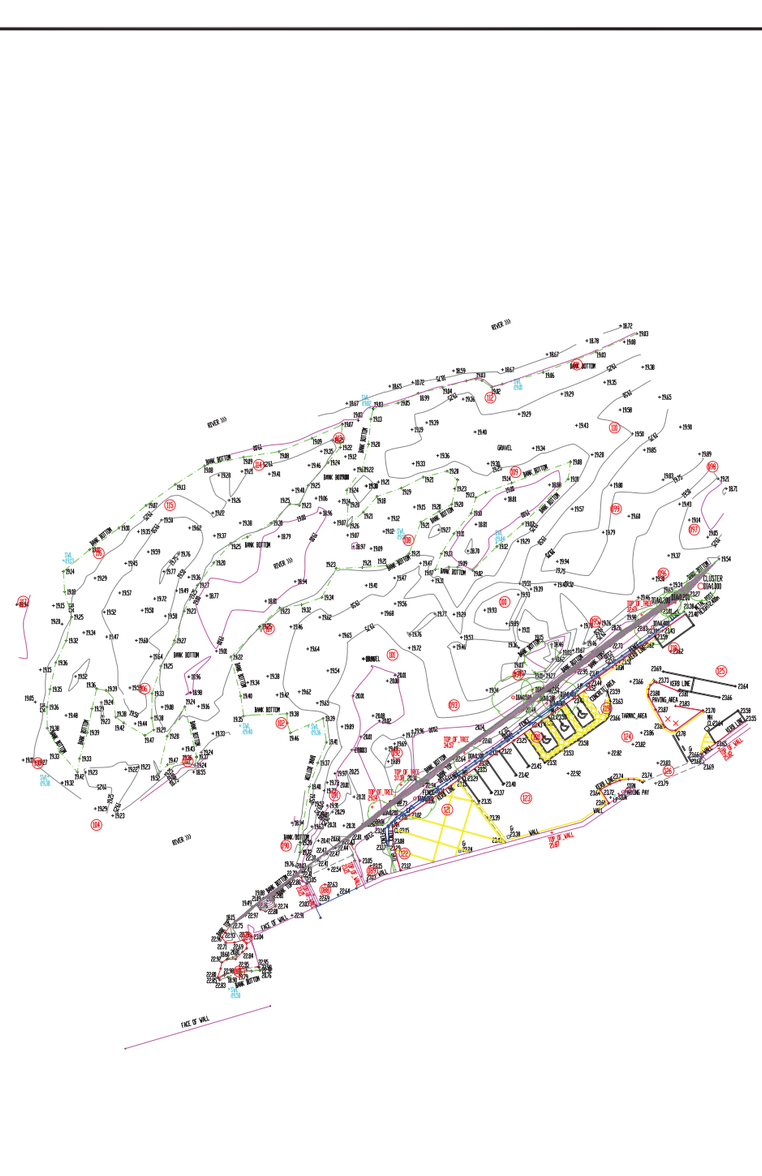
KEY PLAN

REVISION	DATE	DESCRIPTION	DRN BY	CKD BY
02	04-06-20	PHOTOS AND TREES	ML	KOB
01	24-05-20	TOPOGRAPHICAL SURVEY	ML	KOB

Geodata
Chartered Land Surveyors
47 Oliver Plunkett Street Bandon, Co Cork. P72 A443
Phone: (+353) (0)23 8852798 Fax: (+353) (0)23 8852799
Email: info@geodatasurveying.ie Website: www.geodatasurveying.ie

Client: TJ O'Connor 7 Associates
Project: Fermoy, Co Cork.
Title: Topographical Survey 2D
Scale: 1-500
Dwg. No: 20423-101
Date: 04-06-20
Sheet: A1





Topographical Survey
Scale 1:500

ITM NORTH

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4. DO NOT SCALE, THIS SHALL ONLY BE PERMITTED IN DIGITAL FORM.
5. GRID IS 20m X 20m

0 10m 20m 30m
1:500

SYMBOLS

+0.00	SPOT LEVEL	G	GULLY	AV	AIR VALVE	AJ	ARMSTRONG JUNCTION		GATE	O/H ESB	OVERHEAD ESB LINE	SIGN	SIGN	UB	SOFFIT BEAM	+RIDGE	RIDGE LEVEL		FOUL SEWER		UNIDENTIFIED EM SIGNAL		TRAFFIC
	CONTROL SURVEY STATION	WM	WATER METER		FIRE HYDRANT	LP	LAMP POST	SW1.00	SURFACE WATER LEVEL	O/H TEL	OVERHEAD TEL LINE	DIA = 10m	TREE ACTUAL SPREAD	SC CL	SOFFIT CEILING	+EAVES	SOFFIT LEVEL		STORM SEWER		ELECTRICAL CABLE		TRENCH
MH 01	MANHOLE COVER	SV	SLUICE VALVE	TEL	TEL INSP CHAMBER	TP	TELECOM POLE	+BL0.00	BED LEVEL WATERCOURSE	TL	TELECOM POLE	000	TREE TAG NO.	HEAD	HEAD TO FFL	FFL.00	FINISH FLOOR LEVEL		COMBINED SEWER		PUBLIC LIGHTING		COMBINED SEWER
UI	UTILITY INSP CHAMBER	SC	STOP COCK	MP	MINI PILLAR	EP	ESB POLE	+IL	INVERT LEVEL	+TOP	TOP TAG	BL	BOLLARD	WB	WINDOW BOARD TO FFL	+200	PEG REF NUMBER	ESB	ESB BOX		UNIDENTIFIED GPR	ESB	ESB BOX

COORDINATE SYSTEM
ITM-Irish Transverse Mercator

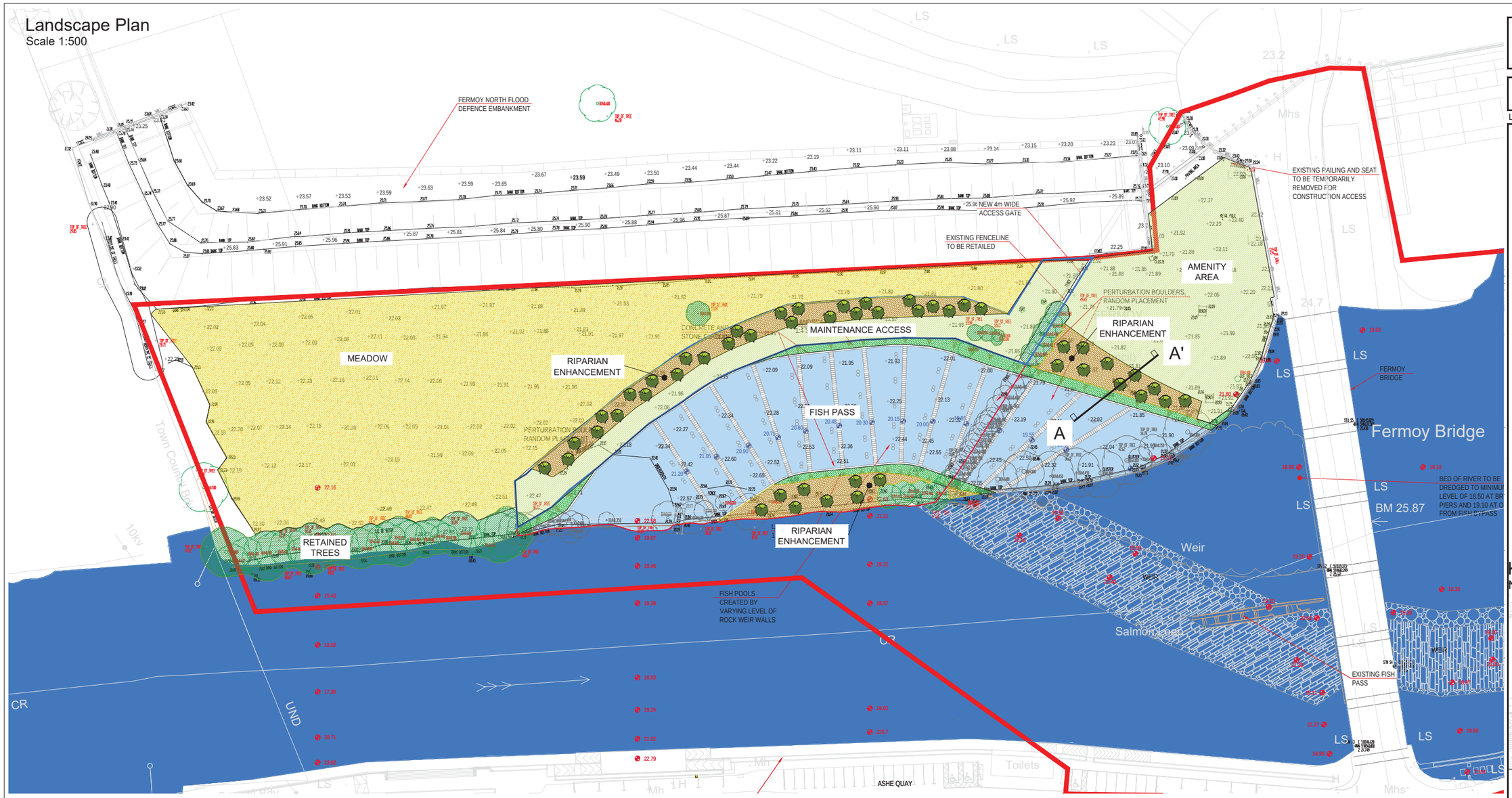
KEY PLAN

REVISION	DATE	DESCRIPTION	DRN BY	CKD BY
01	28-05-20	TOPOGRAPHICAL SURVEY	AL	KDB

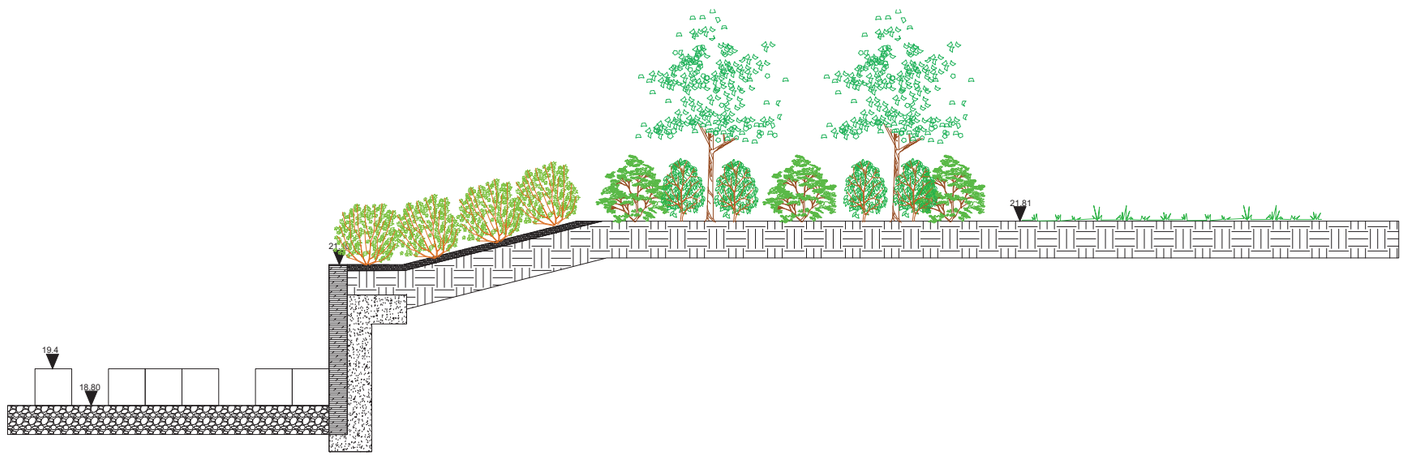
Geodata
Chartered Land Surveyors
47 Oliver Plunkett Street Bandon, Co Cork. P72 A443
Phone: (+353) (0)23 8852798 Fax: (+353) (0)23 8852799
Email: info@geodatasurveying.ie Website: www.geodatasurveying.ie

Client: TJ O'Connor 7 Associates
Project: Fermoy, Co Cork.
Title: Topographical Survey 2D
Scale: 1-500
Dwg. No: 20423-101
Date: 28-05-20
Sheet: A1

Landscape Plan
Scale 1:500



Section A-A'
Scale 1:50



doyle + otroithigh landscape architecture ltd.

North.

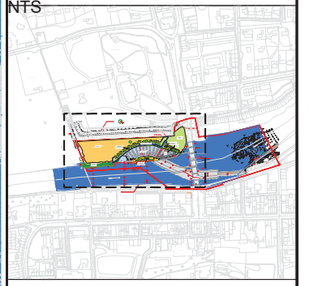
Note:

Legend

Legend:

- Trees
  A mixture of native species are proposed including Alder, Willow, Scots Pine, Birch & Rowan - 12-14cms
- Existing retained trees protected during the site works
- Willow peg plants (locally sourced) set into bank beside fish pass
- **Native Species Riparian Enhancement**
  15% Alder - 8-10 cms Trees / 80-100cms Transplants
  15% Salix 8-10 cms Trees / 80-100cms Transplants
  10% Wild Cherry 8-10cms Trees / 80-100cms Transplants
  10% Bird Cherry 8.10cms Trees / 80-100cms Transplants
  10% Native Black Poplar 80-100cms Transplants.
  15% Holly 40-60Cms Transplants
  15% Blackthorn 90-120 Cms Transplants
  2.5% Bramble - 40-60cms Transplants
  2.5% Hazel - 60-90Cms Transplants
  2.5% Dog Rose - 60-90Cms Transplants
  2.5% Spindle - 90-120 Cms Transplants
- Grass Meadow
- Hardwearing dwarf amenity ryegrass for public access

Keyplan
NTS



Date	Note

Project name: FERMOY FISH PASS	Project number: 21-053
Drawing name: LANDSCAPE PLAN	Drawing number: LP-01-PP

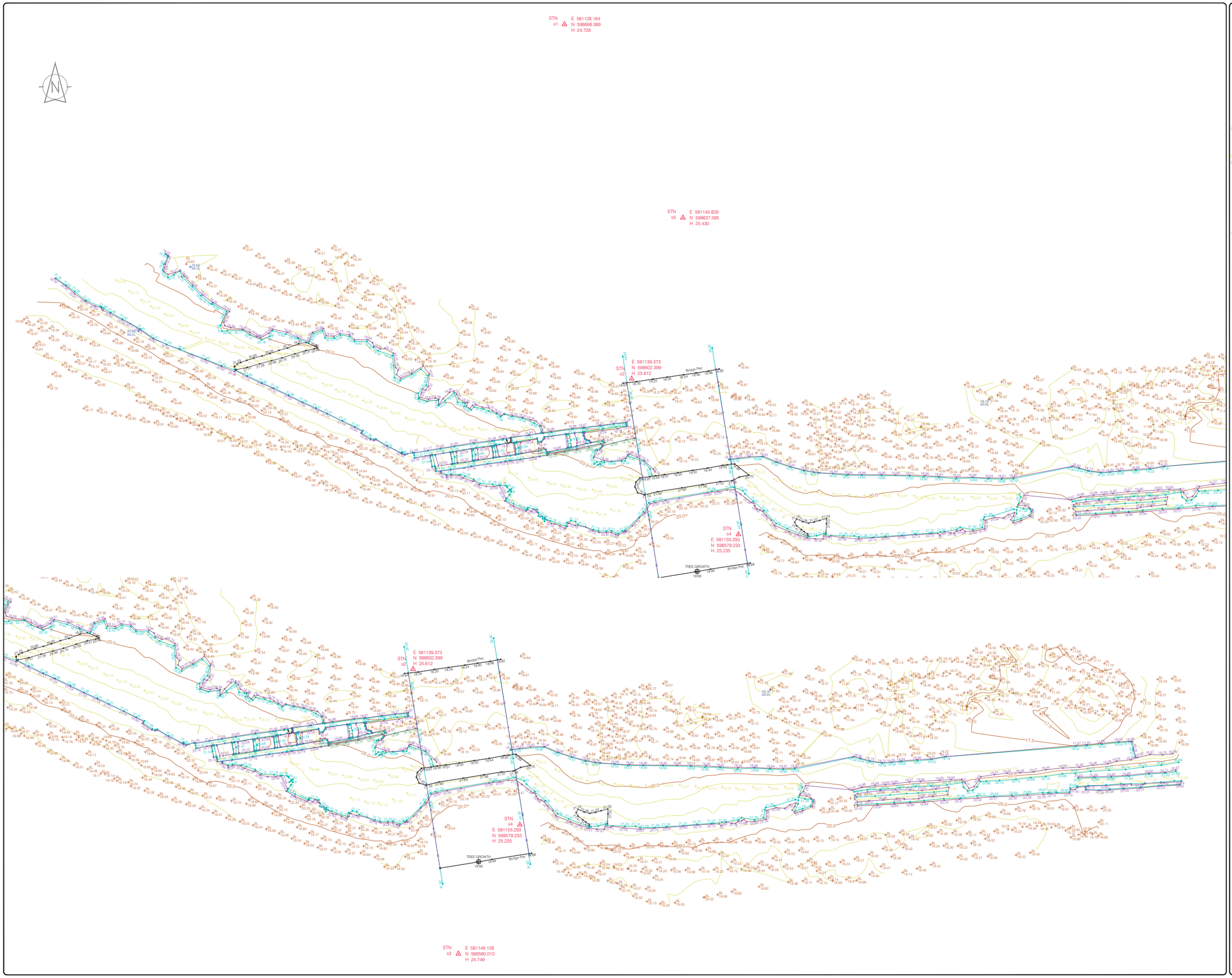
Drawing scale @ A1: 1:500 & 1:50	Drawn by: dos	Checked by: dot
Status: Planning		date: 04.04.2022

Contact details:
Linda Doyle (Director) mobile: 087 267 4196
e-mail: linda@doyle-otroithigh.com
Daithi o'Troithigh (Director) mobile: 086 300 3499
e-mail: daithi@doyle-otroithigh.com

Office address:
Pembroke House
28-32 Upper Pembroke Street
Dublin 2

doyle + o'troithigh
landscape - architecture

www.doyle-otroithigh.com



LEGEND

Street furniture & Services

- Over Head Wires (LUAS) - Pylon ESB
- Flowerbed
- Pipe
- Lift
- Barrier
- Pump
- Trial Pit
- Bus/Train Shelter
- Postbox
- Valve - General
- Water Valve
- Gas Valve
- Sluice Valve
- Air Valve
- Stop Cock
- C P Post
- Marker Post
- Traffic light
- Parking Meter
- Plane Aerial Mark
- Smart Card Validator
- Unknown Valve
- Road Sign
- Bus Stop
- Bollard
- Beacon
- Coalhole Cover
- Bore Hole
- Electricity Pole
- Telegraph pole
- OCS Pole
- CCTV Camera Pole
- Lamp Post
- Foul Manhole
- Surface Water MH
- Manholes
- Air Conditioning Vents
- Services Inspection Cover
- Traffic Inspection Cover
- Cable TV Inspection Cover
- ESAT Inspection Cover
- NTL Inspection Cover
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- Kiosk
- Gully
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- Fire Hydrant
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Natural Features

- Surface Change
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Other

- Survey Station
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Built Features

Roads & Road Markings

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Site Location:

Map Sheet Layout:

Surveyed by : MSL	Date: Aug 2018	Datum:	Malin Head
Drawn by : BK	Date: Aug 2018	Grid System:	
Checked by : KC	Date: Aug 2018	Irish National Grid ☐ ITM ■	

Revisions

No.	Date	Description
1	29.08.18	Final 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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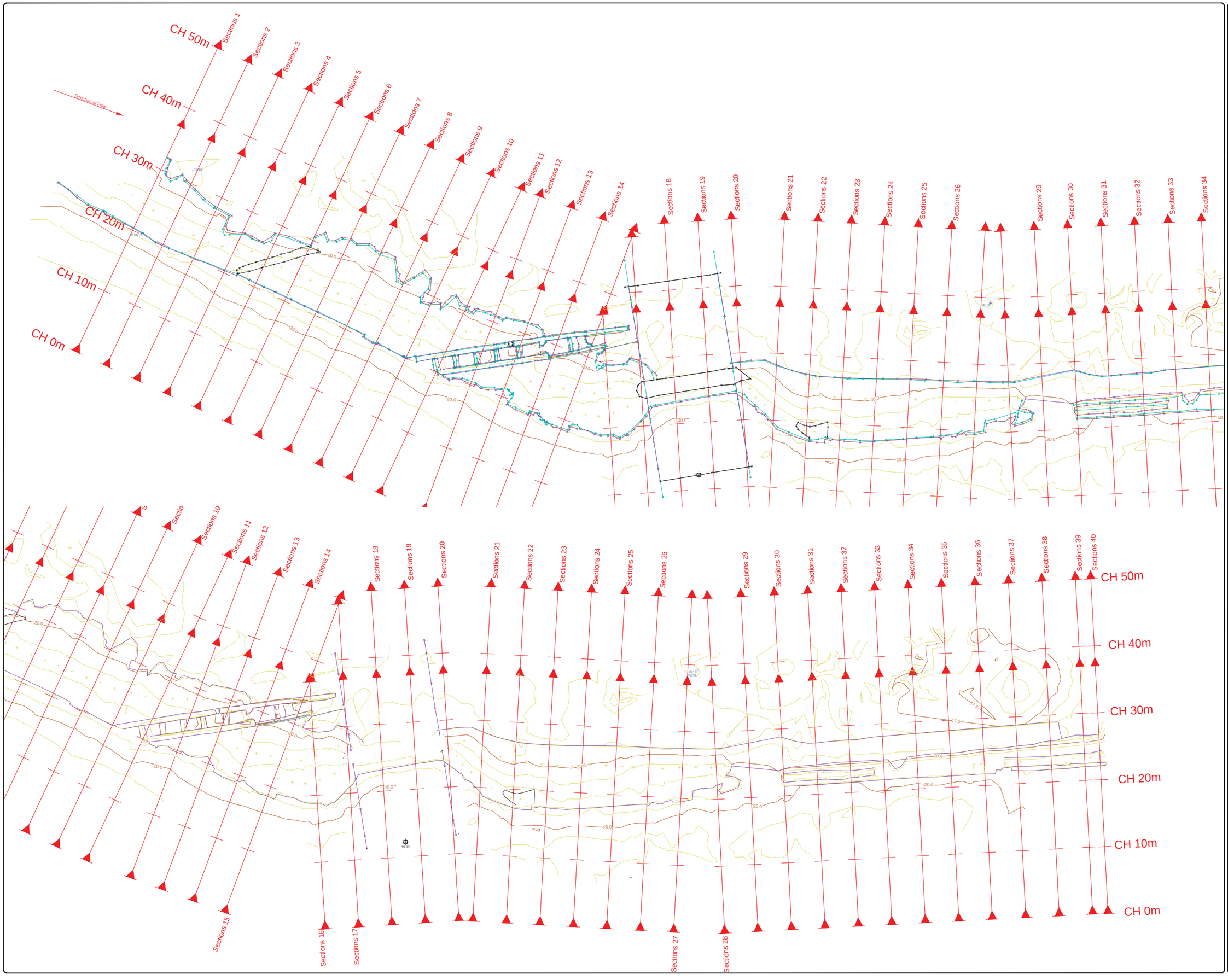
Email: info@murphysurveys.ie

Client :	TJ_O'Connor_&_Associates
Project :	27232 18024_Fermoy_Weir
Date : 28.08.18	**Scale :** 1:250@A1
Description :	Topographical Survey
Drawing Number :	**FERMOY WEIR_PLAN**



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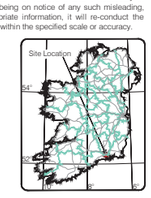

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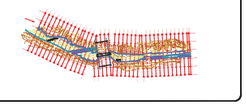

Surveyed by : MSL	Date: Aug 2018	Datum: Malin Head
Drawn by : BK	Date: Aug 2018	Grid System:
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Revisions

No.	Date	Description
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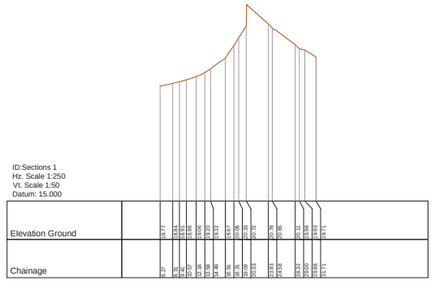

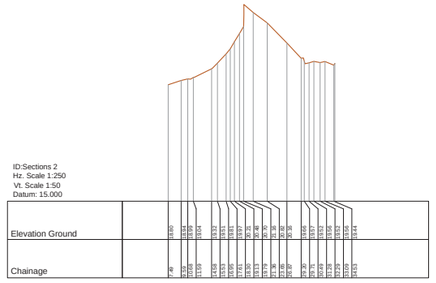

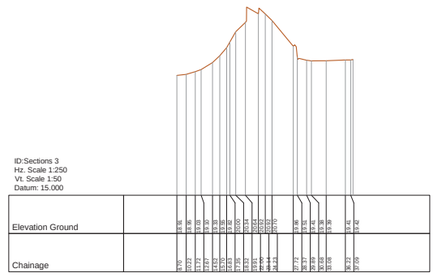

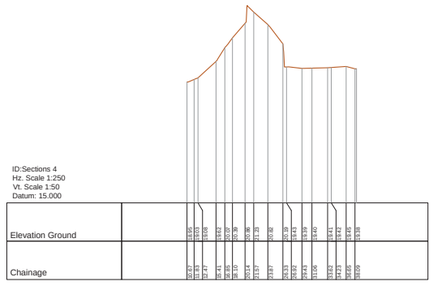

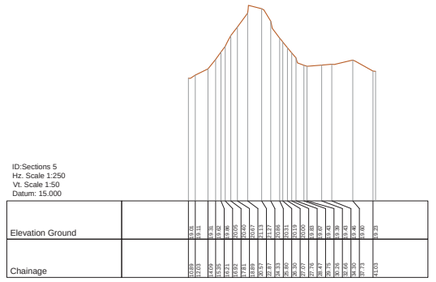

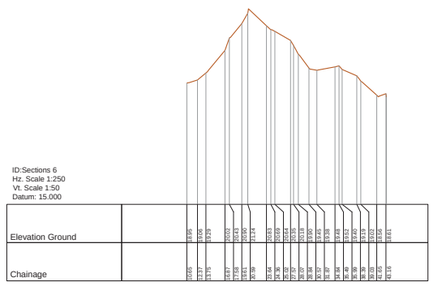

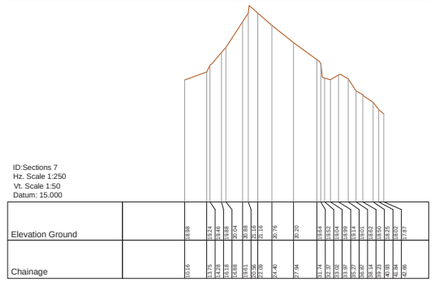

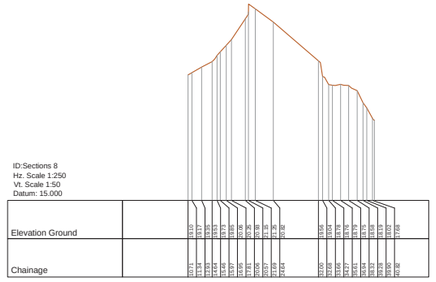

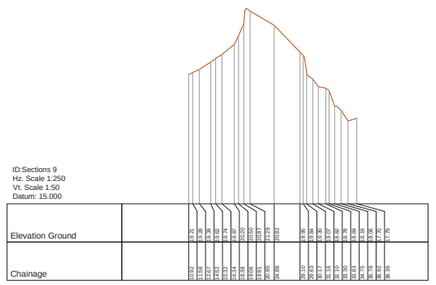

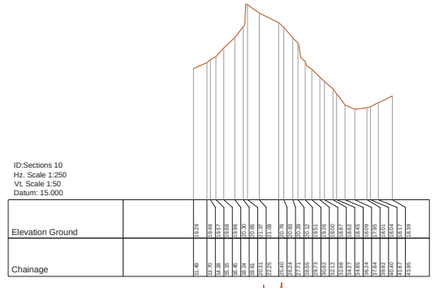

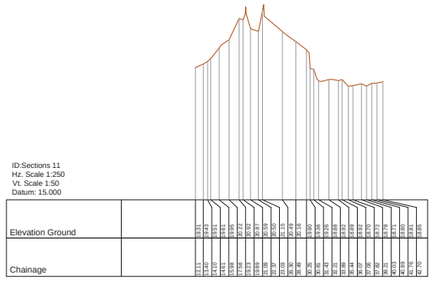

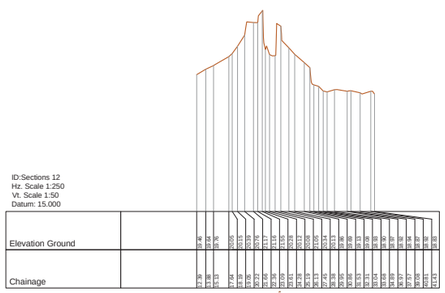

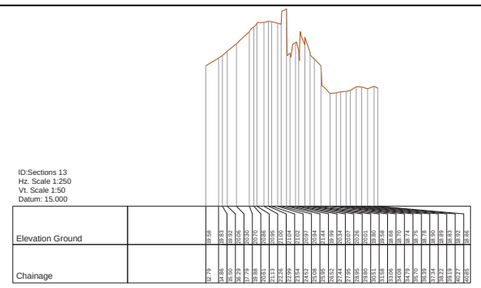

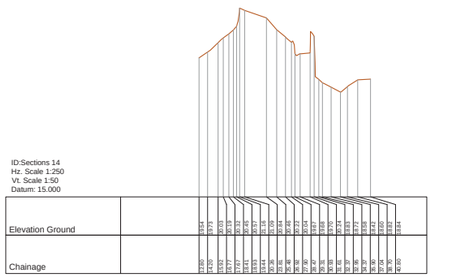

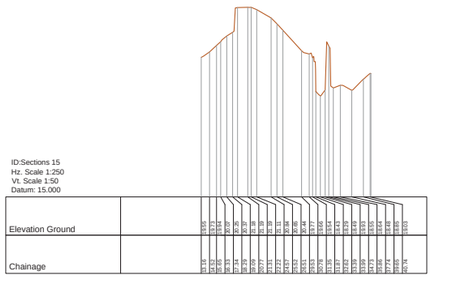

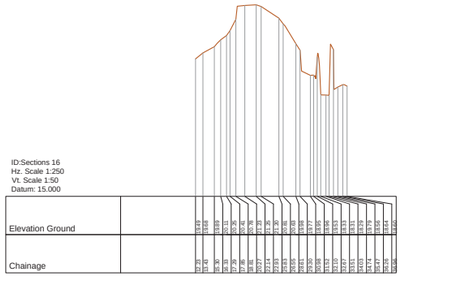

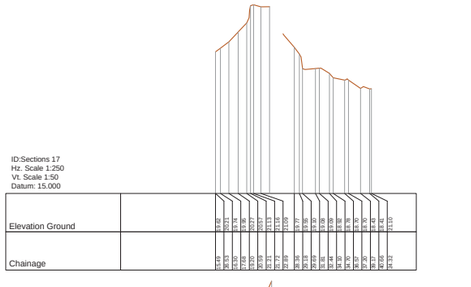

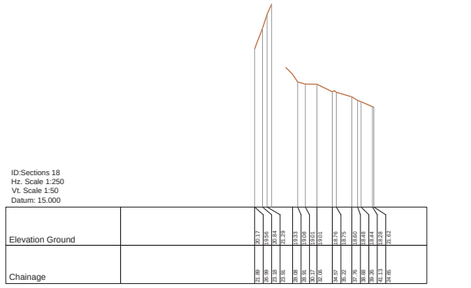

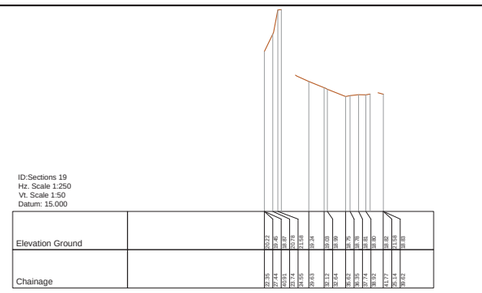

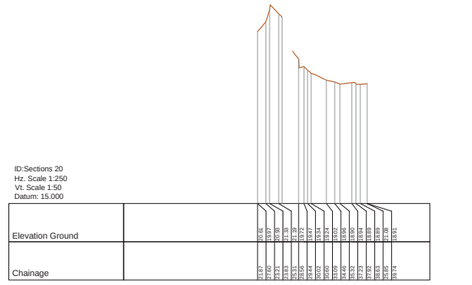

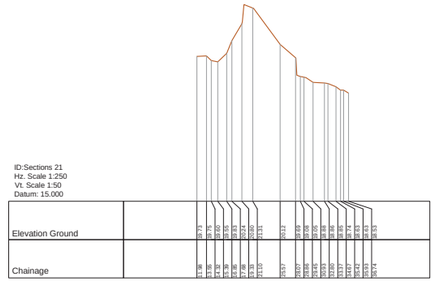

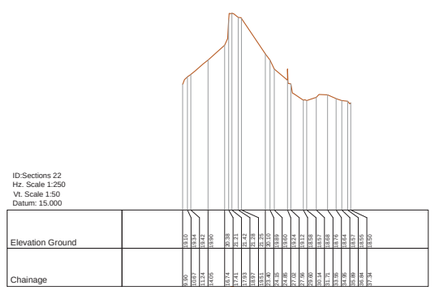

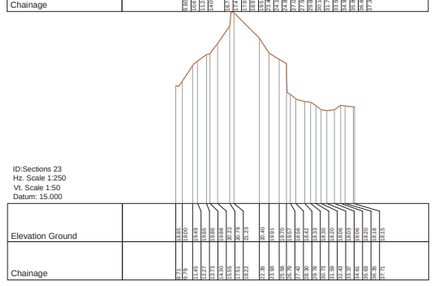

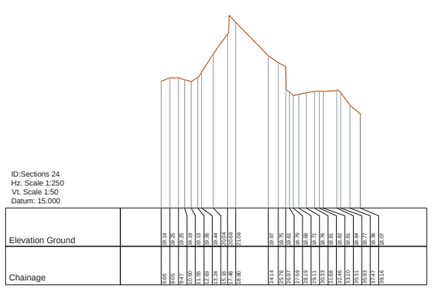

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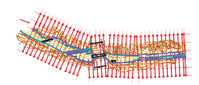

Surveyed by : MSL
Drawn by : BK
Checked by : KC

Date: Aug 2018
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Datum: Malin Head
Grid System:
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1	28.08.18	First Drawing

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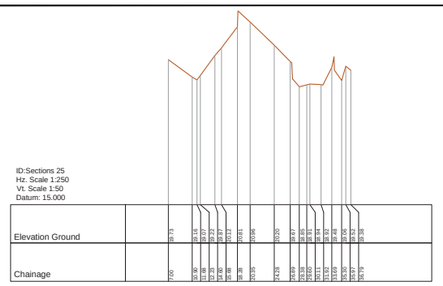
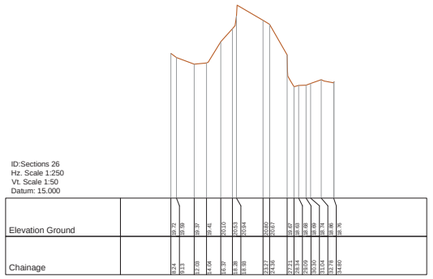
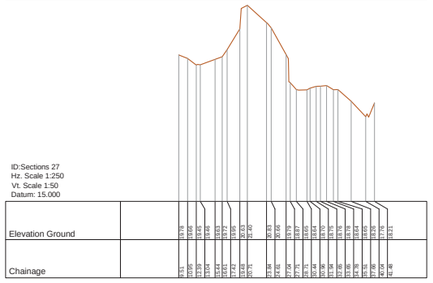
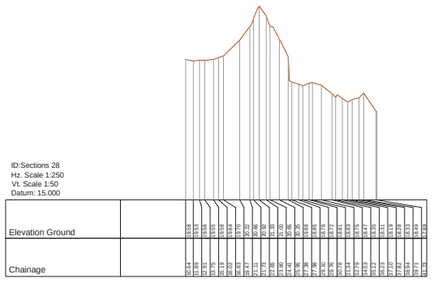
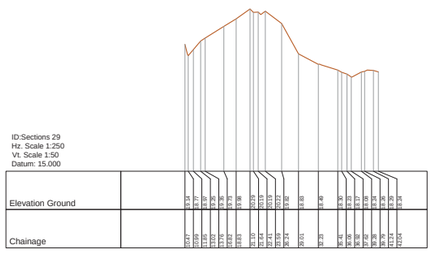
Date : 28.08.18	**Scale :** AS SHOWN@A1
Description :	Topographical Survey
Drawing Number :	FERMOY WEIR_CROSS SECTIONS_PROFILE_01

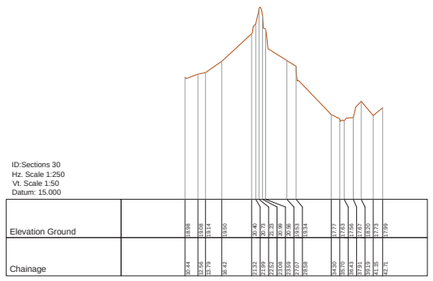


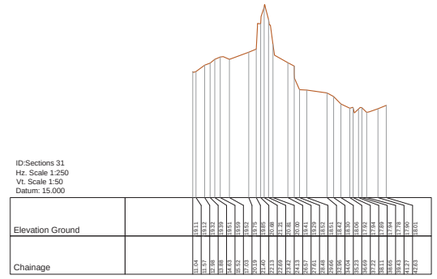


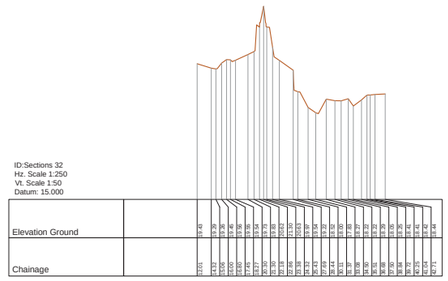


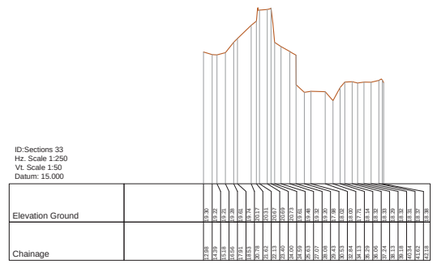


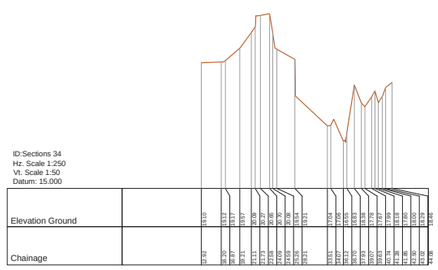


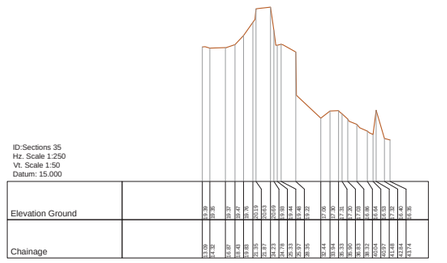


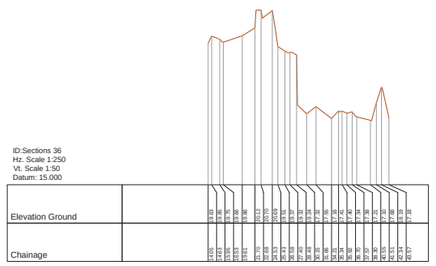


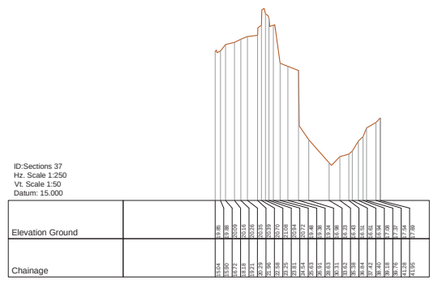


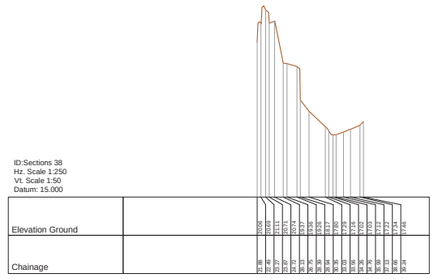


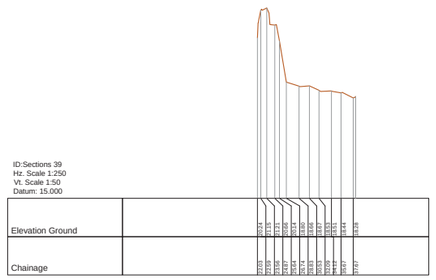


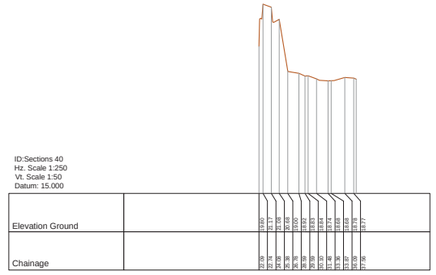












LEGEND
Street furniture & Services

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- Hydrant
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- ESB Box
- ESB Inspection Cover
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- LUAS Technical Cubicle
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- Telecom Inspection Cover
- Monument / Toilets
- Tank Storage
- Basement: MH, Cover & Pipe
- Dished Aerial Mark
- Stay for pole
- Pipe Protection
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Natural Features

- Surface Change
- Land Drain
- Bottom of Slope
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- Hedge / Trees Drip Line / Vegetation
- Tree Coniferous
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- Top of Tree
- Tree Deciduous

Golf

- Fair Way
- Green
- Tee Box

Other

- Survey Station
- Photo point
- River Alignment

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- Kerb Top
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- Bridge Deck
- Bridge Parapet
- Building Façade
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- Damp Proof Course / Verge
- Bridge Pier / Wall & Gate Pillar / LUAS Trackbed
- Cycleway / Private Landing Area
- Fence
- Gate
- Road Centreline
- Top of Wall
- Hoarding
- Property Line
- Road Scar
- Top of Fence
- Floor Level
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Surveyed by : MSL	Date: Aug 2018	Datum:	Malin Head
Drawn by : BK	Date: Aug 2018	Grid System:	
Checked by : KC	Date: Aug 2018	Irish National Grid ☐ ITM ■	

Revisions

No.	Date	Description
1	28.08.18	First Drawing

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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Ireland

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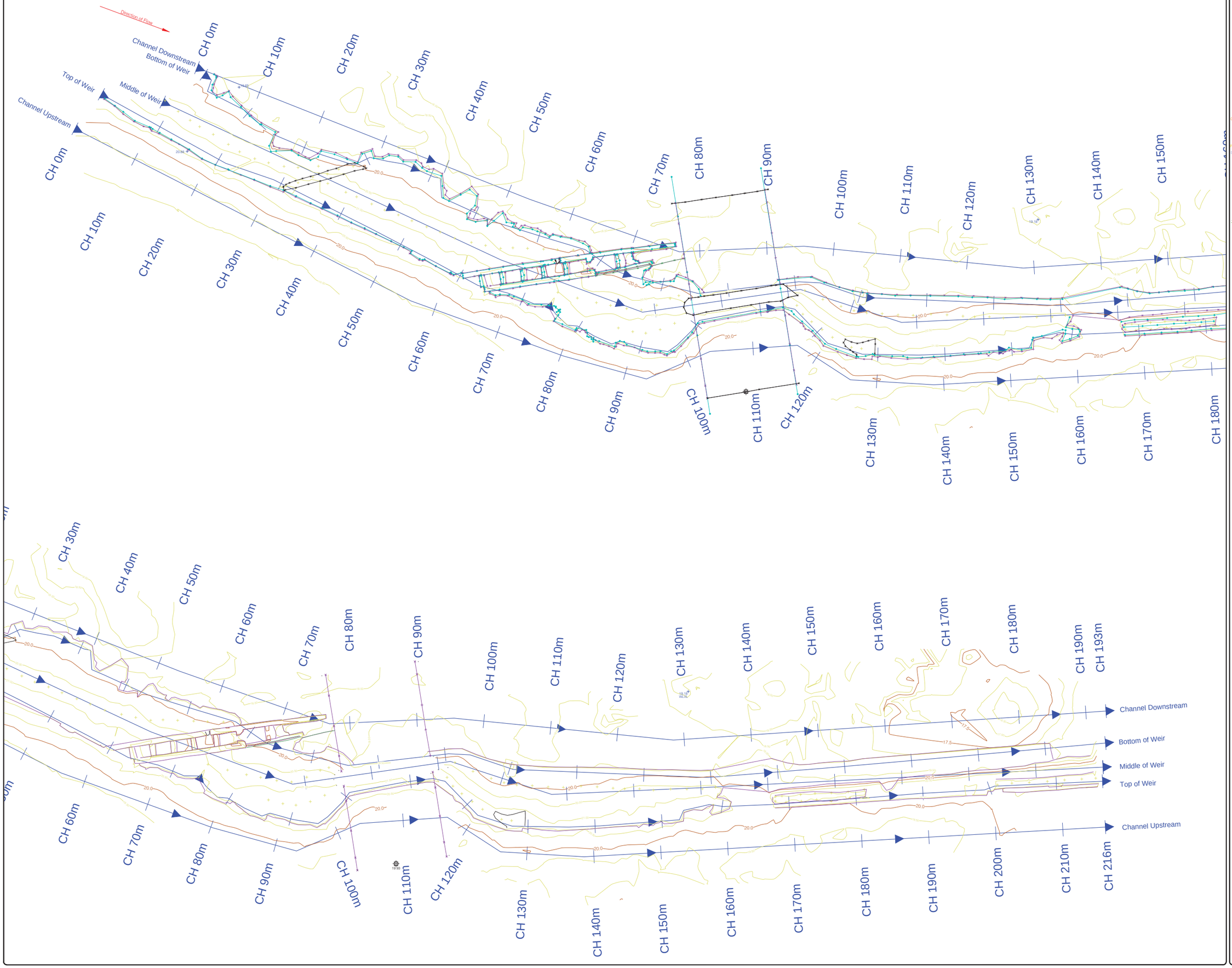
Fax: (+353) 045 484004
Email: info@murphysurveys.ie

Client :	TJ_O_Connor_&_Associates
Project :	27232 18024_Fermoy_Weir
Date : 28.08.18	**Scale :** AS SHOWN@A1
Description :	Topographical Survey
Drawing Number :	FERMOY WEIR_CROSS SECTIONS_PROFILE_02



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Street furniture & Services

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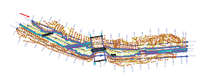
Map Sheet Layout:



Surveyed by :	MSL	Date: Aug 2018	Datum: Malin Head
Drawn by :	BK	Date: Aug 2018	Grid System:
Checked by :	KC	Date: Aug 2018	Irish National Grid ☐ ITM ■

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No:	Date	Description
1	28.08.18	First Drawing

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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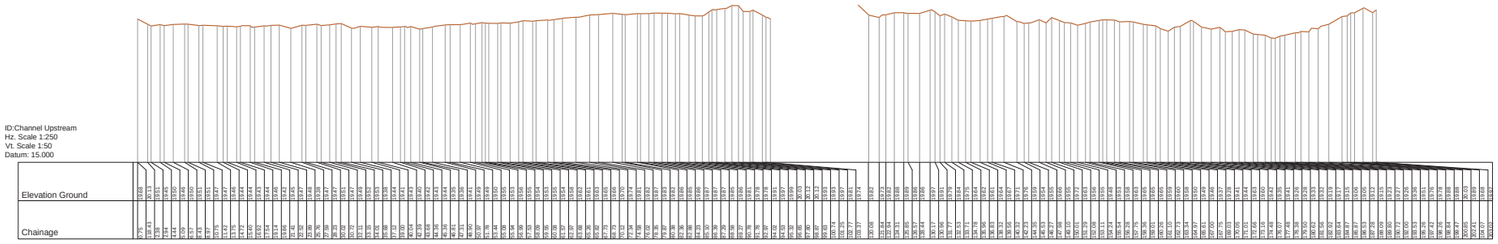
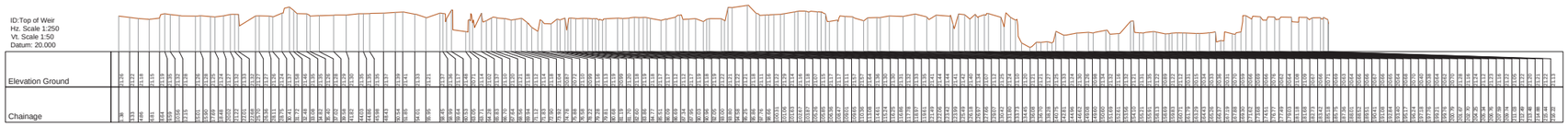
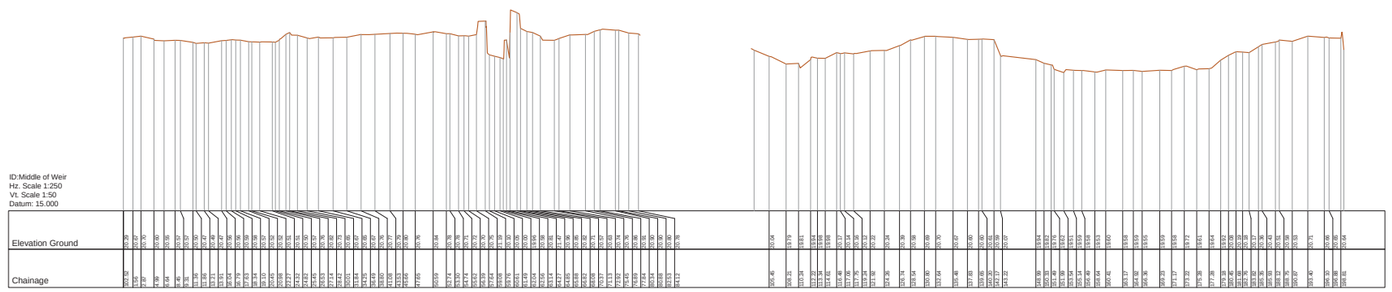
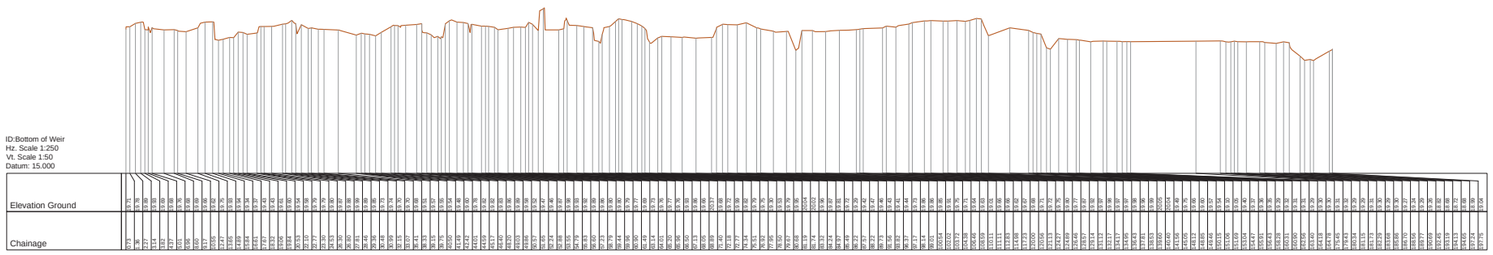
Email: info@murphysurveys.ie

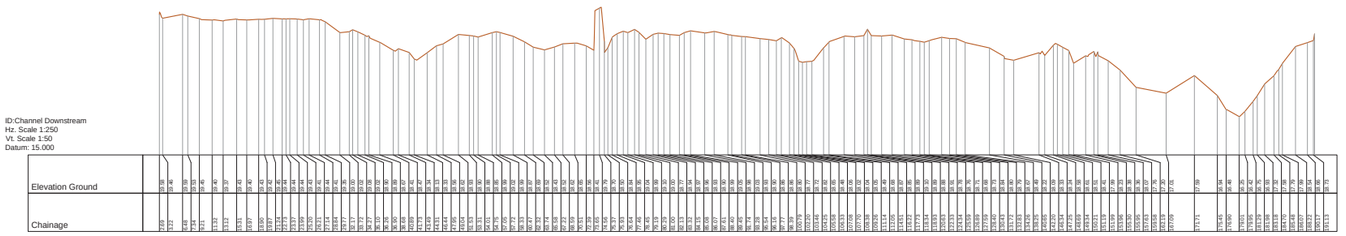
Client :	TJ_O_Connor_&_Associates
Project :	27232 18024_Fermoy_Weir
Date : 28.08.18	**Scale :** 1:250@A1
Description :	Topographical Survey
Drawing Number :	FERMOY WEIR_LONG SECTION_PLAN











LEGEND

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FMH Foul Manhole
SMH Surface Water MH
MH Manholes
AC Air Conditioning Vents
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ICES ESAT Inspection Cover
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Kiosk
GY Gully
UG Vent
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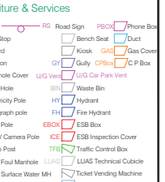

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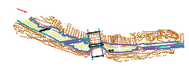

Surveyed by : MSL	Date: Aug 2018	Datum:	Malin Head
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Revisions

No:	Date	Description:
0	28.08.18	First Drawing

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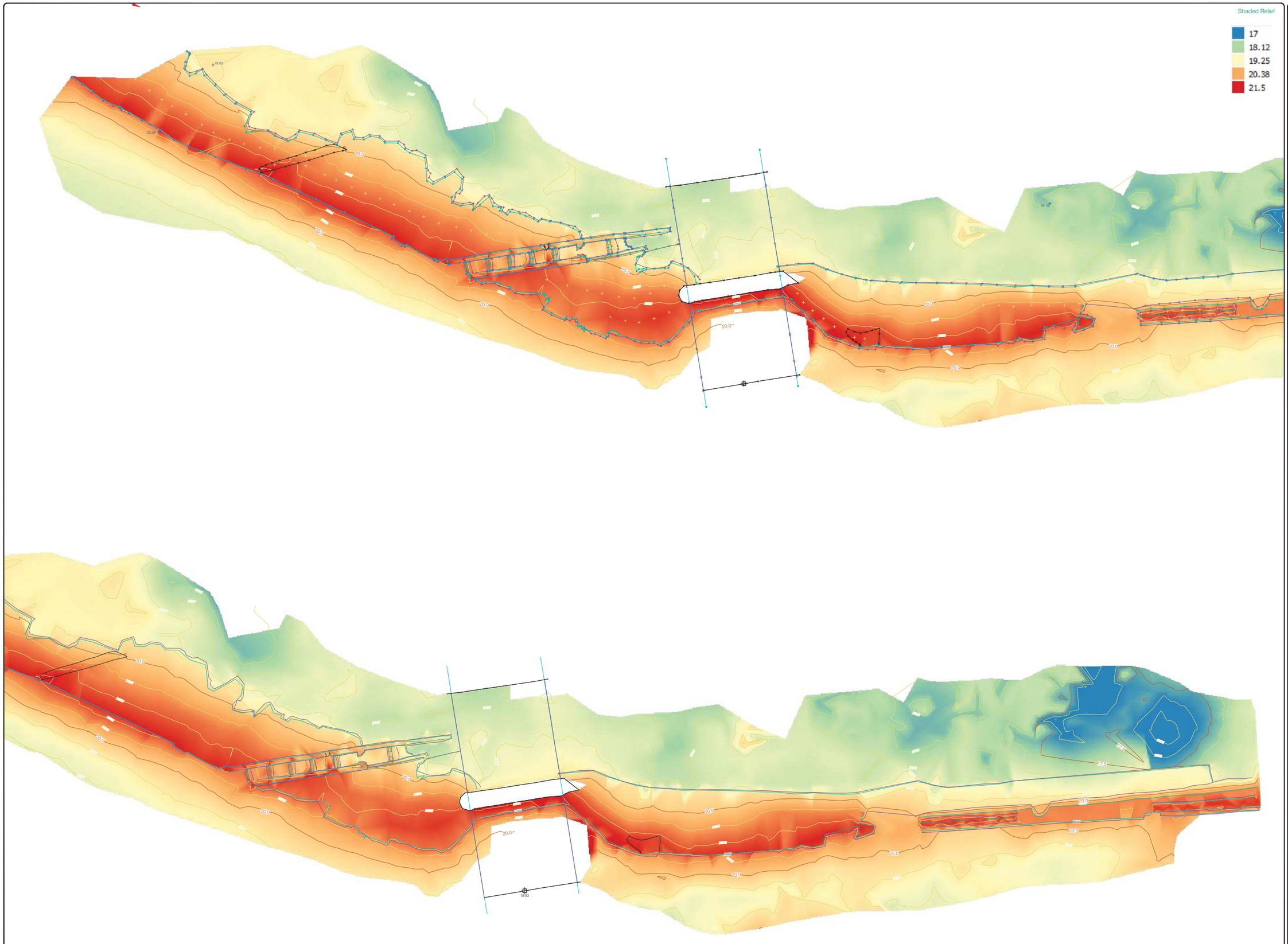
Client :	TJ_O_Connor_&_Associates
Project :	27232 18024_Fermoy_Weir
Date : 28.08.18	**Scale :** AS SHOWN@A1
Description :	Topographical Survey
Drawing Number :	**FERMOY WEIR_LONG SECTION_01**



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

Golf

- Fair Way
- Green
- Tee Box

Other

- Survey Station
- Photo point
- River Alignment

Built Features

Roads & Road Markings

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

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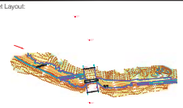
Map Sheet Layout:



Surveyed by:	MSL	Date: Aug 2018	Datum: Malin Head
Drawn by :	BK	Date: Aug 2018	Grid System:
Checked by :	KC	Date: Aug 2018	Irish National Grid ☐ ITM ■

Revisions

No	Date	Description
0	28.08.18	First Drawing

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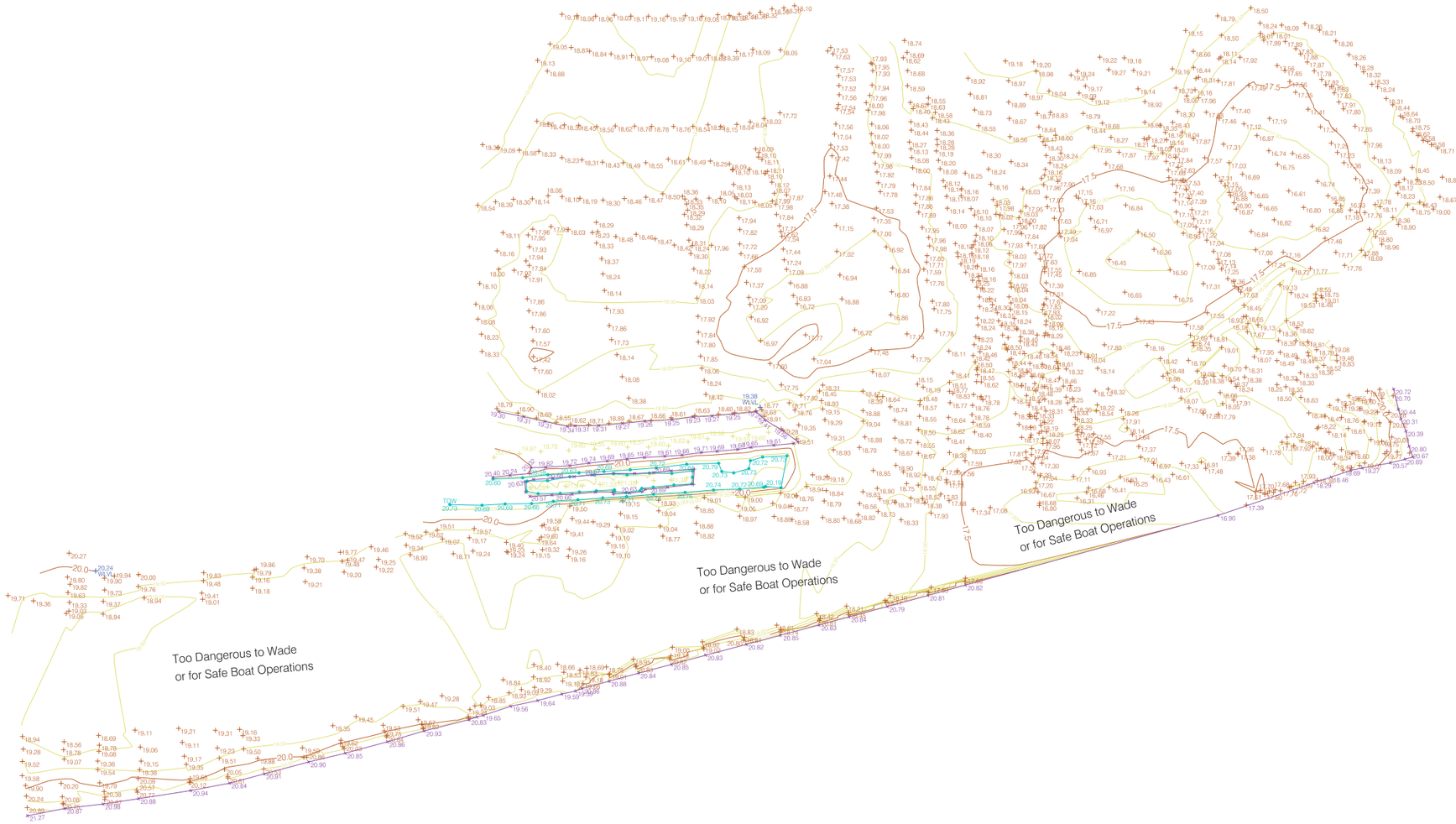
Client :	TJ_O_Connor_&_Associates
Project :	27232 18024_Fermoy_Weir
Date : 28.08.18	**Scale :** 1:250@A1
Description :	Topographical Survey
Drawing Number :	**FERMOY WEIR_DTM**



LEGEND

Street furniture & Services

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

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- Bottom of Slope
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North

Site Location

Map Sheet Layout:

Map Sheet 0000

Surveyed by : MSL	Date: Aug 2020	Datum:	Malin Head
Drawn by : CE	Date: Aug 2020	Grid System:	Irish National Grid ☐ ITM ■
Checked by : BK	Date: 12.08.20		

Revisions

No	Date	Description
0	11.08.20	First Drawing

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Client :	TJ O connor & Associates
Project :	Fermoy Mill Race River Bed Survey
Date : 11.08.20	**Scale :** 1:150@A0
Description :	River Bed Survey
Drawing Number :	**MSL3□□□0_01**

APPENDIX B

Stage 1 Conservation Engineering Report - TWCE

TREVOR WOOD
CONSULTING ENGINEERS

Project:	Fermoy Weir Remediation and Fish Bypass Project. Stage 1 Conservation Engineering Report
Client:	TJ O'Connor & Associates
Reference:	20-02
Date:	11-11-2020

Revision Schedule

Rev	Date	Details	Prepared by	Reviewed by	Approved by
0	31.03.2020	**Preliminary**	T Wood	K Smyth	T Wood
1	10.07-2020	**Final**	T Wood	K Smyth	T Wood
2	11-11-2020	**Final Revised**	T Wood	K Smyth	T Wood

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Web: www.twce.ie

CONTENTS PAGE NO.

1.0 INTRODUCTION

Trevor Wood Consulting Engineers (TWCE) were appointed on behalf of TJ O'Connor & Associates (TJOC) to complete a survey and produce a report on Fermoy Weir, in relation to the conservation engineering aspects of the overall project for the remediation of the Weir and the construction of a new fish bypass channel around the weir.

Fermoy weir was constructed to provide water to power to a nearby mill complex which commenced operation in 1802. The weir stretches across the river diagonally in a NW-SE orientation encompassing the two southern most arches of the seven arch masonry bridge. It is split into three distinct sections for which the weir itself is a typical crump type followed by a long section which would be considered part of the Mill Race Weir Wall. The third section is a small section which abuts one of the piers to the bridge that would have been a partial reconstruction when Fermoy bridge was reconstructed in 1864-5.

A fish-pass is incorporated into the weir which extends through the third arch from the southern end of the bridge.

As of January 2020, two main breaches are visible in the weir structure. One in the Mill Race Weir Wall where it meets the crump shape weir and a more significant one in the same wall structure at the eastern end. These breaches are attracting the flow of the river towards them and when the river is in flood increasing the local damage to the weir at these locations. This damage appears to have commenced since 2015 when photographic evidence notes no visible breach along this section of the weir although water was noticeable to be flowing through joints in the masonry.

Fermoy weir is included in Fermoy Town Council's Development Plan in the Record of Protected Structures (No. 02). The original mill building that the mill race would have supplied water to power water a water wheel is also still in existence although it has been converted to office use. The weir, mill race weir, mill race and mill building form a unique part of Fermoy's history from the early 1800's.

2.0 DESKTOP REVIEW

2.1 Photographs from 'The Lawrence Photographic Collection'

TJOC supplied us with a series of photographs obtained from the National Library Online Digital Catalogue. See Appendix A.

The photographs date from ca. 1865-1914 and show numerous views of the weir as it was over 100 years ago.

The main weir can be seen to be overlain on its downstream face with limestone setts placed in a random pattern with some indication of flattish stones being laid with their narrow edge to the top of the weir.

Another element that can be seen is that the mill race weir section sits roughly the height of its capping stones above the main weir. From a closer view of the same photograph it is also evident that even at this time water was flowing through the mill race weir structure.

2.2 Underwater Archaeological Survey February 2011

Laurence Dunne Archaeology undertook an 'Underwater Archaeological Impact Assessment' in 2011 as part of the works relating to the River-Fermoy South Drainage Scheme for which works were subsequently completed.

This survey noted the works as then proposed were to include the demolition of the mill race and the fish pass to be demolished and reconstructed. Apart from part of the quay wall that formed part of the mill race the mill race weir wall was not eventually impacted by the works undertaken at the time and the fish pass was still as originally constructed.

2.3 National Roads Authority Fermoy Bridge Assessment Report June 2010.

Parsons Brinkerhoff conducted a stage 1 assessment and report for Fermoy bridge in June 2010. Whilst the assessment only relates to the bridge structure our review of photographs within this report show that in 2010 no significant breaches to the weir were present.

2.4 Transport Infrastructure Ireland Fermoy Bridge Principal Inspection Report August 2015.

Atkins conducted a principal inspection and assessment of Fermoy bridge in August 2015. Likewise, this assessment only related to the bridge structure. Nonetheless, from our review of photographs within this report in 2015 no significant breaches to the weir were present.

2.5 Murphy Surveys Topographical and Bathymetrical Survey August 2018

In August 2018 TJOC commissioned Murphy Surveys to complete a topographic and bathymetric survey of the weir and riverbed immediately upstream and downstream of the weir. A few of the main features of this survey are:

- on the downstream toe to the crump weir section it is noticeable that weir is not uniform in terms of its downstream toe. This is a good indication of the undermining damage having also resulted in base material of the weir being eroded away.
- The two breaches in the weir are noticeable from the change in levels being approximately 1m lower for the first breach and approximately 600mm for the second breach. From the cross sections the second breach at the time of the survey appears to be the loss of the mill race weir capping stone and the single course of stonework that the capping sat on before the wall increased in width.

2.6 Infrastruct Survey August 2018

In August 2018 Infrastruct conducted a survey of the weir and concluded that the concrete apron had effectively failed structurally and that any dynamic testing (S'mash) test would not be worth undertaking.

2.7 AGL Consulting Memorandum November 2018

AGL Consulting Geotechnical Engineers assessed the stability of the weir on behalf of TJOC in November 2018. This assessment analysed numerous stability scenarios. From the assessment it was found that whilst the factors of safety against the scenarios assessed do not meet current design code

requirements if remedial works are undertaken to areas of concern then the factors of safety will be improved. The fact that Fermoy weir is a protected structure the addition of protective measures and remedial work will mean the weir can be saved and made more stable.

Three breaches were noted by AGL at the time of their inspection on site one due to further damage since this report one of the breaches is no longer being impacted as much as the other two have increased to the point that most of the river flow occurs through them instead.

2.8 Mizen Archaeology, Underwater Archaeological Impact Assessment (UAIA) September 2020

Mizen Archaeology produced the above noted report on behalf of TJOC in September 2020. The report also deals with a survey that Mizen Archaeology undertook on site in late May 2020.

Within this UAIA it was noted that the original mill was opened in 1802. The weir was constructed in order to channel water to power a water wheel and places its construction to the end of the 1700's and into the early 1800's.

It was also noted that some of the stonework used in the construction of the weir may have originated from a Cistercian Abbey that was present in Fermoy until the dissolution of the monasteries in 1541.

This assessment also noted the date for the reconstruction of Fermoy bridge as being 1864-5. This reconstruction would have resulted in some alteration locally of the weir. This is noted by the change in appearance of the crump weir section when it interplays with one of the bridge piers. Stonework has been repositioned against the bridge pier. The stonework is probably that from the section of weir that would have been disturbed by the reconstruction of the bridge and it has been placed in a similar fashion to the way that the stonework in the crump weir has been set out.

Some of the stonework from the collapsed section of what we have called the mill house weir was found up to 2m downstream of the breach. This stonework should be retrieved as noted for use in the reconstruction of the breached sections.

Another item that was identified from the site work by Mizen Archaeology was numerous timber stakes and pinning evident on exposed sections of the crump weir. These will require further identification in relation to their exact positions being noted and recorded on a survey drawing. During the remedial works they should also be left in position and any disturbance kept to an

absolute minimum. This may result in stonework having to remain in place and be removed small sections at a time in close proximity to these areas to prevent inadvertently damaging or moving them.

2.9 Photographic Surveys

2.9.1 13 July 2016.

From the photographic survey undertaken in 2016 it was clearly visible that part of the mill race weir structure was beginning to show signs of a breach. It was also noticeable that a temporary repair had been undertaken to the fish pass wall on the southern side. This would have been due to the fact that the fish pass is not perpendicular to the weir but cuts across at an angle which has resulted in the side with the temporary remedial works being subjected to far greater forces than the northern side of the fish pass walls.

From these photographs a concrete capping that has been placed over the crump section of the weir is visible and it is evident that this has raised the crump weir level which will increase the risk to the mill race section of weir. There is also evidence of significant material loss on the downstream face of the crump weir sections of the weir with undermining of the concrete apron. The addition of the concrete apron is a classic example of a modern intervention that has caused damage to the original fabric of the weir. Originally the flow over the crump weir section would have been disrupted by the randomness of the limestone setts. This would have lessened the risk of undermining on the downstream toe. Unfortunately the addition of the concrete capping has the result of speeding the flow of water over the crump weir which when the downstream toe end is reached this energy gets dissipated all at once and due to the dynamics an undertow current develops that would be much stronger than from the original surface to the crump weir.

2.9.2 12 July 2018.

From this photographic survey it was noted that the river water level was significantly lower than the photographic survey of 2016. There are two breaches clearly visible to the mill race weir section in relation to capping stones and a concrete covering having been washed away. On the main crump weir section on the downstream slopes it is clearly visible that the concrete apron is breaking up in numerous locations and just to the south of the fish pass the underlying stones that would have faced the random rubble core are visible. Based on the geology of the area and the stones visible there appears to be a significant amount of randomly cut and set limestone. The

fish pass appears to have cut limestone forming both the base side walls and step walls of the structure.

With regards to the mill race section of the weir the river level and flow is such that the flow is not just over the areas of the missing capping's but through the mill race weir walls. This would indicate that wash out of any finer fill material in the core of this wall will be occurring as well. No remedial works have been undertaken to the weir since the 2016 photographic survey.

2.9.3 06 June 2019

Further damage has occurred with more stonework being washed out of the two breaches noted in the photographic survey of 2018. The eastern most breach appears to have resulted in the collapse of the eastern most section of the mill race weir wall which is where the river flow is now concentrated towards. The breach up from this one has removed the next layer of stonework down from the stepped in capping stone level. Immediately below this level of cut limestone appears to be where the random rubble core commences and without immediate remedial action this section is likely to collapse as well.

Both breached sections would be subject to reconstruction using stonework that should still be in the vicinity as it is not likely to have travelled too far downstream. Any additional stonework would be newly sourced local limestone of similar random sizes to those currently in the weir.

2.9.4 02 July 2019

At the smaller of the two breaches some limestone has been deposited on the upstream face of the mill race weir wall. As this stonework has been placed randomly and only up to where the wall section reduces in width for the capping stone level it will not protect the wall from further erosion and collapse when the river is in flood.

2.9.5 05 December 2019

The main eastern breach of the mill race weir wall has now extended up to where flood relief works were completed with parts of the embankment to the north side of the mill race inlet (Western end of Mill Island) being eroded away. We are of the professional opinion that from previous photographic evidence and stonework that will still be located at riverbed level that the original line of the mill race weir wall can be found for an effective reconstruction.

2.10 Other Protected Structure Weir Remedial Works

2.10.1 Carnroe Weir Rehabilitation

Carnroe Weir is a weir located across the river Bann between Lough Neagh and Coleraine in Northern Ireland. It is a protected structure and is awaiting a start of work on site to refurbish the weir. The works entail the construction of a fish pass within the confines of the River which will result in some loss of historic fabric.

On the downstream face of the weir anti erosion protection is to be provided with the remaining weir to be refurbished by resetting existing stonework introducing new stonework where stonework is missing and not able to be found in the local vicinity.

It should be noted that one of the sections of Carnroe Weir is much taller than Fermoy Weir and has steeper slopes so occupying a smaller footprint in terms of width. In this instance pressure grouting has been proposed for the fill material to the weir. The section of weir that is similar in cross section to the crump weir section at Fermoy is to be re set to create a constant 5.1% gradient with rock armour at the end of the downstream face as well as a concrete toe to the end of the existing weir.

2.10.2 Calver Weir Restoration

Calver Weir is located on the River Derwent in North Derbyshire and was constructed around the same time as Fermoy Weir. Like Fermoy Weir, Calver was constructed to provide water to power a mill. Remedial works had been undertaken in the twentieth century but subsequently failed. Included in these works was the addition of a concrete apron in places similar to what has been placed at Fermoy Weir.

The majority of the original rubble fill had been replaced with poor mass concrete and concrete grout and had failed. In 2009 works commenced on site to refurbish the weir and construct a new fish pass which resulted in some loss of historic fabric.

The condition of Calver Weir prior to restoration was in a far more perilous condition than most of the current condition of Fermoy Weir (Breached sections exempted.)

Calver demonstrates that remediation can be undertaken successfully even if in this instance almost a totally new core was constructed with the original

stonework then set atop. Again, additional protection was added the downstream toe of the weir.

3.0 TWCE SITE VISITS

3.1 Inspection 30th January 2020

Upon being appointed to provide conservation Engineering input to TJOC Trevor Wood undertook an initial visit to Fermoy Weir on 30th January 2020. At the time of the visit there had been significant rainfall in the proceeding weeks / days before and the river was near to average winter levels.

The main breach on the eastern end of the Weir appears to have increased in size since the previous photographic survey undertaken in December. See photograph 1.

The main crump weir section has limited flow over it due to the breach now taking most of the flow and reducing levels for the crump section of weir. See photograph 2. The only section of the main crump weir where a noticeable flow over could be seen was close to the fish pass on its southern side. This is also where the temporary remedial works were undertaken on the fish pass side wall.

Because of the high-water levels in the river we will need to undertake a further visual survey. Taking into consideration that a new Underwater Archaeological survey is to be undertaken we would recommend that our survey is conducted at the same time.

3.2 Inspection 20th May 2020

The inspection of the 20th May was conducted on the same day that Mizen Archaeology undertook their survey which included the updated underwater archaeological survey.

At the time of this inspection it was noted that the river water levels were significantly lower than when TWCE last visited the site in January 2020.

The levels were such that a closer inspection was possible of the majority of mill race weir up to where the significant breach has occurred, the crump weir section and the fish pass.

From a closer inspection of the mill race weir section it was noted that there are two types of stonework used in the construction of this section of weir. The base layers are limestone with a section then composed of Red Sandstone topped with Limestone. The make-up of the banding of the stonework can be seen on photographs 3 and 4. The Red Sandstone is part of the Devonian Sandstones and would have been available locally and is also seen on numerous buildings in the locality either on its own or combined as per the weir banded between limestone. Significant washout of fill material made up of smaller stones and pebbles and what would have been finer crushed rock that would have been present between the main stonework was also evident see photograph 5.

Where the mill race weir has been breached it was evident that the breach has extended into the ground behind where flood relief works were undertaken and part of the bank wall behind the flood defence works. Both are clearly now visible. see photograph 6.

The main crump weir was able to be inspected up close especially sections of where the later addition of a concrete capping / apron over the stonework has failed / spalled away. The exposed stonework has been randomly placed with no set coursing. One notable feature is the stonework has been laid such that the side of individual stones face up rather than the stonework being placed flat. This does result in individual stones being bedded deeper into the main structure which would provide additional strength to the weir reducing the incidence of stones being dislodged. See photographs 7-11. Remedial / restoration work will need to take this into consideration. On the downstream end of the crump weir it was noted that the concrete capping has been undermined. See photograph 12. The concrete capping would not have formed part of the original crump weir structure. Due to its relative smoothness compared to the randomly placed stonework we are of the professional opinion that the concrete is a contributory factor in this undermining from the greater eddying currents and back eddy currents that will be formed when the natural river bed level is met.

With regards to the fish pass it was noted that base, walls, and steps are formed from cut limestone blocks. The tooling marks on the blocks are also still visible. See photographs 13 and 14. Two interventions are visible to the fish pass that have occurred since its construction. The first is a concrete cap and plug with a pipe inserted at all the steps in the fish pass. See photograph 15. The second intervention was due to a partial collapse of part of the fish pass where steel sheet piling steel posts and timber infill panels have been inserted see photographs 16 and 17. Some of the cut limestone has become dislodged in a few locations and the majority of the locations where this has

occurred (apart from the section of reconstruction with steel and timber) the limestone blocks are still present in their dislodge location. See photographs 18 and 19. Both interventions should be removed as part of the restoration / remedial works to the weir.

4.0 RECOMMENDATIONS

Fermoy Weir is a protected structure and consequently best conservation practice should be adopted in terms of any remedial works.

The main ethos of conservation is to retain as much existing fabric as possible and keep interventions to a minimum.

The remedial works to the weir can be split into three sections. Works to the crump weir section. Existing fish pass remedials. Mill race weir section. All the initial proposals are subject to further detail being provided and adjusting to accommodate the results from the underwater Archaeological survey and our own survey when river levels are lower.

4.1 Crump Weir Section

There has been previous intervention work at Fermoy weir that in our professional opinion has contributed to some of the damage to the main crump weir that is visible now. The intervention that at the time would have been completed with good intentions was to place a concrete apron over the existing limestone faced section of the crump weir. Conservation techniques and best practice would have been in their infancy at the time the concrete was placed and certainly would not have been a consideration for Fermoy weir which did not become recognised as a protected structure until the change of the planning act in 2000.

The concrete apron has the effect of increasing the speed of the flow over the crump weir. The original facing stonework with random rubble fill would have allowed water to flow over and through (albeit at a reduced rate) the whole structure. The randomness of the stonework and the fact no stone would have been perfectly flat would have disrupted the flow.

The concrete apron with its resulting faster flow over the main crump section of the weir will have increased the incidence and severity of undertow currents at the toe of the weir. These undertow currents have undermined the toe of

the crump weir which is resulting in loss of stonework fill and undercutting of the concrete apron with gradual failure / spalling of same.

For the crump section of the weir the initial intention is to remove the concrete apron. Reset the limestone setts on top of the random rubble / gravel fill with their narrower edges facing up which may require additional material to be added to create a uniform crest level and uniform slopes. Prior the stonework being placed an open texture geotextile mat should be added to assist in preventing core material being washed out but still allow the stonework to bed into the core. During this part of the remedial works any timber stakes post and pinning that was previously identified in the Mizen Archaeology site survey in May 2020 should be left in position accurately recorded and any disturbance kept to an absolute minimum. This may result in stonework having to remain in place and be removed small sections at a time in close proximity to these areas to prevent inadvertently damaging or moving them.

The crest level of the main crump weir should be set in the region of 100mm lower than the crest level of the mill race weir section. At both the upstream and downstream heel and toe of the crump weir section the undercut / missing stonework would be reset on concrete heel and toe footings along with the addition of rock armour on the upstream and downstream side of the weir to protect the toes of the two slopes and reduce the risk from undercurrents undermining the downstream side in the future. See Appendix C for preliminary sketch detail.

The afore mentioned remedial works for the crump weir will also apply where relevant to the stonework that was re-configured from the original weir construction and placed around the bridge pier when Fermoy bridge was reconstructed in 1864-65.

4.2 Existing Fish Pass

The existing fish pass would have the intervention works / temporary remedial works removed. The section of the fish pass structure that was reconstructed with steel sheet piling steel posts and timbers should be reconstructed with new limestone to match the existing. The remaining fish pass side walls would then be pointed with struck pointed natural cement and any other missing stonework replaced with any out of position stonework reset. As a new bypass channel is to be constructed to form a new fish pass this fish pass will need to be effectively decommissioned. The easiest way to undertake this is to close off the upstream end of the fish pass by installing stonework across the current

channel to the same height of the stonework side walls. To prevent white water from forming due to the steps in the fish pass we would recommend that a geotextile mat similar to that used around land drains is placed over the fish pass structure and fill material added with limestone setts to match those of the main crump weir slopes to create a smoother transition from the crest to the toe. The base level of the side wall cap stones would be the level that the slope to the fish pass follows. See Appendix C for preliminary sketch detail.

4.3 Mill Race Weir

The mill race weir that has been breached should be reconstructed with any of the stonework that can be found in the river close to where the breach has occurred. To make up further missing stonework Limestone and Red Sandstone are still quarried locally although it is unlikely that the exact quarry is still being mined. A local match for the Red Sandstone would be Castlewrixon Red Sandstone that is quarried in Castlewrixon Ballyhea Charelville. Limestone is more readily available locally from several suppliers.

A concrete core would be poured for the new sections of mill race weir. For the remaining existing sections of mill race weir, it would be our intention to recommend re filling with stones and pebbles as per the original core construction to fill any large voids then injection grouting with natural cement[1] into the fill / core of the wall. This will reduce the potential for future washout and provide a more stable core to the mill race weir wall. The stonework facing will then be struck pointed in natural cement and the downstream face of the weir protected by adding rock armour. The level of this section of the weir should be slightly higher than the crump weir section to concentrate the main flow of the river over the crump weir and down the bypass channel and only allowing storm flows to overflow the mail race weir section See appendix C for preliminary sketch details.

Although not part of the conservation of the mill race weir section more urgent remedial works are required to the bank / flood defence works where the now collapsed section of mill race weir used to connect to. Ground behind the flood defence works has been eroded away and this is compromising this part of

[1] Natural Cement: Natural Cement obtained by burning argillaceous Limestone followed by grinding. (Prompt by Vicat) Commonly used in restoration of historic engineering works below ground or water.

the flood defence works in terms of capping and facing stonework that surrounds sheet piling.

4.4 Health and Safety

As the river Blackwater can be a fast-flowing river in flood or after storm events undertaking the remedial works in a safe manner will require careful consideration.

In relation to this the initial thoughts are to undertake the works in sections with the use of temporary coffer dam type structures to allow works to be undertaken safely.

As there are already two major breaches in the mill race weir section, we would be of the professional opinion that the work to this section is undertaken first. There is the risk of further damage to this section as well as potentially damaging the flood defence works at Mill Island. The river could be temporarily dammed across the mill race section so diverting the flow over the main crump section of weir to allow the remedial / reconstruction works to occur.

The main crump weir then splits up conveniently into two sections with the existing fish pass works acting as the location where the split in the works occur. Alternatively, if the new bypass channel is constructed then flows can be diverted to this during summer months for work on the main crump weir to progress.

4.5 Construction Programme

With a suitably experienced stonemasons' team and sourcing as much material as possible prior to commencing works the main crump weir should only take one summer season to complete if conducted after the bypass channel has been constructed. Alternatively, two summer seasons may be required if these works are conducted concurrently with the bypass channel works.,

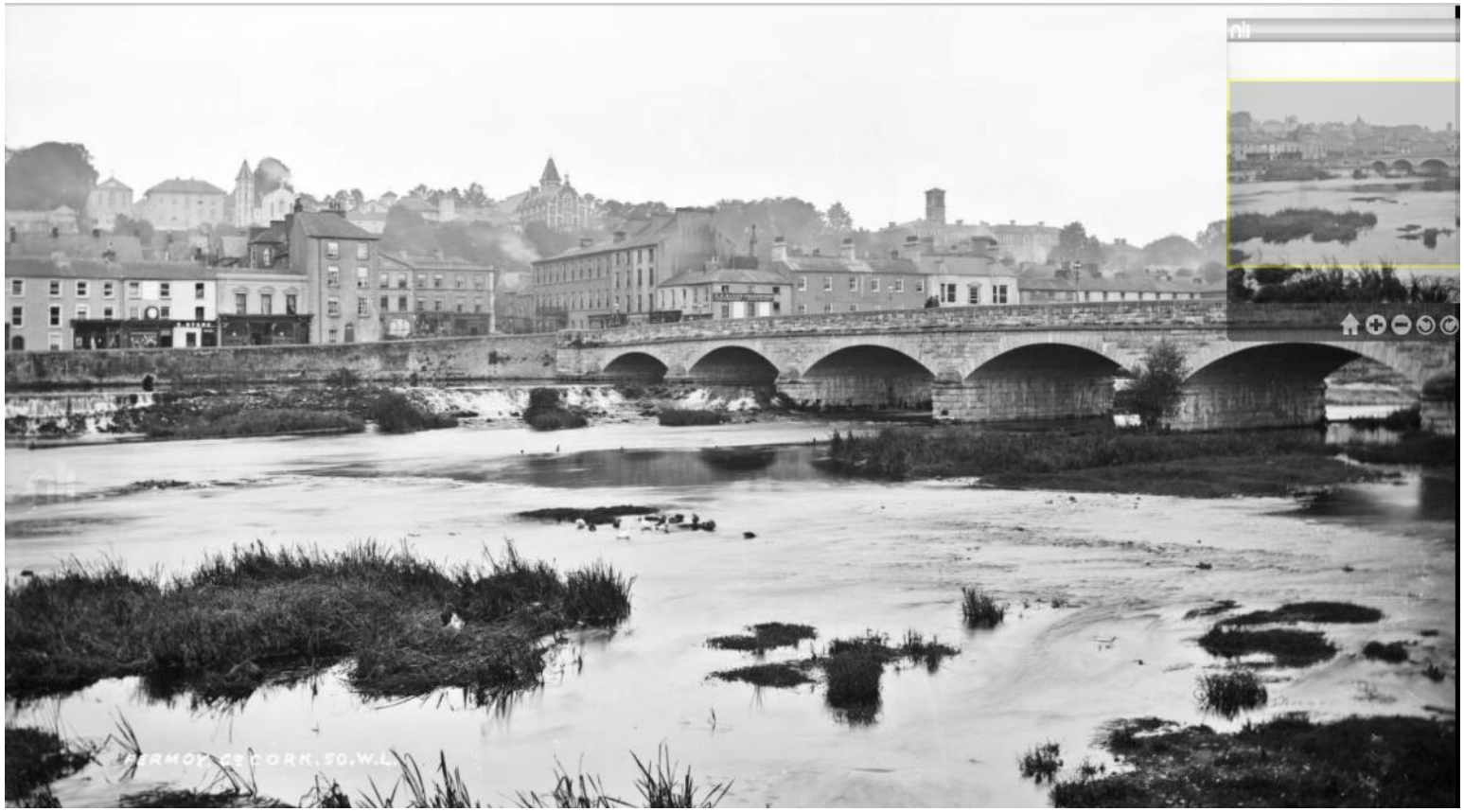
The mill race weir works could also be conducted at the same time as the crump weir works if the bypass channel is completed first and should only take one summer season. Alternatively, the damming / coffer damming this section of the weir could be undertaken earlier especially if the fact that the main

breach has now reached Mill Island and increases the risk of damaging flood defence works. A three-month construction period would in our professional opinion be a reasonable estimate of the time needed to complete the works to this section.

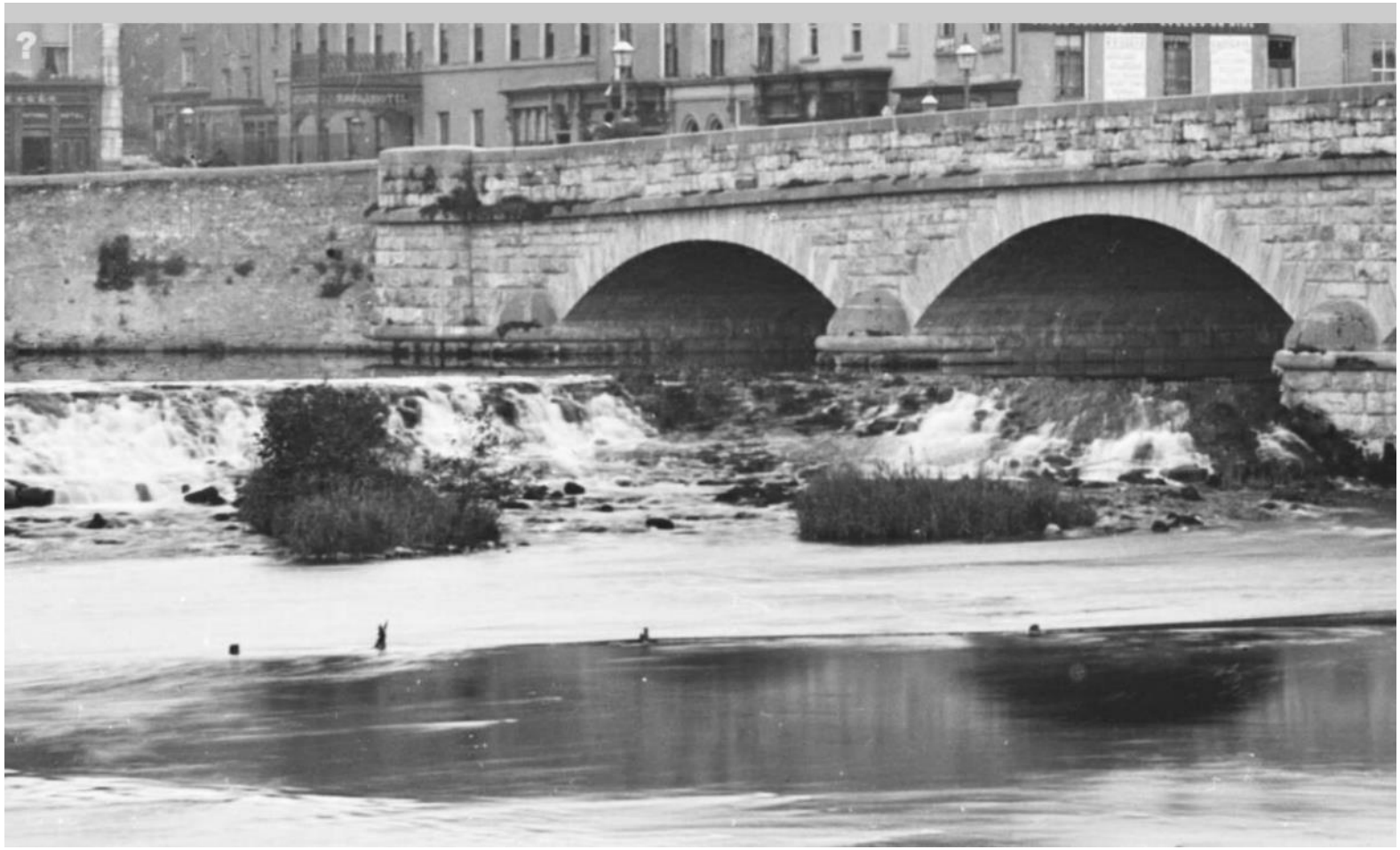
APPENDIX A

NATIONAL LIBRARY, PHOTOGRAPHS FROM

'THE LAWRENCE PHOTOGRAPHIC COLLECTION'

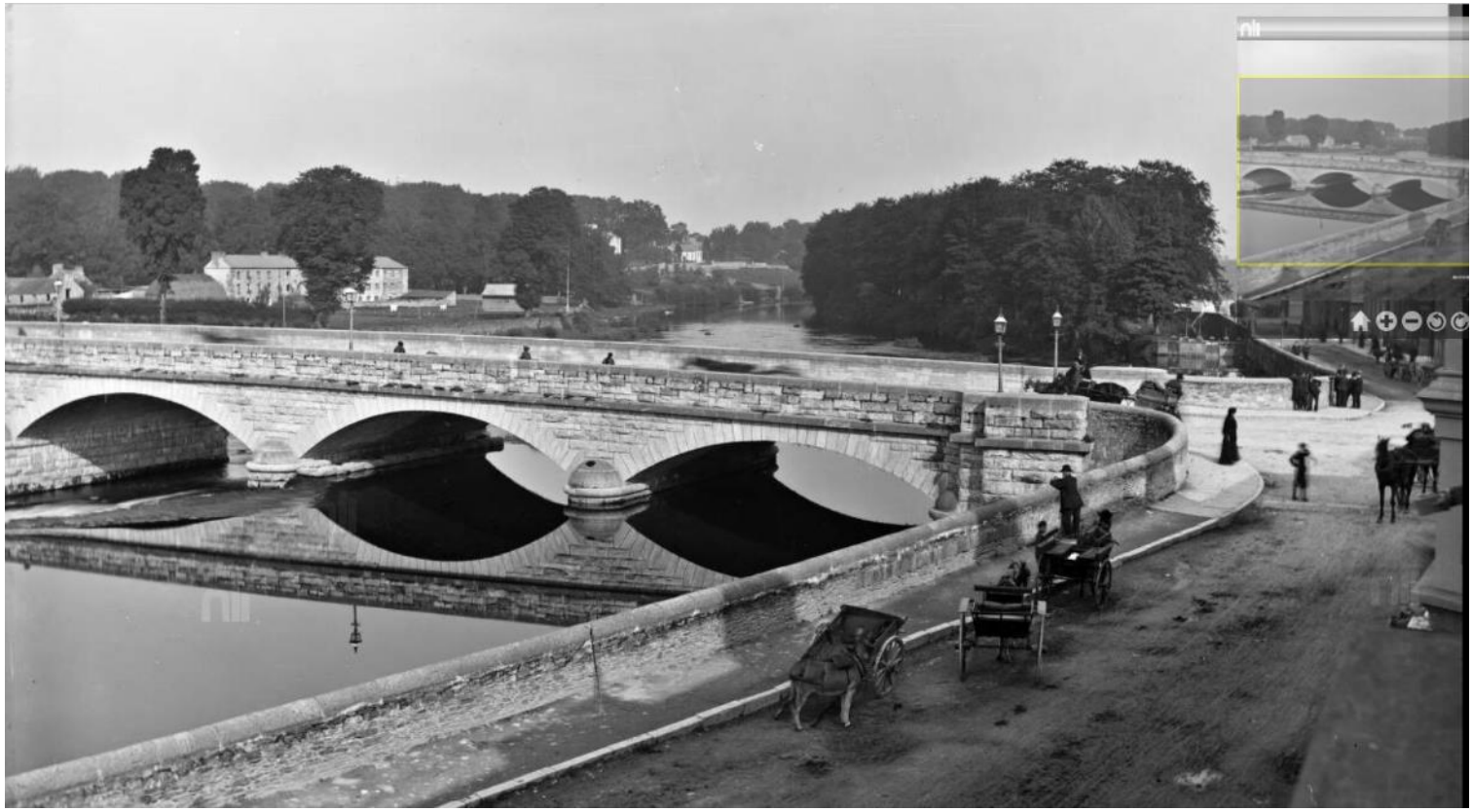


General View, Fermoy, Co. Cork [graphic]
by French, Robert, 1841-1917 photographer
Published / Created: [between ca. 1865-1914].
In collection: The Lawrence Photograph Collection
"...Fermoy. Co. Cork. 50. W. L...."

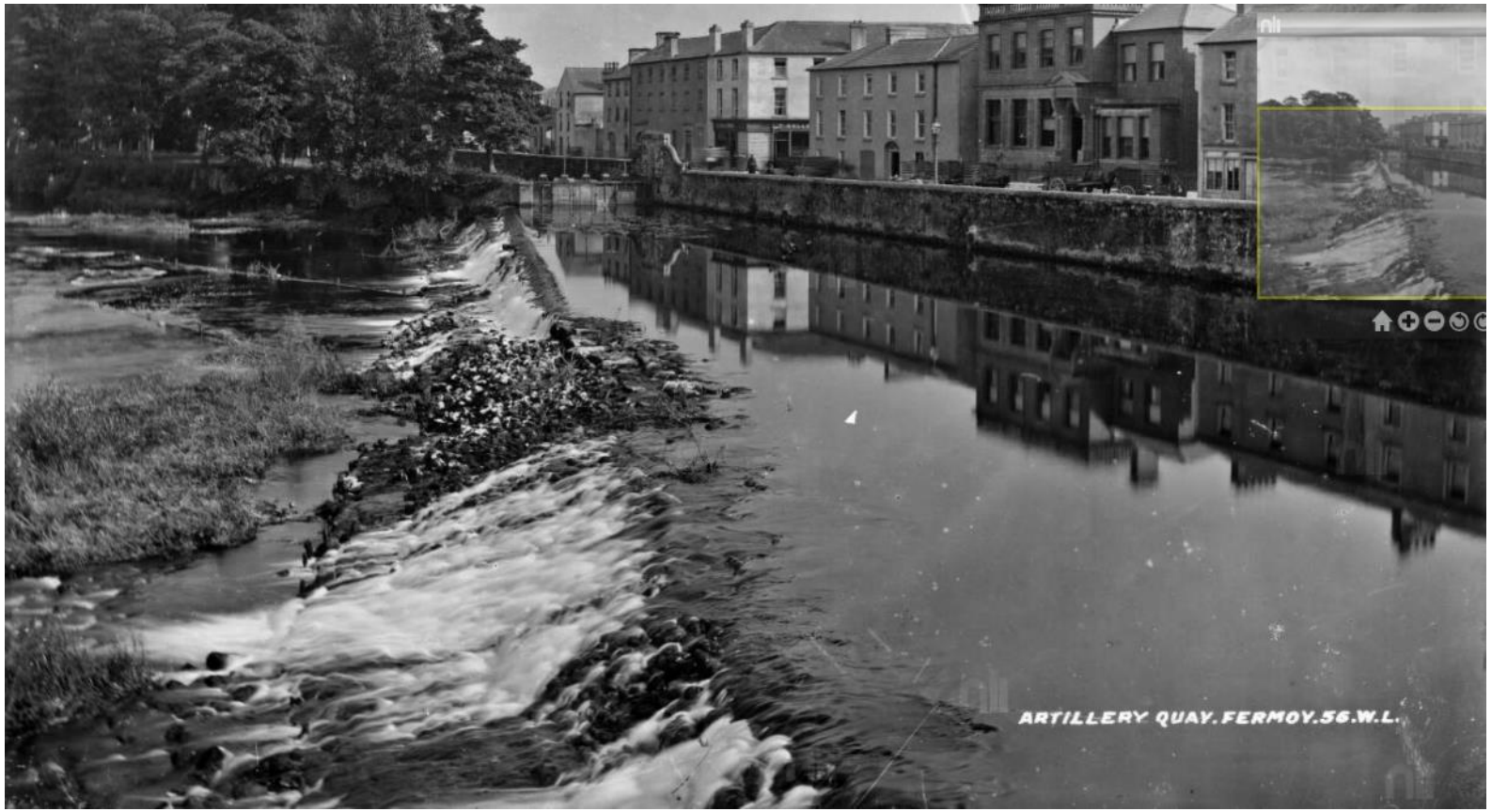


Enlargement of Previous

Blackwater River, Fermoy, Co. Cork [graphic]
by French, Robert, 1841-1917 photographer
Published / Created: [between ca. 1865-1914].
In collection: The Lawrence Photograph Collection
"…River Blackwater. Fermoy. 55. W. L….



Blackwater River (from Ashe Quay), Fermoy, Co. Cork [graphic]
by French, Robert, 1841-1917 photographer
Published / Created: [between ca. 1865-1914].
In collection: The Lawrence Photograph Collection
"…River Blackwater. Fermoy. 7218. W. L…."



Artillery Quay (Now O'Neill Crowley Quay), Fermoy, Co. Cork [graphic]
by French, Robert, 1841-1917 photographer
Published / Created: [between ca. 1865-1914].
In collection: The Lawrence Photograph Collection
"…Artillery Quay. Fermoy. 56. W. L…."

Enlargement of Previous

General View (Mill Race Weir), Fermoy, Co. Cork [graphic]
by French, Robert, 1841-1917 photographer
Published / Created: [between ca. 1865-1914].
In collection: The Lawrence Photograph Collection
"…Fermoy 1418. W. L…."

Salmon Leap, Fermoy, Co. Cork [graphic]
by French, Robert, 1841-1917 photographer
Published / Created: [between ca. 1865-1914].
In collection: The Lawrence Photograph Collection
"…Salmon Leap. Fermoy. 7216. W. L…."

Enlargement of Above showing weir crest close to top of masonry blockwork at Fish Pass

APPENDIX B

PHOTOGRAPHS

Photograph 1: View towards eastern end of weir and breached sections January 2020

Photograph 2: Southern end of weir note reduced water flow over weir January 2020

Photograph 3: Mill Race Weir section with Red Sandstone band of stonework

Photograph 4: Red Sandstone course on Mill Race Weir section

Photograph 5: Fill material within Mill Race Weir made up of random smaller stones as well as gravel

Photograph 6: Breach in weir and damage behind flood defence works

Photograph 7: View of part of back slope to Crump Weir section showing spalled concrete apron exposing original Limestone blockwork under

Photograph 8: Crump Weir section with stonework lain sideways up

Photograph 9: Crump weir limestone of random sizes laid perpendicularly

Photograph 10: Crump Weir section with concrete apron over Limestone blocks laid sideways up

Photograph 11: Crump Weir on downstream slope with Limestone blocks clearly visible in random pattern

Photograph 12: Undermining of concrete apron on down slope side of Crump Weir

Photograph 13: Fish Pass cut Limestone construction

Photograph 14: Cut Limestone block construction of Fish Pass

Photograph 15: Concrete capping and pipe to side intervention work within Fish Pass structure

Photograph 16: Steel and timber intervention works to collapsed section of Fish Pass structure

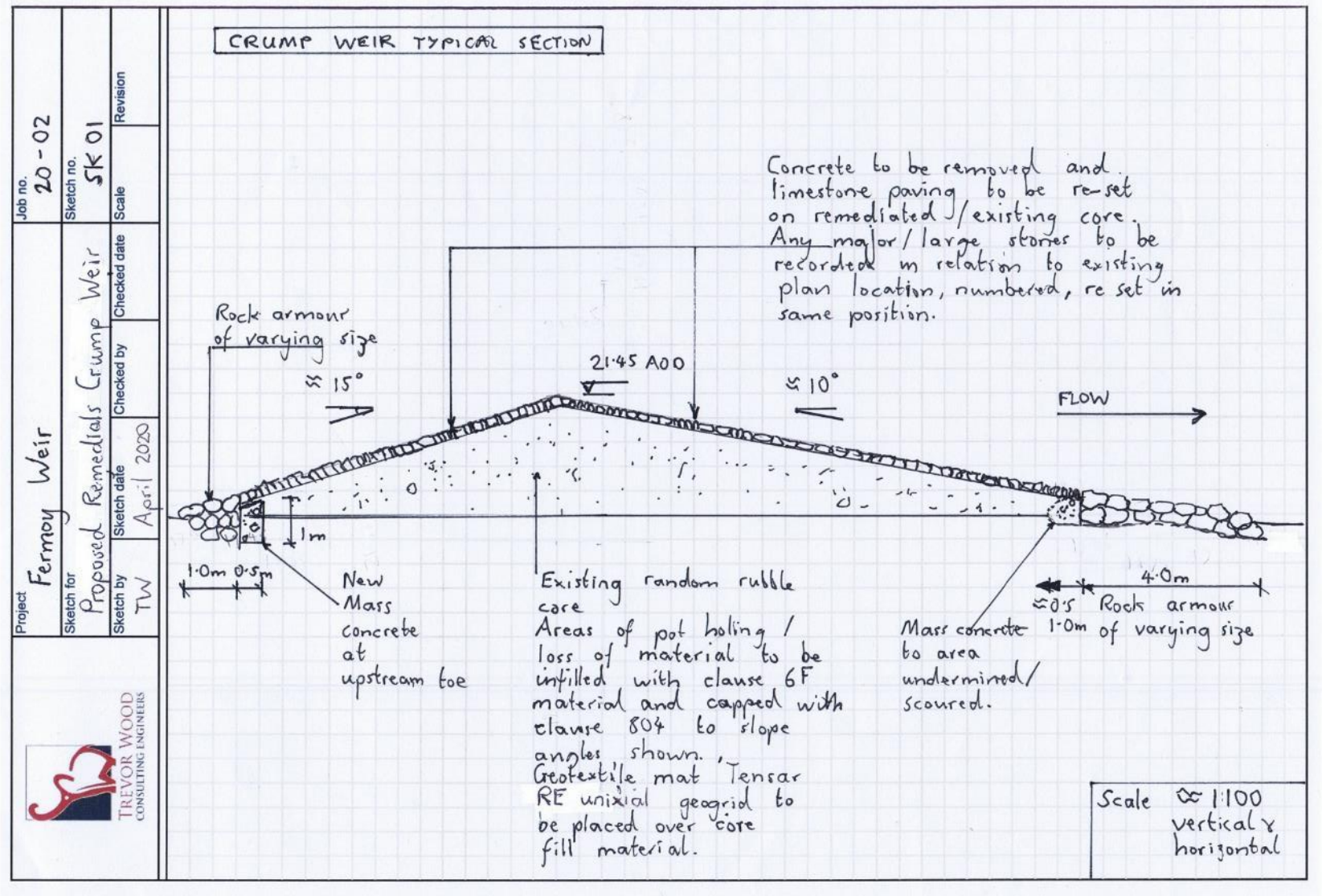
Photograph 17: Steel and timber intervention work to Fish Pass structure

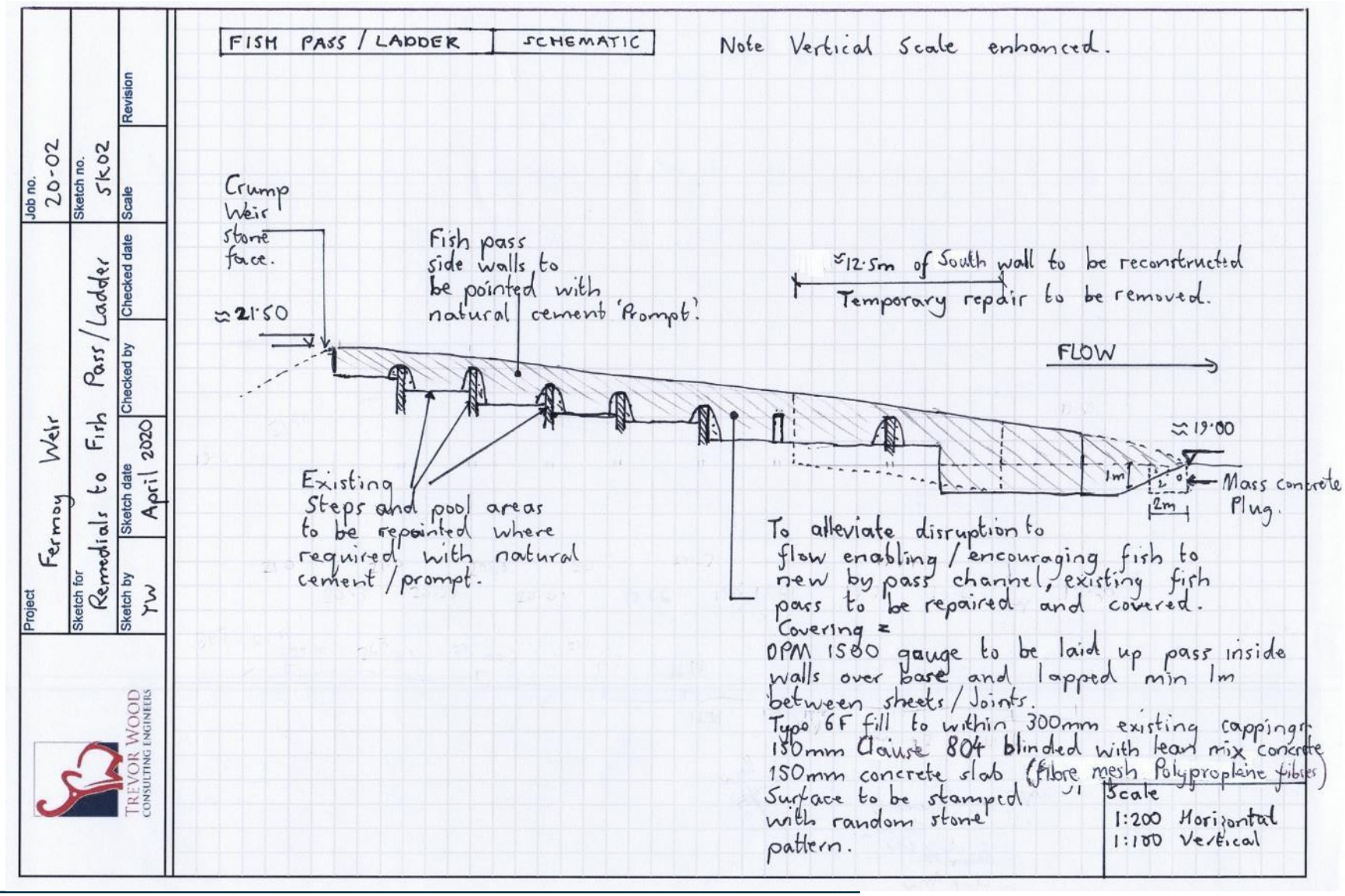
Photograph 18: Dislodged cut Limestone from Fish Pass structure

Photograph 19: Dislodged cut Limestone to Fish Pass structure

APPENDIX C

PRELIMINARY SKETCH DETAILS

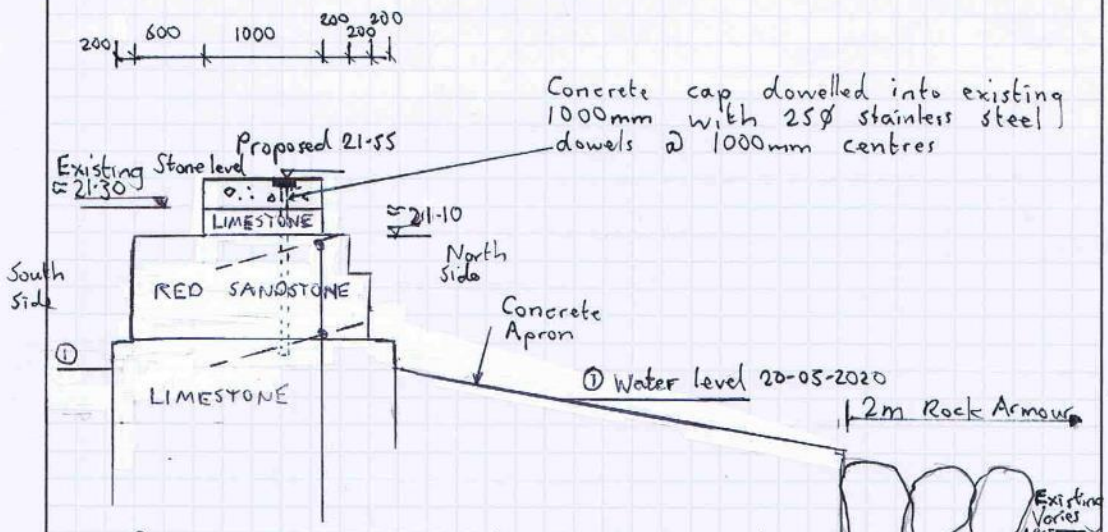

CRUMP WEIR TYPICAL SECTION
Concrete to be removed and limestone paving to be re-set on remediated / existing core. Any major / large stones to be recorded in relation to existing plan location, numbered, re set in same position.
Rock armour of varying size
≈ 15°
21·45 AOD
≈ 10°
FLOW
1m
1·0m 0·5m
New Mass concrete at upstream toe
Existing random rubble core
Areas of pot holing / loss of material to be infilled with clause 6F material and capped with clause 804 to slope angles shown. Geotextile mat Tensar RE unixial geogrid to be placed over core fill material.
Mass concrete to area undermined / scoured.
4·0m
≈0·5 1·0m Rock armour of varying size
Scale ≈ 1:100 vertical & horizontal
Project Fermoy Weir
Sketch for Proposed Remedials Crump Weir
Sketch by TW
Sketch date April 2020
Checked by
Checked date
Scale
Sketch no. SK 01
Job no. 20-02
Revision
TREVOR WOOD CONSULTING ENGINEERS


FISH PASS / LADDER SCHEMATIC
Note Vertical Scale enhanced.
Crump Weir stone face.
≈21·50
Fish pass side walls to be pointed with natural cement 'Prompt'.
≈12·5m of South wall to be reconstructed
Temporary repair to be removed.
FLOW
≈19·00
1m
2m
Mass concrete Plug.
Existing Steps and pool areas to be repointed where required with natural cement / prompt.
To alleviate disruption to flow enabling / encouraging fish to new by pass channel, existing fish pass to be repaired and covered.
Covering =
DPM 1500 gauge to be laid up pass inside walls over base and lapped min 1m between sheets / Joints.
Type 6F fill to within 300mm existing cappings.
150mm Clause 804 blinded with lean mix concrete
150mm concrete slab (Fibre mesh Polypropelene fibres)
Surface to be stamped with random stone pattern.
Scale
1:200 Horizontal
1:100 Vertical
Project Fermoy Weir
Sketch for Remedials to Fish Pass / Ladder
Sketch by YW
Sketch date April 2020
Checked by
Checked date
Scale
Sketch no. SK02
Job no. 20-02
Revision
TREVOR WOOD CONSULTING ENGINEERS

TREVOR WOOD CONSULTING ENGINEERS

	Project: Fermoy Weir			Job no.: 20-02	
	Sketch for: Proposed remedials Mill Race Weir 1 of 2			Sketch no.: Sk 03	
Sketch by: TW	Sketch date: July 2020	Checked by:	Checked date:	Scale:	Revision: (a) July 2020

Remedials to Existing Mill Race Weir Structure



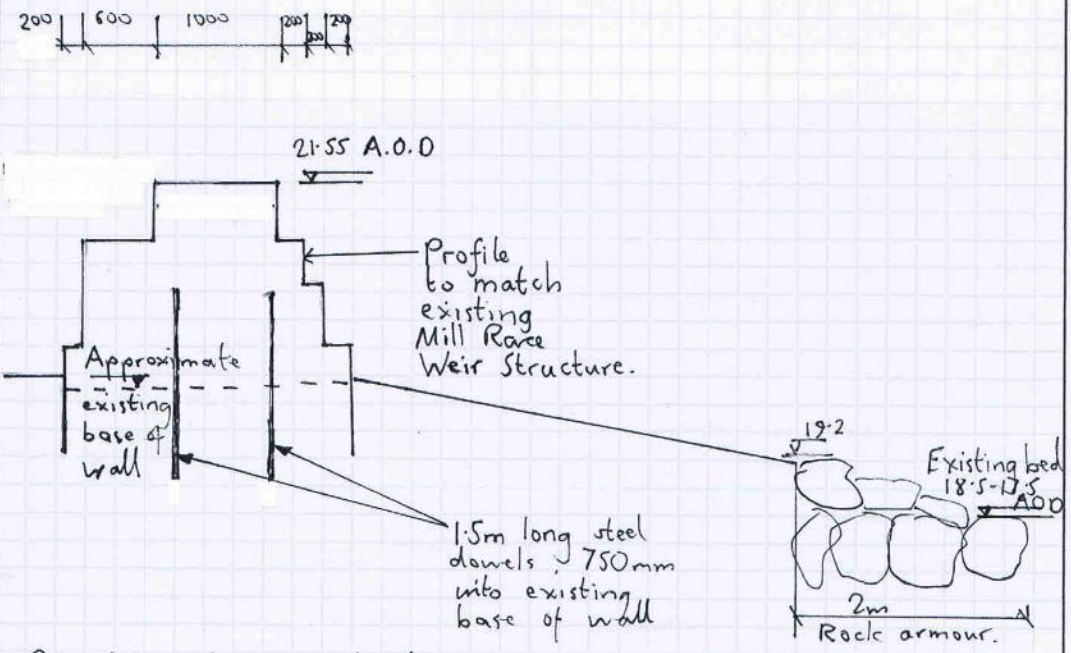
Pressure grouting after larger visible voids filled with rock & cobbles.
Array of grout tubes to be used along Mill Race Weir wall at 2 levels.
Natural cement grout ('Prompt' or similar.)
Re point all faces with struck pointing after 're-setting' dislodged missing stones. 'Prompt' / Natural cement to be used.

Scales
Vertical & Horizontal
1:50

TREVOR WOOD CONSULTING ENGINEERS

TREVOR WOOD CONSULTING ENGINEERS	Project: Fermoy Weir				Job no.: 20-02
	Sketch for: Proposed Remedials Mill Race Weir 2 of 2				Sketch no.: Sk 04
	Sketch by: TW	Sketch date: July 2020	Checked by:	Checked date:	Scale:	Revision: (a) July 2020

Reconstruction of Collapsed Section of Mill House Weir.



2 options for reconstruction.

1. ⇒ Reconstruct using mass concrete core dowelled into bed stones / original core. Face with 200mm thick stonework to match existing stone types and coursing. Stainless steel ties into core.

2 ⇒ As above but instead of stonework imprint concrete face with stone pattern / coursing / joint lines to create distinction between existing and new intervention works.

Scales
Vertical & Horizontal
1:50

APPENDIX C

Hydraulic Design Review Report - RHDHV

Technical Note

HaskoningDHV UK Ltd.
Water & Maritime

To:	T.J. O'Connor
From:	Mark Donoghue
Date:	Friday, 08 October 2021
Copy:	-
Our reference:	BI1645-RHD-ZZ-XX-NT-Z-0002
Classification:	Project related
Checked by:	Peter Brunner
Subject:	**Fermoy Fish Pass – Hydraulic Design Review**
	Appendix A – CFD Modelling Technical Note

1 Background

T.J. O'Connor & Associates have been engaged by Cork County Council to develop a scheme for the remediation of a 200-year-old protected weir structure on the river Blackwater at Fermoy and to provide a bypass channel for fish passage.

After undertaking a preliminary design assessment considering a range of options, T.J. O'Connor & Associates received approval from Cork County Council to proceed on the basis of remediation of the weir, mill race and existing fish pass alongside the construction of a rough channel pool bypass for fish passage on the north bank of the river.

T.J O'Connor commissioned Royal HaskoningDHV to assist in confirmation of the hydraulic design of the bypass channel in combination with the remediated weir.

This technical note presents the findings of the review of the hydraulic design of the fish pass.

2 Proposed Design

The proposed design overall comprises a bypass channel with a rough-channel pool pass (a combination of a close-to-nature style fish ramp and a technical pool and weir pass). The bottom ramp and pools are formed by embedded transverse boulder bars/weirs. The bypass comprises 13 weirs, set 7.9m apart (centre to centre), with each weir crest at 600mm above the bed. In each weir there are five, 0.5m (500mm) wide gaps/slots, to enable fish to swim up the bypass channel. The gaps/slots are staggered/offset in consecutive weirs for better dissipation of flow energy and to prevent discharge jets passing straight through pools. The average gradient of the bed of the bypass channel is approximately 1:10.

The following documents provided by T.J. O'Connor & Associates were reviewed:

- Draft / Issued for information drawing pack issued by (refer to drawing issue sheet dated 22/06/21).
- Spreadsheet: 19011-TJOC-XX-XX-CA-C-5500_Rough_Channel_Pool_Pass_Calculations.

3 Target Species

We understand that the fish pass is designed to provide passage for salmon, lamprey, trout, twaite shad, eels and crayfish. Salmon and river lamprey are qualifying interest features of the River Blackwater Special Area of Conservation (SAC). For the purposes of this review, it is assumed that the Fermoy Fish Pass will operate all year as opposed to shorter periods coinciding with movement patterns of particular species.

3.1 Fish passage flow criteria

Table 1 and **Table 2** provide approximate values of swim speeds and minimum depths for key fish species which the Fermoy Fish Pass should accommodate for a range of flows. It should be noted, if information on fish migration and flow is not available for the site, then it is suggested that the facility for upstream migration should be designed to operate across a flow range from Q90 to Q10 for salmon; Q95 to Q10 for sea trout and brown trout; Q50 to Q20 for coarse fish and shad; and Q99 to Q70 for eel.

It should be noted, on the condition that the flow velocity remains significantly less than the maximum speed, fish can swim more or less at their cruising speed through a fish pass.

Table 1 – *Generic Swim Speeds of Key Fish Species and Migration Windows*

Species	Mean Burst (Swim) Speed	Median Sustained Swim Speed	Maximum Swim Speed	Upstream Migration Window
Salmon	> 1.2 m/s	-	4.5 - 6.5 m/s	October to May (Key Spawning Season, although peak months are October to November for salmonids)
Sea / Brown Trout	1 35 m/s	1.17 m/s	1.8 - 5 m/s	
European Eel	1.14 m/s	0.25 m/s	Young eel < 0.5 m/s	
			Adult eel <1.5 m/s	
Coarse Fish (based on Chub)	1.3 m/s	0.93 m/s	4 m/s	April – July
Sea Lamprey	-	-	5 m/s	
River Lamprey	-	-	3.5 m/s	
Allis shad	-	-	4.1 - 6.1 m/s	
Twaite shad	1.52 - 2.06 m/s	0.44 – 0.59 m/s	2.7 - 5.4 m/s	

Source: IFM/Environment Agency Fish Pass Manual (2015); The ICE Protocol for Ecological Continuity-Assessing the Passage of Concepts, Design and Application (2014); CSAS Fish Swimming Performance Database and Analyses (2016)

Table 2 – *Generic Swim Depths of Key Fish Species*

Species	Minimum Depths (m)
Salmon	0.2 m
Sea / Brown Trout	0.05 m – 0.1 m
European Eel	0.2 m
Coarse Fish (based on Chub)	0.05 m – 0.1 m
Sea Lamprey	0.15 m
River Lamprey	
Allis shad	0.2 m – 0.3 m
Twaite shad	

Source: The ICE Protocol for Ecological Continuity-Assessing the Passage of Concepts, Design and Application (2014)

4 Computational Fluid Dynamics (CFD)

To inform the hydraulic design review, Computational Fluid Dynamics (CFD) model was used to determine if flow conditions within the fish bypass channel complied with the requirements for a variety of fish species (presented in **Table 1** and **Table 2**). A technical note on the CFD modelling exercise is provided to TJ O'Connor as separate deliverable with reference: BI1645-RHD-ZZ-XX-NT-Z-0001

An initial design option was tested in the CFD model, however results showed that the required velocity threshold was exceeded within most of the gaps/slots in the first (most upstream) fish pass weir. To reduce velocities, a revised option was modelled which incorporated increasing the width of three of the gaps/slots and incorporating a flat "sill" in the bed immediately upstream of the first weir.

The revised option of the design was tested for the three flow conditions (Q50, 0.7AADF and 1.0AADF). Results showed that the velocities remain relatively high i.e. above the $2ms^{-1}$ threshold stated in DVWK guidance within two of the five gaps at the first fish pass weir, however velocities in the other three gaps were tolerable for different fish species.

The CFD model results also show that there is no issue with exceeding the flow velocities threshold throughout the rest of the fish pass, where velocities are well below $1ms^{-1}$ and therefore compliant with the fish swim speeds in Table 1.

5 Design Review

Table 3 presents observations on the proposed design against key criteria for a fish pass.

Table 3 – *Key Criteria of Fish Pass and Suitability of Proposed Design*

<table>
<tr><th>Item</th><th>Criteria</th><th>Proposed Design</th></tr>
<tr><td>1</td><td>The size of the fish pass required is dictated by the flow requirements which are either larger than 12.5% of the long-term mean flow or 50% of the flow upstream of the weir as advised by Inland Fisheries Ireland (IFI), the governing body responsible for reviewing and approving the design of fish passes.</td><td>Calculations provided give:
<table>
<tr><th>Event</th><th>Bypass flow m^3s^{-1}</th><th>% of total flow in bypass</th></tr>
<tr><td>Q95</td><td>8.582</td><td>100</td></tr>
<tr><td>0.7AADF</td><td>17.150</td><td>52</td></tr>
<tr><td>1.0AADF</td><td>20.298</td><td>43</td></tr>
</table>
AADF is 47.4 m^3s^{-1}.
12.5% of AADF is 5.9 m^3s^{-1}

Given the length of the existing weir crest, it would be extremely difficult to accurately split the low flows between the main channel and bypass and therefore 100% of the Q95 flow through the bypass is prudent.

The 43% of AADF in the bypass is slightly outside the IFI recommendations. However, this still represents a significant proportion of the flow. Alternate guidance from the IFM Fish Pass Manual recommends a minimum of 5% AADF and if possible “considerably more (≥10%)” in order to provide a sensible size of fishway with good attraction for watercourses in England & Wales.</td></tr>
<tr><td>2</td><td>For the entrance of a fishway to be detected by the majority of upstream migrating organisms, it must be positioned at the bank of the river where the current is highest. Placing the outflow of the fish pass in the immediate vicinity of the weir minimizes the formation of a dead zone between the obstruction and the fish pass entrance, increasing the likelihood of fish finding the pass. (DVWK, 2002).</td><td>Entrance well located on left bank at upstream extent of existing weir.</td></tr>
</table>

Item	Criteria	Proposed Design
3	Entrance must be positioned where fish concentrate while moving upstream; and if possible, the entrance of the fish pass should be at the bank, parallel to the main direct of flow. Attracting current that leaves the fish pass entrance at a maximum angle of 45 degrees is the most effective for fish (DVWK, 2002).	Entrance well positioned. The orientation of the existing weir will lead to fish moving upstream along the structure, attracted towards the flows emerging from the bypass channel. Existing salmon leap to be infilled to focus flows in bypass channel.
4	The bottom of a fish pass should be covered along its whole length with a layer at least 0.2 m thick of a coarse substrate. Ideally the substrate should be typical for the river. From the hydraulic engineering point of view, a coarse substrate is necessary for the creation of an erosion-resistant bottom; while providing a suitable substrate for eels and lamprey. However, the bottom material used for this should be as close to natural as possible and should form a mosaic of interstices with a variety of differently sized and shaped gaps due to the varied grain size. (DVWK, 2002).	Long section (0054) “Selected suitable river gravels, excavated from downstream channel”. “500mm layer of quarry run rock, max size 250kg.
5	Downstream extent: The velocity at which the attracting current exits the fish pass should be within the range of 0.8 to 2.0 m s^{-1}. Generally, except for special cases, flow velocity should not exceed 2.1ms^{-1} (DVWK, 2002).	CFD modelling indicates velocities less than 1.0ms^{-1} at the downstream extent of the bypass channel for all modelled events.
6	Upstream extent: Strong turbulence greater than 2ms^{-1} must be avoided at the exit area of the fish pass (DVWK, 2002).	CFD modelling indicates general channel velocities less than 1.0ms^{-1} at the upstream extent of the bypass channel for all modelled events. Flow velocities local to the gaps/slots in the upstream weir are slightly greater but remain below 2ms^{-1} for all modelled events.
7	The maximum permissible flow velocity in fish passes is 2.0ms^{-1} (DVWK, 2002).	CFD modelling indicates flow velocities lower than 2.0ms^{-1} throughout the pass. Higher velocities are identified local to the low flow channel / slots in the upstream weirs. Perturbance boulders could be added to disrupt flow and slow velocities in the upper pools. Included on plan drawing (0053) throughout all pools (“Perturbation boulders, random placement”). No details are provided but these will need to be sized,

<table>
<tr><th>Item</th><th>Criteria</th><th>Proposed Design</th></tr>
<tr><td></td><td></td><td>distributed and secured/embedded to suit flow conditions.

Velocities may appear high for eels, however the nature of the bed and bank material (natural rock with interstices) should provide an effective substrate to ease movement. This may also assist passage of lamprey.

The proposed pass may not be suitable for shad as this species is known to have very specific requirements. These fish have been found to require the presence of vertical visual references, and enough free space to accommodate the passage of large shoals of fish at the same time. The IFM Fish Pass Manual states that vertical slot passes with a minimum free gap of 0.45m have been found to be the only truly effective pass for shad. The 0.5m width of the gaps in the boulder bars aligns with this requirement and modelled flow velocities are appropriate, however monitoring is recommended to confirm efficacy.</td></tr>
<tr><td>8</td><td>Volumetric power dissipation should be limited to 150 – 200 W/m^3 (DVWK, 2002).</td><td>Volumetric power dissipations calculated for the 12 pools are comfortably within the limits for all modelled flows. The IFM Fish Pass Manual recommends that as the number of pools increases, maximum values should be at the lower end of the acceptable range.
<table>
<tr><th>Event</th><th>Max power dissipation W/m^3</th><th>Min power dissipation W/m^3</th></tr>
<tr><td>Q95</td><td>80</td><td>30</td></tr>
<tr><td>0.7AADF</td><td>120</td><td>50</td></tr>
<tr><td>1.0AADF</td><td>130</td><td>60</td></tr>
</table>
There is scope to include perturbance boulders to further dissipate energy without significant reduction in pool volume. This approach may be prudent</td></tr>
</table>

Item	Criteria	Proposed Design
		to disturb the jets from the gaps / slots in the upstream weir/bar.
9	The width of the rough-channel pool pass channel should not be less than 1.5 m and the clear distance between the boulder bars should be 1.5 to 2.5 m. The minimum water depth required is h = 0.4 m (DVWK, 2002).	Mean channel width 28m, distance between boulder bars 6.9m (7.9m centre to centre). CFD modelling indicates minimum water depth in all pools is greater than 0.4m in all the modelled flows.

6 Conclusion

Based on a review of the information provided and a CFD modelling exercise, the proposed fish pass design at Fermoy will provide suitable hydraulic conditions for passage of a range of target fish species.

It should be noted that the DVWK guidance suggests that the characteristics of irregular rough-channel pool passes cannot be calculated accurately and that a degree of testing and modification should be allowed for during the construction phase. Post construction monitoring of the efficacy of the fish pass for the various target species is also recommended, particularly for shad.

7 References

(DVWK, 2002). Fish Passes: Design, Dimensions and Monitoring.

Institute of Fisheries Management (IFM)(2015). Fish Pass Manual: Guidance Notes on The Legislation, Selection and Approval of Fish Passes in England And Wales. (First Prepared by the Environment Agency).

APPENDIX D

Computational Fluid Dynamics (CFD) Modelling Report - RHDHV

Technical Note

HaskoningDHV UK Ltd.
Water & Maritime

To:	TJ O'Connor
From:	Katarzyna Bozek
Date:	Friday, 15 October 2021
Copy:	Michael Vaughan, Diarmuid Cahalane
Our reference:	Bi1645-RHD-ZZ-XX-NT-Z-0001
Classification:	Project related
Checked by:	Matthijs Bos, Mark Donoghue
Subject:	**Fermoy Fish Bypass – CFD Modelling**

1 Introduction

TJ O'Connor has commissioned Royal HaskoningDHV to assist in confirmation of the proposed hydraulic design of a fish bypass channel around the weir on the Blackwater River at Fermoy, Ireland. Approximate location of the proposed fish pass (outlined in brown) is presented in **Figure 1**.

Scope of works comprises a hydraulic design review of the bypass channel and remediated existing weir at Fermoy Bridge. To inform the hydraulic design review, Computational Fluid Dynamics (CFD) model was required to determine if velocities within the fish pass (bypass channel) comply with the maximum speed requirements for a variety of fish species.

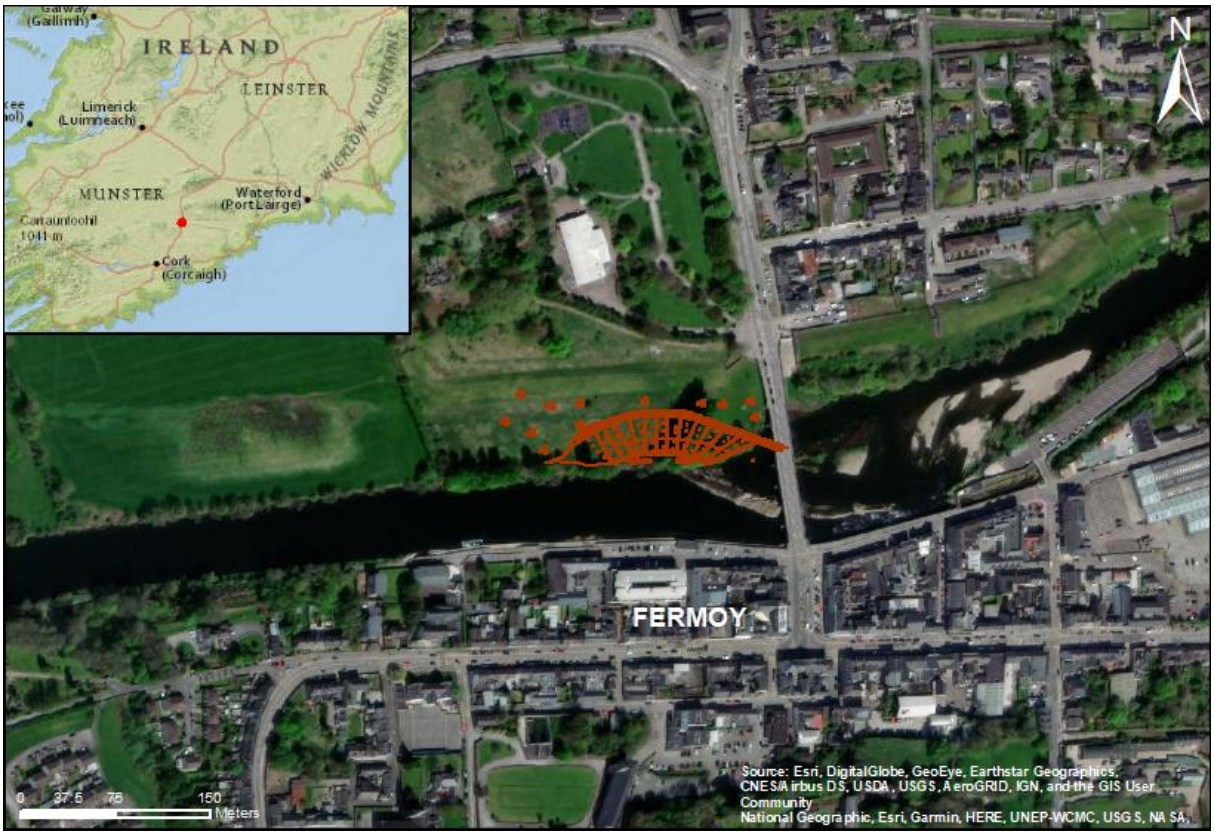


Figure 1: Location of the proposed Fish Bypass at Fermoy, Ireland

For the design review, criteria for the maximum velocity within fish passage were adopted from the 'Fish Passes, Design, Dimensions and Monitoring' guidance (DVWK, 2002) [1] that states: "*Except for special cases flow velocity should not exceed 2ms-1"*. Therefore, when analysing the results, speeds within the fish pass were compared to the 2m/s maximum tolerable velocity for most fish species.

This technical note provides description of the undertaken CFD modelling and presents model results with discussion on the bypass channel meeting the velocity requirements for various fish species. This technical note forms an Appendix to the Design Review Technical Note (BI1645-RHD-ZZ-XX-NT-Z-0002).

2 CFD Model Set-up

2.1 Software selection

For the purpose of this CFD modelling PHOENICS 2020 software package developed by CHAM was chosen. Its name is an acronym for Parabolic Hyperbolic Or Elliptic Numerical Integration Code Series, wherein "parabolic", "hyperbolic" and "elliptic" distinguish the underlying equations. The PHOENICS package is a reliable, cost-effective CFD program with a proven track record of simulating scenarios involving fluid flow, heat or mass transfer and chemical reactions for a wide range of applications.

PHOENICS distinguishes itself from other CFD software through its ease of use and inclusion of innovative features all designed to help the user achieve the best simulation possible.

PHOENICS is a general-purpose software package which uses the techniques of CFD (i.e. Computational Fluid Dynamics) to predict quantitatively:

- how fluids (air, water, steam, oil, blood, etc) flow in and around:
    - engines;
    - process equipment;
    - buildings;
    - human beings;
    - lakes, river and oceans;
    - and so on;
- what are the associated changes of temperature and of chemical and physical composition;
- what are the associated stresses in the immersed or surrounding solids.

As PHOENICS offers both steady and transient simulations for single phase or free surface models, it makes it a great tool to assess flow distribution and velocities within the fish pass at Fermoy. Further information about PHOENICS is available on the CHAM's website: http://www.cham.co.uk/phoenics.php

[1] Food and Agriculture Organization of the United Nations in arrangement with Deutscher Verband für Wasserwirtschaft und Kulturbau e.V. (DVWK), 2002. Fish Passes, Design, Dimensions and Monitoring.

2.2 Model domain

To effectively simulate the proposed fish pass within the CFD model, a 450m long section of the Blackwater River channel was included in the model. This domain size was selected to consider sufficient distance upstream of the fish pass to stabilise the flow from the input boundary before approaching the fish pass and similarly, the downstream boundary was set far enough the channel not to have influence of the boundary at the Fermoy weir (**Figure 2**). Furthermore, limiting the domain size enabled adopting greater resolution of the model mesh around the areas of interest within the fish pass whilst not impacting significantly computational time.

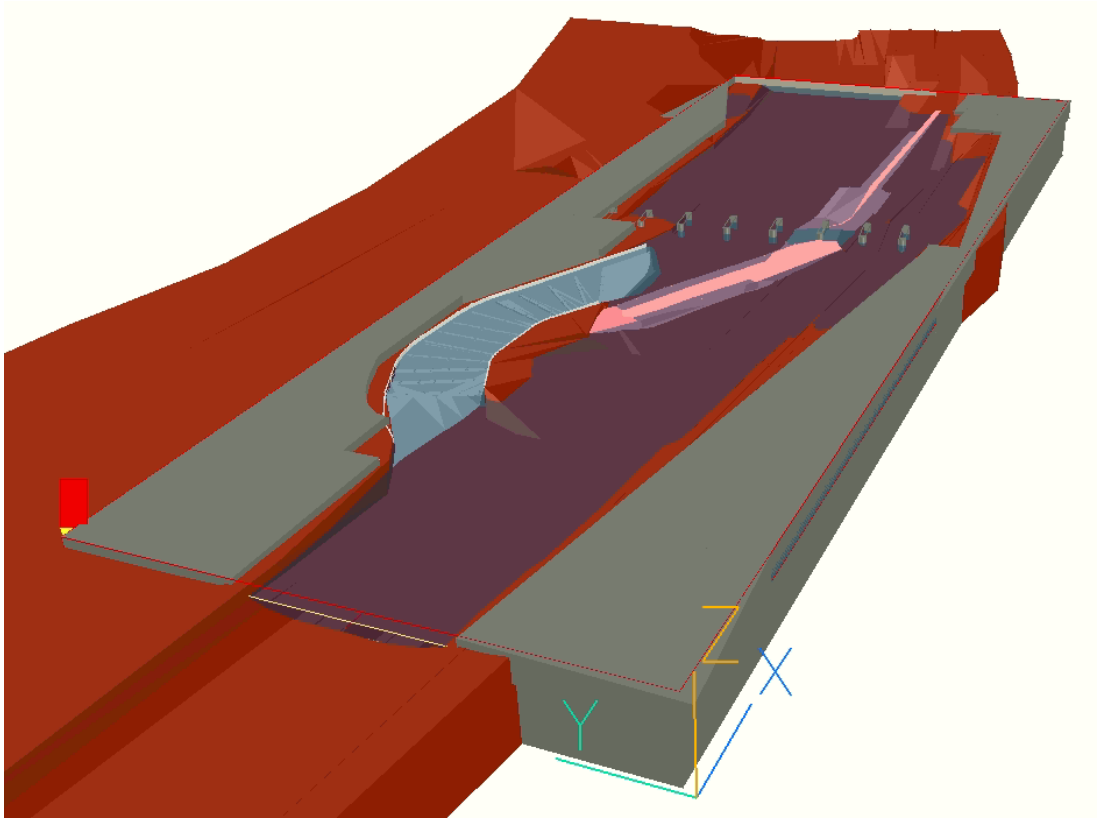


Figure 2:Full extent of the 3D computational domain for the Fermoy fish pass model.

Since the model domain is rectangular, and the shape of the river and fish pass channels is not regular, the model domain was filled with 'blockage' objects to prevent flow of fluid (water) in areas where it should not occur (grey objects in **Figure 2**). This was to prevent model instabilities, otherwise the model would try to solve flow equations for every 'free' space. This also helped to reduce the computational time of the simulations.

Geometry of the Blackwater River channel was constructed based on information provided by the TJ O'Connor. This included spot levels within the channel available from the provided design drawings as well as additional cross-sections (in csv format) of the river from a 2002 channel survey.

Mesh resolution was set to effectively resolve flow velocities through the narrow slots in the fish pass and around the bridge piers as well as flow depth through the pass and over the Fermoy weir. **Figure 3** illustrates the change in mesh resolution at the approach and at the entrance to the fish pass. In other areas the mesh resolution was limited, specifically the vertical mesh size within the ground and air, to reduce computational time of the simulation.

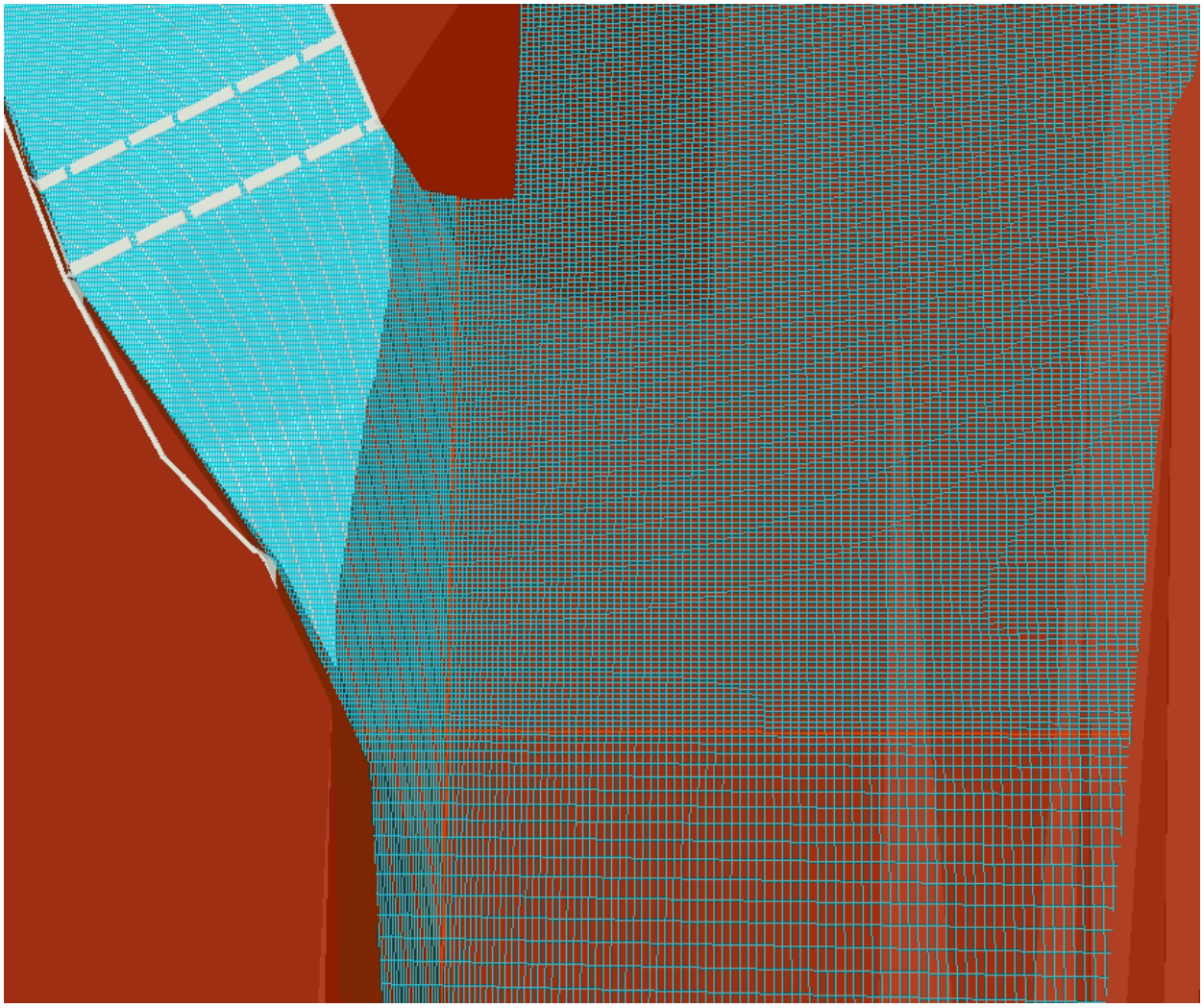


Figure 3:Mesh resolution in the CFD model

2.3 Proposed fish pass design

The proposed design comprises new fish bypass channel and re-constructed existing Fermoy weir, including the embankment section as well as the Mill Race section. In addition, the design assumes re-construction of the existing salmon leap for visual purposes only, i.e. it would not act as passage for salmon (entrance would be blocked) and therefore would not carry any flow. As such, the salmon leap was not specifically included in the CFD model but rather filled as 'blockage' object.

The geometry of the proposed fish pass and its weirs were defined based on the drawings provided by TJ O'Connor. These included plan views, long-sections and cross-sections of all design elements. Extract from the fish pass plan drawing upstream of the Fermoy Bridge is presented in **Figure 4**.

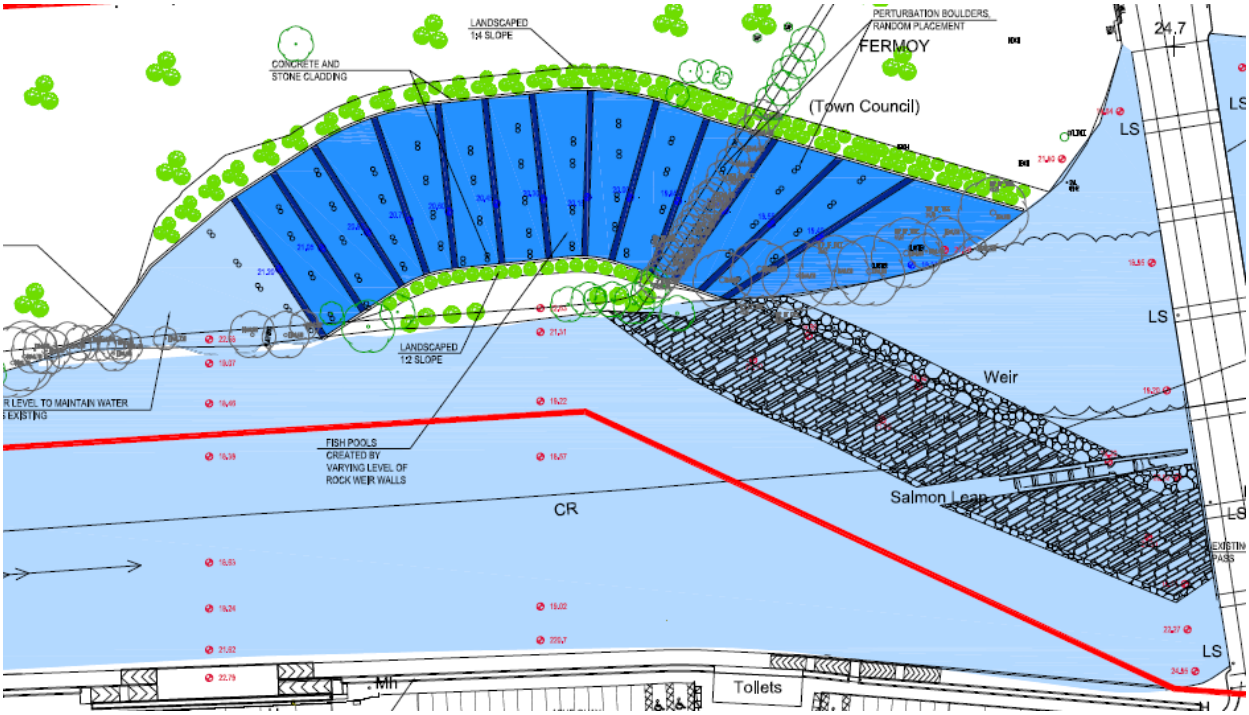


Figure 4: Proposed Fish Pass Plan – extract from drawing no. 19011-TJOC-PL-XX-DR-C-0053

The design of the fish pass comprises 13 weirs, set 7.9m apart (centre to centre), each weir crest at 600mm above the bed. In each weir there are 5 gaps, 500mm wide, to enable fish to swim up the bypass channel. The gaps are staggered, i.e. not at the same location in consecutive weirs, not to create a straight 'channel; that would results in high velocities.

The drop between the fish pass weirs is set to 150mm. The approximate total length of the fish pass is 113m. The first weir crest was set to 21.2mOD, whereas the last one was set to 19.3mOD with the bed downstream at 19.1mOD to tie into the existing river channel. The representation of the fish pass in the CFD model is presented in **Figure 5**.

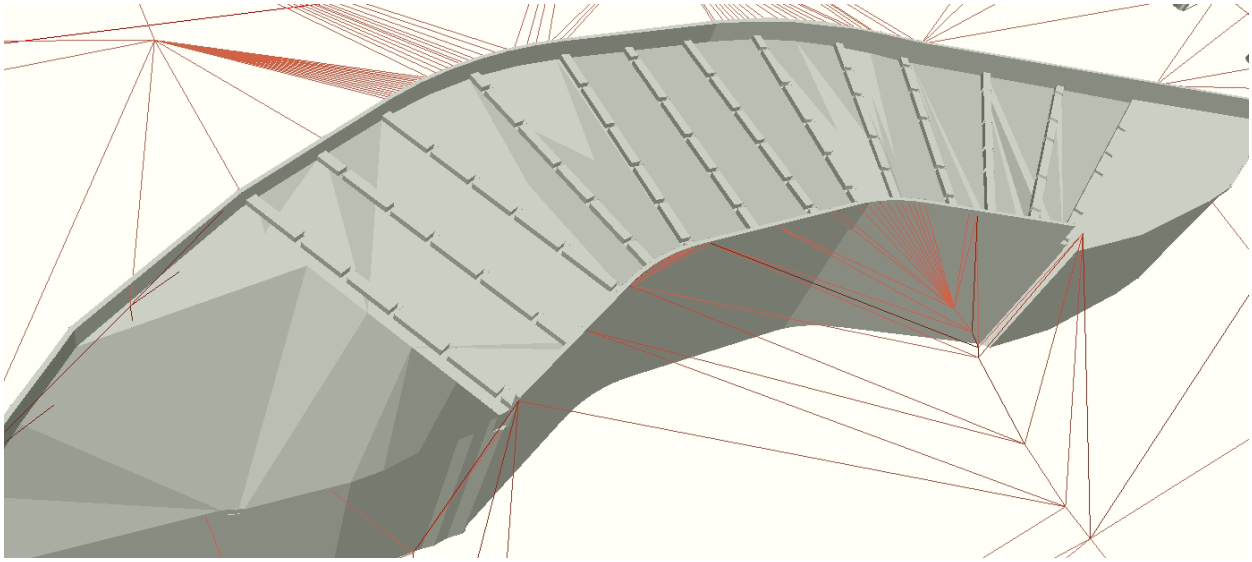


Figure 5: Representation of the fish pass channel in the CFD model

The re-constructed Fermoy weir crest was set to 21.45mOD for the embankment section and 21.55mOD for the Mill Race section. Extract from the weir plan drawing is presented in **Figure 6**.

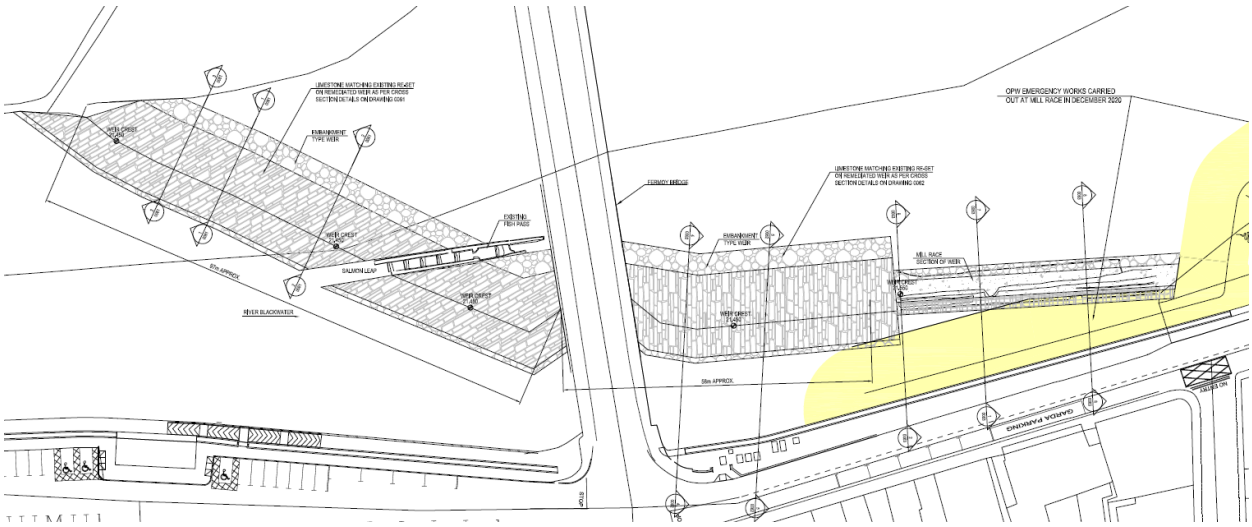


Figure 6: Proposed Re-constructed Fermoy Weir Plan – extract from drawing no. 19011-TJOC-PL-XX-DR-C-0060

2.4 Boundary conditions

The CFD model was setup using a free surface volume of fluid (VOF) method to most effectively resolve the water-air interaction in turbulent flows through the fish pass and over the weir. Initially, extent of the two densities were set in the model, i.e. air as the 'Light fluid' and water as the 'Heavy fluid'. The height of the heavy fluid was adopted based on the water level upstream for the respective flow conditions.

To verify the velocities within the fish pass and water depth over the Fermoy weir, three river flow scenarios were tested in the CFD model. These are: Q95 (flow exceeded 95% of the time and is typical of a dry summer flow), 0.7 annual average daily flow (AADF) and 1 AADF. The three flows were used as the initial conditions for each respective scenario and are shown in **Table 1**.

The Q95 flow is the smallest flow of the three tested conditions and hence has the lowest corresponding water level. This water level does not reach above the Fermoy weir crest (embankment or Milla Race sections) and therefore 100% of the river flow would pass through the fish pass. That is because of design requirements, where flow through the fish pass should be either 12.5% of the long-term mean flow or 50% of the flow upstream of the weir, whichever is larger. Since 12.5% of 1 AADF is approximately 5.93m^3/s and Q95 flow is only 8.52m^3/s, it would not be possible to control the flow over the main Fermoy weir (considering its size) within the remaining 2.59m^3/s, hence the total Q95 flow was designed to pass through the fish pass only.

For the other two flow conditions, the total flow is higher and the corresponding water levels are above both the embankment and Mill Race sections of the Fermoy weir. As such, the total flow is split between the main river and the fish bypass channel. The upstream water levels and flow split for each considered flow conditions are presented in **Table 1** below**.**

Table 1: Initial conditions for each flow scenario

Flow Scenario	Flow Rate (Q, m^3/s)	Upstream Water Level (mOD)	% of Total Flow in Fish Pass
95%	8.52	21.45	100%
0.7 AADF	33.17	21.64	52%
1 AADF	47.41	21.70	43%

2.5 Model settings

For the purpose of this CFD modelling, a One Phase Free Surface (transient) simulation was chosen with defined portion of the domain filled with specified fluid, in this case, water at 20°C. The rest of the domain was set to Air at 20°C with ambient pressure of 1013hPa. As discussed in **section 2.4**, the height of the water within the domain was defined based on upstream water levels for each tested flow condition presented in **Table 1**.

PHOENICS provides the standard high-Reynolds-number form of the two- equation eddy-viscosity KE-EP turbulence model. This model employs a single time scale (KE/EP) to characterize the various dynamic processes occurring in turbulent flows. In order to remedy this deficiency of a single-scale approach in the standard model, Chen and Kim (hereafter referred to as CK) proposed a modification which improves the dynamic response of the EP equation by introducing an additional time scale (KE/PK), where PK is the volumetric production rate of KE. When re-circulation, or other strong elliptic effects, are dominant, one of the 2- or 4-equation turbulence models, such as k-epsilon in Chen-Kim two-equation k-e model, is appropriate and is superior to the standard k-epsilon model. Based on the above, the Chen-Kim two-equation k-e model was applied in this study.

The CFD model has limited options when it comes to defining materials the structures are made of. There is no specific option for rock and as such, the fish pass channel and its weirs in the model was constructed as 'solid with smooth-wall friction'. This is considered as a conservative approach since 'smoother' surface would result in slightly higher velocities than 'rougher' surface.

Other numerical settings of the CFD model were set as default as advised by the software developer.

3 Model Results

3.1 Initial design option

An initial fish pass design discussed in **section 2.3** was tested for the highest flow condition, i.e., 1 AADF, with **Figure 7** – **Figure 9** present flow velocities at the entrance and exit of the fish pass at various vertical slices representing horizontal planes at specified levels.

At the entrance of the fish pass at 20.8mOD, i.e. 0.2m above bed of the fish pass (**Figure 7**) the flow velocity exceeds the adopted threshold of 2m/s through 3 of the gaps within the first fish pass weir, with maximum velocity above 2.4m/s. Only within the first, most southern gap, the velocity is within 1.5m/s. The same situation is at 21.0mOD vertical slice showing that the velocities above the 2m/s are within the height of the gap and not just near bed. Velocities over the first fish pass weir are within the 2m/s threshold, as presented in **Figure 8**.

In contrast, in the second half of the fish pass towards the downstream end, the flow velocity is lower, i.e. between 0.3 - 0.75m/s, as presented in **Figure 8**. That is due to the fact that within the lower section of the fish pass the weirs and gaps are drowned out to a greater depth and the water flowing down the fish pass 'slows down' when it meets the river flow at the downstream end. **Figure 8** also shows slightly higher velocities around the outer bend of the fish pass and slightly lower on the inner bend. This is to be expected considering the angle of the approaching flow when diverted into the fish pass.

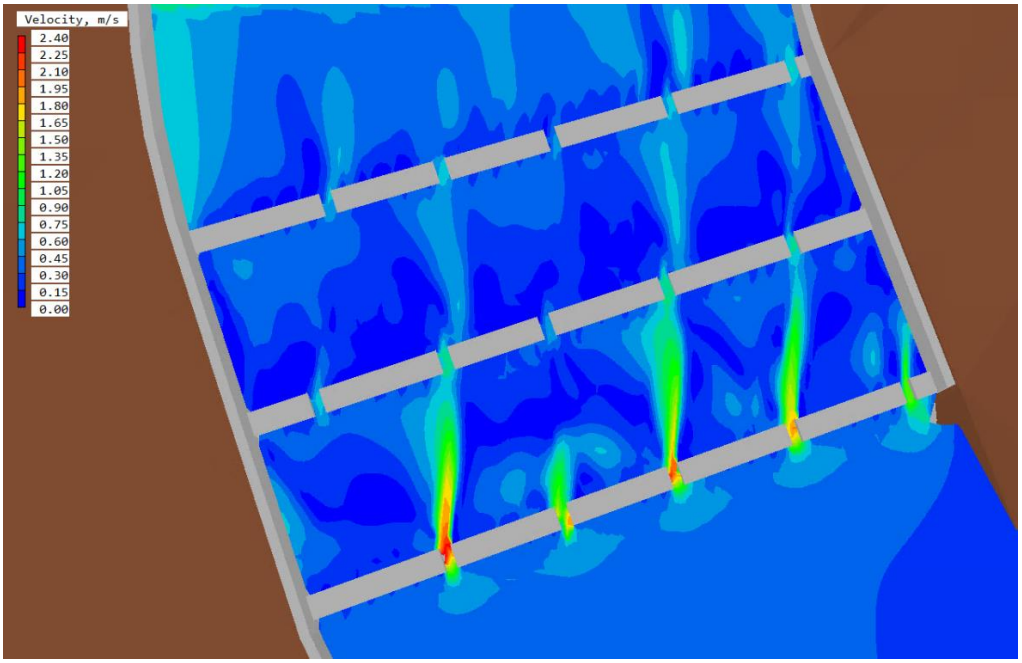


Figure 7:Velocity through the entrance to the fish pass for the 1.0AADF scenario – vertical slice at 20.8mOD

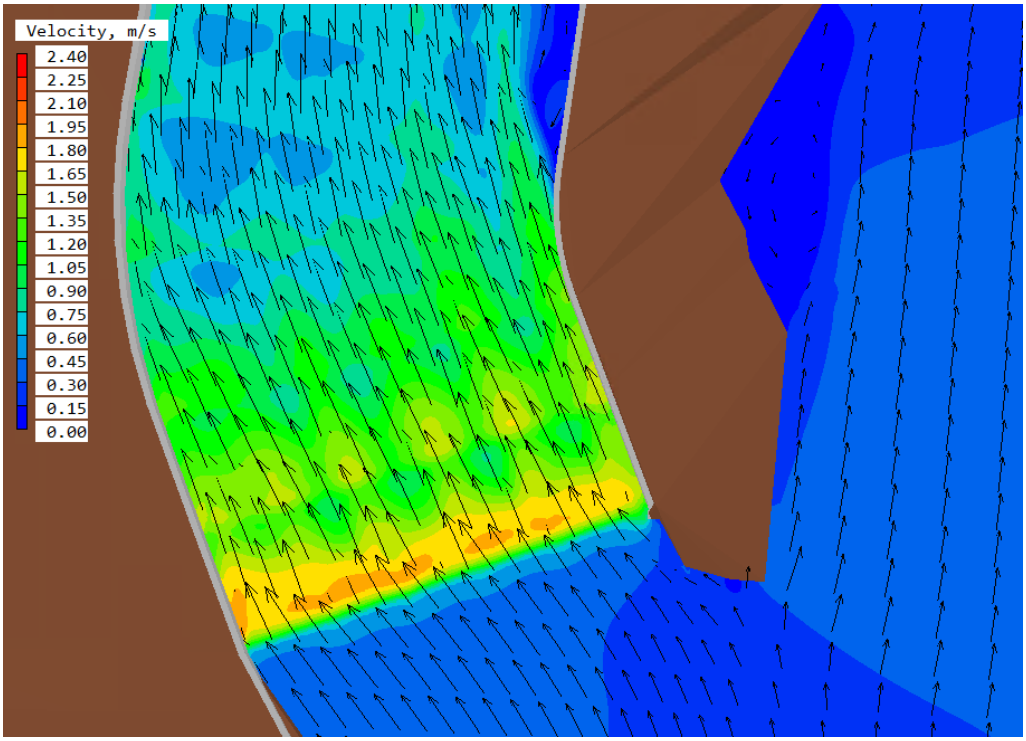


Figure 8:Velocity through the entrance to the fish pass for the 1.0AADF scenario – vertical slice at 21.4mOD

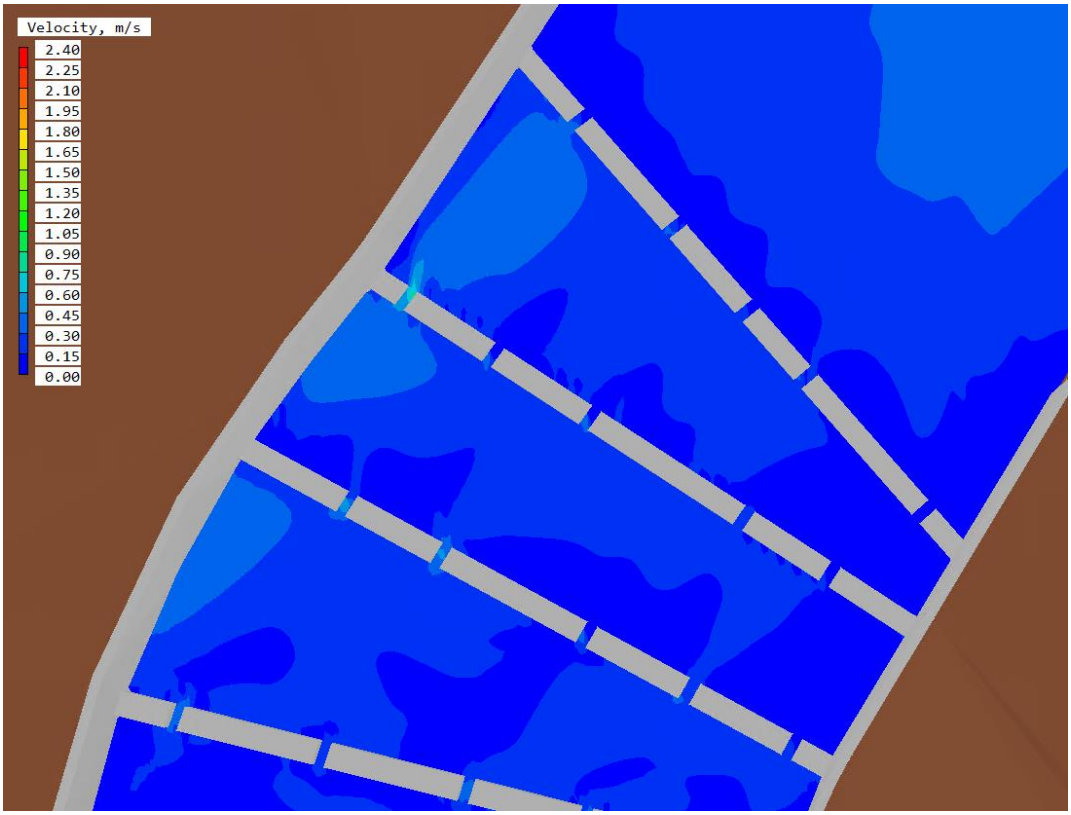


Figure 9:Velocity through the entrance to the fish pass for the 1.0AADF scenario – vertical slice at 19.7mOD

The model results showed lower than expected water depth over the Fermoy weir embankment and Mill Race sections, i.e. 0.15m and 0.05m rather than 0.25m and 0.15m for the two sections respectively. Similarly, water depth of the most upstream fish pass weir was proportionally smaller. That is likely due to the fact that the upstream flow has to be 'spread' over a greater cross-sectional area including both the main river channel and the bypass channel.

From the results presented above, the hydraulic performance of the initial fish pass design would not meet the maximum flow velocities requirements set out by DVWK (2002). As such, some amendments were made to the fish pass design. The design change and subsequent results are outlined in the **section 3.2**.

3.2 Updated design option

In order to resolve the issue of velocities within the fish pass exceeding the adopted threshold of 2m/s, there were a number of changes made to the proposed discussed in **section 2.3**. Firstly, at the entrance of the fish pass, 3 of the 5 gaps were increased in width from 500mm to 650mm in an attempt to reduce the flow velocity through the gaps. From the northern bank (left in **Figure 5**), gaps 1, 2 and 4 were widened.

In addition, the original design assumed a uniform gradient from the river channel up to the first weir of the fish pass. In the revised option, a 1m wide horizontal sill leading up the entrance (on the upstream side of the first fish pass weir) was added, to relieve some of the effect of water going over the slope up to the first weir and then going down the slope of the fish pass. The updated design is presented in **Error! Reference source not found.** and figure showing the wider gaps and flat sill respectively.

The updated design was modelled for all three flow scenarios (**section 2.4**) and are presented in **section 3.2.1**, **3.2.2** and **3.2.3** for the Q95, 0.7 AADF and 1 AADF, respectively.

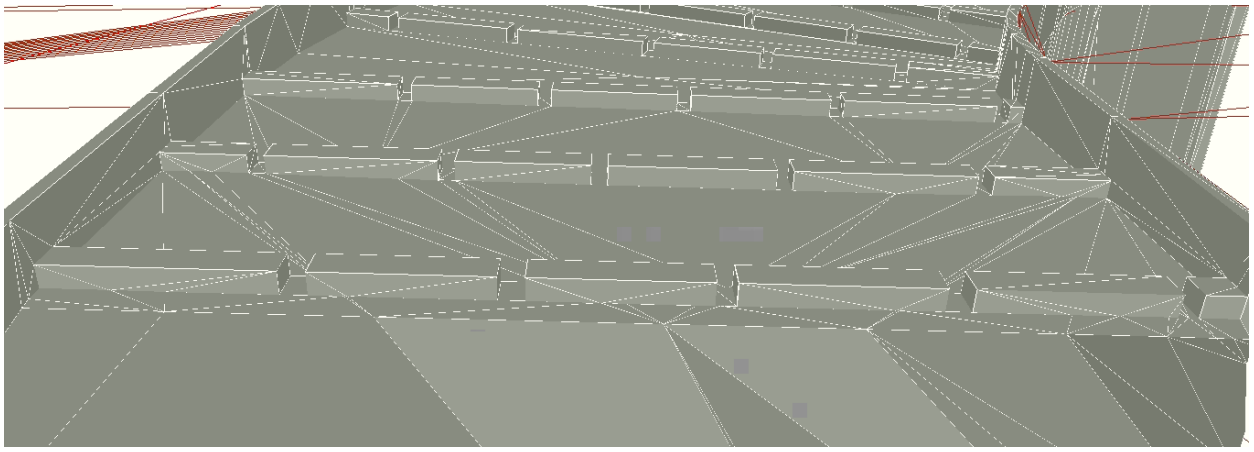


Figure 10:Updated design of the fish pass entrance, showing widened gaps

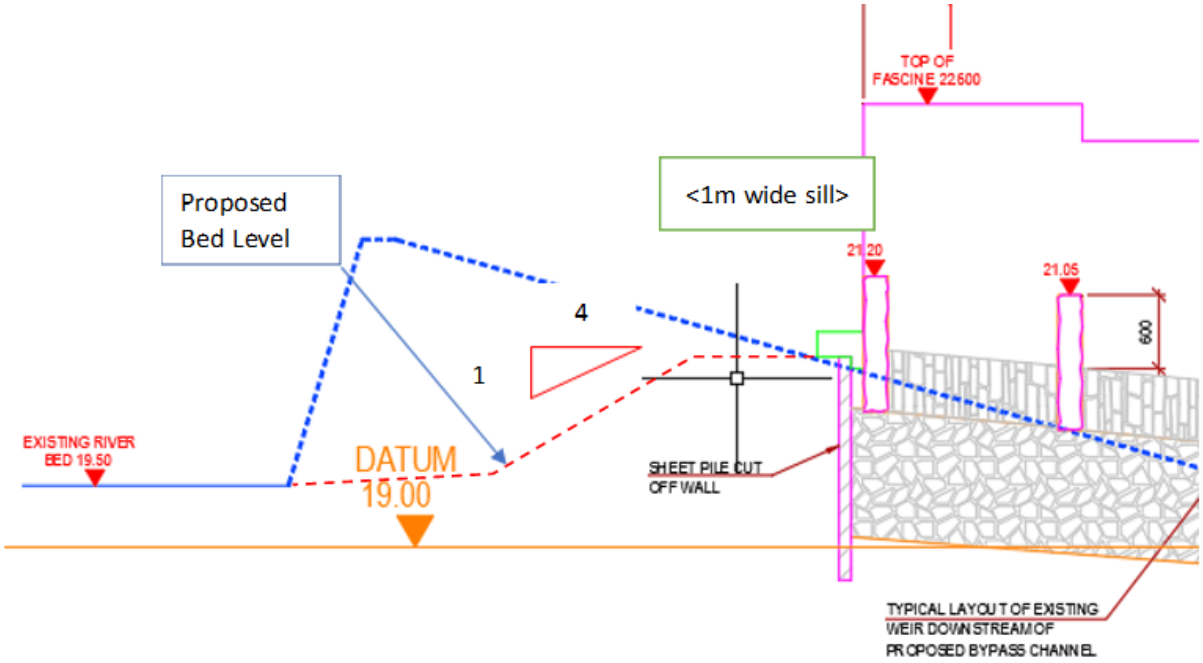


Figure 11:Updated design of the fish pass entrance, showing the 1m fat sill

3.2.1 95%ile flow (Q95)

Figure 12 – **Figure 14** present the flow velocities at the entrance to the fish pass at various vertical slices with specified levels for the Q95 flow scenario, with focus on the first set of weir and gaps where the highest velocity was observed in the initial results. The figures show that only within two out of the five gaps the velocity is above the 2m/s threshold. That is consistent for the slice 0.2, above bed of the fish pass (**Figure 12**) as well as 0.4m above the bed (**Figure 13**). At the top of the gap / crest of the weir (**Figure 14**) the velocity is below the 2m/s swimming velocities threshold for the key fish species.

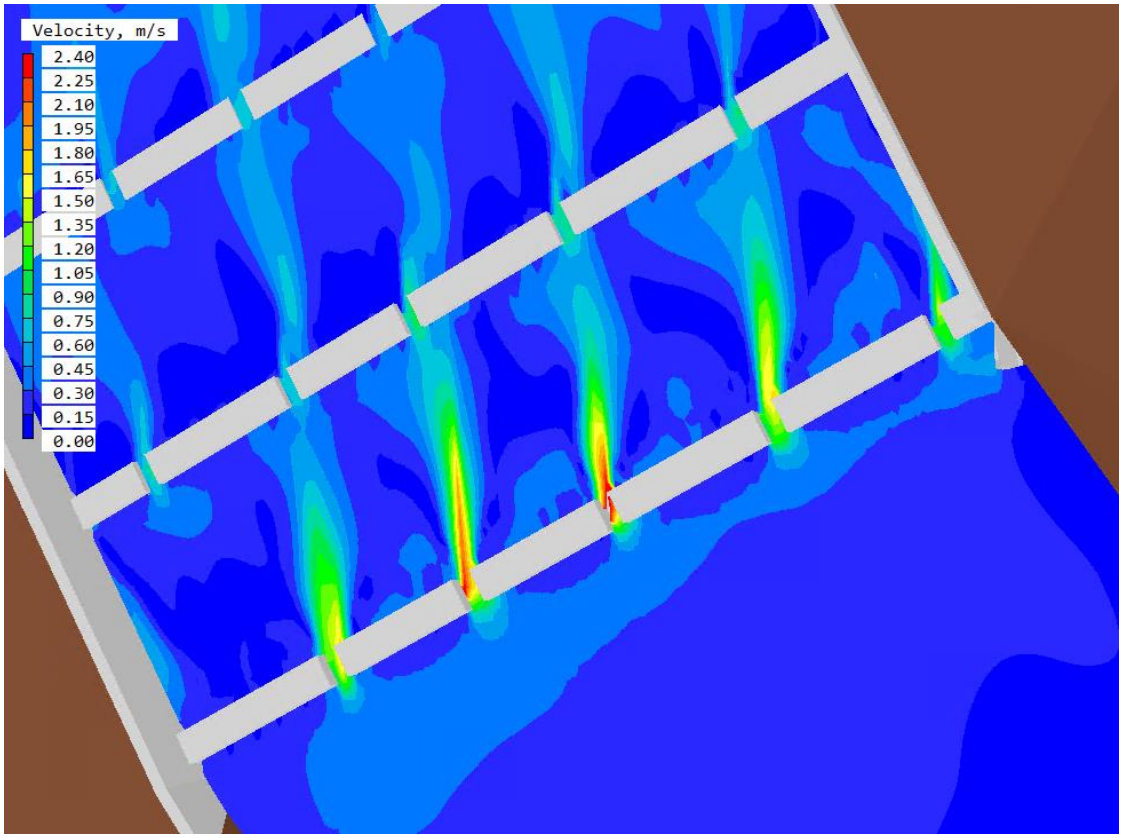


Figure 12:Velocity through the entrance to the fish pass with updated design for the Q95 scenario – vertical slice at 20.8mOD

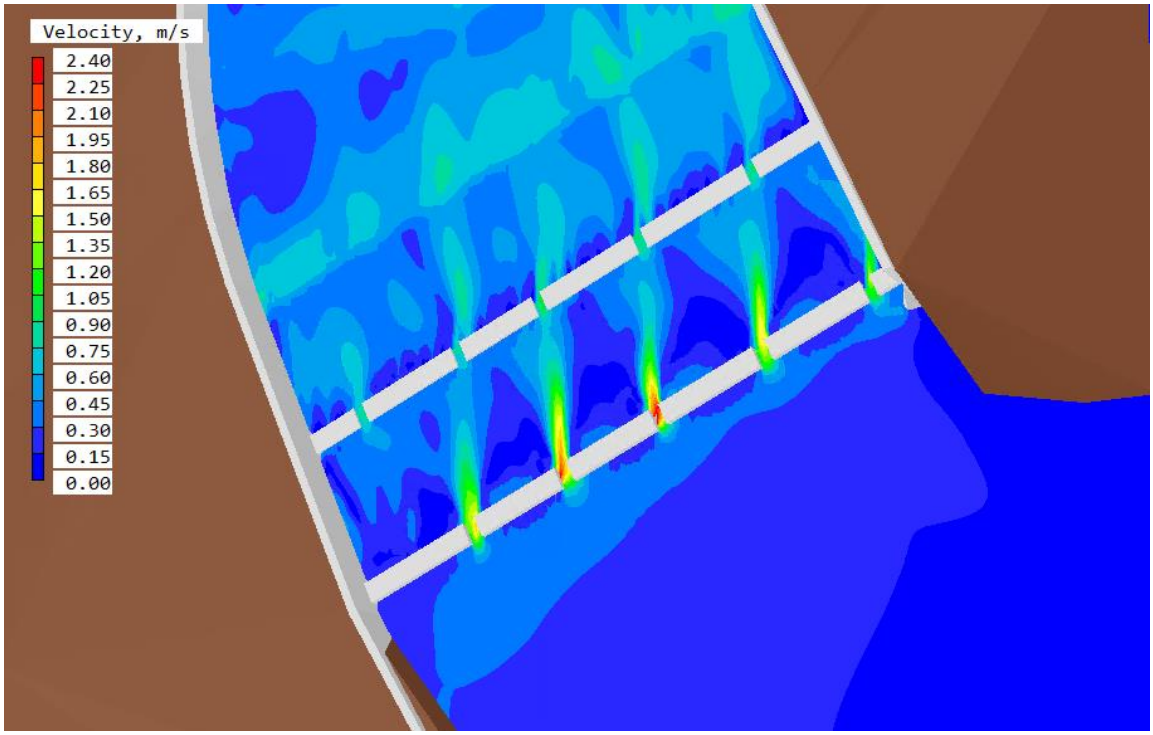


Figure 13:Velocity through the entrance to the fish pass with updated design for the Q95 scenario – vertical slice at 21mOD

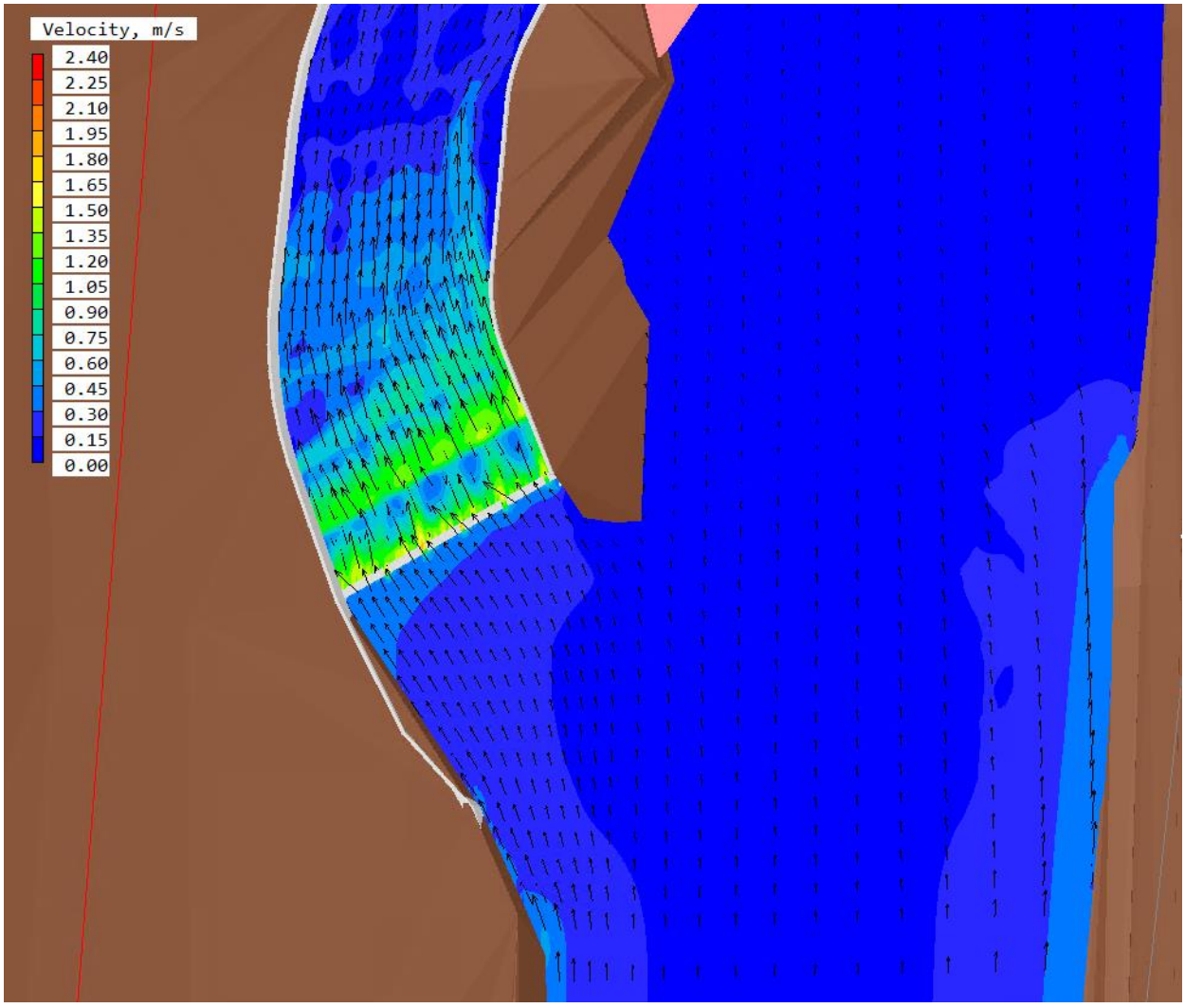


Figure 14:Velocity through the entrance to the fish pass with updated design for the Q95 scenario – vertical slice at 21.2mOD

Results of the modelling show that the water level at the entrance to the fish pass is 21.445, which is in line with the design. As such, the water level is below the Fermoy weir crest levels and therefore there is no flow over the embankment, or the Mill Race sections of the weir and total flow is diverted through the fish bypass channel.

3.2.2 0.7 AADF flow

Figure 15 – **Figure 17** present the flow velocities at the entrance to the fish pass at various vertical slices for the 0.7 AADF flow scenario. **Figure 15** shows that the velocity is above the 2m/s threshold only within a portion of gap 2 and gap 3, which are most 'exposed' to the diverted flow, i.e. there is the least dissipation of flow velocity entering the fish pass at those two gaps. That is also the case at higher levels such as 0.2 below the weir crest level, although the velocity within the two gaps is slightly lower (**Figure 16**).

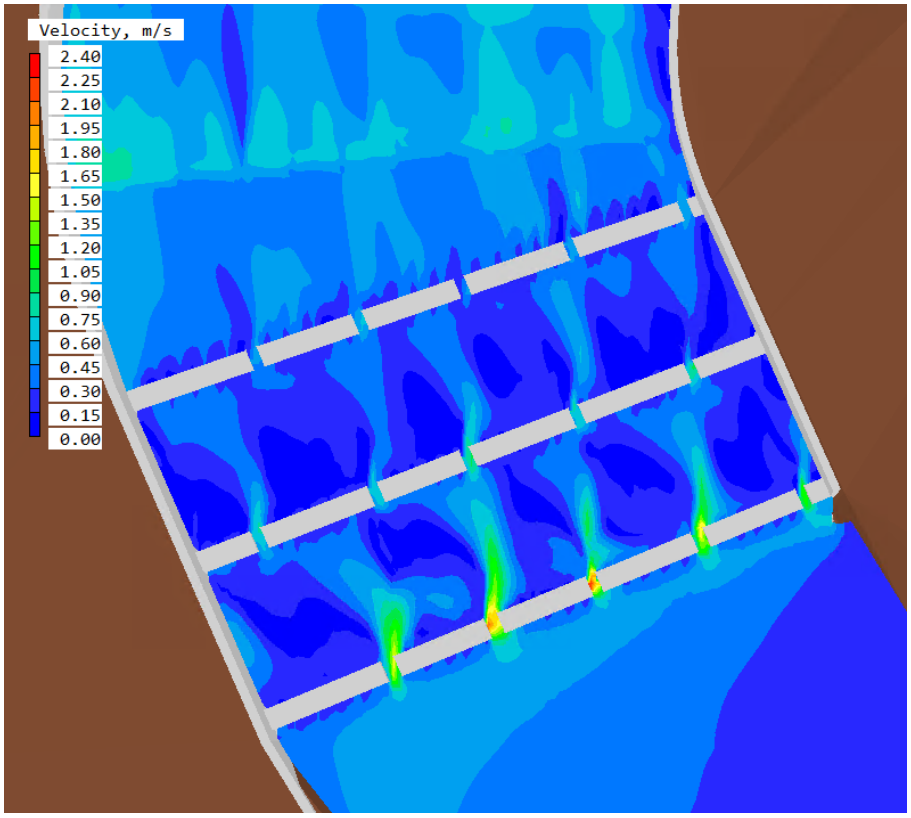


Figure 15:Velocity through the entrance to the fish pass with updated design for the 0.7 AADF flow scenario – vertical slice at 20.8mOD

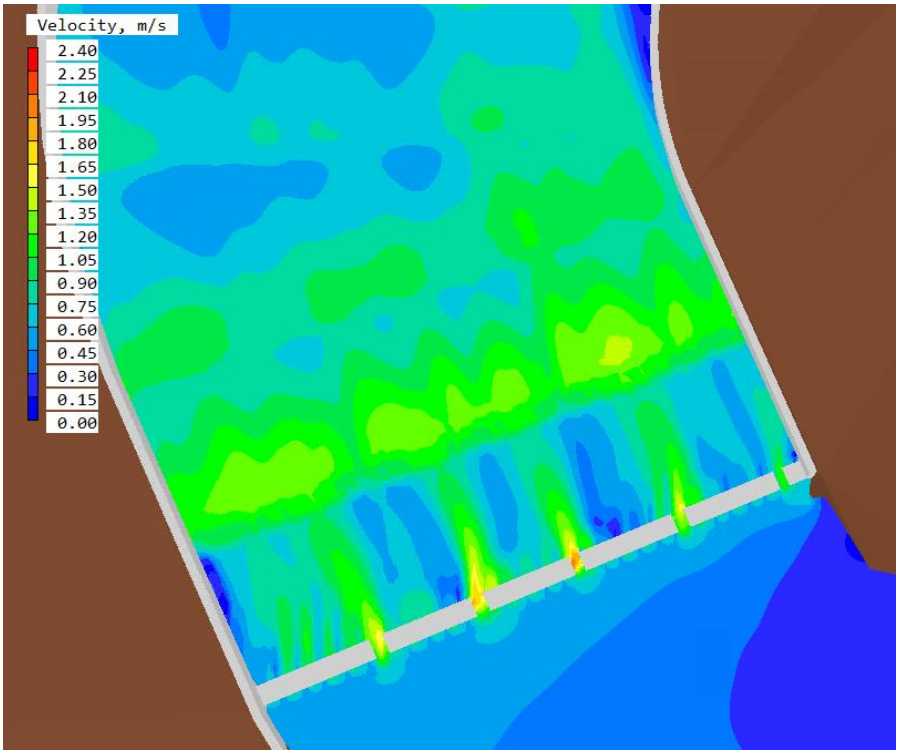


Figure 16:Velocity through the entrance to the fish pass with updated design for the 0.7 AADF flow scenario – vertical slice at 21mOD

Velocity over the weir is well below the 2m/s as illustrated in **Figure 17**, which also shows flow over the embankment section of the Fermoy weir upstream of the Fermoy Bridge. Model results also show that upstream water level is 21.638, which is in line with the design.

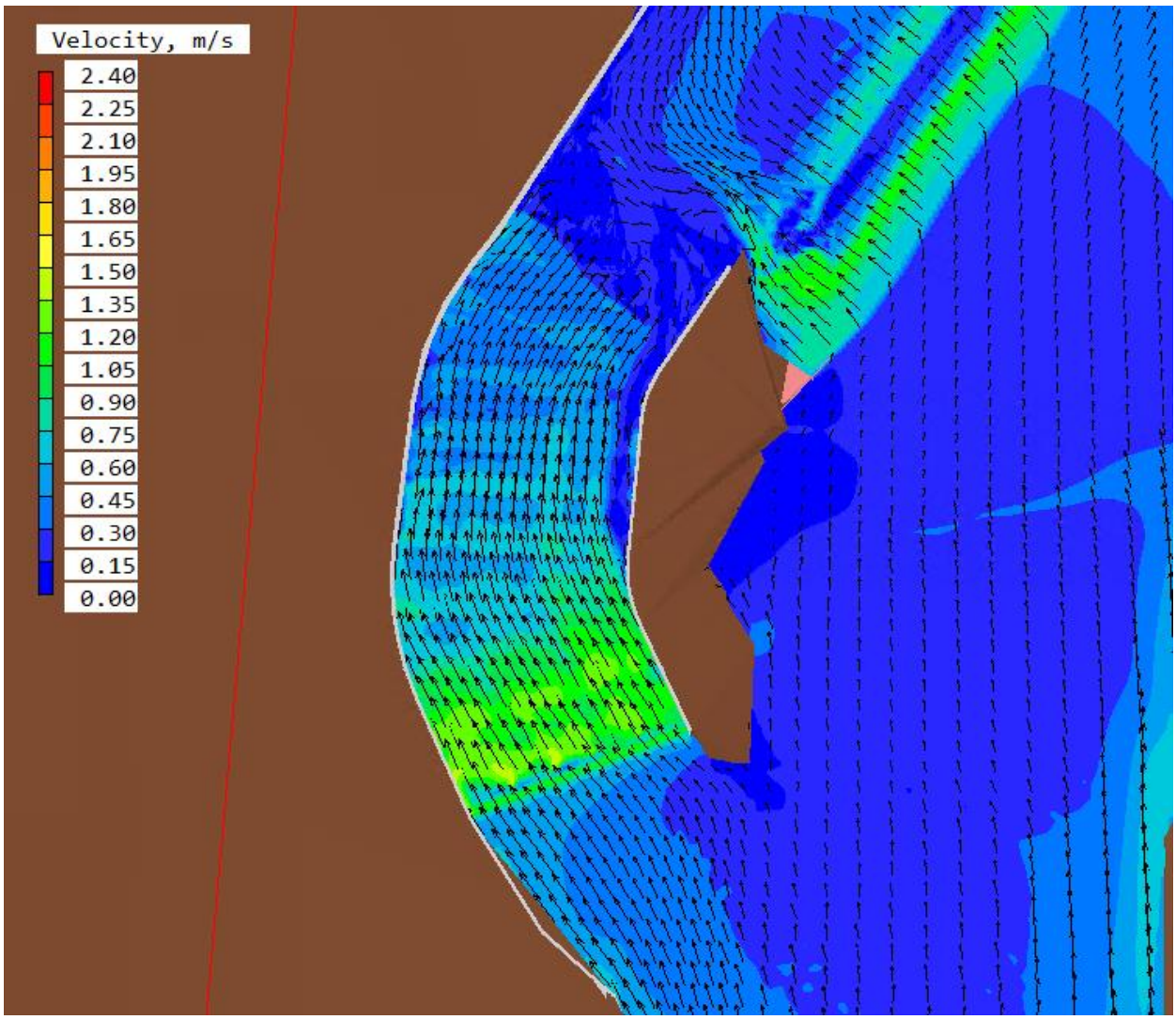


Figure 17:Velocity through the entrance to the fish pass with updated design for the 0.7 AADF flow scenario – vertical slice at 21.6mOD

3.2.3 1.0 AADF flow

Figure 18 and **Figure 19** present the flow velocities at the entrance to the fish pass at various vertical slices for the 1 AADF flow scenario. Similarly to results for the 0.7 AADF, **Figure 18** shows that the velocity is above the 2m/s threshold only within portion of gap 2 and gap 3, which are most 'exposed' to the diverted flow, i.e. there is the least dissipation of flow velocity entering the fish pass at those two gaps. In addition, at gaps 1 and 4 there are small sections around right corners where the velocity is approaching the 2m/s threshold, which is shown also at higher level, i.e. 0.4 above the fish pass bed at this weir presented in **Figure 19** below.

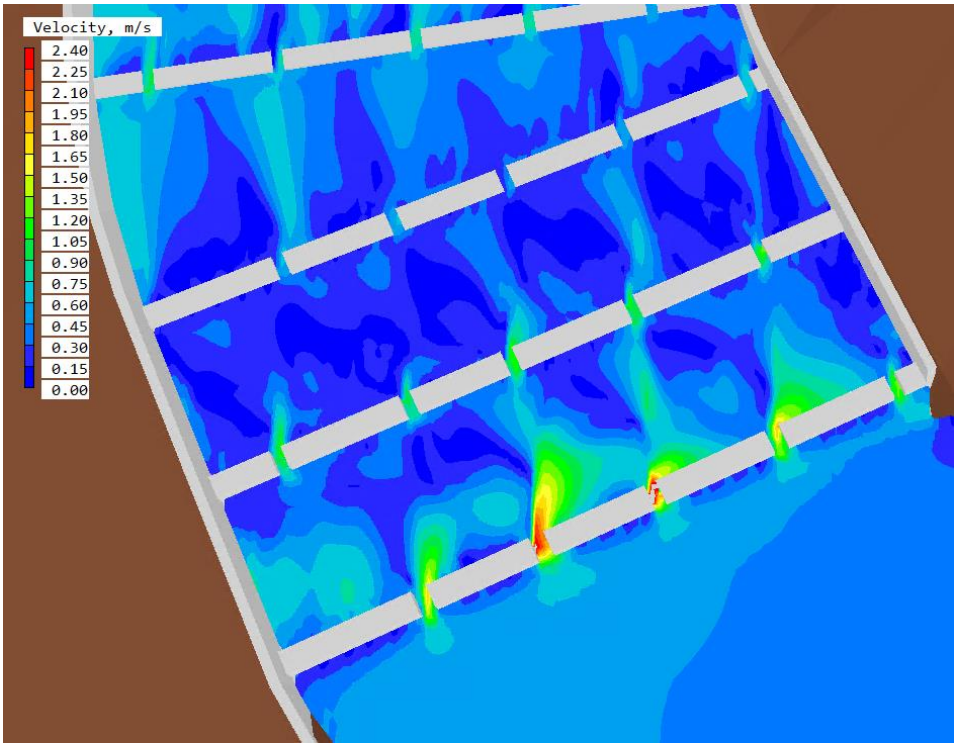


Figure 18:Velocity through the entrance to the fish pass with updated design for the 1 AADF flow scenario – vertical slice at 20.7mOD

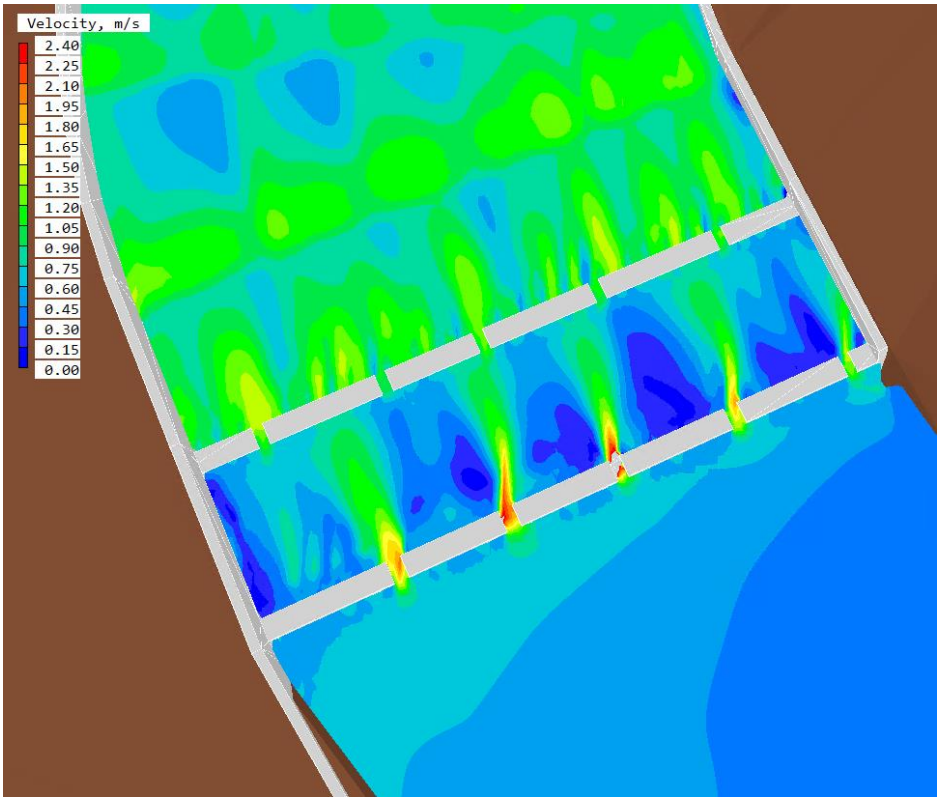


Figure 19:Velocity through the entrance to the fish pass with updated design for the 1 AADF flow scenario – vertical slice at 21mOD

Figure 20 and **Figure 21** show flow velocity over the Fermoy weir embankment section and around the Fermoy Bridge piers. Over the crest of the embankment a maximum velocity of 1.65m/s is simulated and around the base of the piers the velocity does not exceed 0.9m/s. As for the 0.7 AAFD flow results, the model results also show that upstream water level is in line with the design, i.e. 21.7mOD (1 AADF flow).

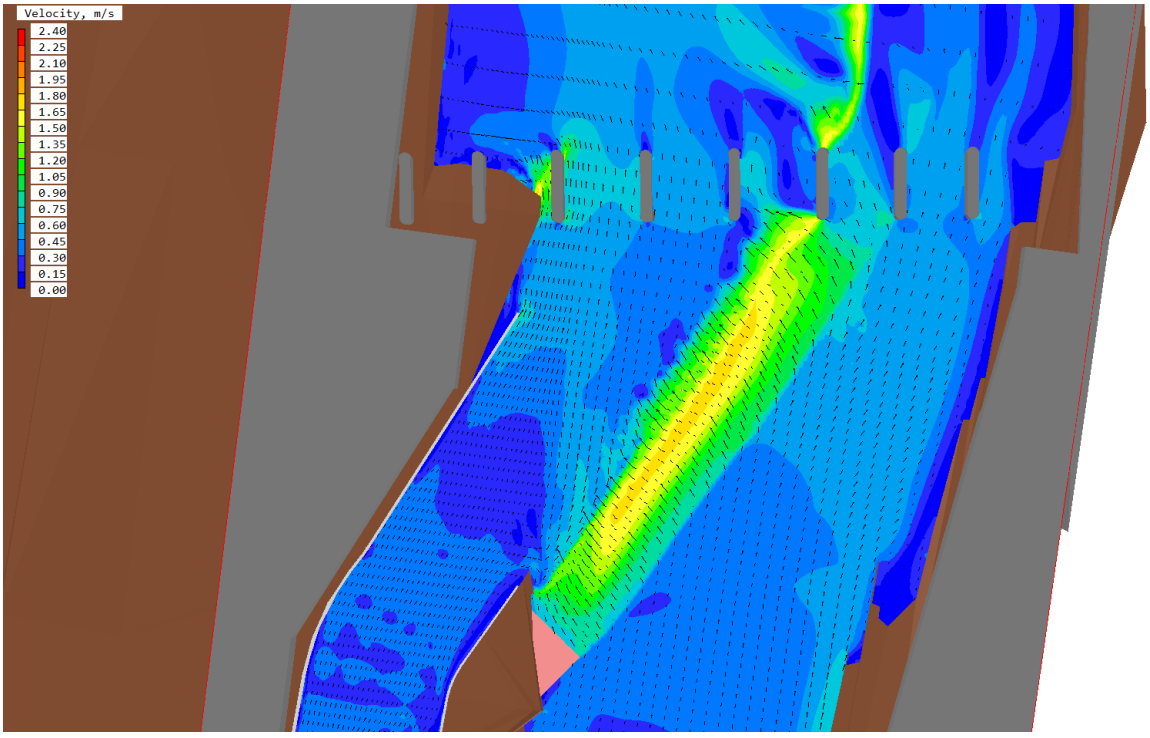


Figure 20:Velocity over the Fermoy weir embankment section and around Fermoy Bridge piers at a water level of 21.5m – 1 AAD flow scenario

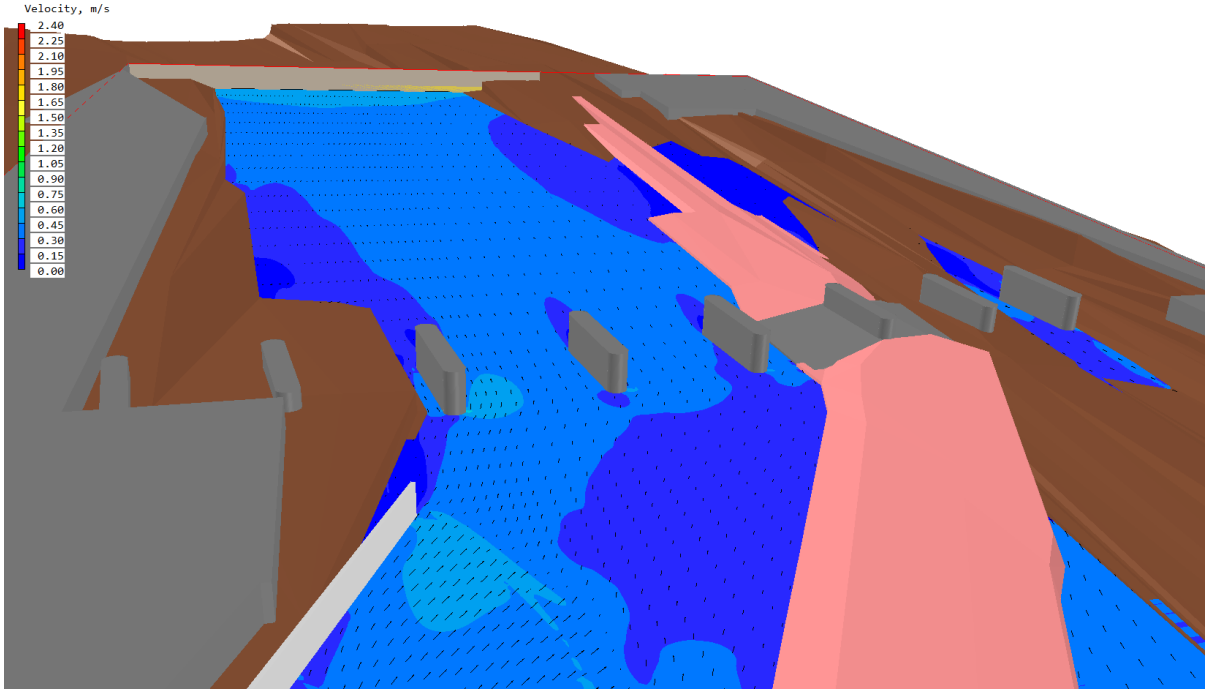


Figure 21: Velocity around the base of the Fermoy Bridge piers at a water level of 19.45m – 1 AAD flow scenario

Table 2 provides the maximum velocities for the 3 flow conditions at the first (most upstream) weir in the bypass channel. These are taken at the middle gap, i.e. third from the left (looking downstream), where greatest velocities were observed. Results in **Table 2** below show that velocities through the middle gap are highest for the 1AADF flow conditions as the amount of flow is the greatest. Within the gap height, the greatest velocity is in the middle vertical layer, approximately 0.4m above the bypass channel bed. This is to be expected as near bed the friction is going to be greater and therefore velocity lower. Similarly, at the top of the gap the flow is split between the gap and also flowing over the weir, hence velocity is lower.

As stated in **section 2.5**, the CFD model assumes 'smooth' bed and walls of the bypass channel which would contribute to higher velocities. Therefore, the results presented in **Table 2** are conservative. Furthermore, such high velocities are limited to one or two gaps (out of five). In the remaining gaps, the maximum velocities at all vertical layers are below 2m/s.

Table 2: Summary of CFD model results for the first (most upstream) bypass channel weir

Flow conditions	Upstream Water Level (mOD)	Water Level at the first (upstream) Bypass weir	Water depth above bypass bed in the middle gap (m)	Maximum velocity in the middle gap (m/s)
95%	21.45	21.44	0.2	2.49
			0.4	2.56
			0.6	1.91
0.7AADF	21.64	21.60	0.2	2.23
			0.4	2.61
			0.6	2.10
1AADF	21.70	21.66	0.2	2.94
			0.4	3.07
			0.6	2.49

4 Conclusion

CFD modelling was undertaken to validate hydraulic performance of the proposed design of the fish bypass channel at Fermoy, including remedial works to the existing Fermoy weir structure across Blackwater River. The modelling was undertaken for three different flow conditions. i.e. 95%, 0.7AADF and 1AADF. These scenarios were tested to assess velocities through the fish pass against maximum tolerable velocity for various fish species set out in the DVWK guidance for 'Fish Passes, Design, Dimensions and Monitoring'.

Design of the fish pass comprised a bypass channel with a series of 13 weirs, each with 5 staggered gaps to enable fish to swim up the channel. The weirs were spaced by set distance and each consecutive weir dropped in crest level. Such cascading design is favourable as it allows fish to swim up through the gaps and then rest within the pools in between the weirs.

The initial design option was tested in the CFD model, however results showed that the velocity threshold was exceeded within most of the gaps at the first (most upstream) fish pass weir. As such some amendments to the design were introduced to help alleviate the high velocities. For that purpose, three out

the five gaps in the first weir were widened and also a flat ‘sill’ immediately upstream of the first weir added to dissipate some of the velocity before entering the first fish pass weir.

The revised option of the design was tested for the three flow conditions. Results showed that the velocities remain relatively high, i.e. above the 2m/s threshold within two of the five gaps at the first fish pass weir. However, that is limited to the two gaps only giving 3 other gaps with tolerable velocities for different fish species. Furthermore, the results show that there is no issue with exceeding the flow velocities threshold throughout the rest of the fish pass, where velocities are well below 1m/s.

The modelled water levels upstream of the Fermoy weir and the first weir in the bypass channel match closely the design assumptions. On that basis, it is concluded that the flow split between the main river and the bypass channel would be as considered in the design.

Maximum velocities over the Fermoy weir embankment section are less than 0.5m/s, 1m/s and 1.6m/s for the Q95, 0.7AADF and 1AADF flow scenarios, respectively. Similarly, for the Mill Race weir section, the maximum velocities are less than 0.4m/s, 1m/s and 1.2m/s for the three flow scenarios respectively.

The CFD model also shows that velocities around the Fermoy Bridge piers are well below 0.5m/s with small sections with velocities up to 0.9m/s. However, such velocities are not caused by the flow through the fish pass but rather over the Fermoy weir. Velocities within the fish pass at the downstream end are relatively low, i.e. less than 1m/s. Presence of the weir does not show any adverse effect on scour around the bridge piers and therefore the re-constructed structure would also not impact the safety of the bridge.

Based on the results of the CFD model, it is concluded that the proposed design does perform hydraulicly as intended, although compliance with fish regulations needs to be considered in greater detail to address the velocities within some sections of the bypass channel exceeding threshold set by the DVWK guidance. The modelled maximum velocities are above the 2m.s within two of the five gaps at the first (most upstream) weir in the bypass channel. However, the modelled velocities are conservative since a ‘smooth’ well used to represent the fish pass design. Furthermore, such high velocities are limited to no more than two gaps (out of five), whereas in the remaining gaps, the maximum velocities are below 2m/s. Velocities throughout the rest of the bypass channel are well below the 2m/s threshold under all considered flow scenarios.

Some additional measure could be implemented to improve the design, e.g. perturbance boulders could be added to disrupt the flow and slow velocities in the upper pools in front of gaps at the fish pass weir where the velocities are the highest. Further comments on the design review and recommendations are discussed in the main Fermoy Fish Pass – Hydraulic Design Review Technical Note (Doc Ref. BI1645-RHD-ZZ-XX-NT-Z-0002).

APPENDIX E

Site Specific Flood Risk Assessment

FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

Flood Risk Assessment

June 2022

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Document Verification

Client:	Cork County Council
Project Name:	Fermoy Weir Remediation & Fish Bypass Channel
Project Ref:	19011
Document Title:	Flood Risk Assessment
File Name:	19015-TJOC-PL-XX-PD-C-3708_Flood_Risk_Assessment

Revision Code	Suitability Code	Description of Revision	Prepared By	Checked By	Approved By	Date of Issue
P01	S3	First Draft	MV	DC	EF	09.06.2022

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1. INTRODUCTION

1.1. Project Background

Cork County Council has identified the need to carry out remediation works to the existing weir in Fermoy and to construct a new permanent fish bypass channel on the north bank of the river Blackwater adjacent to Fermoy bridge. T.J. O'Connor & Associates (TJOC) were appointed by Cork County Council (CCC) to provide civil engineering consultancy services for the project and to develop a scheme to fulfil CCC's requirements while also complying with the relevant standards and statutory requirements.

The project requires CCC to fulfil its obligations to maintain and repair the weir at Fermoy, a Protected Structure under Section IV of the Planning & Development Act 2000, while complying with the conservation and fisheries obligations to provide for the free passage of fish along the river Blackwater Special Area of Conservation (SAC) arising under the Water Framework Directive, Habitats Directive and Inland Fisheries Act 2010 and related legislation.

1.2. Site of the Proposed Development

1.2.1. Site Description

Fermoy is located approx. 35km north of Cork City. The existing weir and fish pass are located on the River Blackwater, at Kent Bridge, Fermoy, which is situated in the centre of Fermoy town and to the west of the M8 motorway. Figure 1-1 below shows a site location map for the scheme.

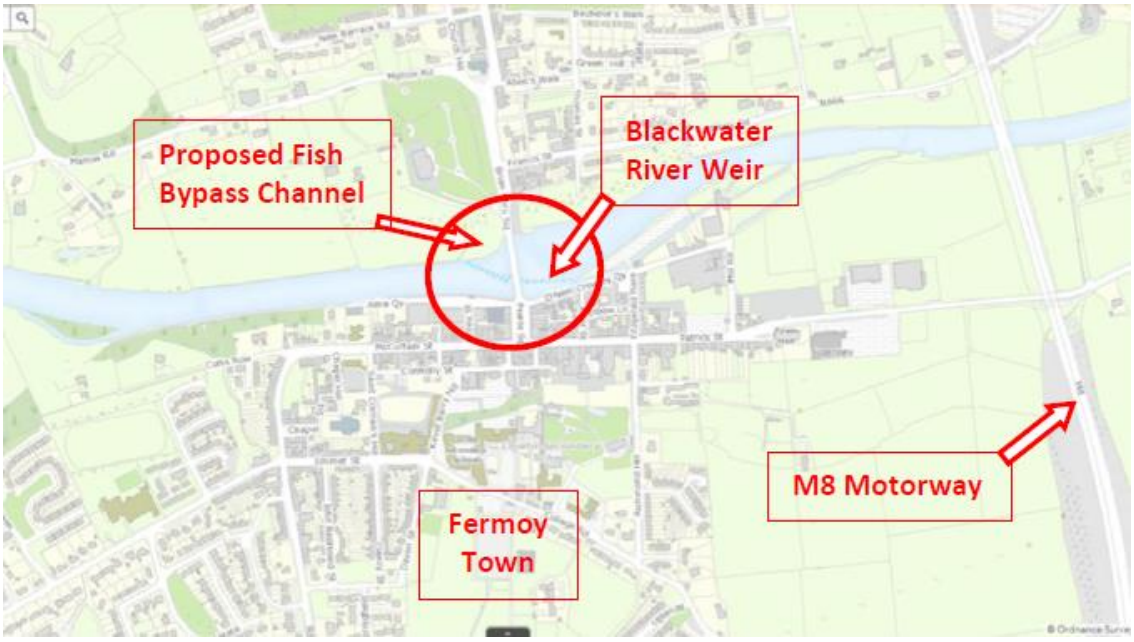

Figure 1-1: Site Location

1.2.2. Existing Scenario

The existing Fermoy weir was constructed in the past using different methods over its length. In general, the weir is constructed as a stone filled embankment with large natural stone bedded in mortar and capped with a thin in-situ concrete capping.

The weir is categorised into two sections namely the embankment section on the upstream side which extends for a distance of 37m east of the second bridge pier. The second section of the weir is referred to as the Mill Race section and forms the remaining section of the weir. Photos of the embankment and Mill Race sections of weir are shown in Figures 1-2 and 1-3 respectively below.

Figure 1-2: Embankment Section of Weir & Existing Fish Pass – June 2021 (Looking Upstream)

The weir has been subjected to localised damage over the years with the capping disintegrating due to the powerful flows in the River Blackwater. The weir has also been breached in two locations.

The effect of the ongoing breaches in the weir is that normal flow in the river Blackwater does not spill over the weir. Instead, the flow in the river is directed through an increasingly narrow section of channel between the downstream section of the weir (Mill Race section) and O'Neill Crowley Quay before passing through the breach in the weir. The velocity of flow within this narrow channel is very high and is almost always in excess of 2m/s. This resultant turbulent flow has contributed to the progressive nature of the breach which is evident in Figure 1-3 overleaf.

Figure 1-3: Mill Race Section of Weir & Breaches – June 2021 (Looking Downstream)

The existing fish pass is incorporated in the weir and is located on the upstream side (west side) of the bridge. This is shown on the Existing Site Layout Plan Drawing No. 19011-TJOC-PL-XX-DR-0051 in Appendix A and can also be seen in Figure 1-2 previous.

The fish pass is located towards the centre of the weir and is of masonry construction. In recent years the fish pass has fallen into a state of disrepair with many of the masonry blocks unravelling and becoming dislodged, some of which can be seen in Figures 1-4 and 1-5 below.

Figure 1-4: View of Existing Fish Pass – June 2021 (Looking Upstream)

Figure 1-5: View of Existing Fish Pass – June 2020 (Upstream)

1.3. Proposed Development

Fermoy weir was constructed in the early 19th Century but has fallen into disrepair with the rate of deterioration accelerating in recent years. The weir is listed as a protected structure, designated as such under the Fermoy Town Development Plan. Cork County Council, as the owner of the weir, is obliged to protect the weir against further deterioration.

Despite the presence of the existing fish pass in the weir, the weir acts as a barrier to the passage of some fish.

The project proposed by CCC involves remediating the existing weir in Fermoy, which is listed as a protected structure under the Planning and Development Act, 2000 and which is also located in the River Blackwater which is designated a Special Area of Conservation (SAC) under the Habitats Directive.

The project requires a solution that will enable CCC to fulfil their obligations to maintain and repair the weir (as its owner) at Fermoy, a Protected Structure under Section IV of the Planning & Development Act 2000, and comply with the conservation and fisheries obligations to provide for the free passage of fish along the river Blackwater arising under the Water Framework Directive, Habitats Directive and Inland Fisheries Act 2010 and related legislation.

In order to comply with the above legislative requirements, CCC propose to construct a new fish bypass channel in the northern bank of the river on the western side of Fermoy bridge and remediate the protected structure that is the weir.

1.3.1. Physical Characteristics of the Development

The proposed project comprises the remediation of the existing weir, including reconstruction of the breaches, and the construction of a rough channel pool bypass to provide for fish passage around the weir. A plan of the proposed works is illustrated on drawing No. 19011-TJOC-PL-XX-DR-C-0052 in Appendix B.

The weir remediation works can be divided into two different elements which comprise the remediation of the upstream section of the weir, including the existing fish ladder incorporated in the weir, and the downstream section of the weir. The weir is categorised as a rubble embankment type weir upstream of the bridge and extending for a distance of 37m east of Fermoy bridge. The remaining section of the weir, extending eastwards, is a gravity wall type weir (Mill Race section). It is this section that has been breached in the approx. locations as shown on the Existing Site Layout Plan drawing 19011-TJOC-PL-XX-DR-C-0051 in Appendix A. These breaches are also visible in Figure 1-4 as noted previously.

A plan of the proposed remediated weir is shown at Drawing 19011-TJOC-PL-XX-DR-C-0060. Proposed remedial details to the existing fish pass are included on Drawing No. 19011-TJOC-PL-XX-DR-C-0081. Both of these drawings are included in Appendix B.

1.3.2. Weir remediation - Embankment Section

The remediation of the embankment (crump) section of the weir will involve the removal of the existing concrete apron and resetting of the limestone setts with the addition of random rubble fill (similar to the existing) where required. A high tensile geotextile will be incorporated to assist in reducing wash out of the fill in the embankment. At both the upstream heel and downstream toe of the crump weir section, the undercut / missing stonework will be reset on concrete heel and toe footings along with the addition of rock armour on both the upstream and downstream sides to prevent undercurrents undermining the embankment, in particular on the downstream section in the future.

The crest of the crump weir will be reinstated to a level corresponding to the historic level of the weir as evident from the historic photographs of the weir. A level of 21.45mOD is proposed for this section on the remediated weir.

Cross-sections through the embankment section of the weir, showing the proposed remediation works, are shown at Drawing No.'s 19011-TJOC-PL-XX-DR-C-0061 and 19011-TJOC-PL-XX-DR-C-0062 in Appendix B.

1.3.3. Weir Remediation – Mill Race Weir Wall

The remediation of the Mill Race section of the weir, east of the Bridge, will involve reconstructing the breached sections with existing or new stonework to closely resemble the existing masonry. Given the nature of this section of the weir, it is proposed to inject natural cement (also referred to as Prompt) into the fill sections and place mass concrete in the core of the new section of the weir. The stonework facing will then be pointed in natural cement and the downstream face of the weir protected by adding rock armour. The capping of the Mill Race wall will be removed, the wall raised and the capping reset to a remediated level higher than the adjacent Crump weir, with a level of 21.55mOD proposed.

Cross-sections through the Mill race weir walt section of the weir, showing the proposed remediation works, are shown at Drawing No. 19011-TJOC-PL-XX-DR-C-0063 in Appendix B.

1.3.4. Proposed Fish Bypass

The proposed bypass consists of constructing a curved rock (rough channel pool) ramp type of bypass in the northern bank of the river Blackwater, west of Fermoy bridge. The rock ramp will provide a ladder for fish migrating upstream and resting pools would be created by the varying levels of rock weir walls.

It is proposed to minimise the height of vertical walls on the sides of the curved bypass channel and grade the bypass channel into the existing landscape.

In order to provide for the required level of fish passage, a 28m wide rock ramp type bypass channel, with a crest level of 21.20mOD at the upstream end, is proposed to be constructed in the northern bank of the river.

Upstream water levels will be maintained by providing an approximate 50/50 flow spit between flows in the river and the proposed bypass channel at long term mean flow levels and by reinstating the crest level of the existing weir to 21.45mOD along the length of the embankment (Crump) weir and to 21.55mOD along the length of the Mill Race Weir Wall. All flows up to 12.5% of the long term mean flow will be diverted through the bypass channel. This satisfies Inland Fisheries Ireland requirements for compliance with the DCENR Guidelines on the Construction and Operation of Small-Scale Hydro-Electric Scheme and Fisheries.

A drawing of the proposed fish bypass channel is presented on Drawing No. 19011-TJOC-PL-XX-DR-C-0053. Long-sections and cross-sections of the Fish Bypass channel are included on Drawing No.'s 19011-TJOC-PL-XX-DR-C-0054 and 19011-TJOC-PL-XX-DR-C-0055 in Appendix B.

The bypass channel will facilitate free movement of migratory fish species listed as qualifying interests for the Blackwater River SAC (Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon and movement of Brook Lamprey). The fish pass will also be passable by eel.

1.4. Scope of Assessment

The scope of the assessment includes the following;

- Review the OPW National Flood Hazard Mapping.
- Review any historic flood information for the site.
- Review any relevant Catchment Flood Risk Assessment and Management Studies.
- Identify any risk of fluvial, tidal, pluvial and groundwater flooding.
- Identify any increased risks of flooding upstream as a result of the proposed development.
- Develop potential mitigation measures if required for receptors.

2. THE PLANNING SYSTEM AND FLOOD RISK MANAGEMENT

The Department of Environment, Heritage and Local Government and the OPW published Guidelines for Planning Authorities on the managing flood risk with regard to planning in a document entitled *"The Planning System and Flood Risk Management".*

These Guidelines are issued under Section 28 of the Planning and Development Act 2000 which requires An Bord Pleanála and Local Planning Authorities to implement these Guidelines in assessing planning applications under the Planning Acts.

The core objectives of the Guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risk for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and
- Ensure that the requirements of European Union and national law, in relation to the natural environment and nature conservation, are complied with at all stages of flood risk management.

The Flood Risk Management Guidelines require the adoption of a sequential approach of flood risk management by regional and local authorities, developers and their agents in attempting to:

- Avoid the risk, where possible;
- Substitute less vulnerable uses, where avoidance is not possible; and
- Mitigate and manage the risk, where avoidance and substitution are not possible (including justification).

2.1. Definition of Flood Zones

Flood zones are defined in the Guidelines as *"geographical areas within which the likelihood of flooding is within a particular range".* There are three types of flood zones as summarised in Table 2-1 below.

Table 2-1: Definition of Flood Zones

Flood Zone	Description
A	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).
B	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 and 0.5% or 1 in 200 for coastal flooding)
C	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.

2.2. Definition of Vulnerability Classes

The Guidelines grades types of development in accordance with how vulnerable they would be to flooding. Table 2-2 below is reproduced from Table 3.1 of the *"Planning System and Flood Risk Management Guidelines"* and outlines the typical developments under the three vulnerability classes.

Table 2-2: Definition of Vulnerability Classes

Class	Description
Highly Vulnerable	Includes: Garda, ambulance, fire stations, hospitals, schools, residential dwellings and institutions, primary transport and utilities distribution and potential significant sources of pollution in the event of flooding.
Less Vulnerable	Includes: retail, leisure, warehousing, commercial, industrial and non-residential institutions etc.
Water Compatible Development	Includes: **flood control infrastructure**, docks, marinas, wharves, **navigation facilities**, ship building, fish processing, **water-based recreation and tourism** (excluding accommodation), lifeguard and coastguard stations, amenity open space and outdoor sports and recreational facilities.

Underlining indicates uses relevant to this development

2.3. Appropriate Development and the Justification Test

Table 3.2 of *"The Planning System and Flood Risk Management Guidelines"* outline those types of development that would be considered appropriate to each flood zone and is reproduced in Table 2-3 below. A justification test is required in instances where development is proposed in areas of moderate or high flood risk. The test is designed to rigorously assess the appropriateness or otherwise, of these developments which would be at risk of flooding.

Table 2-3: Matrix of Vulnerability versus Flood Zones

Class	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable	Justification Test	Justification Test	Appropriate
Less Vulnerable	Justification Test	Appropriate	Appropriate
Water Compatible Development	Appropriate	Appropriate	Appropriate

The proposed fish bypass channel, which is considered as a navigation facility for fish, is classed as water compatible development in Table 2 above.

The weir, before it fell into a state of disrepair, maintained the water level upstream which facilitated recreational activities such as rowing with the weir itself also promoting tourism in the town of Fermoy due to its long-term existence in the river Blackwater. As such, the proposed remedial works to the weir are also categorised as water compatible development in Table 2 above.

Residential developments are classed as highly vulnerable development in Table 3.1 of the *"Planning System and Flood Risk Management Guidelines".*

The Justification Test is discussed further in Section 4.7 of this report.

3. STAGE 1 – FLOOD RISK IDENTIFICATION

3.1. Available Information

In order to conduct the assessment, the following sources of information have been consulted as summarised in Table 3-1:

Table 3-1: Review of Available Information

	Information Source	Coverage	Quality	Confidence	Identified Flood Risks	Flood Risk
Primary Data Sources & Modelled Data	OPW National Flood Hazard Mapping (www.floodmaps.ie)	National	High	Moderate	Flood maps indicate that the site is in Flood Zone A	No
	OPW South Western CFRAM-Fluvial	Regional	High	High	Flood maps indicate that the site is in Flood Zone A	No
	OPW South Western CFRAM-Tidal	Regional	High	High	Site is inland and remote from coastal flood zones	No
Secondary Data Sources	OPW Historic Flood Records	National	Varies	Varies	Previous flooding occurred in the town of Fermoy adjacent to the site prior to construction of OPW Munster Blackwater Fermoy Drainage scheme.	-
	Walkover Survey	Local	Moderate	Moderate	Site comprises existing weir located in the river Blackwater as well lands on the northern bank of the river. Proposed development is water compatible, i.e. remediated weir and new fish bypass channel	-

Other information sources referred to are as follows;

- Guidelines for Planning Authorities on "The Planning System and Flood Risk Management", November 2009 (OPW and Department of Environment, Heritage and Local Government)
- Cork County Council County Development Plan 2014 – 2020 (as varied)
- South Western CFRAM Study

3.2. Identified Flood Sources

3.2.1. CFRAM Programme

The National Catchment Flood Risk Assessment and Management (CFRAM) Programme was developed to meet the requirements of the European Union Floods Directive (2007/60/EC), as well as to deliver on the core components of the 2004 National Flood Policy. The CFRAM Programme is split into three phases, being:

- The Preliminary Flood Risk Assessment (PFRA) – 2011
- The CFRAM Studies and parallel activities – 2011-2015
- Implementation and Review – 2016 onwards

The PFRA was completed in 2011 and comprised of a national screening exercise, based on available and readily-derivable information, to identify areas where there may be a significant risk associated with flooding. Dublin City was noted as being one of these areas.

The proposed development site at Fermoy is located within the confines of the South Western CFRAM Study. This study produced flood extent and flood depth maps for fluvial flooding associated with the River Blackwater. These maps provide the basis for determining the flood zone for the development in line with the Planning System and Flood Risk Management Guidelines.

3.2.2. Historic Flooding at the Site

The historic flooding information available on www.floodinfo.ie was reviewed. A summary of the historic flooding records is provided in Table 3-2 below.

Table 3-2: Summary of Historical Flood Events

No.	Date of Event	Source	Areas Affected
1	30th December 2013	Run-off from Surface Water Drainage	Junction of Elbow Lane / Market Place / Fitzgerald Place, Fermoy
2	19th and 20th November 2009	Fluvial	Fermoy
3	6th November 2000	Fluvial	Fermoy
4	30th December 1998	Fluvial	Fermoy
5	October 1988	Fluvial	Fermoy
6	6th August 1986	Fluvial	Fermoy
7	November 1980	Fluvial	Fermoy
8	Recurring	Unknown	Fermoy

It can be seen from Table 3-2 above that the town of Fermoy is susceptible to fluvial flooding from the river Blackwater.

It should be noted that the Fermoy North and Fermoy South flood defence schemes were completed by the OPW in 2009 and 2014 respectively. These schemes have significantly alleviated the risk of flooding to the town of Fermoy as a result. These schemes comprised the construction of flood defence walls, embankments and the installation of demountable flood barriers which are erected prior to an impending flood event.

3.3. Source-Pathway-Receptor Model

The assessment of flood risk requires an understanding of where the water comes from (the source), how and where it flows (the pathways) and the people and assets affected by it (the receptors).

Water-compatible development is permissible in Flood Zone A as shown in Table 2-3. Therefore, tidal and fluvial flood events will not impact the proposed development which consists of remediating the weir and constructing a new fish bypass channel in the northern bank of the river. However, the potential impacts of reinstating the breaches in the weir, and any increased flood risks associated with the increased upstream water level upstream of the weir, also need to be considered.

The Source-Pathway-Receptor model is used to assess and inform the management of flood risks. The Source-Pathway-Receptor analysis is presented in Table 3-3 below.

Table 3-3: Source-Pathway-Receptor Analysis

Source	Pathway	Receptor	Likelihood	Impact	Risk
Fluvial	Potential for remediated weir to impact upstream landowners and / or increase flood risk due to increased upstream water level from reinstating breaches in weir.	Upstream properties and / or landowners	Possible.	Low	Low
Fluvial	Changes to river levels as a result of remediating weir and constructing new fish bypass channel	OPW Fermoy South flood defence scheme trigger levels in river for erecting demountable flood barriers	Possible	Low	Low
Tidal	Site is remote from coastal flooding zones.	-	Very remote	-	-

	Development is also water compatible				

3.4. Consultation with OPW

The OPW were consulted in regards to the proposed weir remediation and fish bypass channel works for the purpose of establishing what consents and approvals are required to be obtained from them for the works (e.g., Section 50, etc.)

During this consultation process the OPW advised that the impacts of the reinstated weir and new fish bypass channel on upstream lands, and on the current trigger levels for erecting the OPW Fermoy flood defence scheme barriers, would need to be considered as part of the flood risk assessment. The OPW also advised that there should be no increase in flood risk at Fermoy as a result of the proposed works.

4. STAGE 2 – INITIAL FLOOD RISK ASSESSMENT

4.1. Introduction

The Initial Flood Risk Assessment comprises of the following activities:

- Confirmation of the sources of flooding that may affect the development site;
- Assessment of the adequacy of existing information;
- Determination of surveys and modelling approach appropriate to match the complexity of the flood risk issues;
- Determine extent of flooding and assess potential impact of a development on flooding downstream; and
- Scope possible mitigation measures.

The potential source(s) of flooding as identified in the Stage 1 are:

1. Fluvial flooding.

An initial flood risk assessment for this source is considered in the Section 4.2.

4.2. Fluvial Flood Risk

Fluvial flood maps were produced for the South Western CFRAM study. Map No. MMD/296235/E/DR/I18HFY/EXFCDEXF/F/Sht005 included in Appendix C illustrates that the proposed development is located within Flood Zone A.

Node *"Blac_DP15A"* from the CFRAMS map, located on the western (upstream) side of Fermoy bridge, predicts a max water level of 24.82mOD and 25.53mOD in the 1% AEP and 0.1% AEP flood events respectively. The proposed level for the remediated section of the weir is 21.45moD and 21.55mOD at the upstream embankment section and downstream Mill Race section of the weir respectively with the level of the new bypass channel proposed at 21.20mOD on the upstream side. As such, the proposed development will be submerged during flood events of this magnitude. However, water compatible development which, as per the Planning System and Flood Risk Management Guidelines, is appropriate development within Flood Zone A as illustrated in Table 2-3 previous.

As noted in Section 3.4, the OPW advised that the impacts of the reinstated weir and new fish bypass channel on upstream lands and on the current trigger levels for the erecting the Fermoy flood defence scheme barriers would need to be considered as part of this FRA. In view of this, a hydraulic model has been prepared as part of the Stage 3 FRA in Section 5 of this report to consider these impacts.

4.3. Pluvial Flood Risk

Pluvial flooding occurs due to insufficient capacity in the local drainage network system which results in overland flows as well as the ponding of water in topographically low points.

It is usually associated with high intensity rainfall. While pluvial flooding is an important consideration, it can be addressed by site specific drainage and management measures aimed at mitigating the effects of pluvial flooding.

The review of historic flooding at the location of the proposed development, and in close proximity as summarised in Table 3-2, illustrates that the sources of flooding for the flood events which occurred closest to the site were all associated with fluvial flooding. In addition, as the proposed development works are water compatible and are all situated in the river Blackwater, the development will not be at risk to pluvial flooding.

4.4. Overland Flow Flood Risk

Overland flooding can often be characterised by flood waters overspilling watercourses during significant rainfall events, pluvial flooding or by a combination of both, which results in flows overland and subsequent flooding often caused by ponding.

The proposed development site is water compatible and is located in the river Blackwater. Therefore, it is not at risk to flooding from overland flood flows or does not interfere with existing overland flood flow routes.

4.5. Tidal Flood Risk

The Floodinfo maps for Fermoy show that the development site is neither within or near the 0.5% AEP coastal flood zone or the coastal extreme event zone.

The river Blackwater is not subject to tidal influence at Fermoy. As such, tidal flood risk is not considered any further in this report.

4.6. Existing Fermoy Flood Defence Schemes

The Fermoy North and South flood defence schemes were completed in 2009 and 2014 respectively. The overall objective of both projects was to develop a flood alleviation scheme to protect the town of Fermoy from flooding up to a 1% AEP flood event as the town had been severely affected by flooding from the River Blackwater in the past.

The schemes included for the construction of both temporary and permanent demountable walls as well as an earthen embankment on both sides of the Blackwater River. The schemes also included for the construction of storm drains and pumping stations behind the defences to prevent, or substantially, reduce the periodic localised flooding of lands and properties in the area.

The Fermoy Flood Relief Scheme consists of a number of flood alleviation elements which when all correctly operational will protect the North and South side of the River Blackwater against a flood with an annual probability of occurrence of 1% AEP.

The scheme comprises of the following elements:

- Demountable defences;
- Pull up posts and demountable defences on low permanent flood walls;
- Flood walls;
- Embankments and land drains;
- Drainage collection systems;
- Foul and storm pumping stations including intake/outlet debris screens and nonreturn valves;
- Penstock closures;
- Mobile pumps.

Extensive hydrological studies were commissioned by the OPW to inform the design of the Fermoy Flood Defence Schemes. Flood estimates were derived for Fermoy for the eight historical events between 1980 and 2002 using a model which routed flows measured at Killavullen (Babtie 2003). These flood estimates were reviewed in 2011 by Jacobs and DHV to take account of discrepancies that were identified between observed and predicted flood levels in Fermoy.

Following the construction of the Fermoy North and South Drainage Schemes, the OPW undertook some model calibration surveys. However, the hydraulic model was not updated to reflect post construction. The original model included pre-and post-construction scenarios.

Further modelling has been undertaken using HEC-RAS 2D modelling software to consider the flood implications of the diversion of flows to the Bypass and the minor alterations to the weir level and is discussed further in Section 5. The deterioration and subsequent breach of sections of the weir in recent years has led to the flow regime being altered. As a consequence of this, the flow is now concentrated at Mill Race which has resulted in significant erosion which required emergency works to be undertaken by the OPW in the autumn of 2020 to avoid undermining the existing flood defence structures. The current flow regime and its consequences has also been assessed in the modelling which is discussed in Section 5 of this report.

The Office of Public Works have implemented a Flood Warning System for the River Blackwater that will provide the defence installers with at least 8 hours warning time to allow their staff to implement those works that are necessary to complete the defences.

In summary, for a predicted major flood event, the following interventions are required:

- Erection of warning signs;
- Traffic diversion;
- Public preparedness & liaise with local authorities & Gardai;
- Erection of demountable defences;
- Opening / closing of penstocks;
- Installation of mobile submersible pumps.

Protocols have been implemented by the OPW to provide for these interventions on both the Fermoy North and Fermoy South flood defences with trigger levels applied for different modes of operation.

4.7. Justification Test

As discussed in Section 2.3, a Justification Test is required in cases where development is proposed in areas of moderate or high flood risk. Water compatible development within Flood Zone A is permissible and does not require a Justification Test to be carried out.

Therefore, in this instance it is not necessary to apply the Justification Test for the proposed development as water compatible development is permissible in Flood Zone A.

4.8. Stage 2 Conclusion

Following the assessment of flood risk for the proposed development and the available information for the site, it is concluded that the proposed development is entirely located within Flood Zone A as determined from the South Western CFRAMS flood mapping. This is the most up to date information available for classifying the site at the time of writing this report.

The proposed development is located in the river Blackwater and is water compatible development which is permissible in Flood Zone A under the Planning System and Flood Risk Management Guidelines.

As the proposed development is water compatible, it is not considered to be at risk to fluvial or pluvial flooding. The river Blackwater is not subject to tidal influence at Fermoy and is therefore not at risk to tidal flooding.

There is no information or previous hydraulic modelling available to assess the impact of the proposed development on upstream lands or on the trigger levels for the Fermoy flood defence schemes as required based on the OPW consultations discussed previously. The flood risk assessment will therefore need to assess these impacts on the basis of developing a site-specific hydraulic model for the proposed development. This will enable the impact of the proposed development on upstream lands, and on the trigger levels for the Fermoy flood defence schemes (if any), to be assessed. This is addressed in the Stage 3 Site-Specific Flood Risk Assessment in Section 5 of this report.

4.9. Allowance for Climate Change

The *"Planning System and Flood Risk Management Guidelines"* advise a precautionary approach with regard to climate change. The precautionary approach includes:

- Ensuring that the levels of structures designed to protect against flooding, such as flood defences, land-raising or raised floor levels are sufficient to cope with the

effects of climate change over the lifetime of the development they are designed to protect; and

- Ensuring that structures to protect against flooding and the development protected are capable of adaptation to the effects of climate change when there is more certainty about the effects and still time for such adaptation to be effective.

5. STAGE 3 – DETAILED FLOOD RISK ASSESSMENT

5.1. Previous Modelling

Extensive hydrological studies were commissioned by the OPW to inform the design of the Fermoy Flood Defence Schemes. Flood estimates were derived for Fermoy for the eight historical events between 1980 and 2002 using a model which routed flows measured at Killavullen (Babtie 2003). These flood estimates were reviewed in 2011 by Jacobs and DHV to take account of discrepancies that were identified between observed and predicted flood levels in Fermoy.

Following the construction of the Fermoy North and South Drainage Schemes, the OPW undertook some model calibration surveys. However, the hydraulic model was not updated to reflect post construction. The original model included pre-and post-construction scenarios.

A design memo was also prepared by DHV in 2007, based on the previous hydrological studies mentioned above, to determine the trigger levels (detected in the river) for when to erect the demountable flood barriers. In order to define this set of trigger levels, detailed information on the flood levels for different return periods and frequencies had to be developed.
The OPW also commissioned a 1D Hydraulic model of the Blackwater at Fermoy for the South West CFRAMS Study. A 1D-2D HEC-RAS model, which has been developed for this FRA and is discussed in further detail in the following sections, incorporates elements of the CFRAMS 1D model in respect of cross-sections upstream and downstream in the immediate vicinity of the weir and bridge.

5.2. Hydrology

5.2.1. Catchment Description

The River Blackwater rises in County Kerry in the Mullaghareirk Mountains and initially flows in a southern direction to Rathmore before flowing in an easterly direction to join the Irish Sea at Youghal. The river passes through a number of towns along its route with the largest being Mallow, Fermoy and Youghal. Fermoy is located approximately 50km upstream of the mouth of the river and is not tidally influenced as previously noted in Section 4.5.

The valley is broad and relatively flat and is surrounded by mountains with the ranges of Knockmealdown, Kilworth, Galtee, Ballyhoura and Mullaghareirk to the north and the Boggeragh range to the south.

The catchment is entirely rural and is dominated by pasture and grazing with lesser extents of cultivated land and some forest cover principally in the west. No significant urban areas exist that are likely to affect the flood flow characteristics of the river. There is also a lack of large and medium sized water bodies (lakes or reservoirs), which can have an influence on flood flows, for such a large catchment.

5.2.2. Design Flows

A review of the available information was undertaken to identify the most appropriate flow data for use as the design flows in the 1D-2D HEC-RAS model. As noted in Section 5.1 above, previous flow rates for various return periods had been derived previously as part of the memo prepared by DHV in 2007.

In addition to the above, the South Western CFRAMS Unit of Management 18 study (Munster Blackwater Catchment) included Gamma hydrographs for specific nodes on the river and its tributaries. These hydrographs were derived based on the data available for Hydrograph pivotal site 15006 (Figure 5-1) which provides a basis for a hydrograph distribution using the design flows for the Fermoy Bridge Gauge (18107) which are shown in Table 5-1 below.

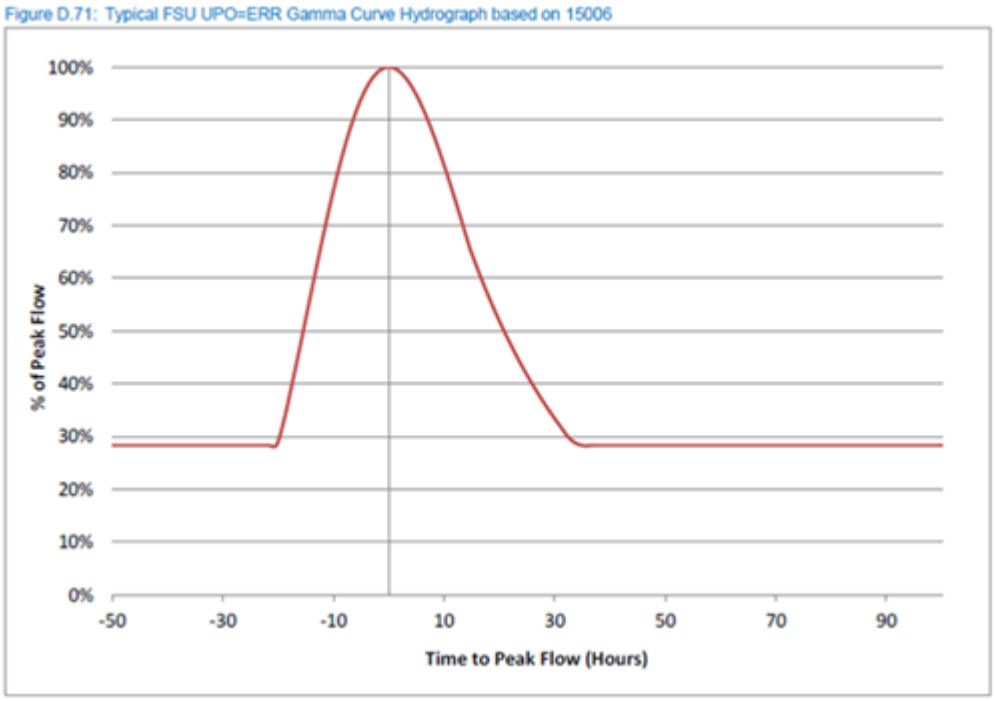

Figure 5-1: UoM 18 Gamma Curve Hydrograph

Table 5-1: Design Flows for Fermoy Bridge Gauge 18107 (CFRAMS UoM 18, 2016)

Table D.30: Fermoy AFA Design Peak Flows

LOCATION	HEP	Pivotal Site	QMED	95% Confidence Limit	Flood Growth Factor									Design Flows								Hydrograph Pivotal Site
					Flood Growth Curve	50	20	10	5	2	1	0.5	0.1	50	20	10	5	2	1	0.5	0.1	
KILLAVULLEN GAUGE 18003	18_1616_5	18003	337.2	632.5	Single Site EV	1.00	1.35	1.58	1.80	2.09	2.31	2.52	3.01	337.0	454.9	525.6	590.8	679.6	752.1	821.3	1009.7	18003
Blackwater	18_2616_3	18003	344.3	632.9	Single Site EV	1.00	1.35	1.58	1.80	2.09	2.31	2.52	3.01	337.2	455.2	532.8	606.9	704.7	778.9	849.7	1014.8	15006
Blackwater/Awbeg us	18_1614_3	18003	347.5	632.9	Single Site EV	1.00	1.35	1.58	1.80	2.09	2.31	2.52	3.01	337.2	455.2	532.8	607.0	704.7	778.9	849.7	1014.9	15006
Blackwater/Awbeg ds	18_352_1	18107	358.5	646.2	Single Site EV	1.00	1.35	1.58	1.80	2.09	2.31	2.52	3.02	344.3	464.8	544.0	619.8	719.6	795.4	867.7	1036.3	30007
Blackwater	18_353_1	18107	359.7	652.2	Single Site EV	1.00	1.35	1.58	1.80	2.09	2.31	2.52	3.02	347.5	469.1	549.0	625.5	726.2	802.7	875.7	1045.8	30007
Blackwater at Castlehyde	18_351_2	18107	364.7	672.9	Single Site EV	1.00	1.35	1.58	1.80	2.09	2.31	2.52	3.02	358.5	484.1	567.2	647.0	750.2	827.6	904.6	1083.2	15006
Blackwater/Glenabo u/s	18_351_6	18107	365.5	685.9	Single Site EV	1.00	1.35	1.58	1.80	2.09	2.31	2.52	3.02	359.7	485.7	569.1	649.1	752.6	830.2	907.6	1086.7	15006
Blackwater/Glenabo d/s	18_1158_1	18107	366.8	688.5	Single Site EV	1.00	1.35	1.58	1.80	2.09	2.31	2.52	3.02	365.5	493.5	578.2	659.5	764.7	843.5	922.1	1104.1	15006
Fermoy Bridge Gauge (18107)	18_1158_5	18107	369.6	693.8	Single Site EV	1.00	1.35	1.58	1.8	2.09	2.31	2.52	3.02	366.8	495.3	580.4	662.0	767.6	846.7	925.6	1108.3	15006
Blackwater/Strawhall u/s	18_1158_8	18107	369.7	693.9	Single Site EV	1.00	1.35	1.58	1.80	2.09	2.31	2.52	3.02	369.6	499.1	584.8	667.0	773.4	853.2	932.6	1116.7	15006

The peak flows that have been derived from the Gamma curves are summarised below in Table 5-2.

Table 5-2: Flow Rates from Gamma Curves

Return Period (years)	Gamma Flow (m^3/s)
1	-
2	366.8
5	495.3
10	580.4
20	662
25	-
50	767.6
100	846.7
200	925.6
1000	1108.3

5.3. Hydraulic Model

5.3.1. Model Configuration

As previously noted, a 1D-2D HEC-RAS model has been developed as part of this flood risk assessment. The OPW commissioned a 1D hydraulic model of the Blackwater at Fermoy as part of the South West CFRAMS Study. The 1D-2D HEC-RAS model which has been developed for this flood risk assessment incorporates elements of the OPW's 1D model in respect of cross-sections upstream and downstream of the weir and bridge. The 1D-2D HEC-RAS model produced for this report has been developed to consider the implications of the detailed layout of the proposed weir remediation and fish bypass channel. As noted in Section 3.4, the OPW requires that any proposed modification to the weir and any works within the flood plain will not result in any increased flood risk at Fermoy.

The model extends for a distance of approx. 365m upstream and 380m downstream of Kent bridge. The model has been developed with the weir in its existing condition with a separate model also prepared with the weir in its proposed remediated state as per the details on the drawings included in Appendix B of this report. The proposed fish bypass channel, as also detailed on the above-mentioned drawings, is also incorporated into the proposed hydraulic model in conjunction with the weir in its remediated state.

The model extent is shown at Figure 5-2 below. This figure also identifies the location of critical points as per a 2007 OPW assessment of flood levels for the emergency response Programme.

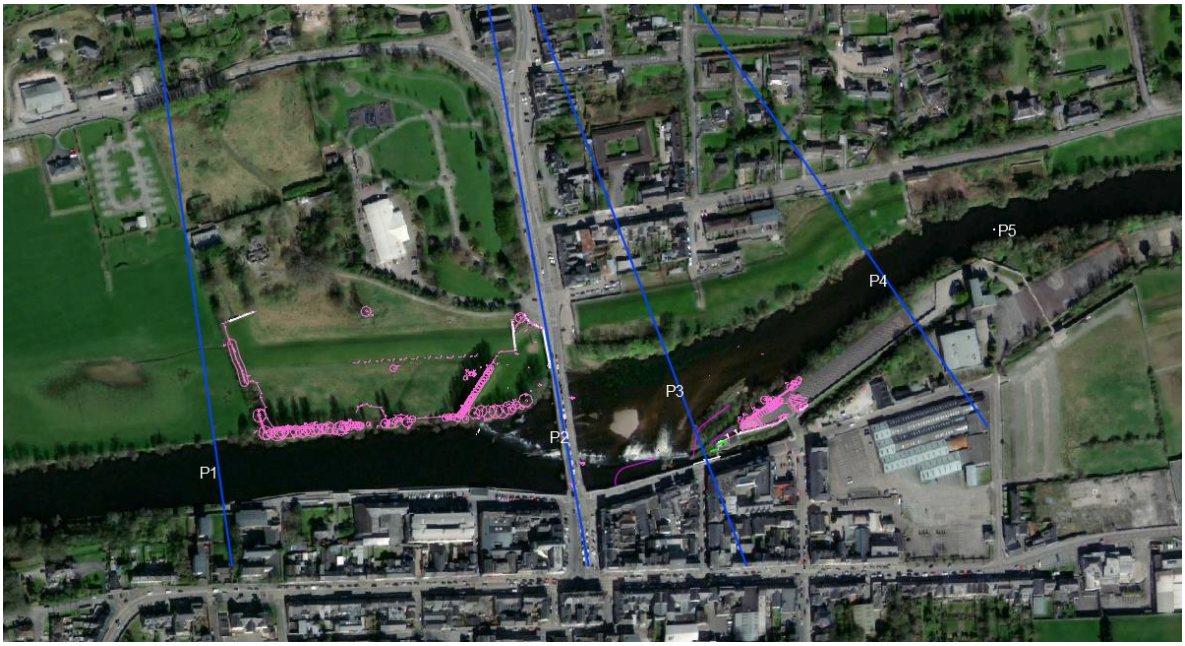

Figure 5-2: HEC-RAS 2D Model Extent and Critical Point Locations

5.3.2. Topographical Information & Model Surface

The surface for the hydraulic model was developed based on a range of datasets which were compiled together to generate the surface for the hydraulic model. The data was compiled from a range of sources, the majority of which TJOC had on file from previous and current projects in Fermoy over the years. The data used to generate the 2D surface in HEC-RAS is made up of the following sources;

- 2003 Aerial Survey relating to CFRAMS.
- Fermoy North and South flood defence schemes as-built drawings, surveys and studies.
- 2018 weir survey undertaken by Murphy Geospatial.
- 2020 river bed survey undertaken by Murphy Geospatial.
- As-built drawings from the OPW 2020 emergency works.

5.3.3. Model Calibration

The levels within the 2D element of model surface were calibrated with the levels available in the sources of information described in Section 5.3.2 above for accuracy prior to beginning the simulations.

The water levels which were identified in the DHV memo of 2007 as the trigger levels for raising the flood defence works were used to calibrate the model simulations for accuracy. This was achieved by correlating the predicted water levels at locations P1 to P5 in the 2007 memo to that of the levels predicted in the hydraulic model developed for this SSFRA. The locations of P1 to P5 are illustrated on Figure 5-2 above.

Table 5-3 below shows the water levels predicted at locations P1 to P5 in the 2007 memo prepared by DHV which were used to calibrate the hydraulic model.

Table 5-3: Water Levels used to Calibrate Hydraulic Model (mOD)

Location	1/1 yr	1/2 yr	1/5 yr	1/10 yr	1/20 yr	1/50 yr	1/100 yr	1/200 yr
P1	22.61	22.85	23.46	23.86	24.24	24.88	25.42	25.99
P2	22.36	22.64	23.31	23.71	24.09	24.73	25.28	25.83
P3	22.04	22.45	23.19	23.61	23.99	24.65	25.19	25.76
P4	21.92	22.33	23.06	23.47	23.86	24.51	25.07	25.64
P5	21.82	22.21	22.93	23.33	23.72	24.40	24.97	25.56

5.3.4. Model Results

Hydraulic modelling was undertaken for a range of return periods ranging from 1 in 2 year to 1 in 200 year flood events for both the existing and proposed scenarios. The water levels predicted in these various return periods are shown in Tables 5-4 and Table 5-5 below for the existing and proposed scenarios respectively. The water levels noted in the tables below have been related to locations P1 to P4 which are within the model extents, i.e. the same locations used to calibrate the model as illustrated in Figure 5-3 above.

Table 5-4: Predicted Water Levels (mOD) for Existing Scenario

Location	*1/2 yr	*1/5 yr	1/10 yr	1/20 yr	1/50 yr	1/100 yr	1/200 yr
P1	22.70	23.36	23.81	24.09	24.90	25.36	25.79
P2	21.94	22.81	23.34	23.84	24.60	25.21	25.66
P3	21.69	22.59	23.13	23.71	24.50	24.93	25.33
P4	21.56	22.51	23.10	23.56	24.35	24.60	25.00

Table 5-5: Predicted Water Levels (mOD) for Proposed Scenario

Location	*1/2 yr	*1/5 yr	1/10 yr	1/20 yr	1/50 yr	1/100 yr	1/200 yr
P1	22.67	23.33	23.78	24.08	24.84	25.35	25.75
P2	21.91	22.81	23.25	23.74	24.51	25.15	25.60
P3	21.65	22.54	23.12	23.68	24.45	24.90	25.27
P4	21.56	22.50	23.10	23.55	24.32	24.60	25.00

**Water levels predicted with no flood defences erected*

From the predicted water levels in Tables 5-4 and 5-5 above for locations P1 to P4, it can be seen that the proposed development does not increase the water levels or alter the flood risk of flooding in the area. The proposed development will not result in an increase to the river level.

Graphical results from the hydraulic modelling are reproduced in Appendix D of this report. These illustrate the results for the flood depths for the various return periods. The results of the existing and proposed scenarios for the various return periods are shown together for illustrative purposes.

It can be seen from the graphical results that the proposed development does not increase the risk of flooding in the area or alter the flood regime.

5.4. Detailed Fluvial Flood Risk Assessment

5.4.1. Risk to Upstream Lands

The 1D-2D hydraulic model that was prepared for this FRA extended a distance of 365m upstream of Kent bridge. At location P1, which is approx. 310m upstream of Kent bridge, there is no increase in the water levels as a result of the proposed development as demonstrated by the tabular results in Tables 5-4 and 5-5. The proposed development does not lead to an increase in the river at P1 for any of the return periods considered in the analysis.

It is therefore considered that the proposed development does not increase the flood risk to upstream lands as illustrated by Tables 5-4 and 5-5 and also by the modelling results included in Appendix D of this report.

5.4.2. Risk to OPW Fermoy Flood Defence Scheme Trigger Levels

The outputs from the HEC-RAS modelling were reviewed against the trigger levels for the Fermoy North and South Flood Defence Schemes to assess if the proposed works would have a negative impact on the levels associated with the flood protocols. These levels are shown in Table 5-6 below for the various return periods.

Table 5-6: Comparison of OPW Trigger Levels vs Predicted Levels for Proposed Works (mOD)

Return Period	P1	P1 (Prop.)	P2	P2 (Prop.)	P3	P3 (Prop.)	P4	P4 (Prop.)
1 in 2 yr	22.85	22.67	22.64	21.91	22.45	21.65	22.33	21.56
1 in 5 yr	23.46	23.33	23.31	22.81	23.19	22.54	23.06	22.50
1 in 10 yr	23.86	23.78	23.71	23.25	23.61	23.12	23.47	23.10
1 in 20 yr	24.24	24.08	24.09	23.74	23.99	23.68	23.86	23.55
1 in 50 yr	24.88	24.84	24.73	24.51	24.65	24.45	24.51	24.32
1 in 100 yr	25.42	25.35	25.28	25.15	25.19	24.90	25.07	24.60
1 in 200 yr	25.99	25.75	25.83	25.60	25.76	25.27	25.64	25.00

It can be seen from Table 5-6 that the proposed works will not increase the water levels in the river which in turn would not have a negative impact on the trigger levels for the Fermoy North and South flood defence scheme protocols and erection procedures. As can be seen from Table 5-5 above, the predicted flood levels for the proposed development are all lower than the OPW trigger levels. Therefore, the proposed development will not impact the OPW trigger levels.

5.5. Residual Risks

A site compound will be required during the construction phase of the works for the storage of materials, plant and equipment, and for a site office(s). It is envisaged that the location of the site compound will be to the west of the proposed Bypass channel.

The works will be undertaken within flood defence walls and embankments which comprise the Munster Blackwater Fermoy Drainage Scheme. Therefore, site offices located on a compound within the site on the north bank of the river could be at risk of flooding and would be inaccessible when the flood defence demountable barriers are erected. Therefore, it is recommended that site offices and welfare facilities should be located above the 1% AEP flood level at this location, based on the OPW's flood maps of the area.

6. APPLICATION OF "FLOOD RISK MANAGEMENT GUIDELINES"

6.1. Flood Zone & Vulnerability Class of the Site

As is demonstrated in Section 3 above:

1) The proposed development site is classified as Flood Zone A based on the CFRAM flood maps of Fermoy in Appendix C.
2) The type of development proposed is appropriate for the relevant flood zone, i.e. water compatible development in Flood Zone A.
3) The development is not considered at risk to fluvial flooding as it is water compatible development.
4) The development of the site does not alter the risk from pluvial flooding.
5) The development of the site does not alter overland flood flow paths.
6) The site is not at risk from coastal flooding.
7) The site is with in an area with a history of flooding and is within a designated Drainage scheme under the Arterial Drainage Act.
8) The proposed development will not increase flood risk upstream.
9) The proposed development will not have a negative impact on the OPW trigger levels.

As can be seen in Table 2-2, water compatible development is permissible in Flood Zone A and does not require a Justification Test to be carried out as noted in the Planning System and Flood Risk Management Guidelines.

7. CONCLUSIONS

A flood risk assessment was carried out to establish if the proposed development at Fermoy would be at risk of flooding.

The flood risk assessment concluded that:

1) The proposed development is classified as water compatible development under the Planning System and Flood Risk Management Guidelines.
2) The site is classified as Flood Zone A.
3) The site lies within an area which is at risk to fluvial flooding.
4) The development of the site does not alter the risk from pluvial flooding.
5) The development of the site does not interfere with existing overland flood flow paths.
6) The site is not at risk from coastal flooding.
7) There is a history of flooding at the site.
8) The development is considered appropriate in accordance with *"The Planning System and Flood Risk Management Guidelines for Planning Authorities"* as published by the Department of Environment, Heritage and Local Government and the OPW.
9) The proposed development will not increase flood risk upstream.
10) The proposed development will not have a negative impact on the OPW trigger levels.
11) The proposed development will not increase the flood risk in the area as demonstrated by the modelling results in Section 5.

APPENDIX A

Existing Site Layout Plan
(Drg. No. 19011-TJOC-PL-XX-DR-C-0051)

NOTES:

1. TREE INFORMATION SHOWN ON THIS DRAWING IS TAKEN FROM GEODATA SURVEYING LTD, TOPOGRAPHICAL SURVEY OF JUNE 2020.
2. EXISTING WEIR INFORMATION SHOWN ON THIS DRAWING IS TAKEN FROM WEIR SURVEY CARRIED OUT BY MURPHY GEOSPACIAL IN AUGUST 2018. EXTENT OF BREACHES SHOWN ARE AS SURVEYED IN 2018 AND MAY HAVE INCREASED IN THE TIME SINCE THE SURVEY HAD BEEN CARRIED OUT.
3. PHOTOS TAKEN IN MARCH 2021.

LEGEND:

SITE BOUNDARY

EXISTING TREES

PHOTO LOCATION AND DIRECTION

EXISTING BREACHES IN WEIR

N

0 10 20 30 40 60 80 100m
1:1000

PHOTO 1 - EMBANKMENT WEIR

PHOTO 3 - INTERFACE BETWEEN EMBANKMENT AND MILL RACE WEIR

PHOTO 5 -EXISTING BREACHES IN MILL RACE SECTION OF WEIR

PHOTO 2 - EXISTING FISH LADDER

PHOTO 4 - EXISTING BREACHES IN MILL RACE SECTION OF WEIR
(LOOKING DOWNSTREAM)

PHOTO 6 -EXISTING BREACHES IN MILL RACE SECTION OF WEIR
(LOOKING UPSTREAM)

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING SITE LAYOUT PLAN

SCALE: 1:1000 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE -ROLE - NUMBER: 19011-TJOC-PL-XX-DR-C-0051

REV: C01

APPENDIX B

Proposed Development Layout Plans

19011-TJOC-PL-XX-DR-C-0053_FISH_PASS_PLAN
19011-TJOC-PL-XX-DR-C-0054_FISH_PASS_LONG_SECTION
19011-TJOC-PL-XX-DR-C-0055_FISH_PASS_SECTIONS
19011-TJOC-PL-XX-DR-C-0060_PLAN_PROPOSED_WEIR
19011-TJOC-PL-XX-DR-C-0061_PROPOSED_SECTIONS
19011-TJOC-PL-XX-DR-C-0062_PROPOSED_SECTIONS
19011-TJOC-PL-XX-DR-C-0063_PROPOSED_SECTIONS
19011-TJOC-PL-XX-DR-C-0080_EX_FISH_LADDER_DETAILS

FERMOY NORTH FLOOD DEFENCE EMBANKMENT

NEW 4m WIDE ACCESS GATE

EXISTING FENCELINE TO BE RETAILED

EXISTING RAILING AND SEAT TO BE TEMPORARILY REMOVED FOR CONSTRUCTION ACCESS

PERTURBATION BOULDERS, RANDOM PLACEMENT

CONCRETE AND STONE CLADDING

LANDSCAPED 1:4 SLOPE

LANDSCAPED 1:2 SLOPE

PERTURBATION BOULDERS, RANDOM PLACEMENT

FISH POOLS CREATED BY VARYING LEVEL OF ROCK WEIR WALLS

FERMOY SOUTH FLOOD DEFENCE WALLS

EXISTING FISH PASS

BED OF RIVER TO BE DREDGED TO MINIMUM BED LEVEL OF 18.50 AT BRIDGE PIERS AND 19.10 AT OUTLET FROM FISH BYPASS

BM 25.87

FERMOY (Town Council)

FERMOY BRIDGE

Fermoy Bridge

Weir

Salmon Leap

ASHE QUAY

Toilets

Hotel

Hall

Boat Club

BARNANE WALK

Town Council Bdy

CF

UND

10kv

BRIAN BORU SQUARE

Apts 1-7

0 5 10 15 20 30 40 50m
1:500

LEGEND:

EXISTING RIVER BED LEVELS	19.02
PROPOSED LEVELS	19.02
EXISTING TREES	
EXISTING TREES TO BE REMOVED	
PROPOSED PLANTING	

NOTES:

1. REFER TO DRAWINGS 0054 AND 0055 FOR SECTION DETAILS OF PROPOSED FISH BYPASS CHANNEL.
2. ALL LEVELS SHOWN RELATE TO ORDNANCE DATUM MALIN HEAD.

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: PROPOSED FISH BYPASS PLAN

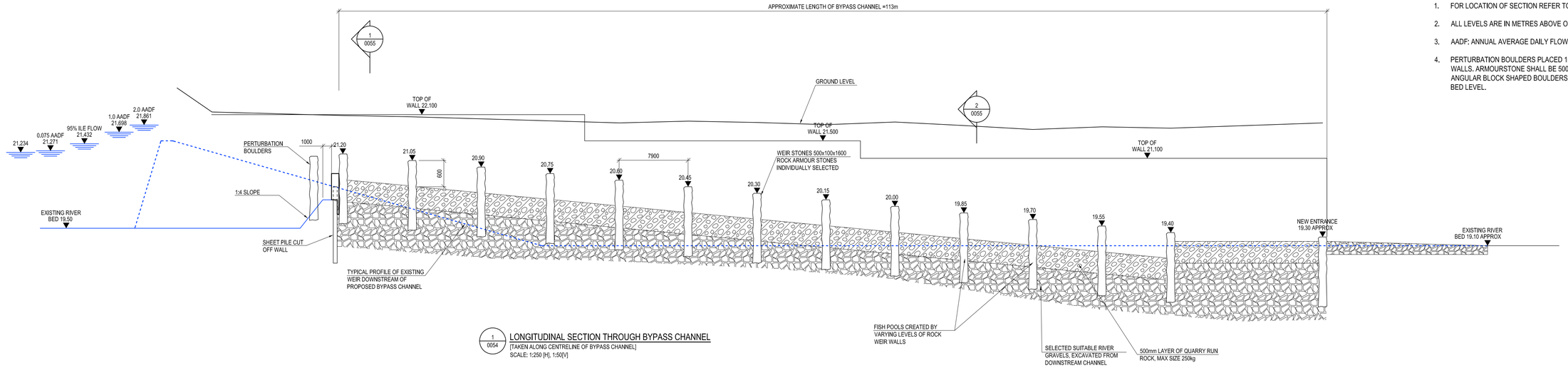
SCALE: 1:500 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE -ROLE- NUMBER
19011-TJOC-XX-XX-DR-C-0053

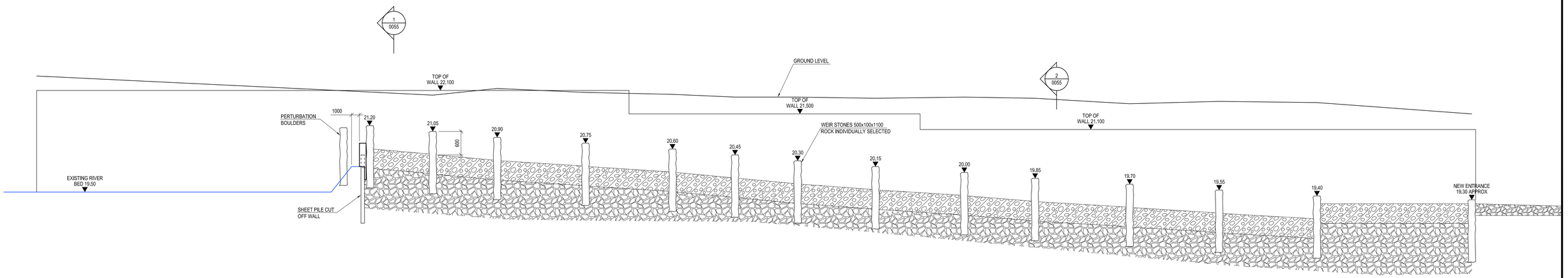
REV: C01

NOTES:

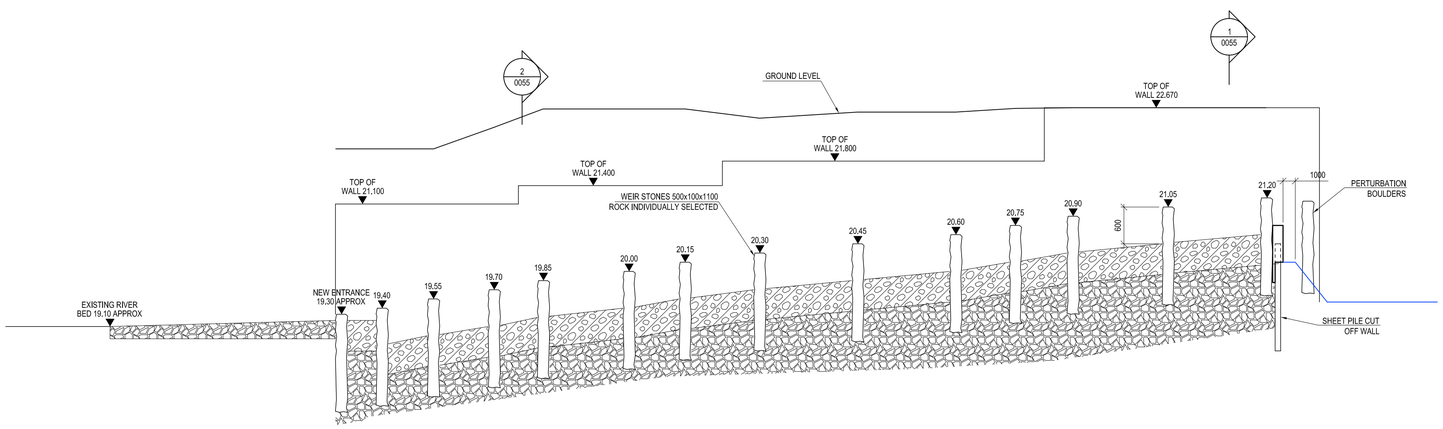
1. FOR LOCATION OF SECTION REFER TO DRAWING 0053.
2. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM MALIN HEAD.
3. AADF: ANNUAL AVERAGE DAILY FLOW
4. PERTURBATION BOULDERS PLACED 1m UPSTREAM OF GAPS IN THE WEIR WALLS. ARMOURSTONE SHALL BE 500x1000x1600 HIGH MIN. DIMENSIONS ANGULAR BLOCK SHAPED BOULDERS PROJECTION 500mm ABOVE THE RAMP BED LEVEL.



1 0054 **LONGITUDINAL SECTION THROUGH BYPASS CHANNEL**
[TAKEN ALONG CENTRELINE OF BYPASS CHANNEL]
SCALE: 1:250 [H], 1:50[V]



2 0054 **ELEVATION OF NORTHERN WALL OF BYPASS CHANNEL**
SCALE: 1:250 [H], 1:50[V]



3 0054 **ELEVATION OF SOUTHERN WALL OF BYPASS CHANNEL**
SCALE: 1:250 [H], 1:50[V]

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS
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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

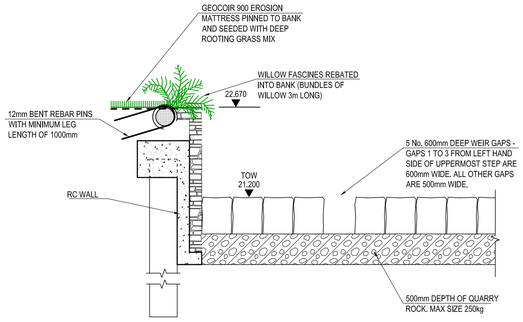
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: PROPOSED FISH BYPASS LONGITUDINAL SECTION

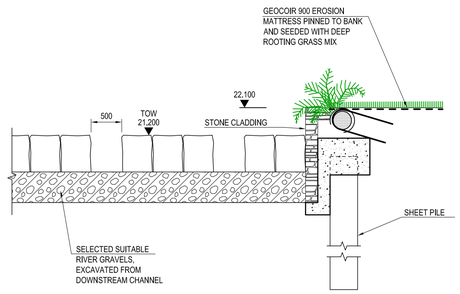
SCALE: 1:250 [H], 1:50 [V] (A1)

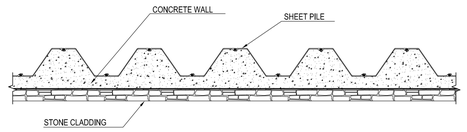
PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-XX-XX-DR-C-0054

REV: C01



1 / 0055 SECTION
SCALE: 1:50

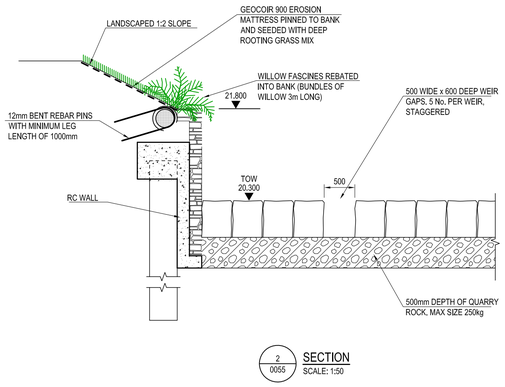




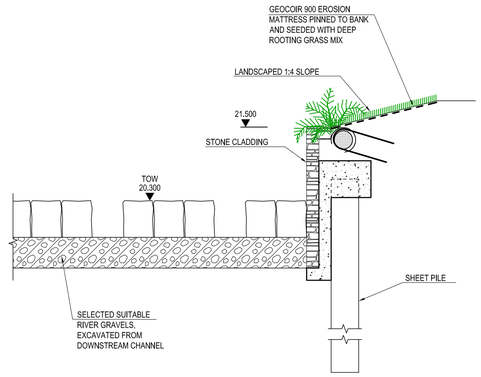
4 / 0055 DETAIL PART PLAN OF SHEET PILE WALL
SCALE: 1:50

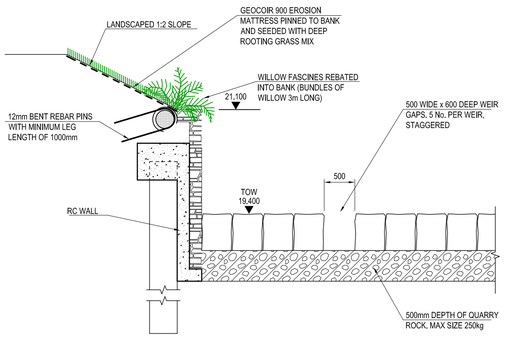
NOTES:

1. FOR LOCATION OF SECTIONS REFER TO DRAWING 0053.
2. ALL LEVELS ARE IN METERS ABOVE ORDNANCE DATUM MALIN HEAD

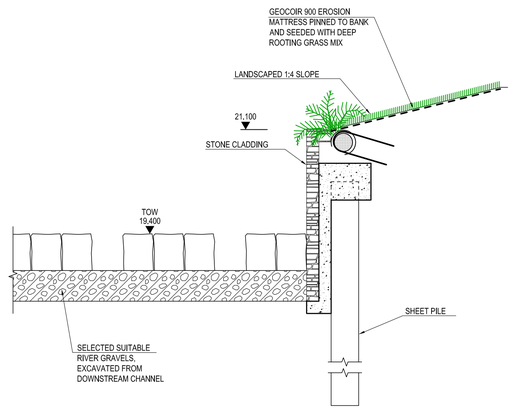


2 / 0055 SECTION
SCALE: 1:50





3 / 0055 SECTION
SCALE: 1:50



REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY: LC | REVIEWED BY: MV | APPROVED BY: DC

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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

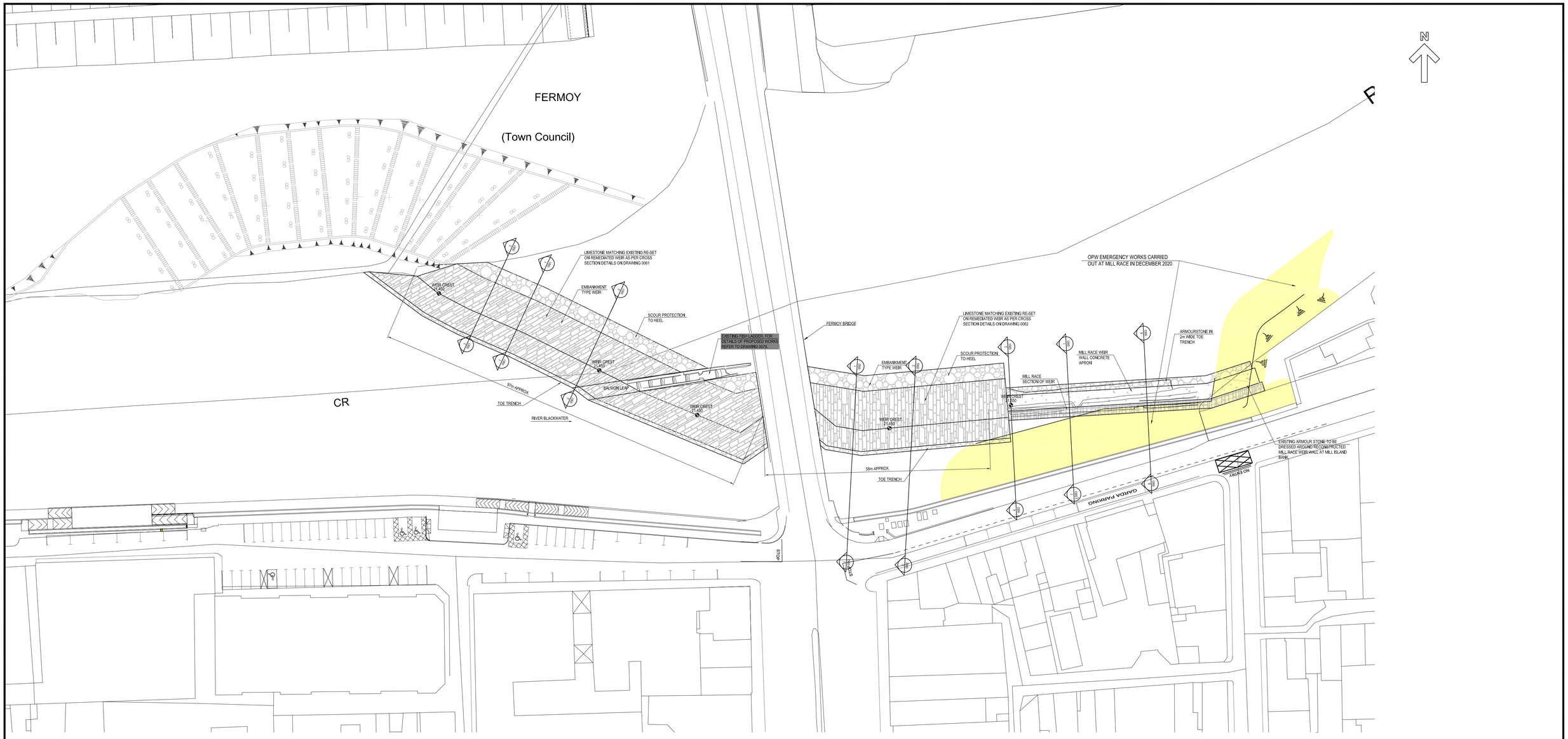
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: FISH BYPASS SECTIONS

SCALE: 1:50 (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER: 19011-TJOC-XX-XX-DR-C-0055

REV: C01



0 5 10 15 20 30 40 50m
1:500

NOTES:

1. FOR SECTIONS THROUGH PROPOSED EMBANKMENT WEIR REFER TO DRAWINGS 0061 AND 0062.
2. FOR SECTIONS THROUGH PROPOSED MILL RACE WEIR REFER TO DRAWING 0063.
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM MALIN HEAD.
4. WEIR REMEDIATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CONSERVATION ENGINEER'S RECOMMENDATIONS.

APPROXIMATE EXTENT OF BED STABILISATION WORKS UNDERTAKEN BY THE OPW IN 2020

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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PROJECT: FERMOY EMBANKMENT WEIR REMEDIATION AND FISH BYPASS CHANNEL

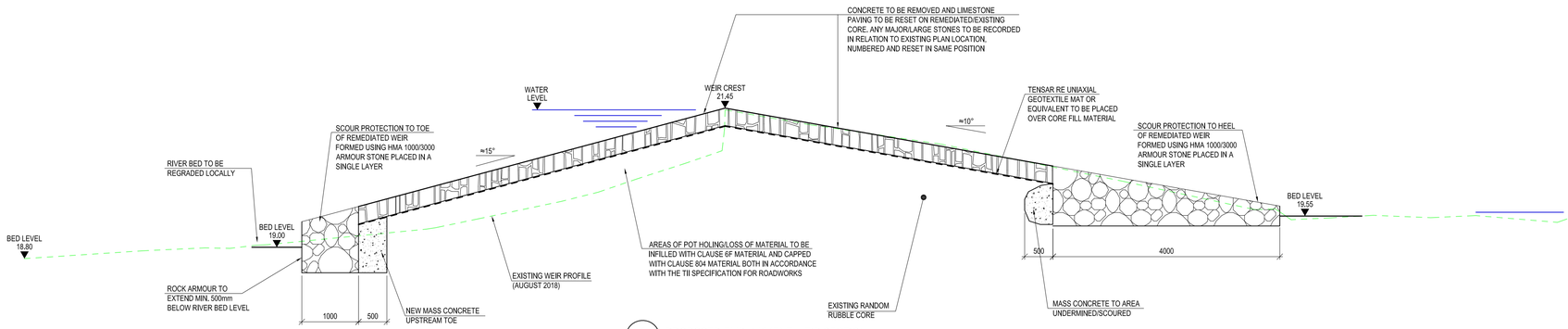
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: WEIR REMEDIATION PLAN OF PROPOSED WEIR

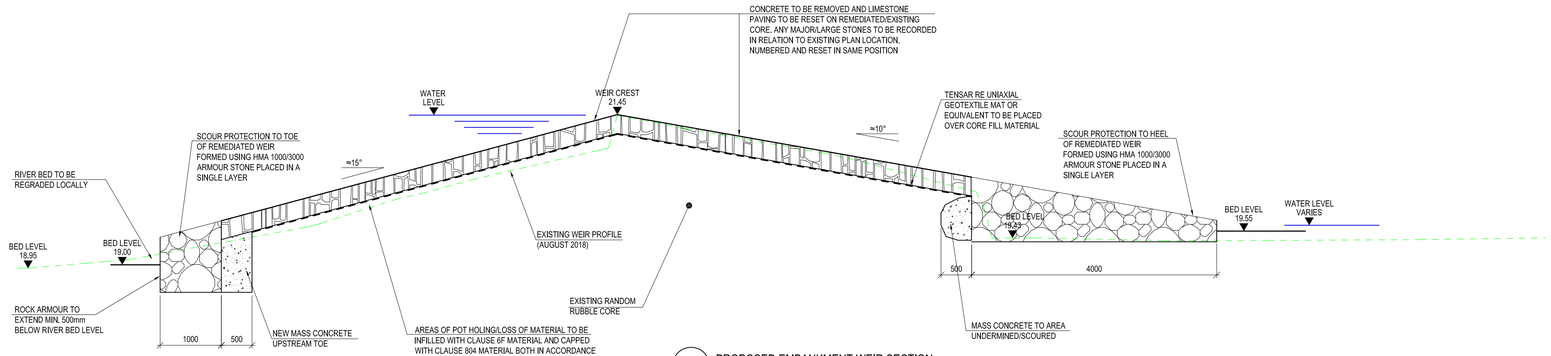
SCALE: 1:500 (A1)

PROJECT - ORIGINATOR - VOLUME -LOCATION- TYPE -ROLE- NUMBER
19011-TJOC-PL-XX-DR-C-0060

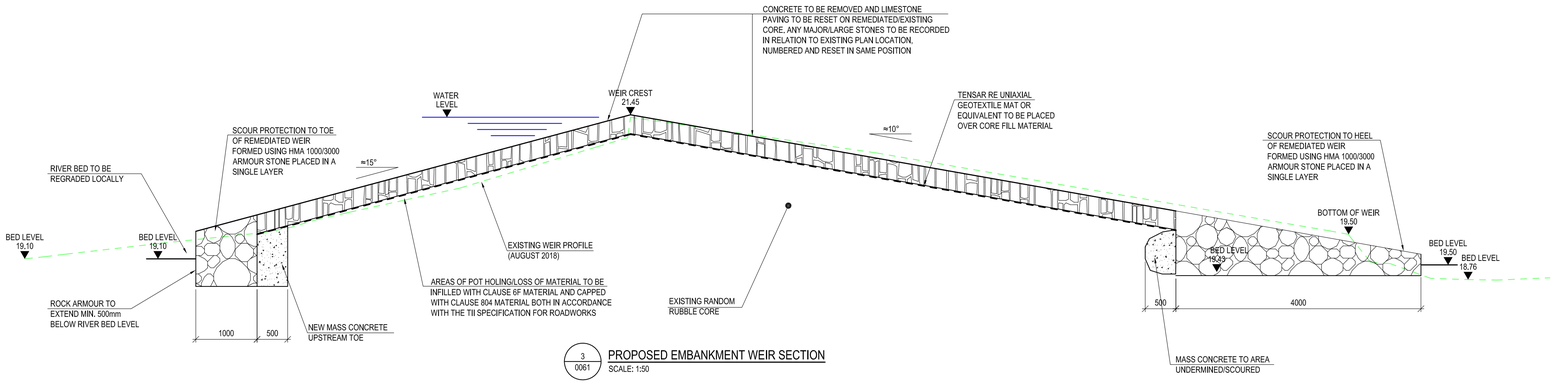
REV: C01



1/0061 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50



2/0061 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50



3/0061 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50

NOTES:

1. ALL LEVELS SHOWN ARE IN METERS ABOVE ORDNANCE DATUM, MALIN HEAD.
2. FOR LOCATIONS OF SECTIONS REFER TO DRAWING 0060.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH SURVEY DRAWINGS OF EXISTING WEIR STRUCTURE AND WITH SECTION DRAWINGS 0062 AND 0063.
4. WEIR REMEDIATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CONSERVATION ENGINEER'S RECOMMENDATIONS.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

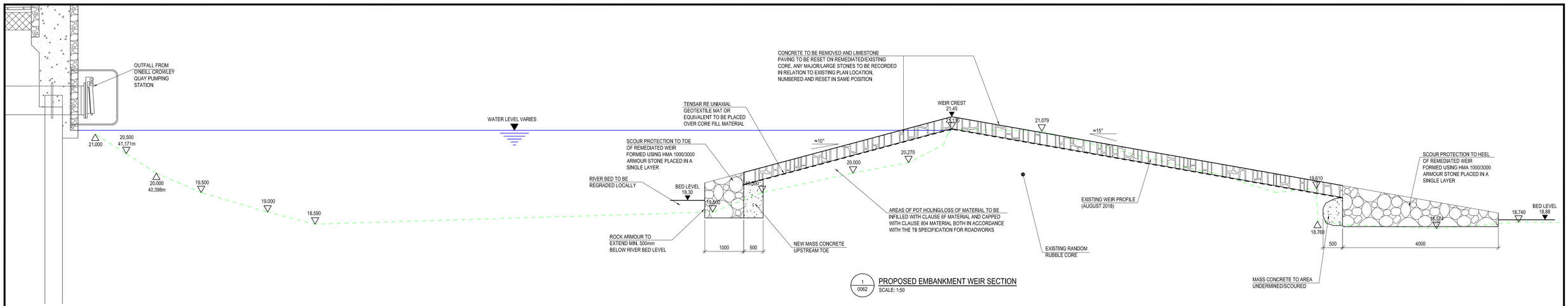
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: WEIR REMEDIATION PROPOSED SECTIONS

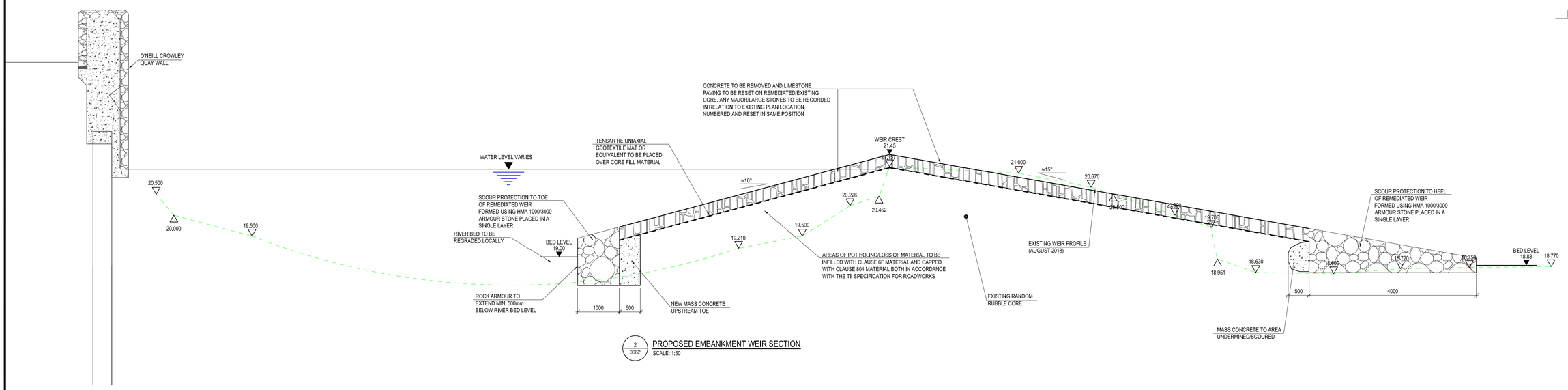
SCALE: AS SHOWN (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0061

REV: C01



1/0062 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50



2/0062 PROPOSED EMBANKMENT WEIR SECTION
SCALE: 1:50

NOTES:

1. ALL LEVELS SHOWN ARE IN METERS ABOVE ORDNANCE DATUM, MALIN HEAD.
2. FOR LOCATIONS OF SECTIONS REFER TO DRAWING 0060.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH SURVEY DRAWINGS OF EXISTING WEIR STRUCTURE AND WITH SECTION DRAWINGS 0061 AND 0063.
4. WEIR REMEDIATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CONSERVATION ENGINEER'S RECOMMENDATIONS.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

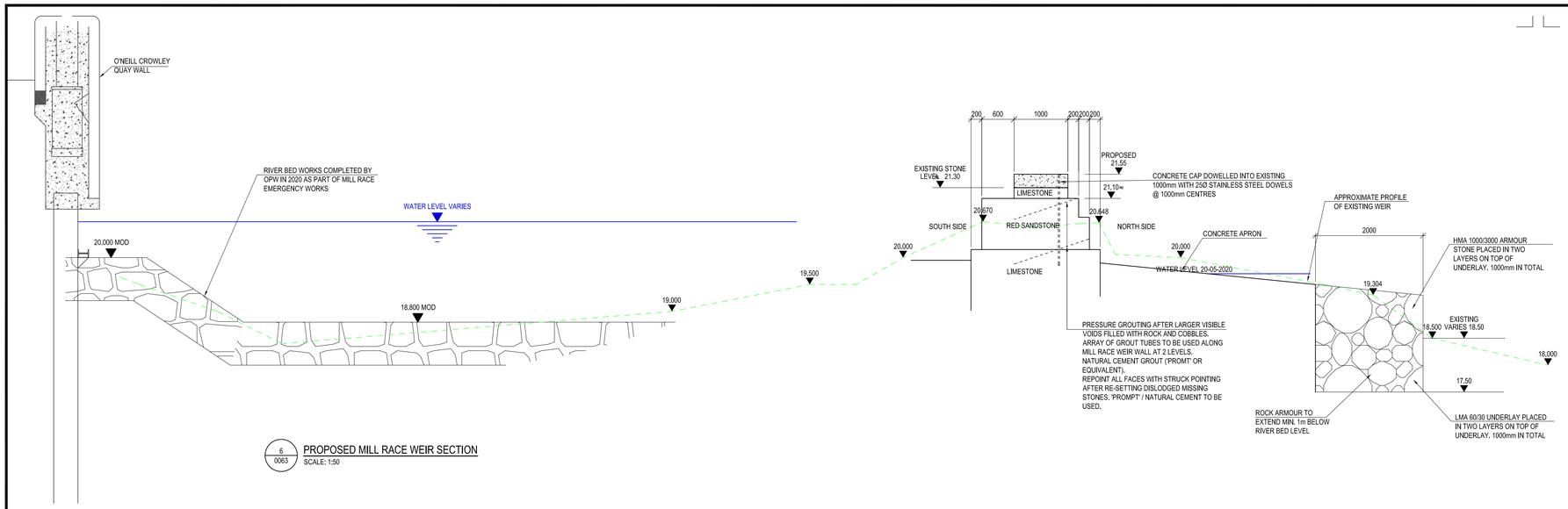
CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: WEIR REMEDIATION PROPOSED SECTIONS

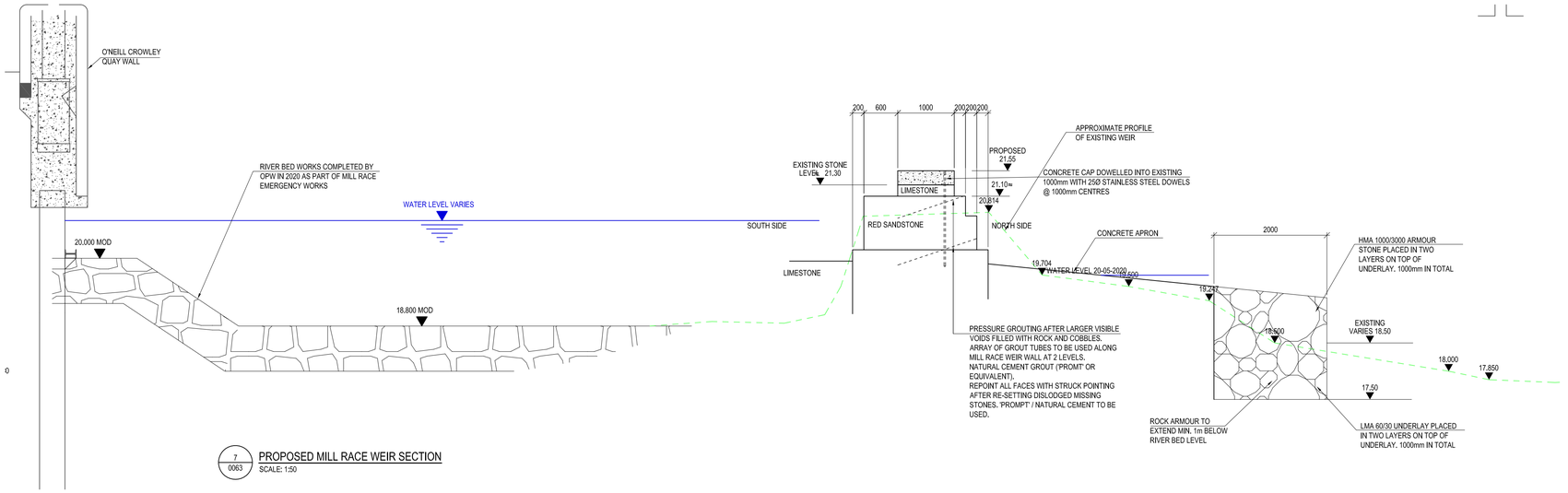
SCALE: AS SHOWN (A1)

PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0062

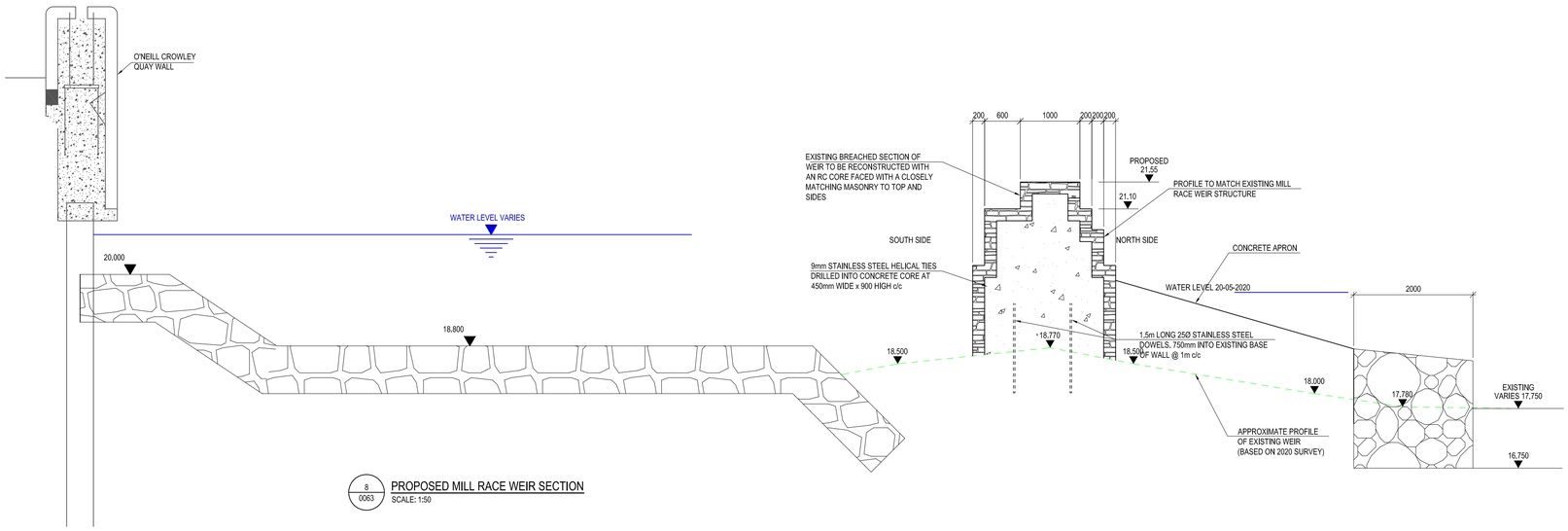
REV: C01



6/0063 PROPOSED MILL RACE WEIR SECTION
SCALE: 1:50



7/0063 PROPOSED MILL RACE WEIR SECTION
SCALE: 1:50



8/0063 PROPOSED MILL RACE WEIR SECTION
SCALE: 1:50

NOTES:

1. ALL LEVELS SHOWN ARE IN METERS ABOVE ORDNANCE DATUM, MALIN HEAD.
2. FOR LOCATIONS OF SECTIONS REFER TO DRAWING 0060.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH SURVEY DRAWINGS OF EXISTING WEIR STRUCTURE AND WITH SECTION DRAWINGS 0061 AND 0062.
4. WEIR REMEDIATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE CONSERVATION ENGINEER'S RECOMMENDATIONS.

REV	SUIT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

CHECKED BY:	REVIEWED BY:	APPROVED BY:
LC	MV	DC

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Tel: 01-295 2321 Fax: 01-295 4541 Email: tjoc@tjoc.ie Web: www.tjoc.ie

PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: WEIR REMEDIATION PROPOSED SECTIONS

SCALE: AS SHOWN (A1)

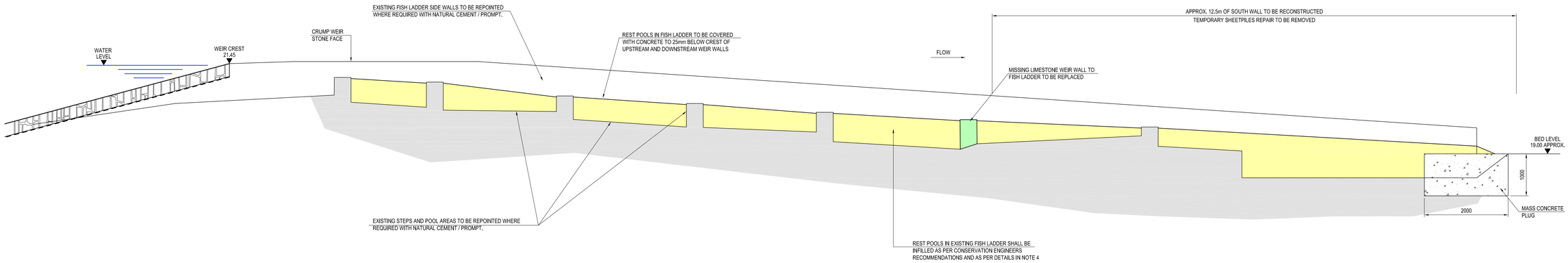
PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER
19011-TJOC-PL-XX-DR-C-0063

REV: C01

1 / 0081 EXISTING FISH LADDER SECTION
SCALE: 1:50

NOTES:

1. ALL WORKS CARRIED OUT IN THE RIVER AND TO THE FISH PASS TO BE AGREED WITH INLAND FISHERIES IRELAND PRIOR TO COMMENCEMENT OF THE WORKS.
2. WORKS IN THE RIVER WILL ONLY BE PERMITTED BETWEEN THE BEGINNING OF AUGUST TO MID SEPTEMBER IN ACCORDANCE WITH INLAND FISHERIES IRELAND GUIDELINES.
3. PROPOSED REMEDIAL WORK DETAILS AS PER CONSERVATION ENGINEER, TREVOR WOODS CONSULTING ENGINEERS, DETAILS.
4. COVERING
   DPM 1500 GAUGE TO BE LAID UP PASS INSIDE WALLS OVER BASE AND LAPPED MINIMUM 1m BETWEEN SHEETS / JOINTS.
   TYPE 6F FILL WITHIN 300mm EXISTING CAPPING.
   150mm CLAUSE 804 BLINDED WITH LEAN MIX CONCRETE.
   150mm CONCRETE SLAB (FIBRE MESH POLYPROPYLENE FIBRES)
   SURFACE TO BE STAMPED WITH RANDOM STONE PATTERN.
5. ALL LEVELS AS PER MURPHY SURVEYS 2018 SURVEY OF WEIR STRUCTURE.
6. EXISTING FISH LADDER SHALL BE INFILLED IN ORDER TO AVOID WHITE WATER CREATED BY THE STEPS IN THE LADDER ATTRACTING FISH FROM DOWNSTREAM OF THE WEIR.



2 / 0081 PROPOSED FISH LADDER SECTION
SCALE: 1:50

REV	STAT	DESCRIPTION	DATE
C01	AP	ISSUED FOR PLANNING	02.06.2022

DRAWING STATUS: ISSUED FOR PLANNING

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PROJECT: FERMOY WEIR REMEDIATION AND FISH BYPASS CHANNEL

CLIENT: CORK COUNTY COUNCIL

DRAWING TITLE: EXISTING FISH LADDER REMEDIATION DETAILS - SHEET 2

SCALE: AS SHOWN (A1)

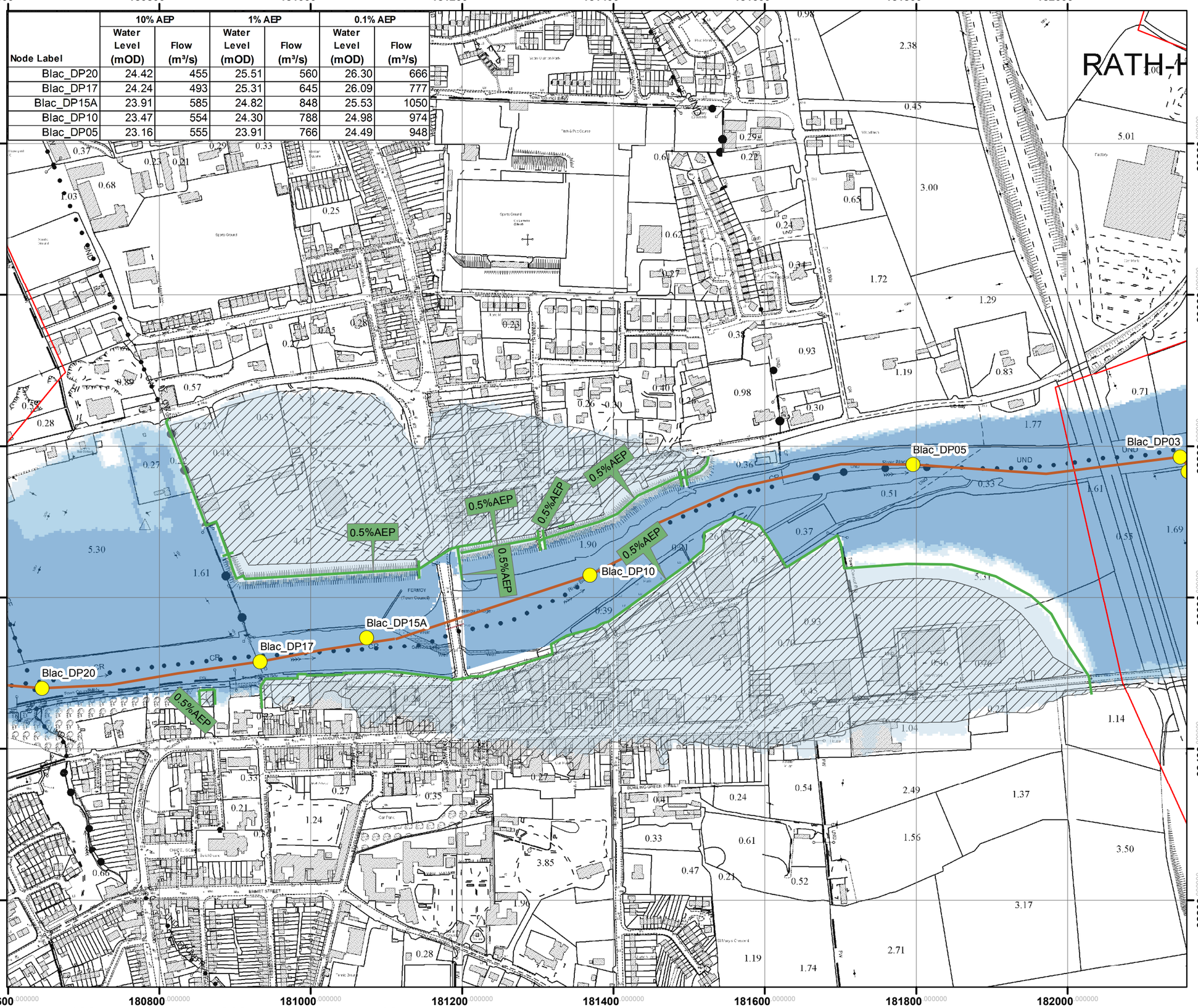
PROJECT - ORIGINATOR - VOLUME - LOCATION - TYPE - ROLE - NUMBER: 190080-TJOC-PL-XX-DR-C-0081

REV: C01

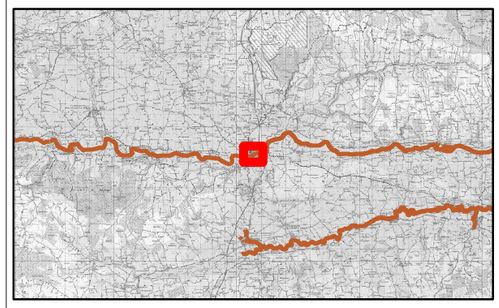
APPENDIX C

South Western CFRAM Fluvial Flood Zoning Map

Node Label	10% AEP Water Level (mOD)	10% AEP Flow (m^3/s)	1% AEP Water Level (mOD)	1% AEP Flow (m^3/s)	0.1% AEP Water Level (mOD)	0.1% AEP Flow (m^3/s)
Blac_DP20	24.42	455	25.51	560	26.30	666
Blac_DP17	24.24	493	25.31	645	26.09	777
Blac_DP15A	23.91	585	24.82	848	25.53	1050
Blac_DP10	23.47	554	24.30	788	24.98	974
Blac_DP05	23.16	555	23.91	766	24.49	948



Location Plan:



Legend:

- Model Nodes
- Flood Defence - Embankment
- Modelled River Centreline
- Defended Area
- AFA Boundary
- 10% AEP Flood Extent
- 1% AEP Flood Extent
- 0.1% AEP Flood Extent

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

SOUTH WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

OPW
Oifig na nOibreacha Poiblí
The Office of Public Works

Office of Public Works
Jonathan Swift Street
Trim Co. Meath

Mott MacDonald

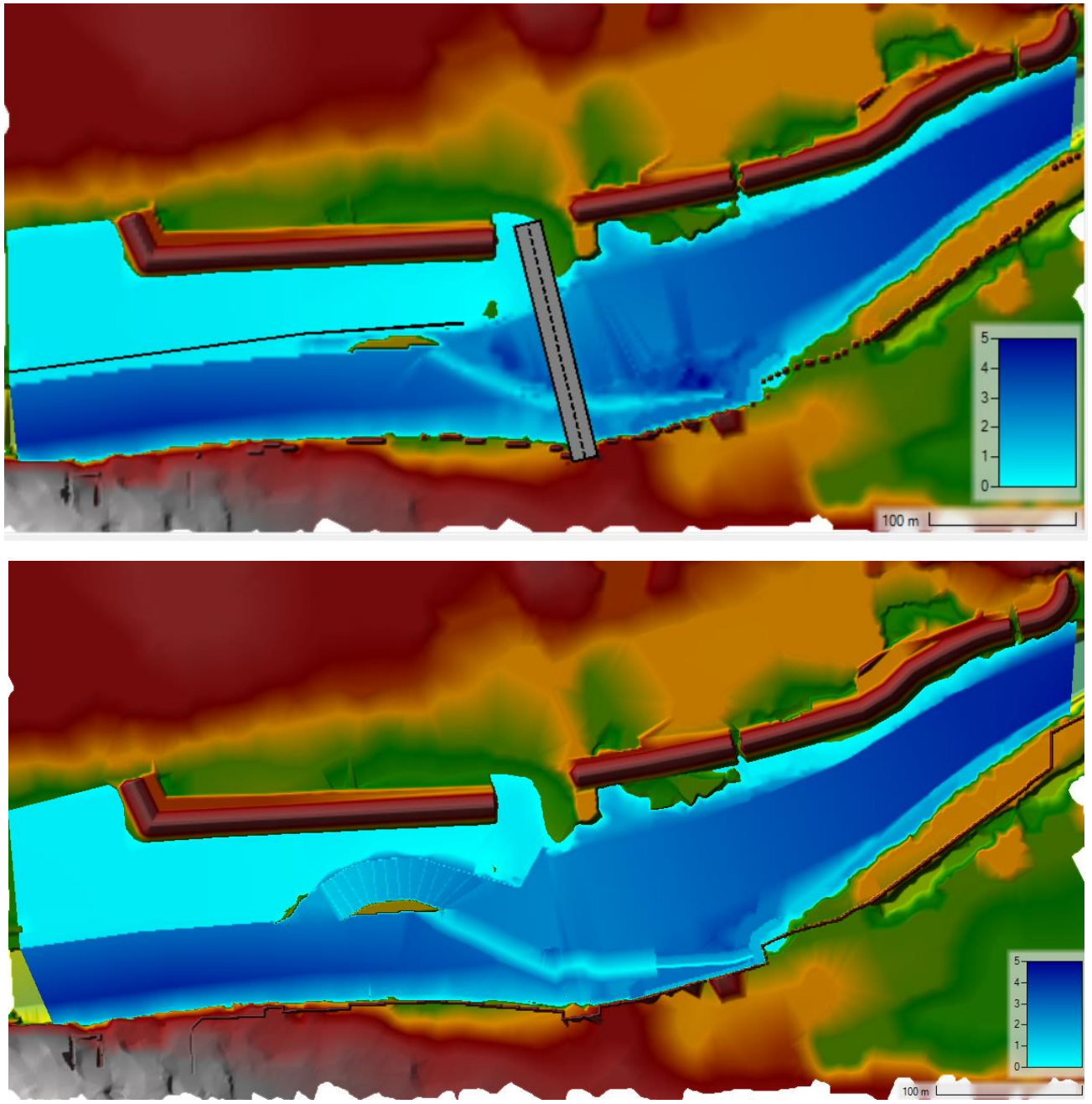
Mott MacDonald Ireland
5 Eastgate Avenue
Little Island
Co. Cork

Project:	South Western CFRAM Study		
Map:	Fermoy - Flood Extent		
Map type:	Flood Extent		
Source:	Fluvial Flooding		
Map area:	Urban Area		
Scenario:	Current		
Drawn by:	Lee Cutting	Date:	June 2016
Checked by:	Marianne Piggott	Date:	June 2016
Approved by:	Christian Hetmank	Date:	June 2016
Map No.:	MMD/296235/E/DR/I18HFY/EXFCDEXF/F/Sht005		
Sheet:	5 of 7	Revision:	F
Drawing Scale:	1:5,000	Plot Scale:	1:1@A3

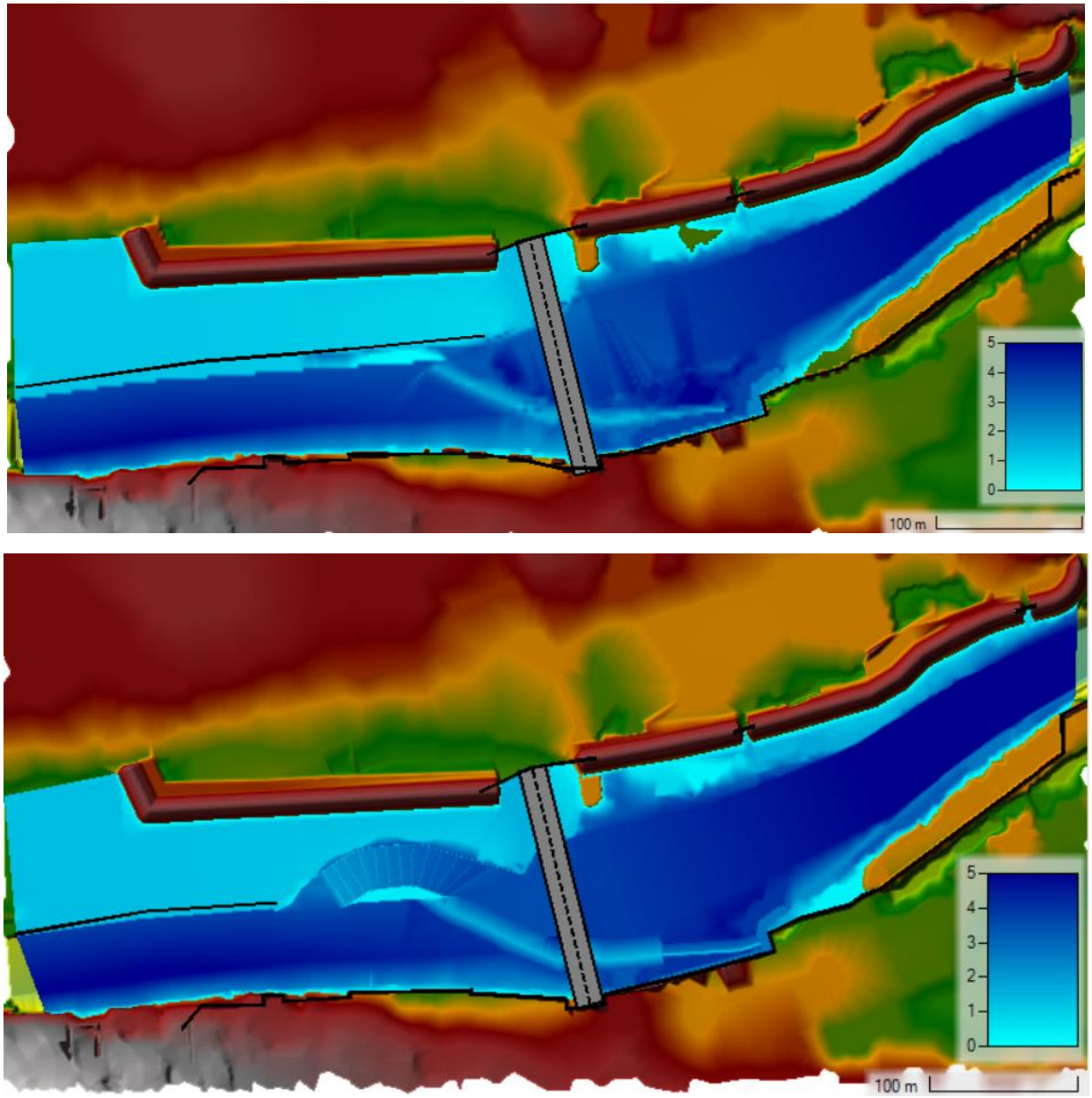
APPENDIX D

HEC-RAS Model Outputs

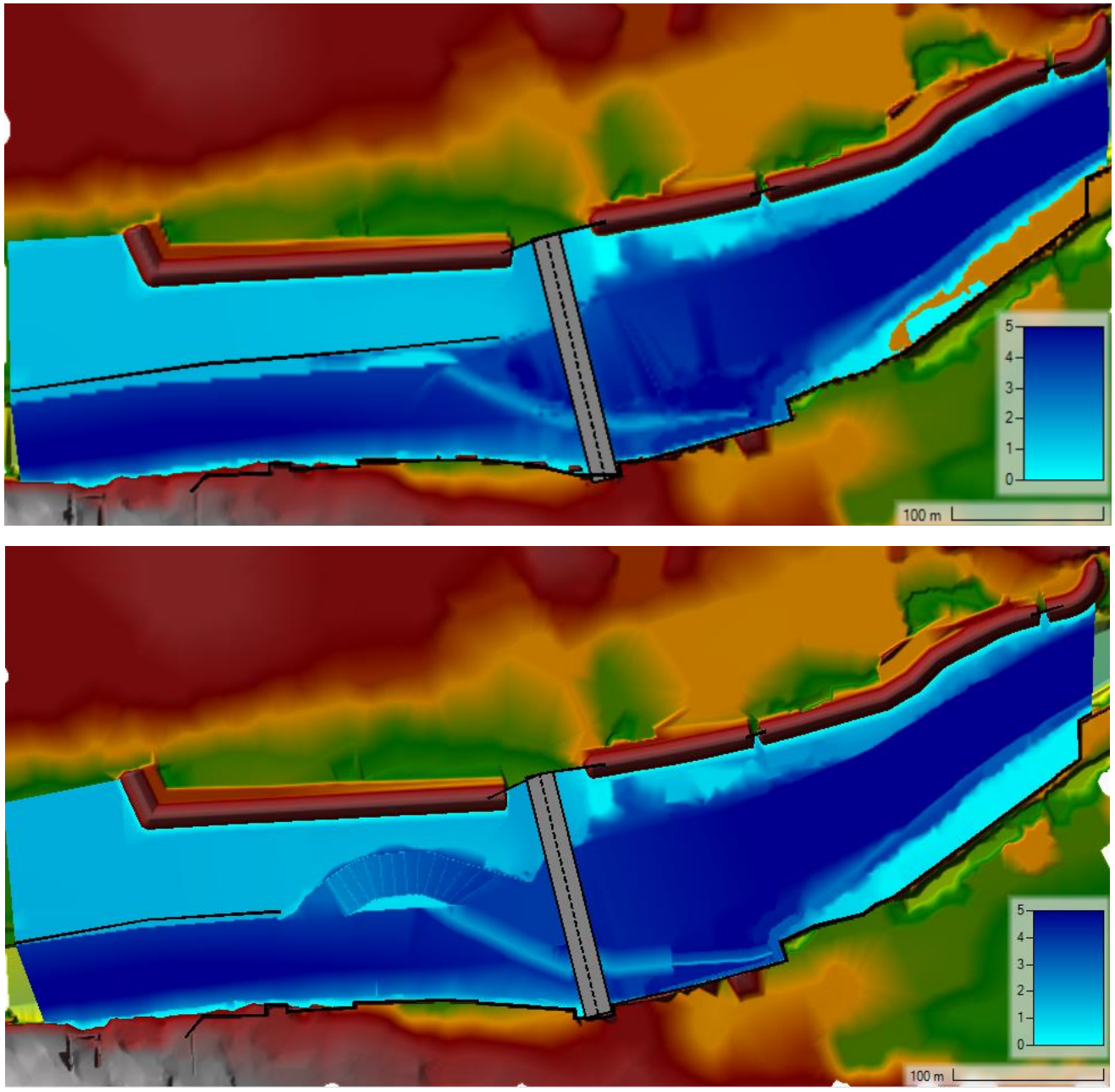
1 in 2 Year Depths – Existing (Top) & Proposed (Bottom)



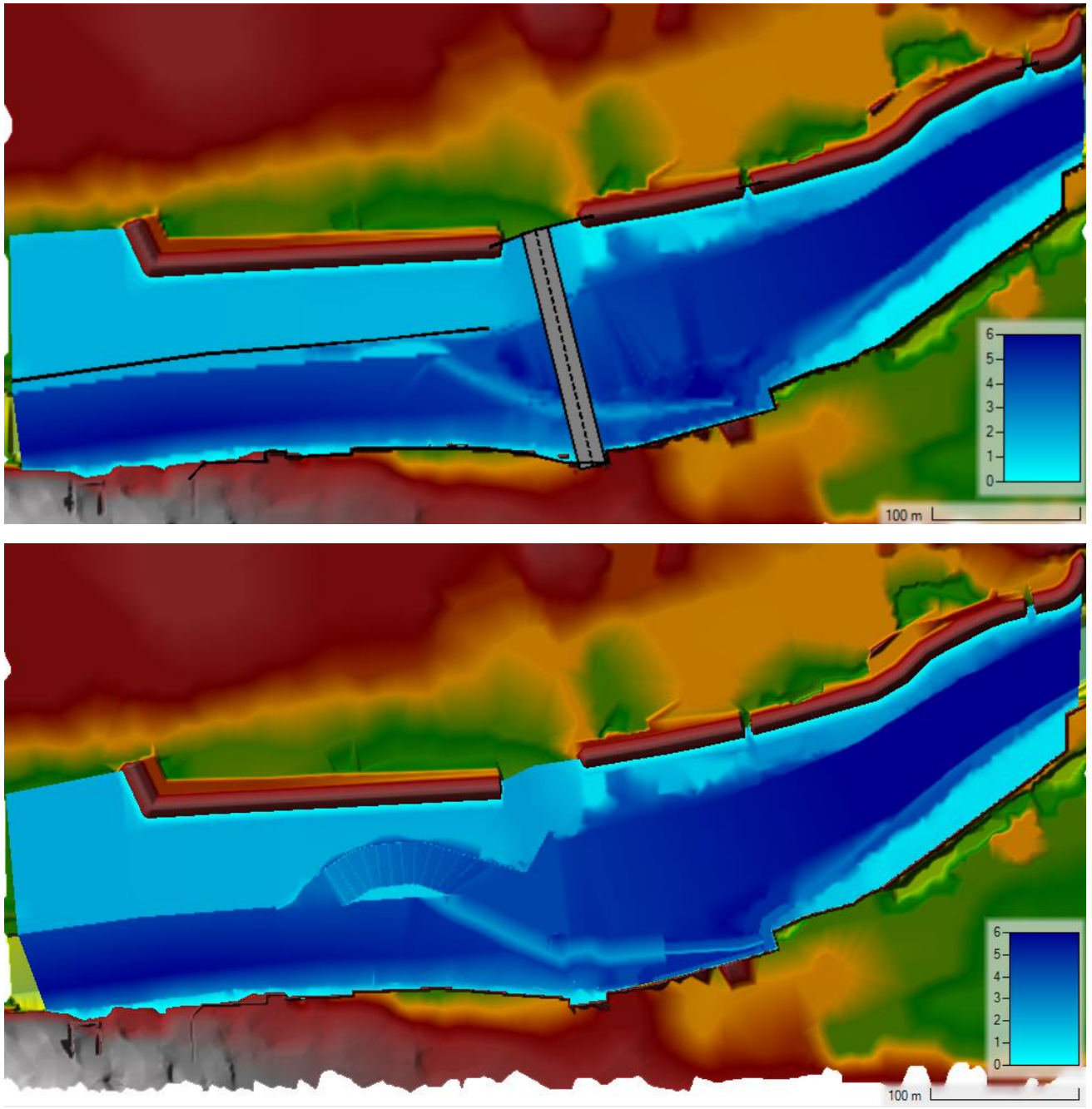
1 in 5 Year Depths – Existing (Top) & Proposed (Bottom)



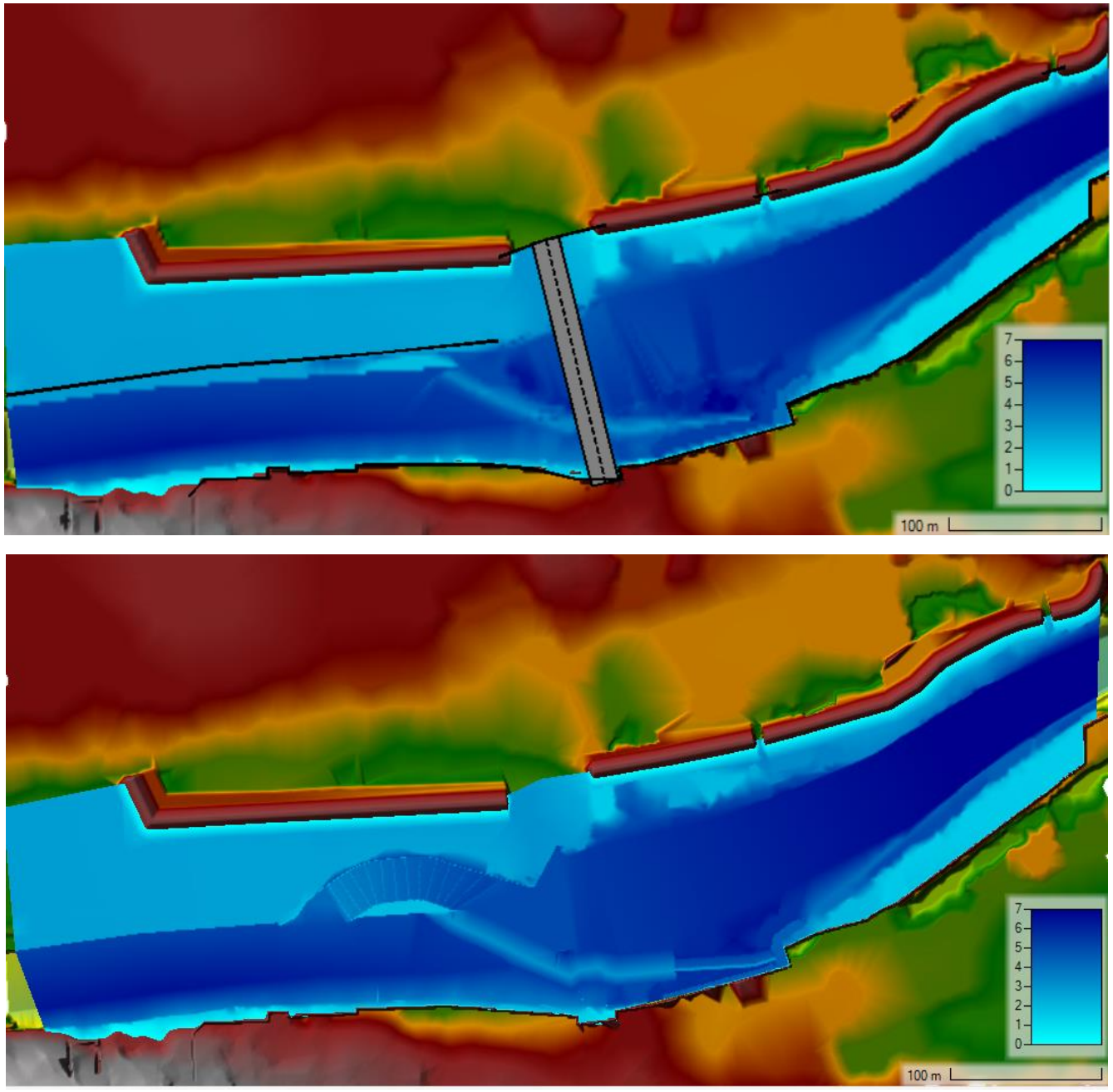
1 in 10 Year Depths – Existing (Top) & Proposed (Bottom)



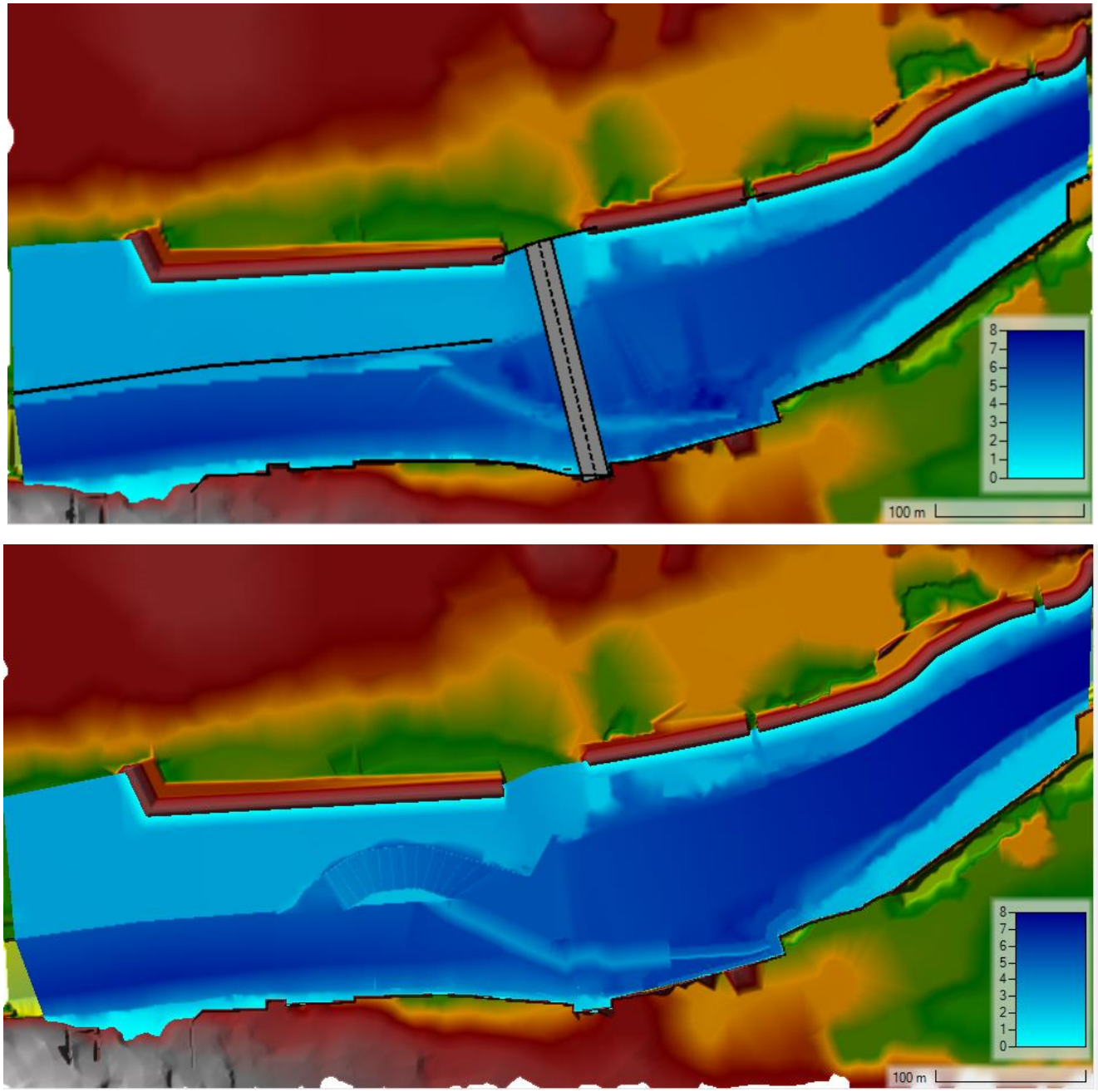
1 in 20 Year Depths – Existing (Top) & Proposed (Bottom)



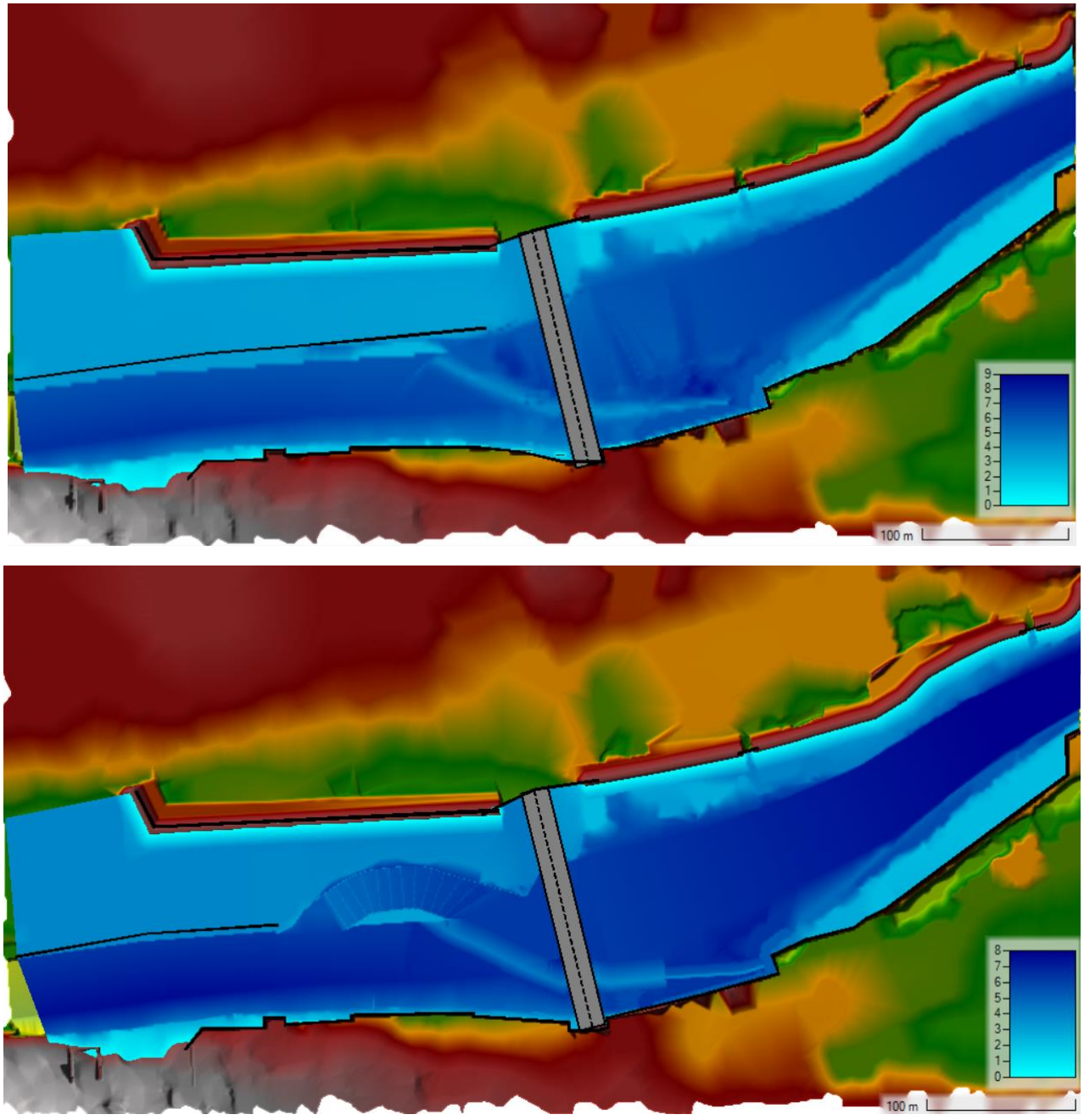
1 in 50 Year Depths – Existing (Top) & Proposed (Bottom)



1 in 100 Year Depths – Existing (Top) & Proposed (Bottom)



1 in 200 Year Depths – Existing (Top) & Proposed (Bottom)



APPENDIX F

Options considered for the Fermoy Weir Remediation and Fish Bypass Project

Fermoy Weir and Fish Bypass Channel

September 2020

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS

Fermoy Weir

Over 200 years old - A Protected Structure

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS

Fermoy weir

Mill Race Weir Wall

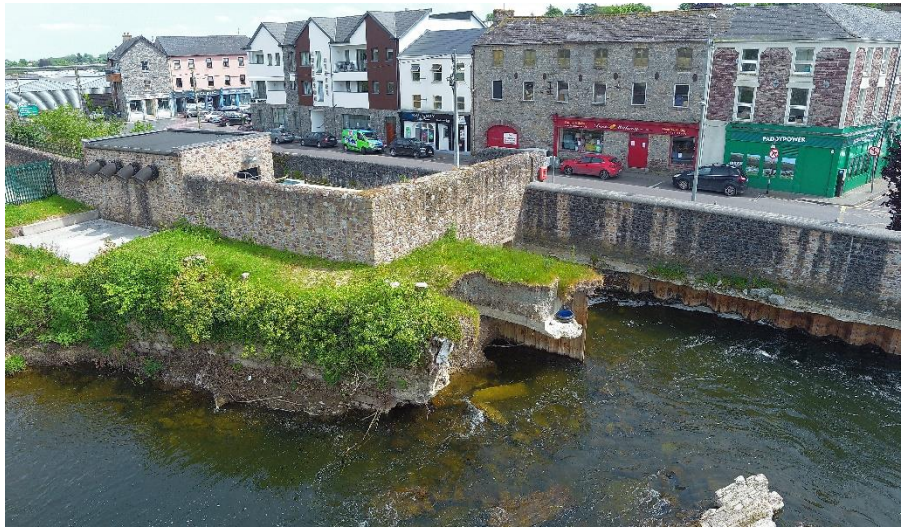
- loss of grout
- Open Joints
- Loose masonry

TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS

The Issues

Protected Structure

- CCC obliged to prevent deterioration of weir
- Weir breached and in poor Condition
- Leading to bank and bed erosion



Environmental issues

- Any works to reinstate weir be compatible with the requirements of the Habitats Directive
- Weir is a barrier to Fish Passage

Weir before the Breach (2015)

Effects of Breach in Weir

Erosion of Bed and Bank leading to real risk of undermining of flood defence structures

Velocities in low flow conditions are a hindrance to fish passage

Increased flows lead to increased gravel

2005

2020

Lawrence Collection Photos c. 1890

Existing Fish Pass

Not ideally situated in weir
Does not provide for passage of all fish

Fish Pass in late 19th Century

Fish Pass Today

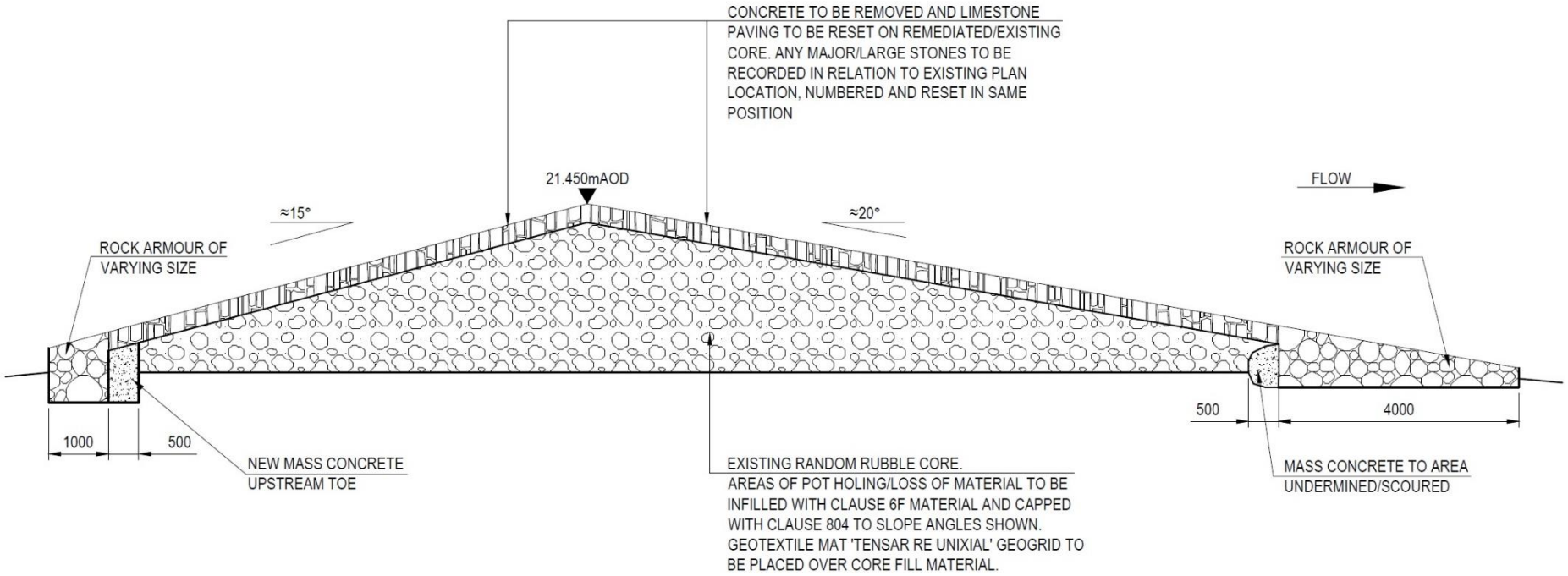
Options Considered
Must satisfy different demands

Weir Repair

- Reconstruct using original materials
- Record and replace as new

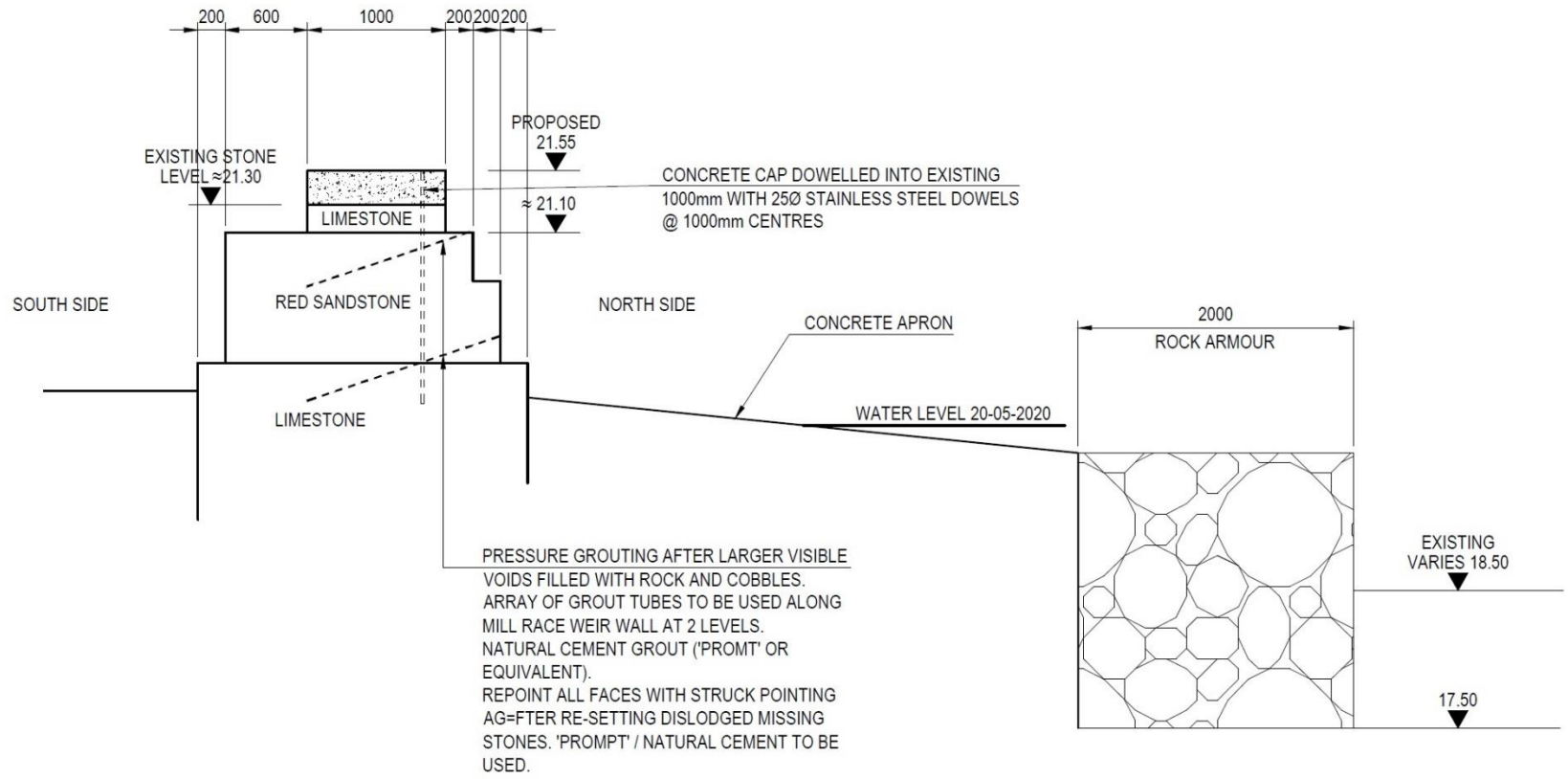
Fish Passage

1. Do Nothing
2. Stabilise remaining section of weir
3. Remediate the existing fish pass.
4. Complete removal of the weir
5. Construct an in-river rock ramp.
6. Construct a fish ramp (rock ramp) in the existing breach
7. Construct a near natural bypass channel.
8. Bypass river around weir
9. Construct a rough channel pool bypass.



Crump Weir Typical Section of Proposed Remediation

- Strip off Concrete apron
- Rock armour and concrete to stabilise toe of embankment
- reinstate limestone cobbles on face of weir



Mill Race Weir Wall Typical Section of Proposed Remediation

- Fill larger voids in wall with rock and cobbles
- Pressure grout using natural cement
- Re set dislodged stones and Point all faces
- Re Build breached section of wall using similar type materials

1. Do Nothing

Leave existing situation as is

Weir will continue to deteriorate

Complete collapse will eventually allow fish migration

Bank and bed erosion could undermine flood defences

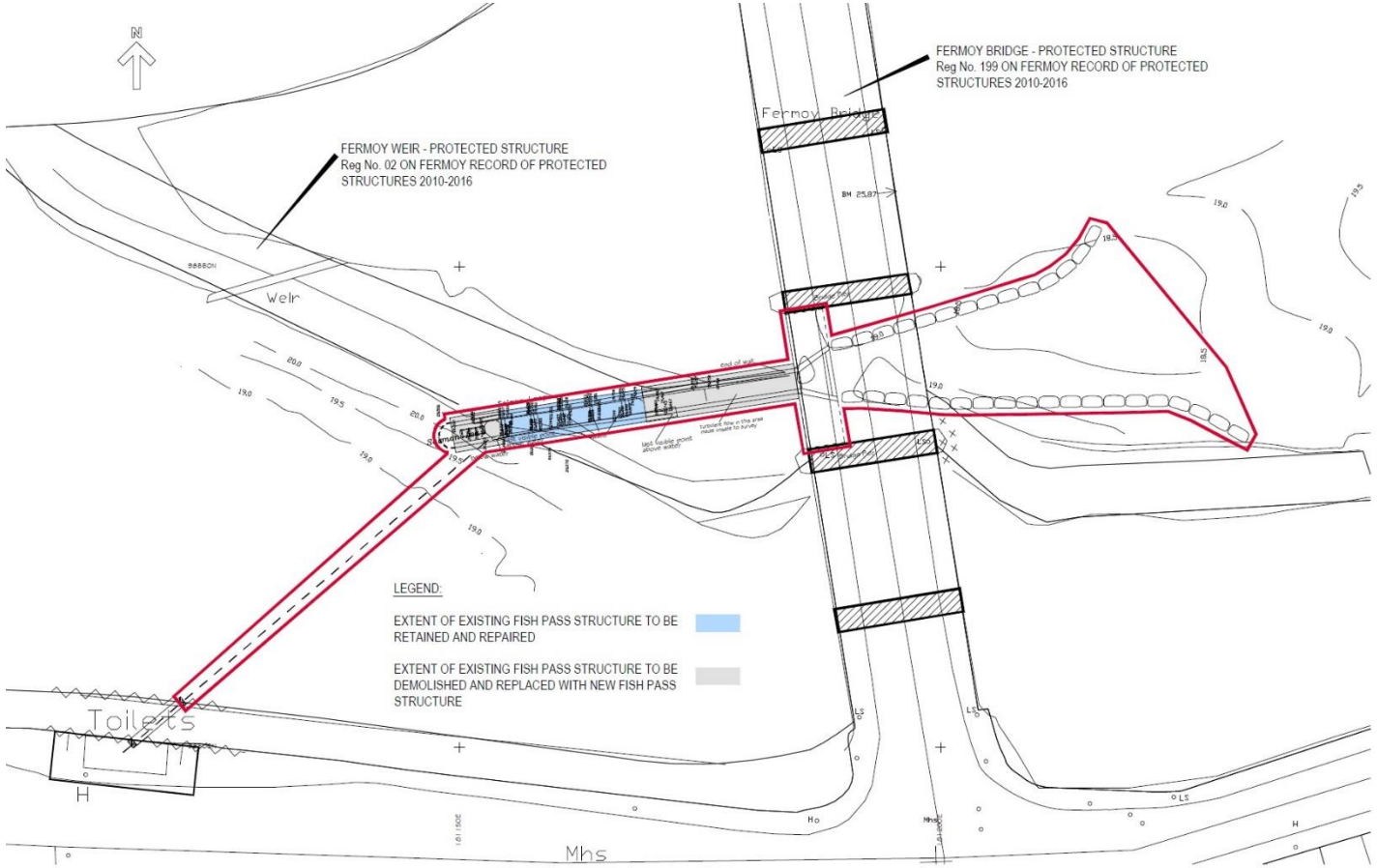
2. Stabilise remaining section of weir

Leave existing breach in place

Upstream river level would not return to pre-breach levels

Excessive velocities in mill race channel causing bed and bank erosion

Passage of all fish species not ensured



3. Remediate Existing Fish Pass

Not ideally located at upstream end of weir

Does not provide satisfactory fish passage

Therefore does not satisfy Conservation objectives

Acceptable for Protected Structure Status

Maintains upstream river levels

4. Complete removal of the weir

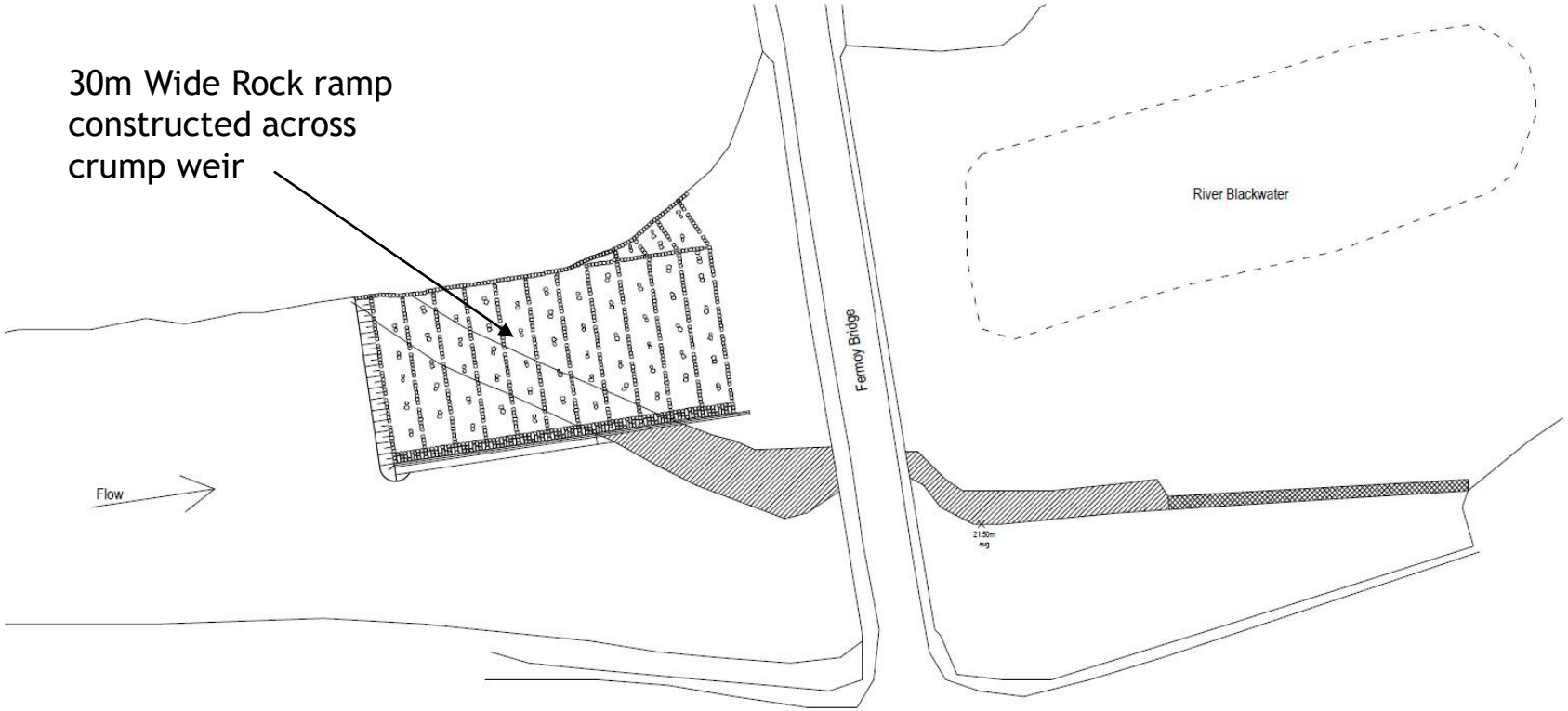
Provides for free passage of fish

Lower river levels U/S of Bridge

Protected structure status breached

River amenities affected, e.g. rowing

Potential issues for Flood defence structures if bed levels are lower



5. Construct an in-river rock ramp.

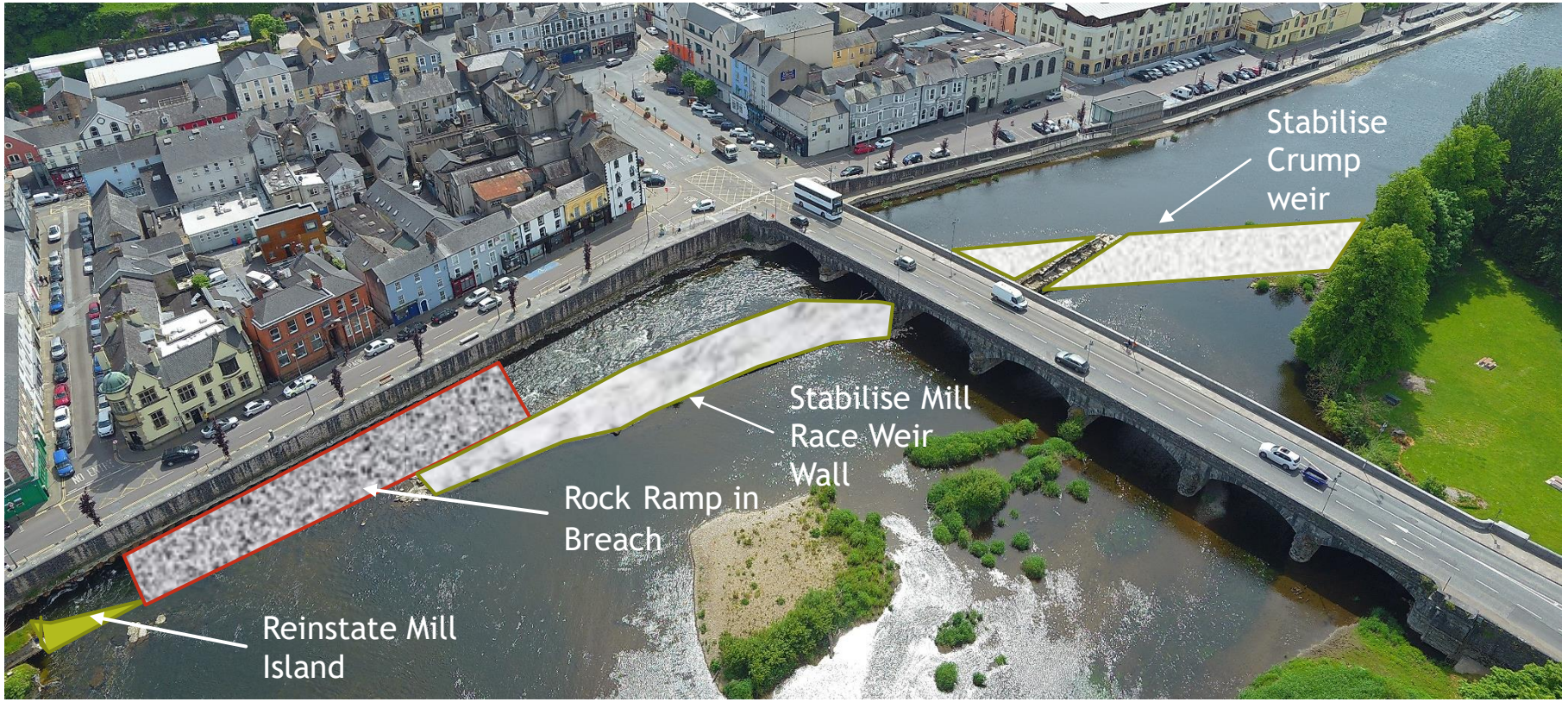
Provides satisfactory passage for all fish

Requires removal of part of protected structure

Extends upstream in main channel of river affecting amenity uses

Visual impact alongside bridge

Potential scour impact on bridge piers



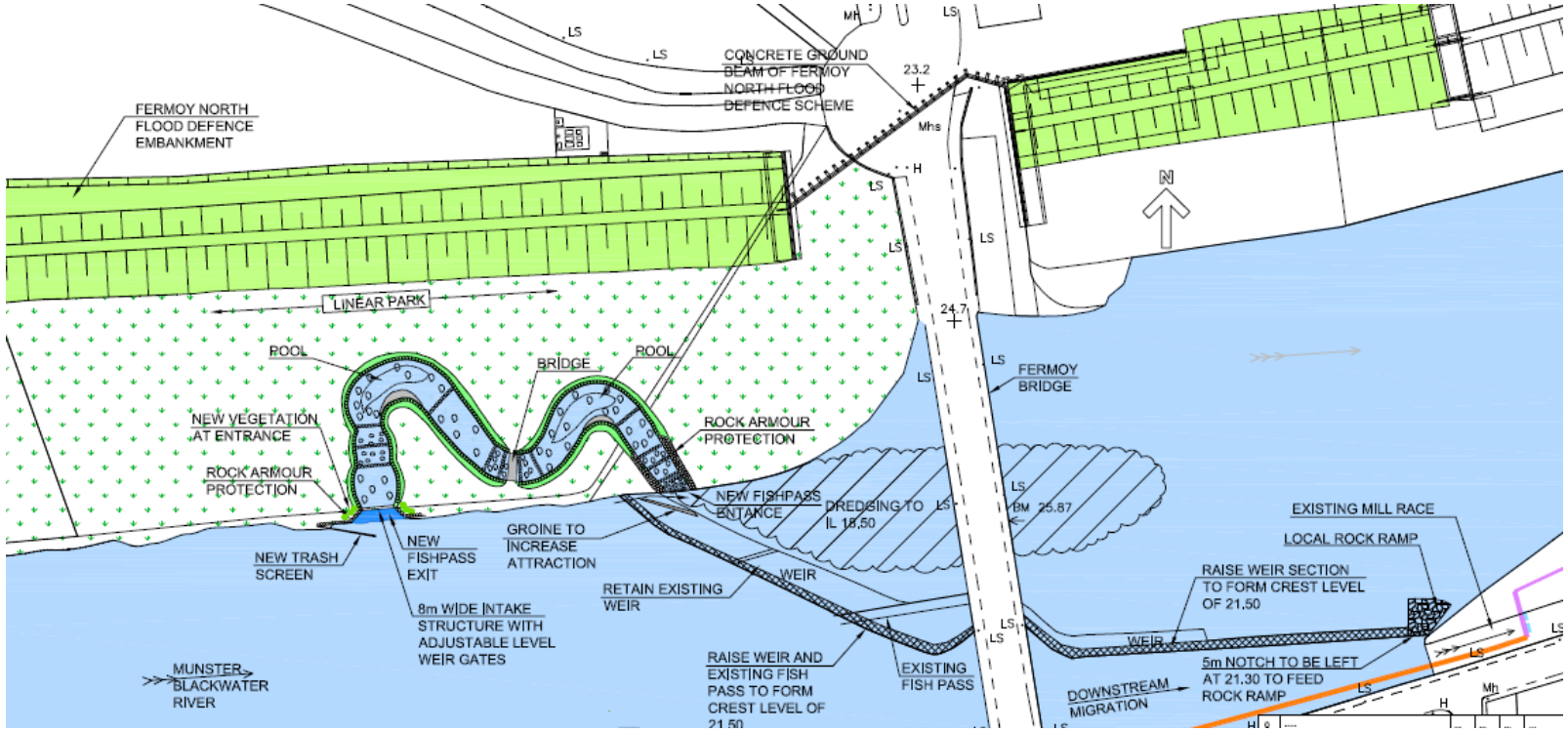
6. Fish Ramp (rock ramp) in the Existing Breach

Ramp not ideally located to attract fish

May be issues with excessive velocities

May conflict with flood defence structural design

Protected Structure obligations not fully complied with



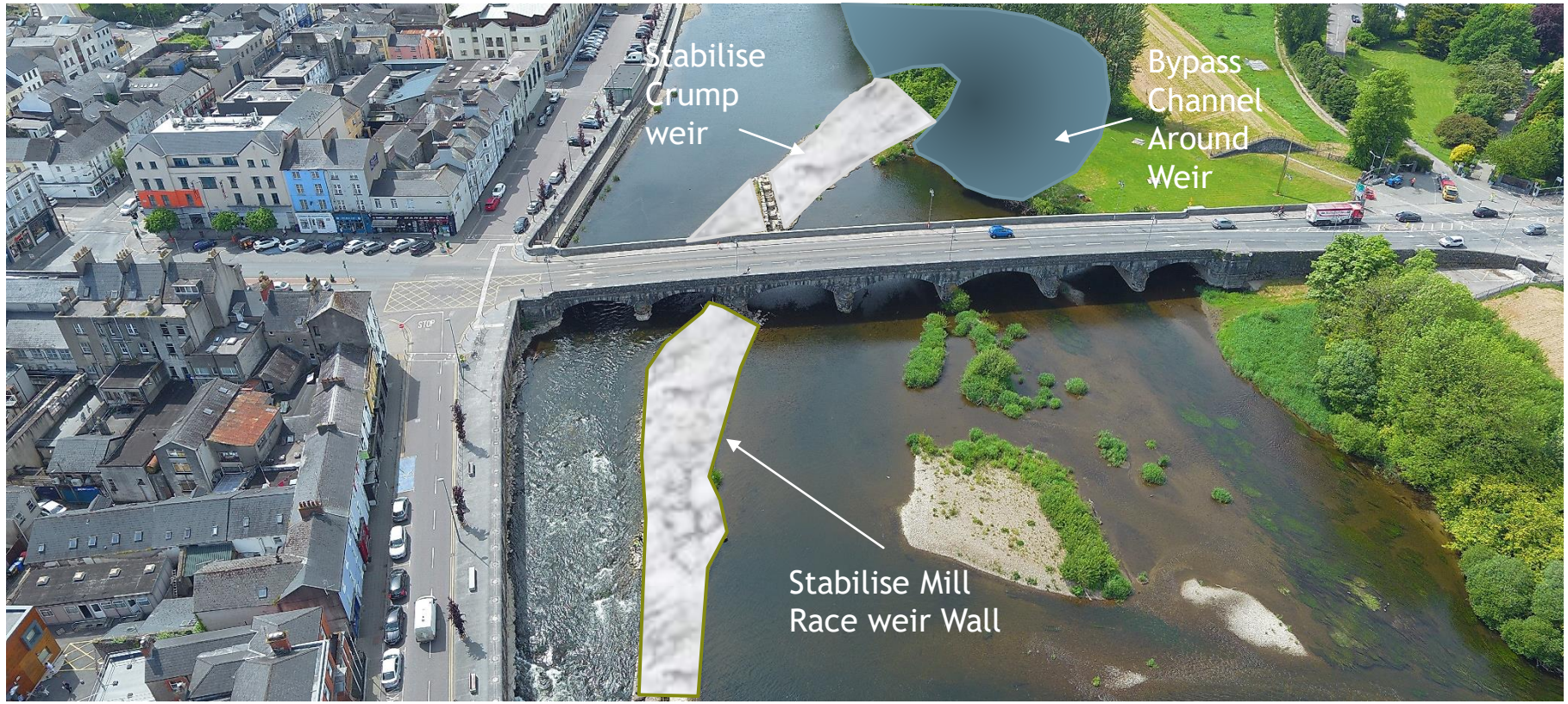
7. Near Natural Bypass Channel

Reduces in-stream works

Land acquisition required

May not facilitate passage of all fish

Avoids negative visual impacts



8. Bypass Channel Around Weir

Large flow to be accommodated in Bypass channel

Fish Passage accommodated

Upstream Water Levels lowered

Adverse impacts on Conservation objectives

Large land Acquisition required

9. Rough Channel Pool Bypass

Maintains Upstream Water level

Facilitates fish passage

Minimises instream works

Land acquisition required

Significant visual impact