Shannon Technology and Energy Park (STEP) Power Plant

Appendix A6.3: Site-Specific Flood Risk Assessment (FRA) Report

Shannon LNG Limited

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Shannon Technology and Energy Park (STEP) Power Plant

Environmental Impact Assessment Report

Site Specific Flood Risk Assessment

Shannon LNG Limited

April 2024

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1. Introduction

Shannon LNG Limited (an Irish owned subsidiary of New Fortress Energy (NFE) Inc.) has appointed AECOM to prepare a Flood Risk Assessment (FRA) to accompany a planning application for a Combined Cycle Gas Turbine (CCGT) gas-powered power plant capable of 600 MW of electricity generation, 120 MWh (1-hr) Battery Energy Storage System (BESS), Above Ground Installation (AGI), and associated plant, equipment and infrastructure which will be known as the Shannon Technology and Energy Park Power Plant (STEP Power Plant) (herein referred to as the "Proposed Development").

In accordance with the 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' there is a requirement to undertake a Flood Risk Assessment Report, which will accompany the planning application.

The extent of the Proposed Development is shown below in Figure 1.

Figure 1. Site Location

1.1 Background

A site-specific flood risk assessment in respect of the Proposed Development is required as part of the planning process for the works.

1.2 Scope of Services

AECOM is required to undertake a site-specific Flood Risk Assessment (FRA) for the proposed works.

This FRA study has been undertaken in consideration of the following guidance document:

- ‘The Planning System and Flood Risk Management – Guidelines for Planning Authorities’ DOEHLG 2009.

The assessment will demonstrate that the Proposed Development will:

1. Not increase flood risk elsewhere and, if practicable, will reduce overall flood risk.
2. Include measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible.
3. Include measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design and implementation of any future flood risk management measures and provisions for emergency services access.

2. Site Information

2.1 Site Description

The project commences approximately 420 m to the west of Ardmore Point and extends to approximately 1.6 km to the east of Salleen Pier. This 1.6 km stretch of land proposed for development is located near the mouth of the Shannon Estuary and is running parallel to the L1010 Road. The Proposed Development runs through agricultural lands and between a handful of properties.

2.2 Proposed Works

The Proposed Development will be operated using natural gas as its primary fuel and generate power to be exported via the proposed 220 kV connection to the national electricity grid.The 220 kV connection, which is subject to a separate application, will (subject to approval), be installed prior to commencing operation of the Proposed Development.

The Proposed Development shall consist of the following elements:

- Three (3 No.) blocks of Combined Cycle Gas Turbines (CCGT), each block with a capacity of approximately 200 megawatts (MW) for a total installed capacity of up to 600 MW
- A 120 MWh (1-hr) Battery Energy Storage System (BESS)
- High voltage 220 kV GIS Substation
- Auxiliary Boiler
- Raw water treatment and storage
- Firewater storage tanks and fire water pumps
- Ancillary buildings
- Secondary Fuel Offloading and Storage
- Above Ground Installation (AGI) compound

A full description of the Proposed Development can be found in Chapter 2 of the EIAR.

2.3 Site Walkover Survey

A site visit was carried out on 29th January 2020 by AECOM personnel, as per Appendix A. The information obtained during the site visit informed the hydrology and the hydraulic model build.

The topography in the area is expected to be an influential factor in terms of hydrology. Observations were recorded and later compared to the existing topographic survey provided by the client. A number of observations were made during the site visit;

- Topography varies considerably throughout the site;
- The river channel varies considerably in terms of slope, width, and depth;
- The ground conditions appeared waterlogged in some areas limiting access.

It was clear that the river channel was not well represented in the topographic survey. It was also clear that structures and restrictions such as bridges and fences etc. were not captured during the topographic survey. Such details are required for flood risk analysis.

While the site visit was conducted in 2020, the data obtained is deemed unlikely to have significantly changed within a four year period as the development area remains undeveloped.

2.4 Local Hydrology, Land Use and Existing Drainage

The Ralappane Stream flows through the centre of the site, see Figure 2 below. The watercourse flows from the south-east in a north-westerly direction. The source of the watercourse is to the east of the Ralappane townland and the watercourse outfalls into the Shannon Estuary. The catchment area of the watercourse at outfall is circa 312ha.

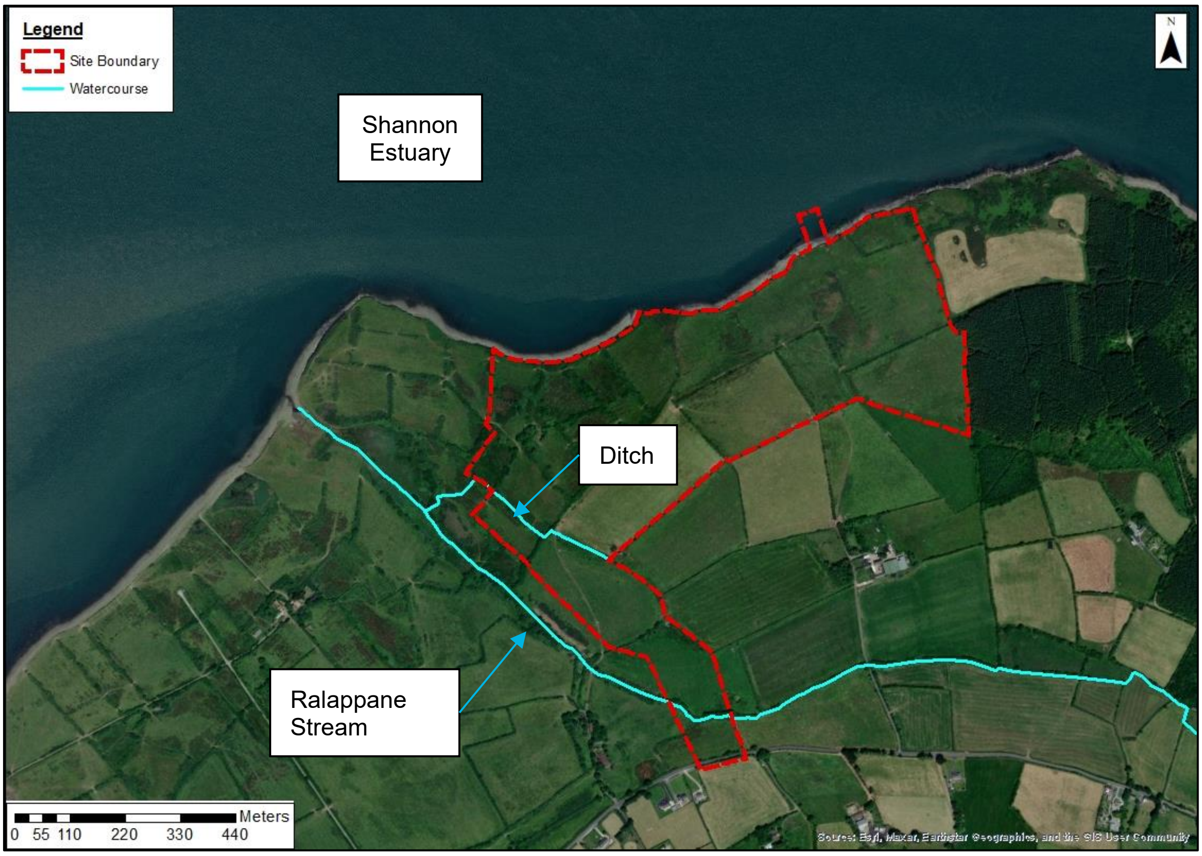


Figure 2. Watercourses

There is also a small ditch which rises to the east of the site and confluences with the Ralappane Stream prior to discharging into the Shannon Estuary.

Presently the land is used for agricultural purposes and would appear to have limited drainage with the exception of small ditches and channels. As previously mentioned, parts of the site were saturated and unpassable on foot during the site walkover in January 2020. Figure 3 below is a picture of a significant marshland area near the downstream end of the watercourse.

Figure 3. Marsh area near downstream end

3. Stage 1 – Flood Risk Identification

The purpose of Stage 1 is to establish whether a flood-risk issue exists or may exist in the future. If there is a potential flood risk issue then, in accordance with 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities (DOEHLG 2009)', the flood risk assessment procedure should move to 'Stage 2 – Initial Flood Risk Assessment'. If no potential flood risk is identified during Stage 1 then the overall flood risk assessment can be concluded.

The following information and data have been collated as part of the screening assessment for the Proposed Development.

3.1 Hydrometric Data

Existing sources of hydrometric data from the OPW (www.waterlevel.ie) were investigated, refer to Figure 4. This investigation has determined that the closest gauging station to the Proposed Development is the Moneycashen station (23068) located approximately 18.6 km to the southwest. A second station at Foynes (24064) is located approximately 23.3 km east of the Proposed Development.

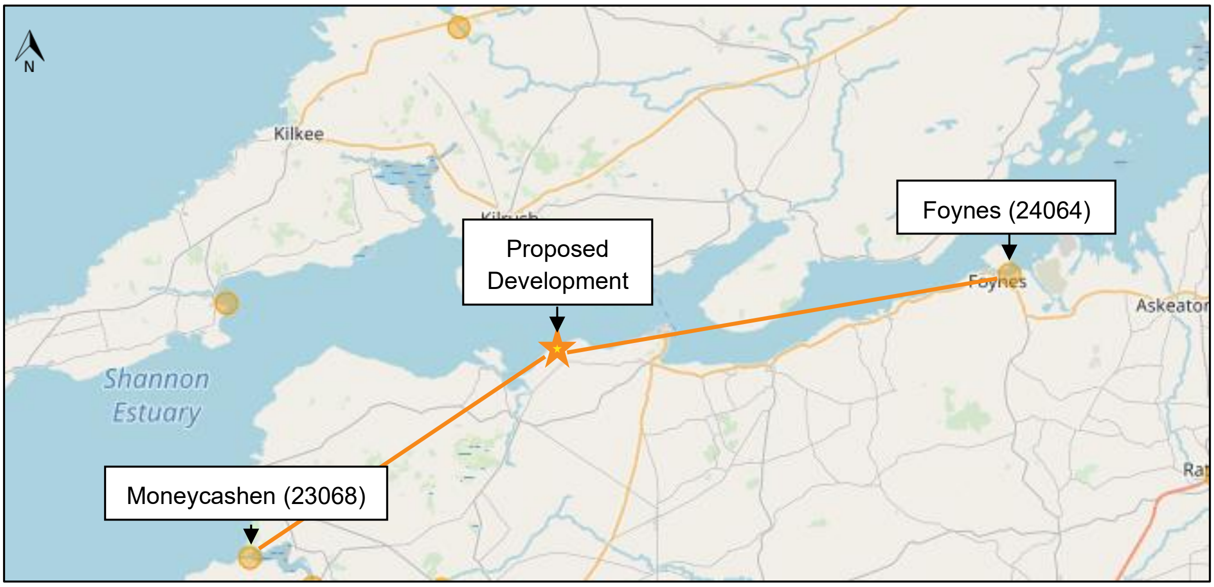


Figure 4. Gauging Stations (www.waterlevel.ie)

The presence of both gauging stations is noted however the information from the station only monitors coastal levels. The above information is beneficial to the project as the proposed watercourse is tidally influenced.

3.2 OPW Flood Hazard Maps

The OPW Flood Hazard Maps Website (www.floodmaps.ie) was consulted in relation to available historical or anecdotal information on any flooding incidences or occurrence in the vicinity of the Proposed Development area. No flood events have been recorded within the site boundary. Figure 5 and Figure 6 below show mapping from the aforementioned website, which indicates that there are a few historical records of flooding which have occurred in the wider surrounding area.

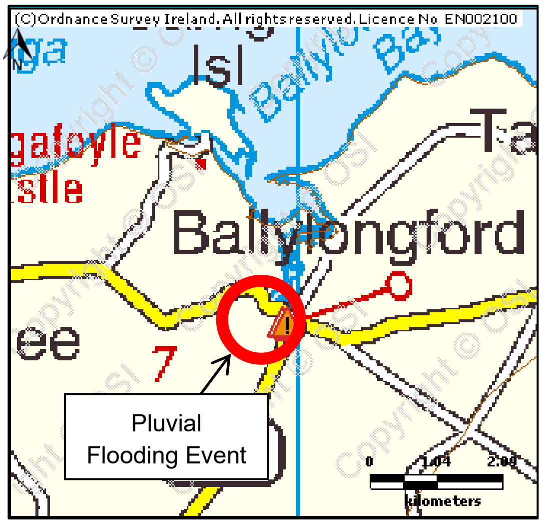


Figure 5. OPW Flood Hazard Map - Historical records of flood events near Ballylongford

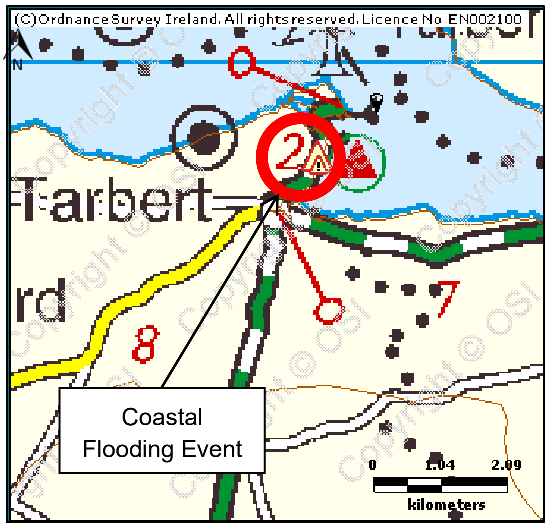


Figure 6. OPW Flood Hazard Map - Historical records of flood events in Tarbert

On the 6th of January 2002, there was a recorded flood event on Bridge Street, Ballylongford as shown on Figure 5. This was a pluvial flood event caused rainfall and runoff in the Ballyline catchment. These events are tidally influenced. The flood event caused the R551 to become impassable for approximately 6 hours and at least 12 houses were affected. This flood event has been described as the worst current flood problem in Kerry.

Flooding has also been recorded along Ferry Road, Tarbert. The N67 road connecting the Ferry Pier to Tarbert village becomes inundated at least twice a year. This restricts access to the N67 on the Clare side of the Shannon which is accessed via the Ferry. There have been reports of waves overtopping the wall.

3.3 Groundwater Wells and Springs

An investigation into the rise and abstraction of water from underground wells and springs around the site was taken from the Department of Communications, Climate Change and Environment (http://dcenr.maps.arcgis.com). This was to identify if there are any areas of rising groundwater that could contribute to flooding.

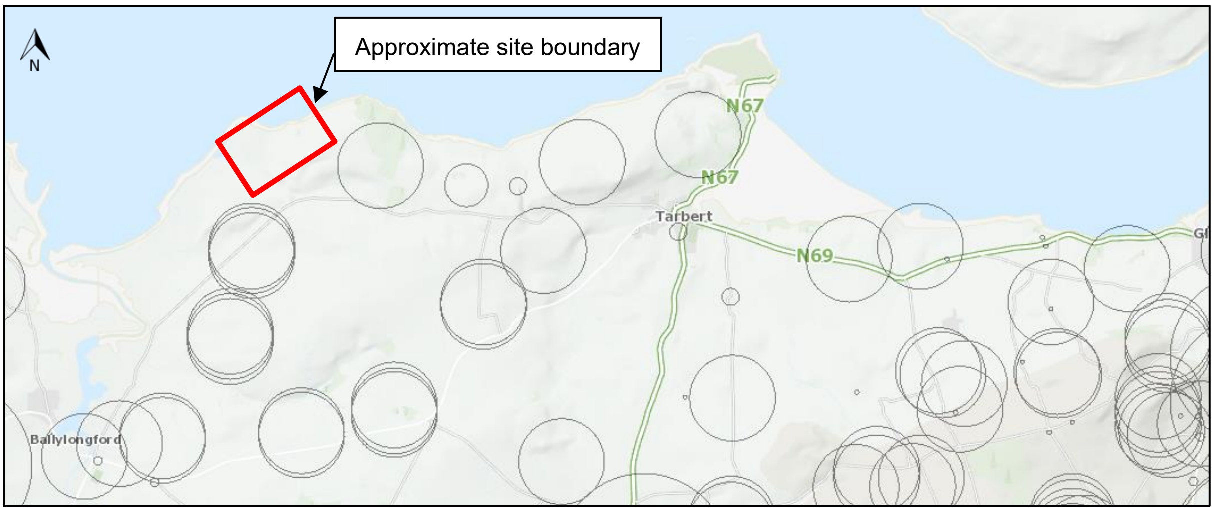


Figure 7. GSI Viewer Groundwater Wells and Springs

Figure 7 shows that there are multiple springs or wells in close proximity to the Proposed Development site. There have been no recorded issues with these groundwater sources contributing to flooding within the area. During the site visit several aquifer testing instruments were recorded along the floodplain.

The groundwater vulnerability has been classified at Moderate. The Aquifer category is described at locally important and is moderately productive locally.

3.4 OSi Flood Mapping

Figure 8 below shows the areas identified in the OSi Flood Maps GeoHive viewer (http://map.geohive.ie/) as being susceptible to flooding and marshy ground conditions. The section of the site within this area is not proposed for construction and is bordering the Shannon Estuary.

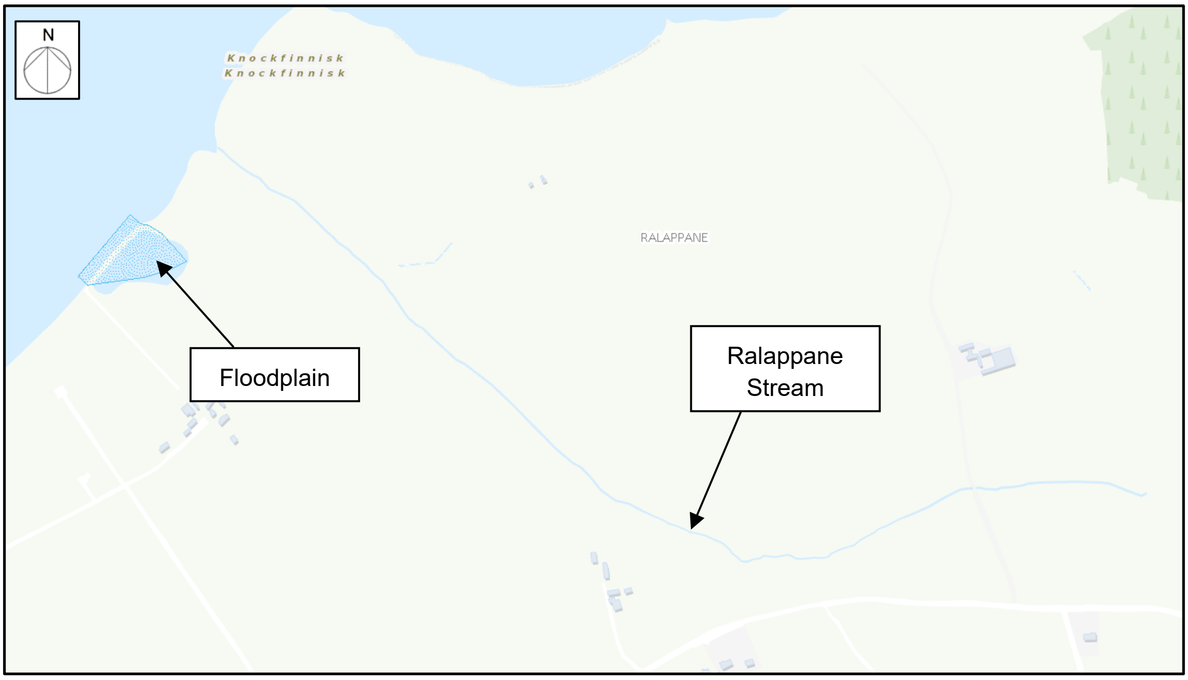


Figure 8. OSi Flood Maps showing Known Risk Areas within the site

The mapping suggests that there is area of risk within the Proposed Development boundary however no physical development is proposed at this location. This is the only area specifically identified within the site boundary.

3.5 Irish Coastal Protection Strategy Study (ICPSS)

The Irish Coastal Protection Strategy Study (IPCSS) was undertaken between 2005 and 2011 to produce an overview of coastal flood hazards at a strategic level. The findings of this study were then incorporated in to the OPW PFRA mapping.

The ICPSS data provides flood levels for a number of flood event probabilities in terms of percentage Annual Exceedance Probability (AEP). Depth data is provided for the 0.5% AEP event and flood extents are provided for the 0.1% and 0.5% AEP events. Figure 9 and Figure 10 provide extracts of the ICPSS mapping. These maps illustrate the same coastal flood extents as the OPW PFRA maps and are included in Appendix C.

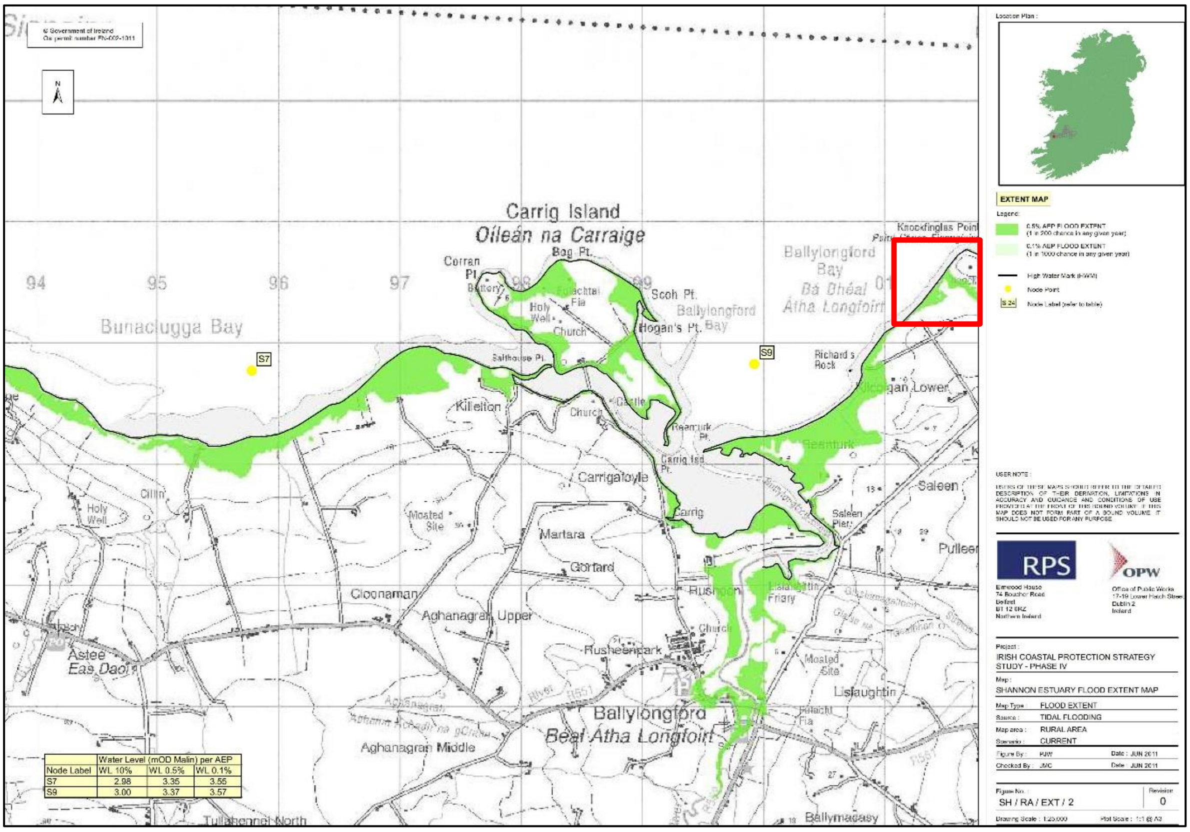


Figure 9. ICPSS mapping. 0.1% and 0.5% AEP events

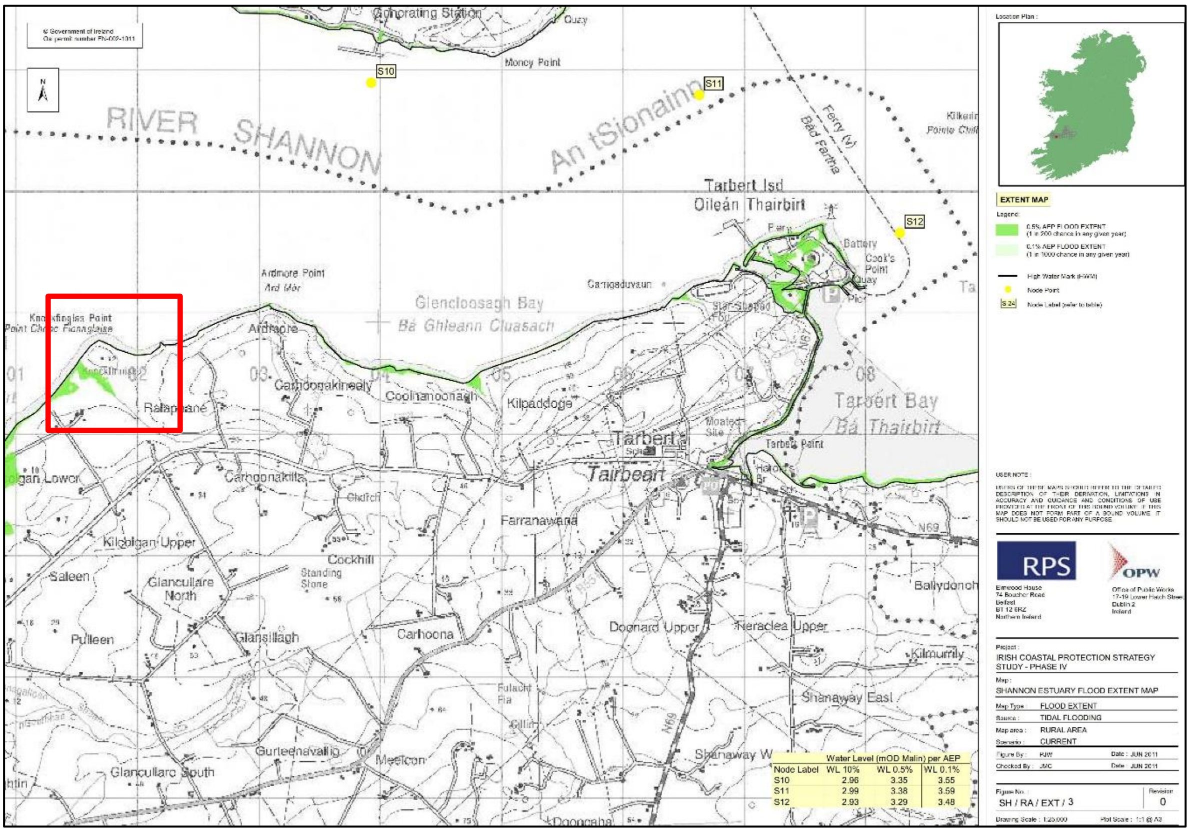


Figure 10. ICPSS mapping. 0.1% and 0.5% AEP events

The closest prediction point is "S9" in Ballylongford Bay which gives a 0.5% AEP tidal level of 3.37 mOD and a 0.1% AEP tidal level of 3.57 mOD for the present day scenario. Both of these levels include allowances for tidal surge along with extreme water levels.

3.6 OPW Preliminary Flood Risk Assessment (PFRA) and CFRAM Mapping

Both the OPW PFRA and CFRAM mapping were consulted in relation to potential flooding at the Proposed Development site. No mapping information was available for the area, refer to Figure 11.

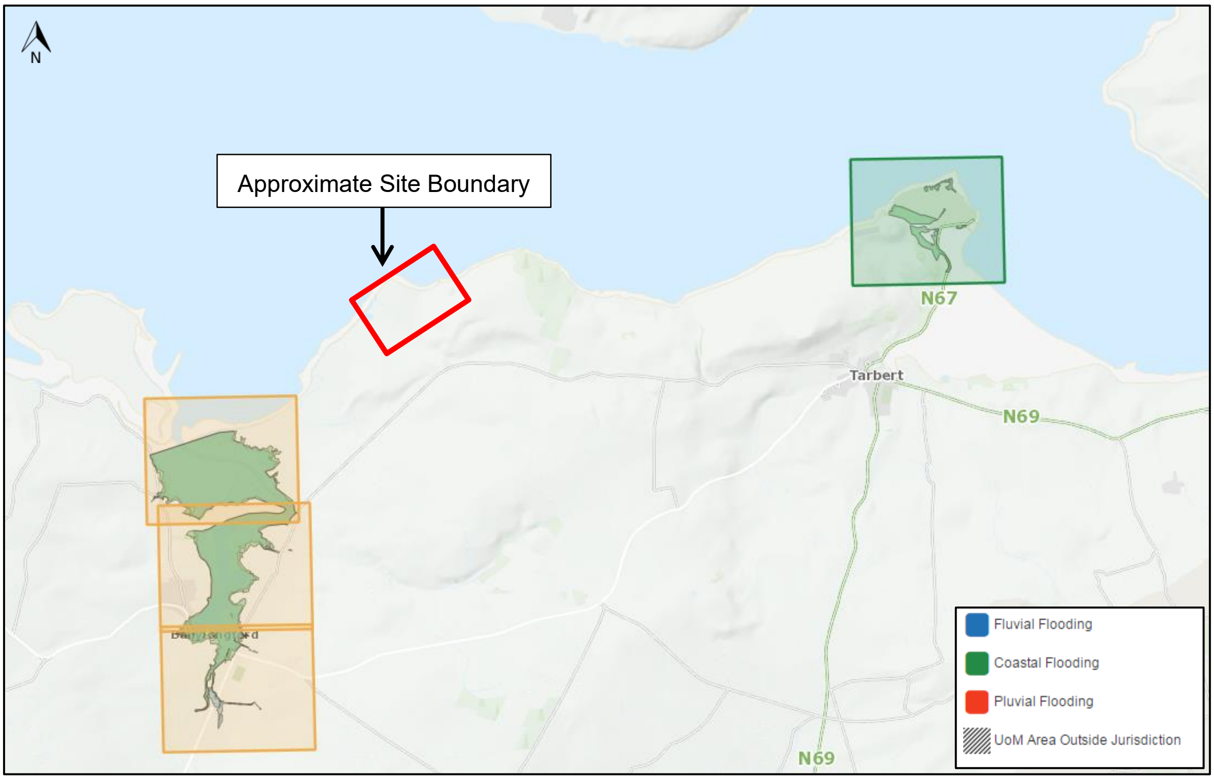


Figure 11. CFRAM Coastal and Fluvial Flood Maps in the surrounding area

While no additional mapping is available from the PFRA and CFRAM studies, this does not mean that there is no risk of flooding at the site. The CFRAM studies focused on population centres where the impact of flooding is greatest. The Proposed Development site is within a rural agriculture area and no mapping was produced.

3.7 Kerry County Development Plan

The Kerry County Development Plan 2022-2028[1] (KCDP) outlines flooding objectives to be applied in the preparation of future town development plans and in the assessment of planning applications, referring to the 'Flood Directive' (2007/60/EC) and 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities (DOEHLG 2009)'. Volume Five – Environmental Assessments[2] identifies the Proposed Development to be situated within the 'Tarbert-Ballylongford SDL' area which the KCDP states a Stage 2 SFRA requirement for both fluvial and coastal flood risk.

The Tarbert-Ballylngford strategic development location land use zoning assessment notes the coastal fringes have been identified as being at risk of coastal flooding while there is also

[1] County Development Plan | (c) Kerry County Council (kerrycoco.ie)
[2] Kerry CoCo Development Plans (469474)_Volume 5_R2.indd

potential for relatively small areas of the SDL to be at risk of fluvial flooding from the streams which flow through the land.

Section 5.2.4 also notes the SDL area is to be developed to create an Energy Hub, potentially consisting of marine related industry and general industrial development related to the Energy Hub and existing uses. While the majority of these lands are within Flood Zone C, areas within Flood Zones A and B is representative of a small and localised encroachment into the site which should not preclude the development of the entire site.

3.8 Ordnance Survey Historic Mapping

Historic mapping for the area was assessed for evidence of historical flooding incidents within the site. The historic maps assessed were the pre-1900's 25inch (Figure 12) and 6inch mapping (http://map.geohive.ie/). The historic mapping did not identify any area liable to flood.

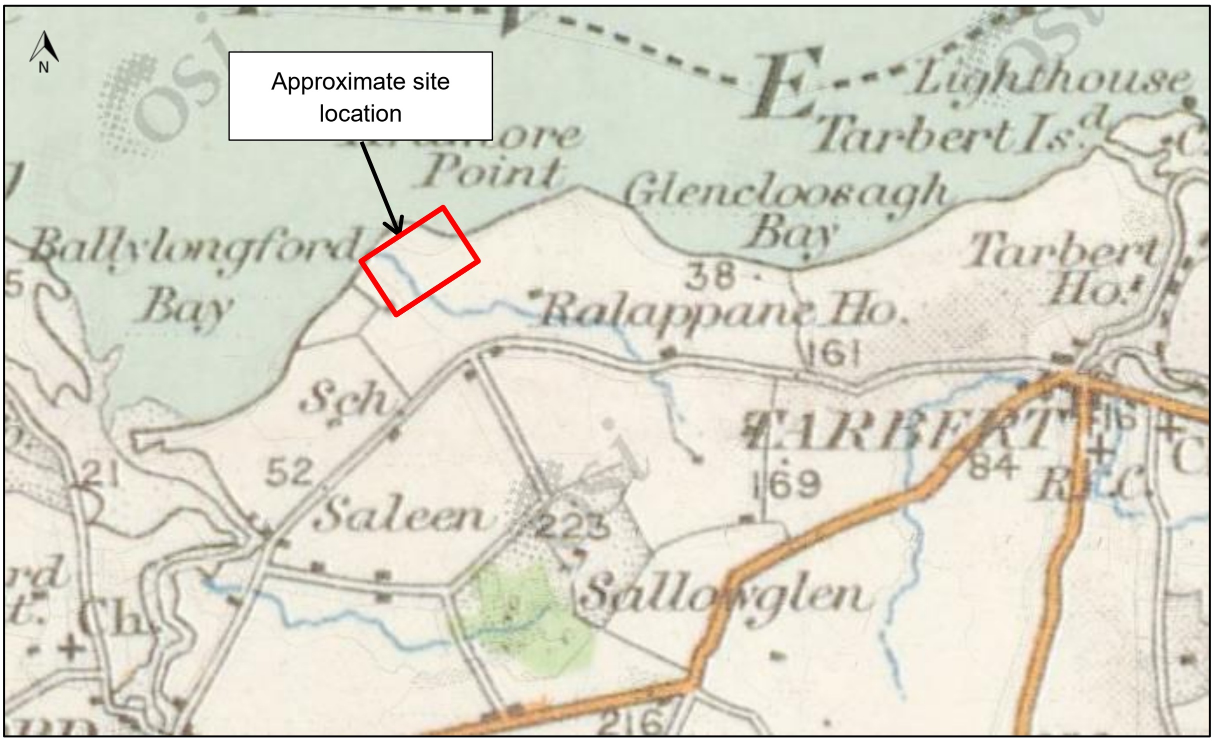


Figure 12. 25inch Historic Map

3.9 Screening Assessment Conclusion

The possible flooding mechanisms in consideration of the Proposed Development are summarised in Table 1 below.

The purpose of this screening assessment was to identify whether a potential risk of flooding exists and to what extent within the Proposed Development site. This assessment is based on the collation and analysis of existing current information, historical information and data which may indicate the level or extent of any flood risk.

Table 1. Possible Flood Mechanisms

Source of Flooding	Significant?	Comment / Reason
Tidal / Coastal	Yes	The ICPSS flood extents suggest the site is tidally influenced and is partially at risk of tidal flooding.
Fluvial	Potential	Flooding is likely to occur in areas of lower elevation near the downstream extent of the watercourse as the watercourse is tidally influenced this could impact the hydraulics along the watercourse.
Pluvial (Urban Drainage)	No	The existing site is a greenfield site. There are no records and no known instances of failure of the associated drainage systems.
Pluvial (Overland Flow)	No	Flooding is not likely to occur from overland flow
Groundwater	No	There are springs and groundwater discharges recorded in the immediate vicinity of the site, but no recorded flood risk.

In consideration of the data sources assessment, this flood risk assessment is required to proceed to ‘Stage 2 - Initial Flood Risk Assessment’. The screening assessment shows that there is a flooding risk to the Proposed Development site.

4. Stage 2 – Initial Flood Risk Assessment

In order to undertake the initial flood assessment a determination of the flood zone in which the site is located along with a determination of the vulnerability of the proposed works is required.

4.1 Determination of Vulnerability

The vulnerability of the proposed works is classified into three classes as given below in Table 2.

Table 2. Classification of Vulnerability

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

* Uses not listed here should be considered on their own merits

Source: The Planning System and Flood Risk Management - Guidelines for Planning Authorities

The guidelines would indicate that the site, as Natural Gas Plant Infrastructure, should be considered to be a **highly vulnerable development**.

4.2 Determination of Flood Zone

In accordance with 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities (DOEHLG 2009)', there are three flood zones designated in the consideration of flood risk to a particular site. The three flood zones are described in Table 3 below.

Table 3. Flood Zone Description

Flood Zone	Description
Flood Zone A	Where the probability of flooding from watercourses is the highest (greater than 1% or 1 in 100 year for watercourse flooding or 0.5% or 1 in 200 for coastal flooding)
Flood Zone B	Where the probability of flooding from watercourses is moderate (between 0.1% or 1 in 1000 year and 1% or 1 in 100 year for watercourse flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding)
Flood Zone C	Where the probability of flooding from watercourses and the sea is low or negligible (less than 0.1% or 1 in 1000 year for both watercourse and coastal flooding). Flood Zone C covers all areas which are not in Zones A or B.

Source: The Planning System and Flood Risk Management - Guidelines for Planning Authorities

The planning implications for each of the flood zones are:

Zone A - High probability of flooding. Most types of development would be considered inappropriate in this zone. Development in this zone should be avoided and/or only considered in exceptional circumstances, such as in city and town centres, or in the case of essential infrastructure that cannot be located elsewhere, and where the Justification Test has been applied. Only water-compatible development, such as docks and marinas, dockside activities that require a waterside location, amenity open space, outdoor sports and recreation, would be considered appropriate in this zone.

Zone B - Moderate probability of flooding. Highly vulnerable development, such as hospitals, residential care homes, Garda, fire and ambulance stations, dwelling houses and primary strategic transport and utilities infrastructure, would generally be considered inappropriate in this zone, unless the requirements of the Justification Test can be met. Less vulnerable development, such as retail, commercial and industrial uses, sites used for short-let for caravans and camping and secondary strategic transport and utilities infrastructure, and water-compatible development might be considered appropriate in this zone. In general, however, less vulnerable development should only be considered in this zone if adequate lands or sites are not available in Zone C and subject to an FRA to the appropriate level of detail to demonstrate that flood risk to and from the development can or will adequately be managed.

Zone C - Low probability of flooding. Development in this zone is appropriate from a flood risk perspective (subject to assessment of flood hazard from sources other than rivers and the coast) but would need to meet the normal range of other proper planning and sustainable development considerations.

In consideration of the above guidelines, the 1% AEP fluvial event and 0.5% AEP coastal event is to be taken into account in order to assess whether any parts of the site are located within Flood Zone 'A'. Also, consideration should be given to the 0.1% AEP fluvial and coastal events to assess if any parts of the site are located within Flood Zone 'B' given the classification of the development as highly vulnerable.

4.2.1 Coastal Flooding

The site is at risk of coastal flooding as the river is tidally influenced. The watercourse outfalls to the Shannon Estuary. The ICPSS flood maps suggest the site is partially within 'Flood Zone A' and 'Flood Zone B'.

4.2.2 Fluvial Flooding

The lack of information available is prohibiting the designation of a flood zone at the development site.

4.3 Justification Test Requirement

The requirement for a justification test was reviewed for this study to determine whether the proposed works would be considered acceptable in terms of flood risk. The conclusion of 'Stage 1 – Flood Risk Identification' noted that the works may be impacted by fluvial and coastal flooding.

The requirement for a Justification Test is determined based on the type of development and flood zone designation as indicated in Table 4 below.

Table 4. Justification Test Matrix

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

Source: The Planning System and Flood Risk Management - Guidelines for Planning Authorities

Given the determination of the development as 'Highly vulnerable development' a justification test is required to be passed for the development to proceed should it fall into within either Flood Zone A or Flood Zone B. The present information available however is not sufficient to allow a full determination of the flood zones present across the site.

4.4 Stage 2 Flood Assessment Conclusion

In order to fulfil the Justification Test there is a requirement to quantify the flood risk at the proposed site, and where necessary mitigate the flood risk.

The purpose of the scoping stage is to identify possible flood risks and to implement the necessary level of detail required to assess these possible flood risks, and to ensure these can be adequately addressed in the FRA. The scoping exercise should also identify that sufficient quantitative information is already available to complete an FRA appropriate to the scale and nature of the development.

The ICPSS flood map indicates that there is a potential flood risk to the Proposed Development site from coastal flooding. Also, given the presence of a watercourse there is the potential for localised fluvial flooding however this cannot be determined based on the information available. In order to determine the flood extents and level on the proposed site, a Stage 3 Detailed FRA is required.

It is proposed that a hydraulic model of the watercourse is developed to determine the level and extent of flooding and the impact of the proposed works. The model can then be used, if required, to develop mitigation measures to ensure the flood risk is appropriately managed or remediated.

5. Stage 3 – Detailed Flood Risk Assessment

Section 4 of this report has concluded that a justification test is required to be passed for the development to proceed if any of the Proposed Development falls within Flood Zone A or Flood Zone B. This is due to the determination of the development as 'highly vulnerable development'.

In order to determine the flood extents and level on the proposed site, a hydraulic model will be required. The following section will outline the process undertaken in the development of the hydraulic model.

5.1 Assessment of Flow

AECOM have undertaken a river flood flow assessment for the Ralappane Stream employing best practice techniques. Figure 13 below indicates the catchment area of 3.1 km^2 for the watercourse at the site taken from the OPW Flood Studies Update (FSU) database. This has been checked using other mapping and topographic sources with the calculated area in agreement with the FSU figure.

Figure 13. Catchment Area

Given the small catchment (<25 km^2) area it is not appropriate to undertake flow estimation using the FSU method. AECOM have instead undertaken flow estimation using a number of methods with the 1% AEP peak flow from each of these given below in Table 5. A full calculation record can be found in Appendix B.

Table 5. 1% AEP Peak Flow Summary

Calculation Method	1% AEP Peak Flow (m^3/s)
Flood Studies Report 6 variable equation (FSR-6)	3.946
Flood Studies Report 3 variable equation (FSR-3)	5.939
Flood Studies Supplementary Report No.6 (FSSR6)	4.357
Institute of Hydrology Report No.124 (IH124)	5.958
Flood Estimation Paper, Cunnane, Lynn 1976 (FEP)	3.672

The above flows include factorial error allowances for the 95% confidence banding.

5.1.1 Discussion of Flow Choice

The FSR-3 and IH124 methods are more suited to smaller catchments and hence have been deemed to be over-estimating the flow in this instance. The flows produced by FSSR6 and the FEP are within ±10% of the FSR-6 and therefore AECOM have decided to adopt the flow generated by FSR-6 equation as a suitable flow estimate going forward for use in the hydraulic model.

A unit hydrograph has been produced for the catchment to allow unsteady hydraulic analysis to be undertaken. This has been subsequently scaled so the peak matches that calculated by the FSR-6 method. This hydrograph has also been scaled to provide the 50% AEP and 0.1% AEP events using the Irish Growth Curves giving the following peak flows:

Table 6. Scaled Peak Flows

Return Period	Peak Flow (m^3/s)
50% AEP	1.913
1% AEP	3.946
0.1% AEP	5.130

5.1.2 Climate Change Considerations

The Flood Policy Review Report (2004) produced by OPW states that climate change considerations should be taken into consideration when undertaking flood risk assessments. Two possible scenarios are proposed in this report:

- The 'Mid-Range Future Scenario' (MRFS) considers the more likely estimates of climate change to the future scenario drivers by 2100. This includes extreme rainfall depths increase by 20%, a resulting 20% increase in flood flow, 0.500 m sea level rise and decrease in time to peak by 1/6 (Tp) due to deforestation. This is supported by the Defra FCDPAG3 (2006) guidance policy, where 20% is used as a sensitivity range to be adopted for peak river flow.
- The 'High End Future Scenario' (HEFS) considers the less likely estimates of climate change to the future scenario drivers by 2100. This includes extreme rainfall depths increase by 30%, a resulting 30% increase in flood flow, 1 m sea level rise and decrease in time to peak by 1/3 (Tp) and addition of 10% to the Standard Percentage Runoff (SPR) rate due to deforestation.

Given the critical nature of the proposals, sensitivity testing will be undertaken for both the MRFS and the HEFS by increasing the flood flow estimates by 20% and 30% respectively.

5.2 Downstream Conditions

As outlined earlier in this report, the Ralappane Stream discharges into the Shannon Estuary at the western site boundary and therefore the lower reaches of the watercourse are likely to be influenced by the tidal cycles.

A cyclical tidal profile has therefore been generated for the 50%, 0.5% and 0.1% AEP tidal events based on the information available in the ICPSS reports which includes for both extreme water levels and a tidal surge profile. Table 7 summarises the peak tidal level for each return period. The peak of the tidal cycle will be set to coincide with the peak of the fluvial event to represent worst case.

Table 7. Tidal Levels

Return Period	Peak Level (mOD)
50% AEP	2.79
0.5% AEP	3.37
0.1% AEP	3.57

5.2.1 Climate Change Considerations

As outlined in Section 5.1.2, climate change considerations should be taken into consideration when undertaking flood risk assessments. With regards to the downstream conditions and given the critical nature of the proposals, sensitivity testing will be undertaken for both the MRFS and the HEFS by increasing the level estimates by 0.5 m and 1.0 m respectively to account for potential sea level rises.

5.3 Model Geometry, Build and Parameters

5.3.1 Topographic and Hydrographic Data

In order to construct a hydraulic model representative of the current conditions, a hydrographical survey of designated river channel cross sections was undertaken by Murphy Surveys in October 2020. This also included cross sections of a minor tributary to the north of the main channel. The survey included details of the watercourse bed levels. It also includes details of hydraulic structures such as culverts and bridges. The survey included watercourse cross sections and other feature levels at regular intervals within the study area.

A previous topographic survey had been undertaken of the site by Murphy Surveys in July & August 2006 which was used to create a DTM of the area surrounding the watercourse channels to feed into the 2D elements of the model. Where necessary this has been supplemented by the use of OSi LiDAR data outside of the topographic survey limits. Figure 14 below gives a graphic illustration of the topography of the site from the development DTM.

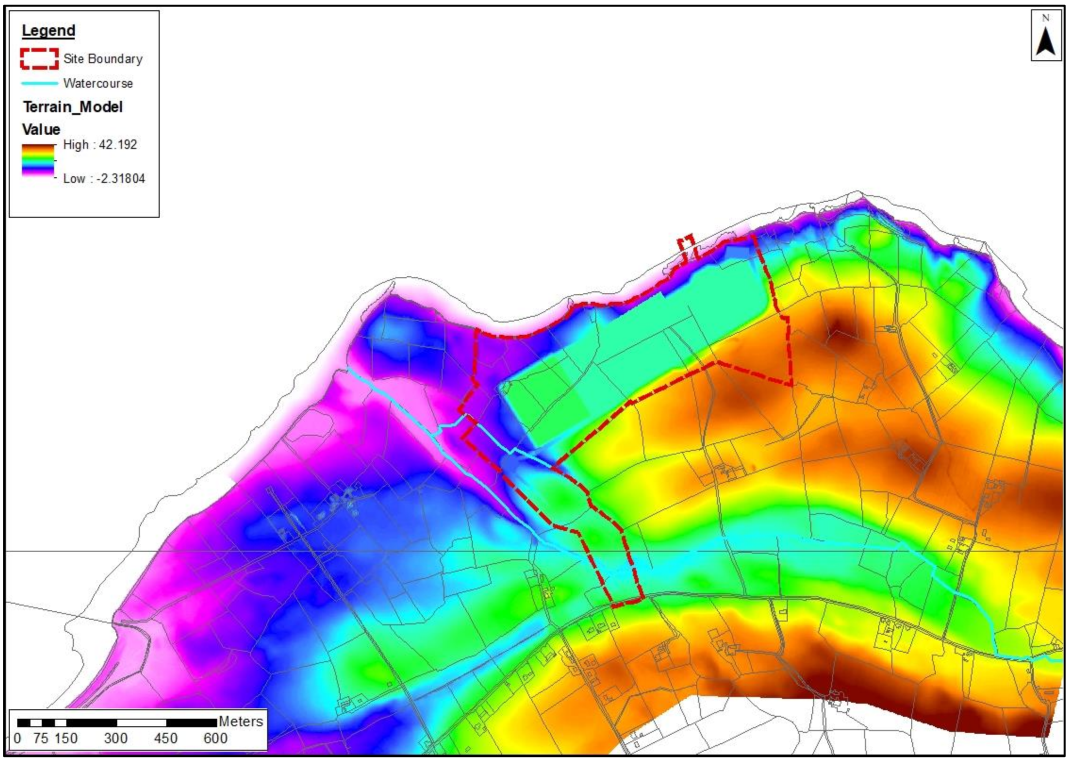


Figure 14. Site Topography

5.3.2 Hydraulic Structures

There are a number of crossings of both the main watercourse and the minor tributary; these are all for private access across the watercourses and most are only for field access with only SLNG01515 serving a dwelling house and associated outbuildings. Details of these are given below in Table 8.

Table 8. Hydraulic Structures

Structure ID	Photograph/ Image	Details
SLNG01515	Upstream face 	Structure Type: Arch Height: 1.75 m Width: 1.70 m Upstream Invert: 15.47 mOD Downstream Invert: 15.47 mOD Upstream Soffit: 17.22 mOD Downstream Soffit: 17.19 mOD
SLNG00770	Upstream face 	Structure Type: Clear Span Height: 1.10 m Width: 7.70 m Upstream Invert: 13.34 mOD Downstream Invert: 13.17 mOD Upstream Soffit: 14.44 mOD Downstream Soffit: 14.27 mOD
SLNG_R1_00315	Upstream face 	Structure Type: Box Culvert Height: 0.2 m Width: 0.4 m Upstream Invert: 8.23 mOD Downstream Invert: 8.13 mOD Upstream Soffit: 8.43 mOD Downstream Soffit: 8.33 mOD

Structure ID	Photograph/ Image	Details
SLNG_R1_00268	*No Picture Available*	Structure Type: Box Culvert Height: 0.2 m Width: 0.8 m Upstream Invert: 7.54 mOD Downstream Invert: 7.46 mOD Upstream Soffit: 7.74 mOD Downstream Soffit: 7.66 mOD

5.3.3 Model Build

A linked 1D-2D model of the watercourse was constructed using Infoworks ICM. The model geometry consists of river cross sections, bank lines, culverts, and floodplain. The main river channel and tributaries have been constructed as a 1D channel which is then linked to the 2D floodplain. Over-bank flow allows flood waters to escape from the 1D channel into the 2D floodplain. Figure 15 below is a screenshot of the model constructed.

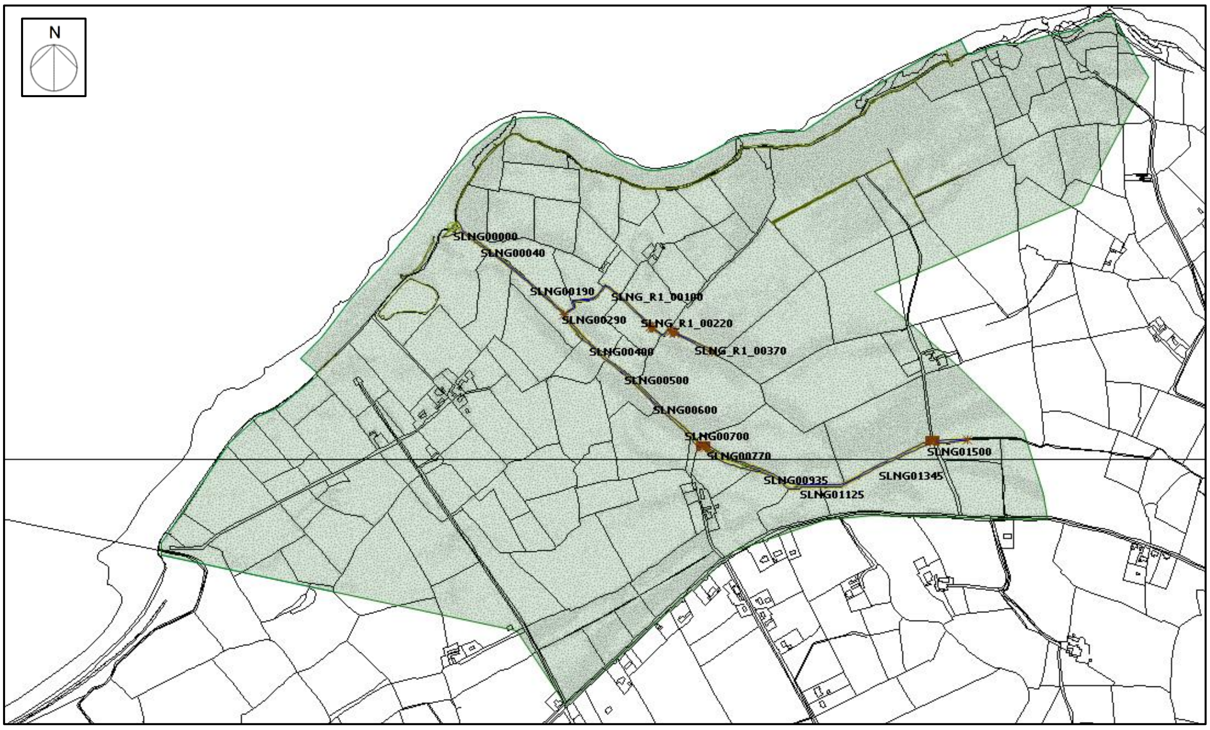


Figure 15. Existing Model Scenario

5.3.4 Model Parameters

The Infoworks ICM engine operates by representing the modelled hydraulic network using a system of nodes and links to represent hydraulically significant features. Nodes utilised by the software may include manholes, pipes, river cross sections, bridges, inflows and outflows etc.; while links represent the river channel, closed conduits, etc.

All of the nodes and links within the model require a series of parameters and coefficients to enable the hydraulic calculations to be completed.

5.3.5 Roughness Coefficients

Evidence from the photographic information provided as part of the survey as well as aerial imagery was used to provide a best estimate of Manning’s ‘n’ values for the terrain for use in the hydraulic model. Manning’s ‘n’ values were used as a measure of the bed roughness. The areas that were out of the assigned bank stations were designated Manning's coefficient which were taken from Chow, 1959. Table 9 summarises the Manning's 'n' values used within the analysis.

Table 9. Manning's 'n' Values

Location	Manning's 'n'
Maintained Grass	0.030
Brushes	0.050
Tree	0.070
Channel poorly maintained – relatively clean channel floor, brush along bank	0.060
Roads, Tracks and Paths	0.025
River Channel	0.035
Earth bank – Stonewall, vegetation	0.070
General Manmade Surface	0.015
Mixed Vegetation	0.070

5.4 Model Scenarios

In order to allow comparison of the potential impacts of the Proposed Development it is necessary to construct a number of scenarios as outlined below.

5.4.1 Baseline Model

An existing model is constructed which is representative of the current site conditions. This is then used for simulations for multiple flood events to produce a baseline set of results. It is also used for undertaking sensitivity testing on parameters such as roughness coefficients and the impacts of climate change.

5.4.2 "Proposed without Mitigation" Model

The Proposed Development is added to the base model to create a "Proposed without Mitigation" model. This model includes the scheme along with proposed watercourse culverts, ditches, watercourse re-alignments and bridges etc. to determine the potential impact the scheme will have on the flood regime. At this stage the culverts and bridges etc. are generally designed on a hydraulic or structural basis only.

5.5 Baseline Model Results

5.5.1 Existing Scenario – Flood Zone "A"

Figure 16 below shows the predicted present day flood extents from the flood model for the 1% AEP fluvial flood event using a 50% AEP downstream tidal boundary.

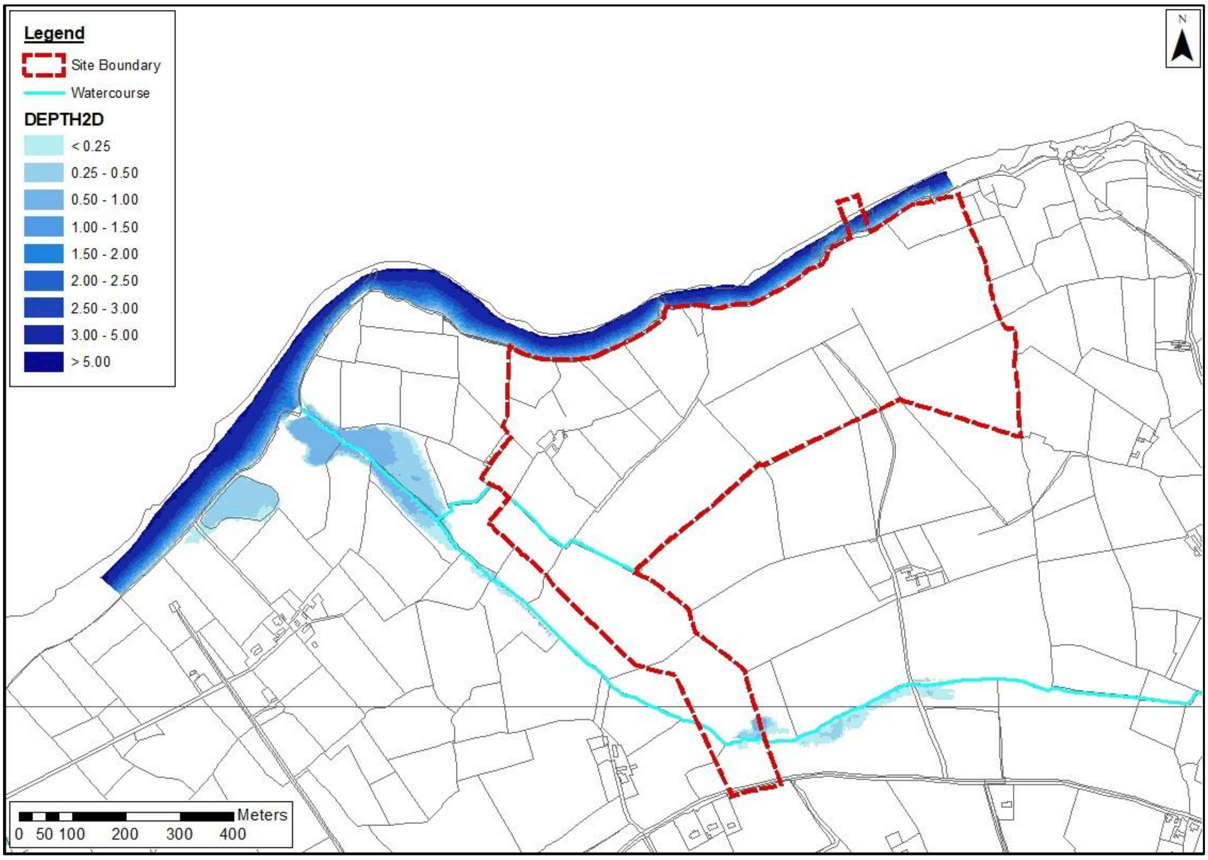


Figure 16. Baseline Model; Present Day 1% AEP Fluvial Flood Extents

The results suggest areas of land within the site can be classified as being in fluvial Flood Zone "A" however this is limited to an area near the downstream reaches and no development is proposed in this location. There is also some minor out-of-bank flooding near and beyond the upstream boundary of the site which is attributed to a lack of hydraulic capacity in the channel. The out-of-bank flooding is confined to a very small area local to the watercourse channel.

The lower reach of the main channel is tidally influenced with circa 400 m upstream of the outfall point having tidal flooding as the dominant flood mechanism. Tidal flooding is also dominant on the tributary for circa 50 m upstream of its confluence with the main channel.

Figure 17 below show the predicted present day flood extents from the flood model for the 0.5% AEP tidal flood event using a 50% AEP fluvial flow.

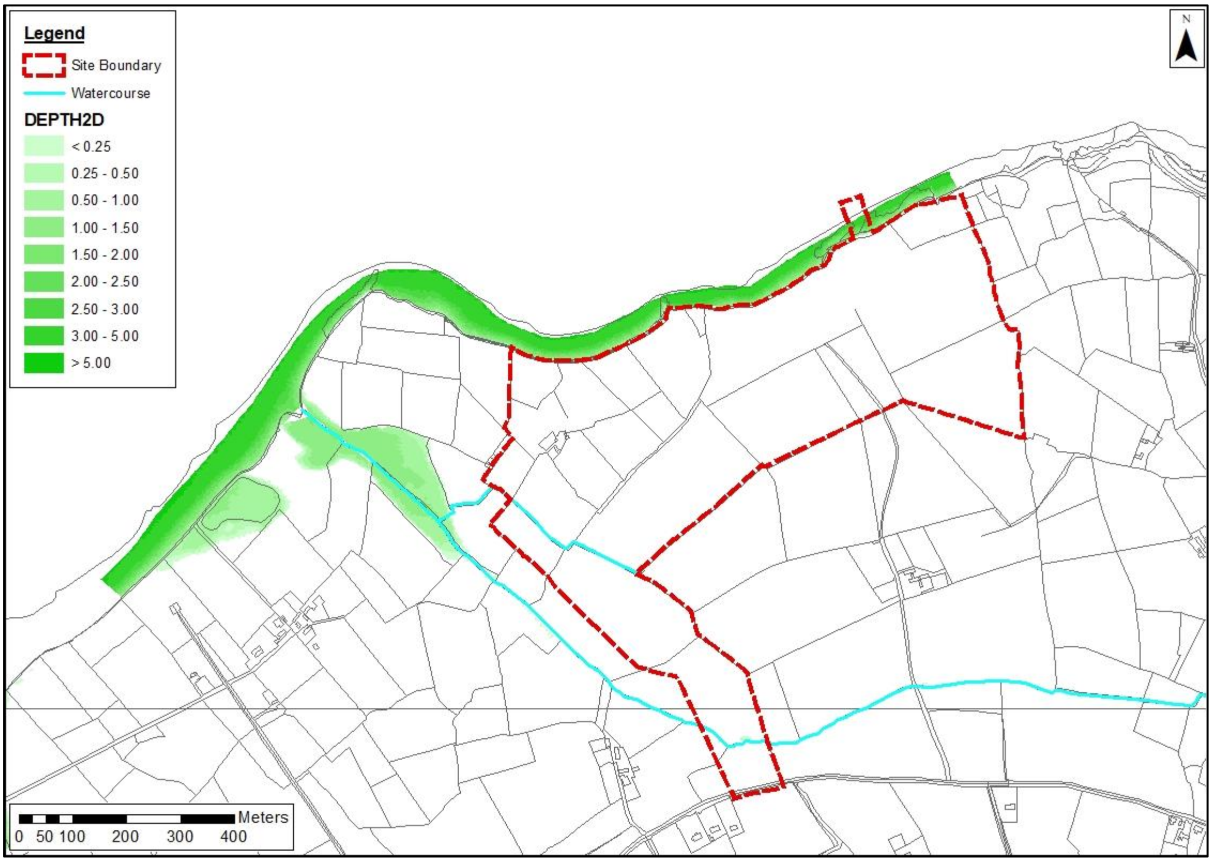


Figure 17. Baseline Model; Present Day 0.5% AEP Tidal Flood Extents

The results suggest areas of land within the site can be classified as being in tidal Flood Zone "A" however this is limited to an area near the downstream reaches and no development is proposed in this location.

5.5.2 Existing Scenario – Flood Zone "B"

Given the determination that the development would be considered as "highly vulnerable" it is also important to consider the 0.1% AEP fluvial and tidal events to determine the limits of "Flood Zone B"

Figure 18 and Figure 19 below show the increased extents of the 0.1% AEP fluvial and tidal events in comparison to the 1% AEP fluvial and the 0.5% AEP tidal extents respectively. The downstream condition applied for the 0.1% AEP fluvial run is the 50% AEP tidal event with a 50% AEP fluvial event used in conjunction with the 0.1% AEP tidal run.

Both figures show a very limited increase in flood extent from Flood Zone "A" to Flood Zone "B". The maximum increase in fluvial flood level is 185 mm at cross section SLNG01075 with an average increase of circa 90 mm. The maximum increase in tidal flood level is 222 mm at cross section SLNG00000 with an average increase in the tidally influenced section of 206 mm. The flood levels for the cross section locations can be found in Appendix D.

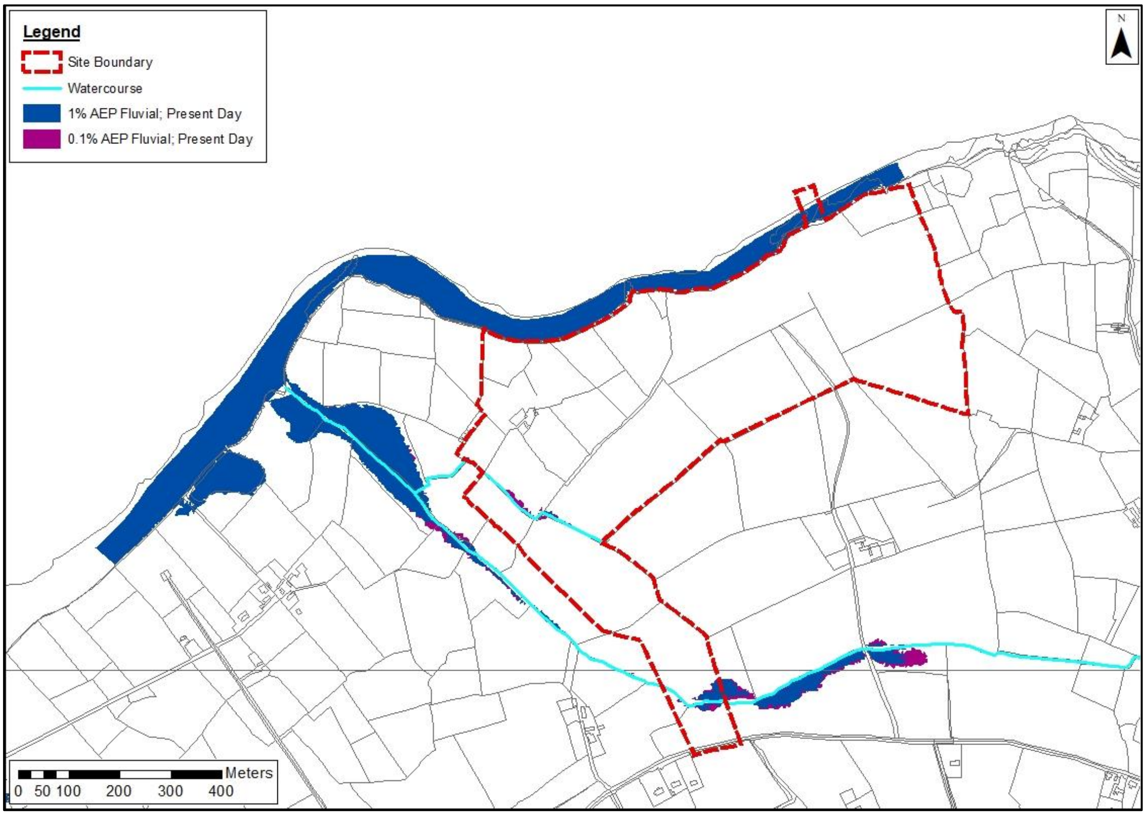


Figure 18. Baseline Model; Present Day 0.1% AEP Fluvial Flood Extents

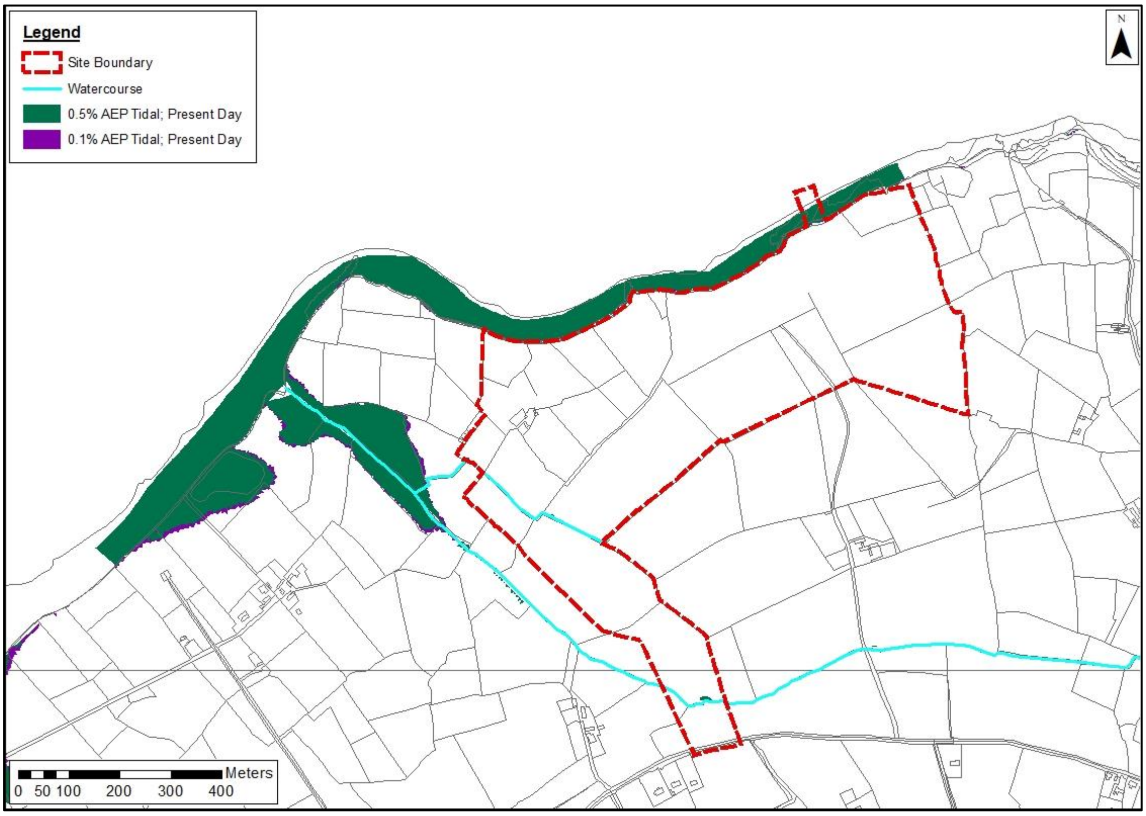


Figure 19. Baseline Model; Present Day 0.1% AEP Tidal Flood Extents

5.5.3 Climate Change Sensitivity

As outlined in Sections 5.1.2 and 5.2.1, climate change considerations have been allowed for by undertaking a series of additional runs for both the MRFS and HEFS fluvial and tidal estimations.

Figure 20 and Figure 21 illustrate the increase in fluvial flood extent for the 1% & 0.1% AEP fluvial runs; these runs use the corresponding MRFS or HEFS 50% AEP downstream boundary condition.

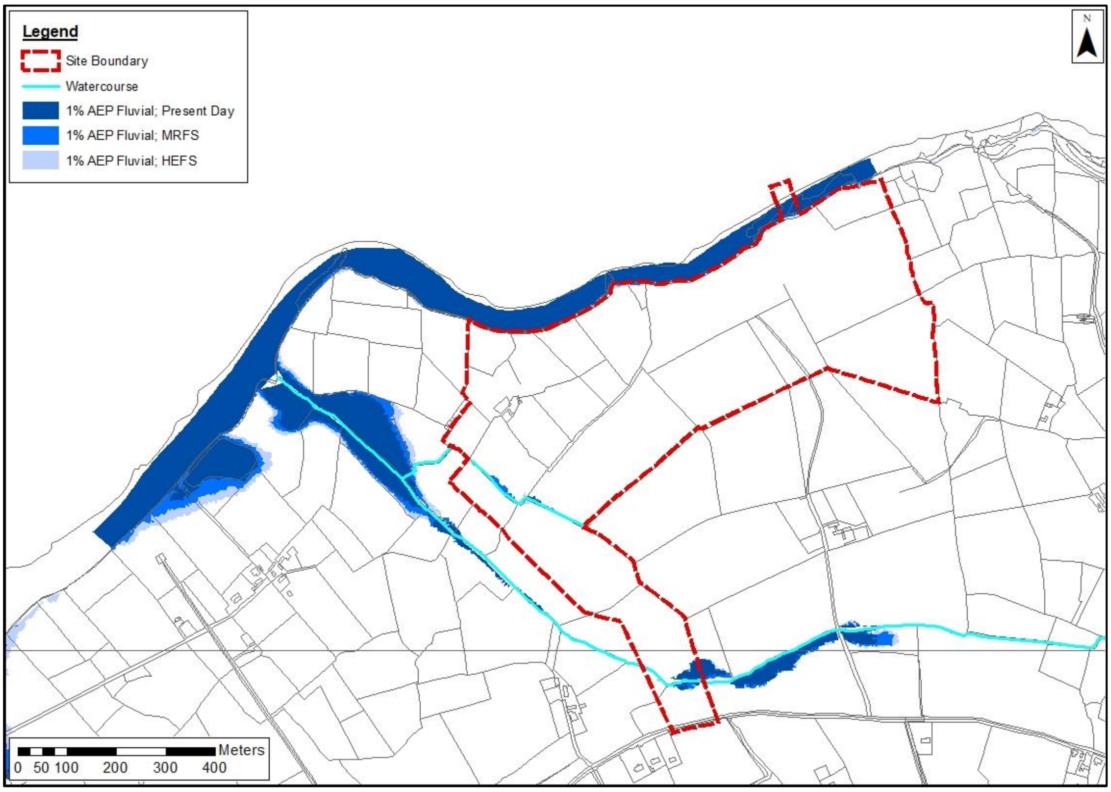


Figure 20. Baseline Model; 1% AEP Climate Change Fluvial Extents

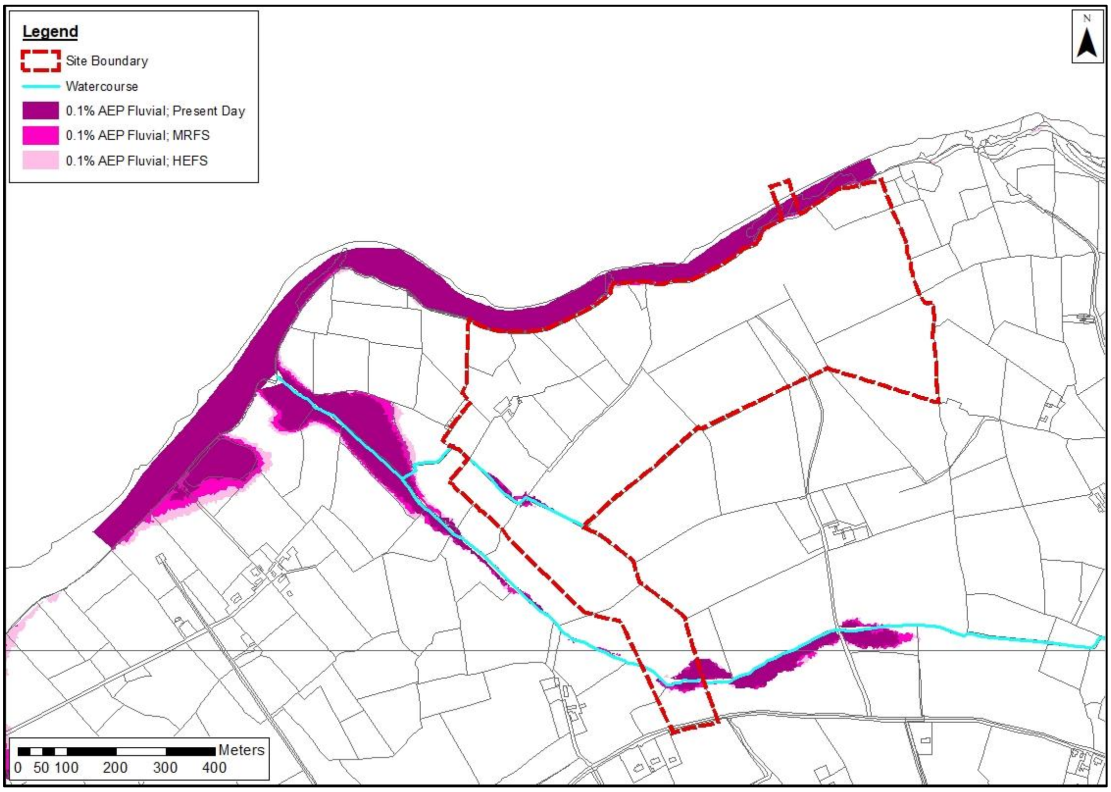


Figure 21. Baseline Model; 0.1% AEP Climate Change Fluvial Extents

An average increase in fluvial flood level of circa 80 mm is experienced for the MRFS when compared with the present day levels for both the 1% & 0.1% AEP fluvial flows. An average increase in fluvial flood level of circa 115 mm is experienced for the HEFS when compared with the present day levels for both the 1% & 0.1% AEP fluvial flows. Note that these increases exclude the tidally dominant section at the downstream end.

Figure 22 and Figure 23 illustrate the increase in tidal flood extent for the 0.5% & 0.1% AEP tidal runs; these runs use the corresponding MRFS or HEFS 50% AEP fluvial flow conditions.

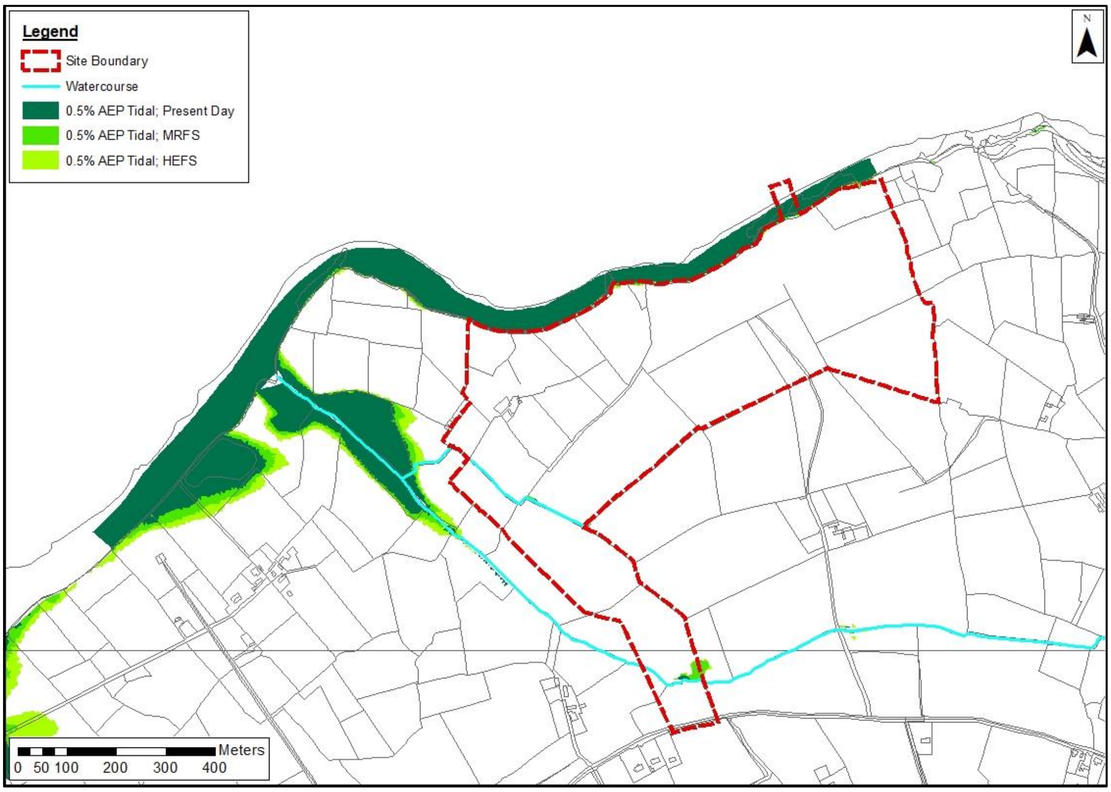


Figure 22. Baseline Model; 0.5% AEP Climate Change Tidal Extents

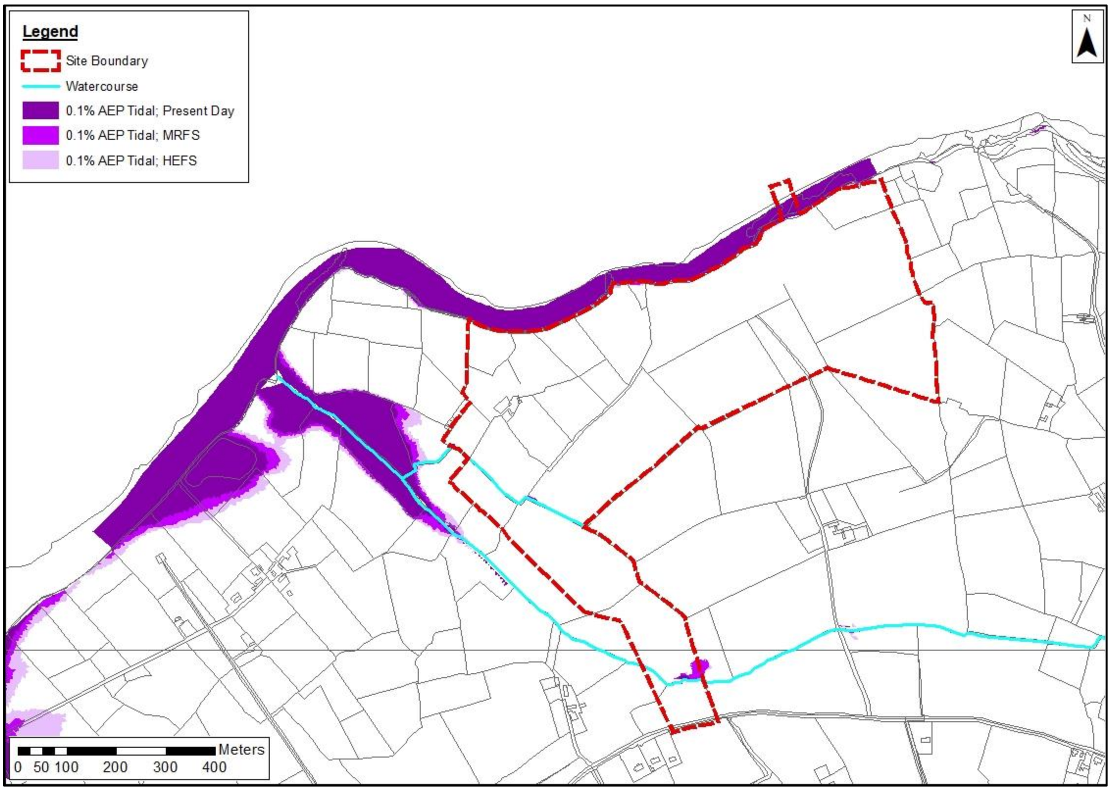


Figure 23. Baseline Model; 0.1% AEP Climate Change Tidal Extents

An average increase in tidal flood level of circa 500 mm is experienced for the MRFS when compared with the present day levels for both the 0.5% & 0.1% AEP tidal levels. An average increase in fluvial flood level of circa 1010 mm is experienced for the HEFS when compared with the present day levels for both the 0.5% & 0.1% AEP fluvial flows. Note that these increases exclude the fluvially dominant section further upstream.

The flood levels for the cross section locations can be found in Appendix D.

5.5.4 Manning's 'n' Sensitivity

Sensitivity analysis was undertaken using the baseline model to ascertain the impact of an increase in Manning's 'n' roughness coefficient using the present day 1% AEP fluvial flows. This showed a limited increase in levels ranging from 0 mm to 141 mm and averaging circa 50 mm. The flood levels for the cross section locations can be found in Appendix D.

5.6 "Proposed without Mitigation" Model Results

The "Proposed without Mitigation" model was created as follows:

- Addition of a new watercourse crossing on main watercourse between existing structures SLNG01515 and SLNG00770
  - Box culvert, 3.0 m width, 2.4 m height with 0.3 m embedment, 11.0 m long
- Removal of one existing ditch crossing on minor tributary at SLNG_R1_00315
- Addition of one new ditch crossings on minor tributary upstream of SLNG_R1_00315
  - Pipe culvert, 0.9 m diameter, circa 25.0 m length
- Inclusion of Proposed Development DTM into base DTM

Figure 24 below is a screenshot of the model constructed.

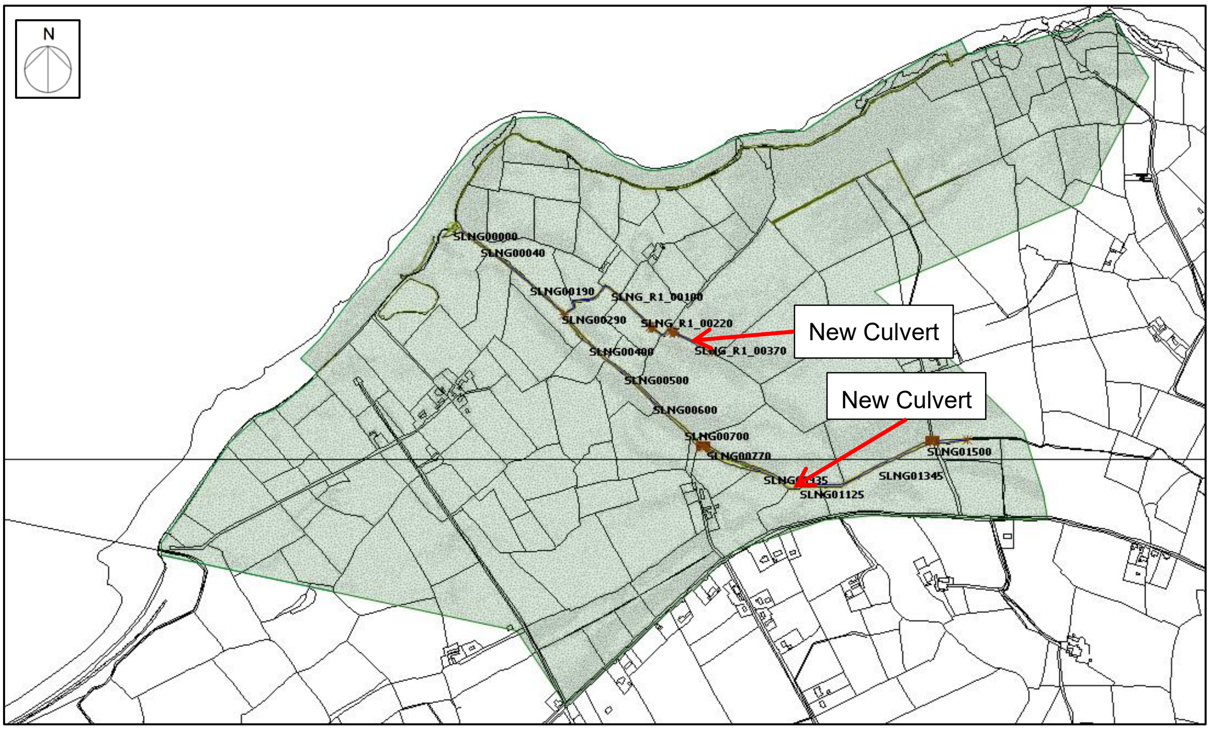


Figure 24. Proposed Model Scenario

5.6.1 Present Day Fluvial Flooding Comparison

Figure 25 below is a comparison plot for the "Baseline" versus the "Proposed without Mitigation" predicted present day flood extents from the flood model for the 1% AEP fluvial flood event using a 50% AEP downstream tidal boundary. This figure shows a negligible difference in flood level across the study area as a result of the Proposed Development.

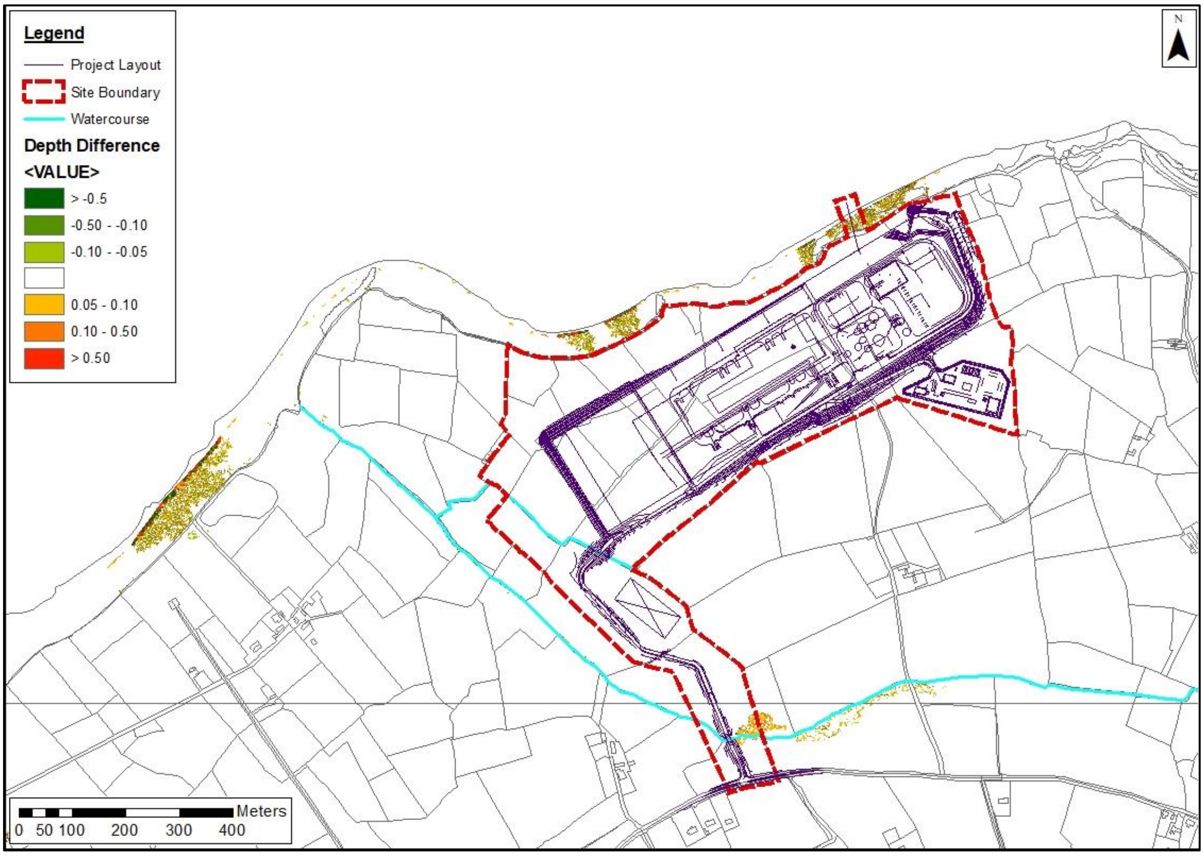


Figure 25. Present Day Fluvial Flooding Comparison – 1% AEP

The cross section results show a small increase in the in-channel flood level upstream of the proposed main watercourse access road crossing of circa 65 mm for the 1% AEP present day fluvial event which is well within the acceptable afflux limits at structures of 300 mm as set by OPW. The freeboard at the proposed structure is circa 700 mm for the 1% AEP present day event. The increase for the 0.1% AEP present day event is circa 80 mm with a freeboard of circa 500 mm.

A notable decrease in level is experienced on the minor tributary for the 1% AEP present day event upstream of existing crossing point due to the removal of the existing culvert suggesting this was causing a hydraulic restriction. The proposed new culvert on the minor tributary is adequately sized so as not to result in any impact to the flood levels for both the 1% and 0.1% AEP present day events. The freeboard at the proposed culvert is circa 400 mm for the 1% and circa 320 mm for the 0.1% AEP present day events.

The flood levels for the cross section locations can be found in Appendix D.

5.6.2 MRFS Fluvial Flooding Comparison

As with the Present Day fluvial flows, the MRFS fluvial flows show a negligible difference in flood level across the study area as a result of the proposals.

The cross section results show a small increase in the in-channel flood level upstream of the proposed main watercourse access road crossing of circa 85 mm for the 1% AEP MRFS fluvial event which is well within the acceptable afflux limits at structures of 300 mm as set by OPW. The freeboard at the proposed structure is circa 570 mm for the 1% AEP MRFS event. The increase for the 0.1% AEP present day event is circa 90 mm with a freeboard of circa 375 mm.

The proposed new culvert on the minor tributary is adequately sized so as not to result in any impact to the flood levels for both the 1% and 0.1% AEP MRFS events. The freeboard at the proposed culvert is circa 350 mm for the 1% and circa 260 mm for the 0.1% AEP MRFS.

The flood levels for the cross section locations can be found in Appendix D.

5.6.3 HEFS Fluvial Flooding Comparison

As with the Present Day fluvial flows, the HEFS fluvial flows show a negligible difference in flood level across the study area as a result of the Proposed Development.

The cross section results show a small increase in the in-channel flood level upstream of the proposed main watercourse access road crossing of circa 85 mm for the 1% AEP HEFS fluvial event which is well within the acceptable afflux limits at structures of 300 mm as set by OPW. The freeboard at the proposed structure is circa 510 mm for the 1% AEP HEFS event. The increase for the 0.1% AEP present day event is circa 40 mm with a freeboard of circa 370 mm.

The proposed new culvert on the minor tributary is adequately sized so as not to result in any impact to the flood levels for both the 1% and 0.1% AEP HEFS events. The freeboard at the proposed culvert is circa 320 mm for the 1% and circa 225 mm for the 0.1% AEP HEFS.

The flood levels for the cross section locations can be found in Appendix D.

5.6.4 Tidal Flooding Comparison

Given the limited area subject to tidal influence and no proposed works within this area there is a negligible impact on the tidal flood levels experienced for all flow scenarios. The flood levels for the cross section locations however can be found in Appendix D.

6. Conclusion

Shannon LNG Limited has appointed AECOM to prepare a Flood Risk Assessment (FRA) to accompany a planning application for a proposed 600 MW Combined Cycle Gas Turbine (CCGT) Power Plant located between Tarbert and Ballylongford, Co. Kerry.

The information collated during Stage 1 – Flood Risk Identification and the subsequent Stage 2 – Initial Flood Risk Assessment was insufficient to assess the potential flood risk to the proposed site. The proposals have been classified as 'Highly Vulnerable Development' and therefore their construction within either Flood Zone 'A' or Flood Zone 'B' require the justification test to be passed.

The Stage 3 – Detailed Flood Risk Assessment involved the construction of a linked 1D-2D hydraulic model using Infoworks ICM modelling software based on hydrographic and topographic survey information. Fluvial flow estimation was undertaken for the 50%, 1% and 0.1% AEP events along with tidal level estimation for the 50%, 0.5% and 0.1% AEP events. Climate Change flows and levels were also derived for the MRFS and HEFS in line with current OPW guidance. These flows and levels were subsequently applied to the model to obtain flood extents and levels. Both a baseline and proposed model were developed.

The model results showed that circa 400 m at the downstream end of the model is tidally influenced with a sizeable area liable to tidal flooding. A limited degree of fluvial flooding is present and limited to an area near and beyond the upstream site boundary. The extents of Flood Zone 'A' and Flood Zone 'B' have been determined based on the baseline model outputs.

With the exception of crossings of the watercourses for access there is no development proposed within either Flood Zone 'A' or Flood Zone 'B' and therefore the Proposed Development has a negligible impact on the existing flood regime in the area. Given no development within either flood zone the proposals are therefore seen to pass the justification test.

The proposed crossings of the watercourses have been adequately sized to have a minimal impact on the current hydraulic regime in the area. They also provide an adequate freeboard in accordance with current OPW guidelines for the 1% MRFS AEP fluvial event which would be seen as an acceptable design flow event for culverts.

Appendix A Site Photographs

1)		2)	
3)		4)	

5)

6)

7)

8)

9)		10)	
11)		12)	

13)		14)	

Appendix B Flood Flow Estimation

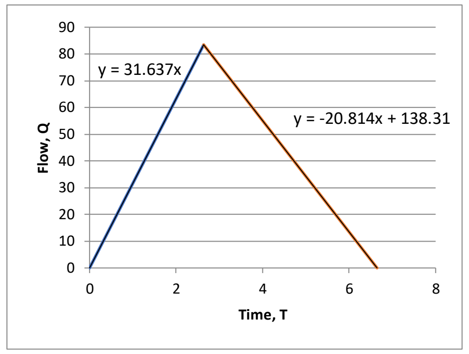
Input Data

S1085	10.6823	m/km	*from measurement*
URBAN	0		*from FSU*
SAAR	1070.35	mm	*from FSU*
MSL	3.5	km	*from FSU*
S1	0		*from FSR Maps*
S2	0		*from FSR Maps*
S3	0		*from FSR Maps*
S4	1		*from FSR Maps*
S5	0		*from FSR Maps*
CWI	124	mm	*from chart*
P	55.5	mm	*from FSU*
A	3.121	km^2	*from measurement*
ARF	0.973		*from FSU*

Equation	Parameter	Value	Unit
$Tp(0) = 283.0\ S1085^{-0.33}\ (1+URBAN)^{-2.2} SAAR^{-0.54} MSL^{0.23}$	Tp(0)	4.00	hrs
$T \cong Tp(0)/5$	T	0.50	hrs
$Tp(T) = Tp(0) + T/2$	Tp(T)	4.25	hrs
$D = (1.0 + SAAR/1000) T_p$	Dcalc	8.79	hrs
	D	8.50	hrs
$SPR = 10\ S1 + 30\ S2\ \ 37\ S3 + 47\ S4 + 53\ S5$	SPR	47.00	
$DPR_{CWI} = 0.25\ (CWI - 125)$	DPRcwi	-0.25	
$DPR_{RAIN} = 0.45\ (P - 40)^{0.7}$ for P > 40 mm; $= 0$ for P ≤ 40 mm	DPRrain	3.07	
$PR_{RURAL} = SPR + DPR_{CWI} + DPR_{RAIN}$	PRrural	49.82	
$PR_{TOTAL} = PR_{RURAL}\ (1.0 - 0.3\ URBAN) + 70\ (0.3\ URBAN)$	PRtotal	49.82	
$ANSF = [33\ (CWI - 125) + 3.0\ SAAR + 5.5] \times 10^{-5}$	ANSF	0.03	

Unit Hydrograph

$Qp = 220/Tp(T)$	Qp	51.83
$Tb = 2.52Tp(T)$	Tb	10.70



0	0
4.25	51.83
10.70	0

Rise, x	12.209
Fall, x	-8.032
Fall, intercept	85.921

Rainfall Distribution

% Duration	% Rain	Increment %	Increment (mm)
11.11	26	26	14.04
33.33	64	38	20.52
55.56	83	19	10.26
77.78	93	10	5.40
100.00	100	7	3.78

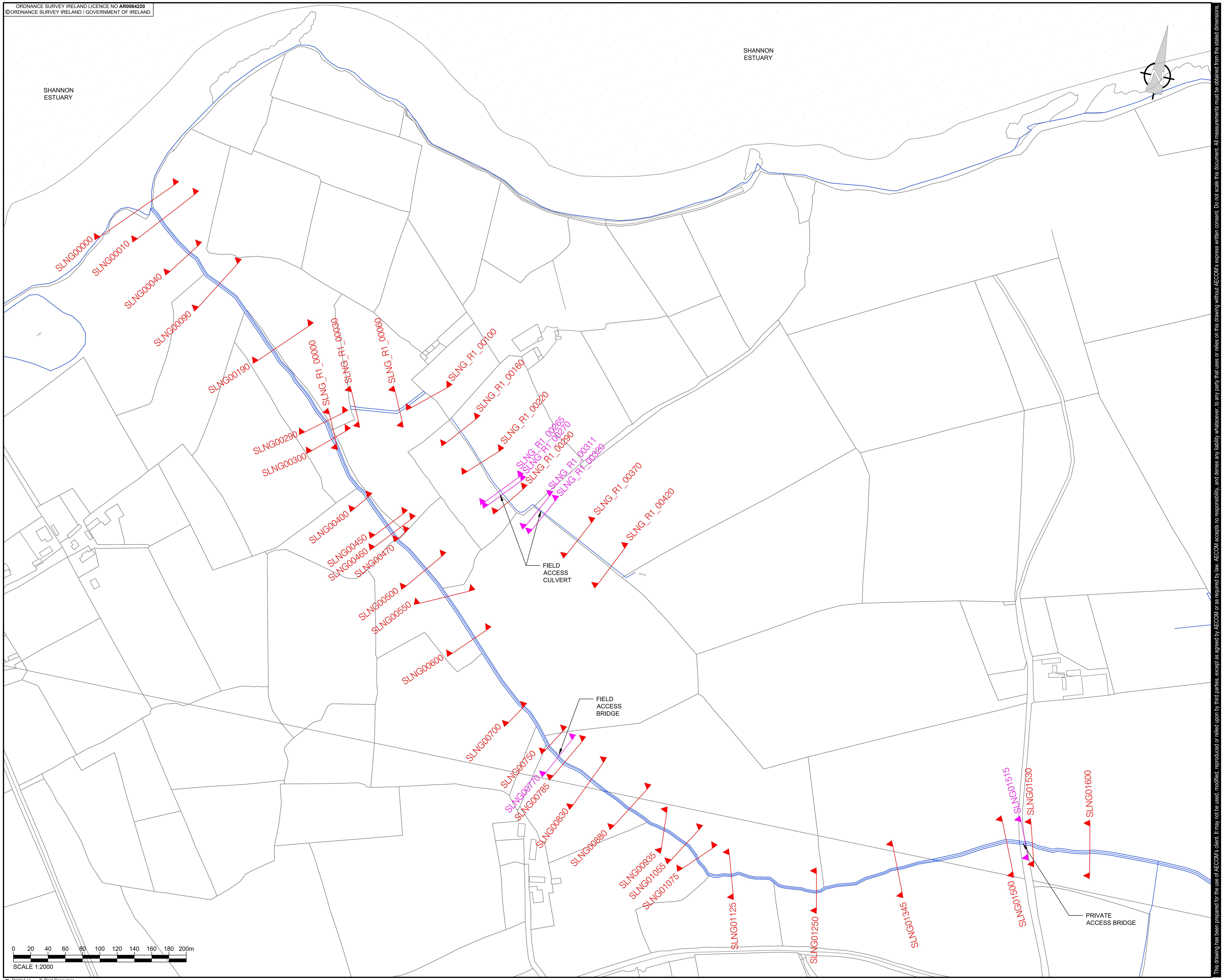
Interval	Total Rain (mm)	Net Rain (mm)
1	1.89	0.94
2	2.70	1.35
3	5.13	2.56
4	10.26	5.11
5	14.04	6.99
6	10.26	5.11
7	5.13	2.56
8	2.70	1.35
9	1.89	0.94

Convolition of Unit Hydrograph and Net Rain Profile

Unit Hydrograph (cumecs)

Net Rain (cm)	0	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50	11.00	11.50	12.00	12.50	13.00	13.50	14.00	14.50
	0.00	0.19	0.38	0.57	0.76	0.95	1.14	1.33	1.52	1.55	1.43	1.30	1.18	1.05	0.93	0.80	0.68	0.55	0.43	0.30	0.17	0.05								
0.09	0.00	0.02	0.04	0.05	0.07	0.09	0.11	0.13	0.14	0.15	0.13	0.12	0.11	0.10	0.09	0.08	0.06	0.05	0.04	0.03	0.02	0.00	0.00	0.00	0.00					
0.13		0.00	0.03	0.05	0.08	0.10	0.13	0.15	0.18	0.21	0.21	0.19	0.18	0.16	0.14	0.12	0.11	0.09	0.07	0.06	0.04	0.02	0.01	0.00	0.00	0.00				
0.26			0.00	0.05	0.10	0.15	0.19	0.24	0.29	0.34	0.39	0.40	0.36	0.33	0.30	0.27	0.24	0.20	0.17	0.14	0.11	0.08	0.04	0.01	0.00	0.00	0.00			
0.51				0.00	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78	0.79	0.73	0.67	0.60	0.54	0.47	0.41	0.35	0.28	0.22	0.15	0.09	0.03	0.00	0.00	0.00		
0.70					0.00	0.13	0.27	0.40	0.53	0.67	0.80	0.93	1.07	1.09	1.00	0.91	0.82	0.74	0.65	0.56	0.47	0.39	0.30	0.21	0.12	0.03	0.00	0.00	0.00	
0.51						0.00	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78	0.79	0.73	0.67	0.60	0.54	0.47	0.41	0.35	0.28	0.22	0.15	0.09	0.03	0.00	0.00	0.00
0.26							0.00	0.05	0.10	0.15	0.19	0.24	0.29	0.34	0.39	0.40	0.36	0.33	0.30	0.27	0.24	0.20	0.17	0.14	0.11	0.08	0.04	0.01	0.00	0.00
0.13								0.00	0.03	0.05	0.08	0.10	0.13	0.15	0.18	0.21	0.21	0.19	0.18	0.16	0.14	0.12	0.11	0.09	0.07	0.06	0.04	0.02	0.01	0.00
0.09									0.00	0.02	0.04	0.05	0.07	0.09	0.11	0.13	0.14	0.15	0.13	0.12	0.11	0.10	0.09	0.08	0.06	0.05	0.04	0.03	0.02	0.00
Total	*0.00*	*0.02*	*0.06*	*0.15*	*0.34*	*0.67*	*1.09*	*1.56*	*2.05*	*2.55*	*3.01*	*3.41*	*3.68*	*3.77*	*3.67*	*3.44*	*3.15*	*2.83*	*2.49*	*2.16*	*1.82*	*1.48*	*1.15*	*0.84*	*0.55*	*0.31*	*0.15*	*0.06*	*0.02*	*0.00*
Base Flow	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total Q	**0.10**	**0.12**	**0.16**	**0.25**	**0.44**	**0.77**	**1.19**	**1.65**	**2.15**	**2.65**	**3.11**	**3.51**	**3.78**	**3.87**	**3.76**	**3.54**	**3.25**	**2.93**	**2.59**	**2.26**	**1.92**	**1.58**	**1.25**	**0.94**	**0.65**	**0.41**	**0.25**	**0.16**	**0.12**	**0.10**

Appendix C Drawings



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ISO A1 594mm x 841mm

Approved: KMcC

Checked: RR

Designer: RR

Project Management Initials:

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Last saved by: RICHARD.REID(2021-01-06) Last Plotted: 2024-04-05

AECOM

PROJECT

Shannon Technology and Energy Park (STEP) Power Plant

CLIENT

Shannon LNG Limited

CONSULTANT

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▲———▲ MODELLED CROSS SECTION

ISSUE/REVISION

AECOM DRAFT

I/R	DATE	DESCRIPTION
A	NOV 2020	ISSUED FOR INFORMATION

PROJECT NUMBER

60619377

SHEET TITLE

FLOOD RISK ASSESSMENT
MODELLED CROSS SECTIONS
BASELINE SCENARIO

SHEET NUMBER

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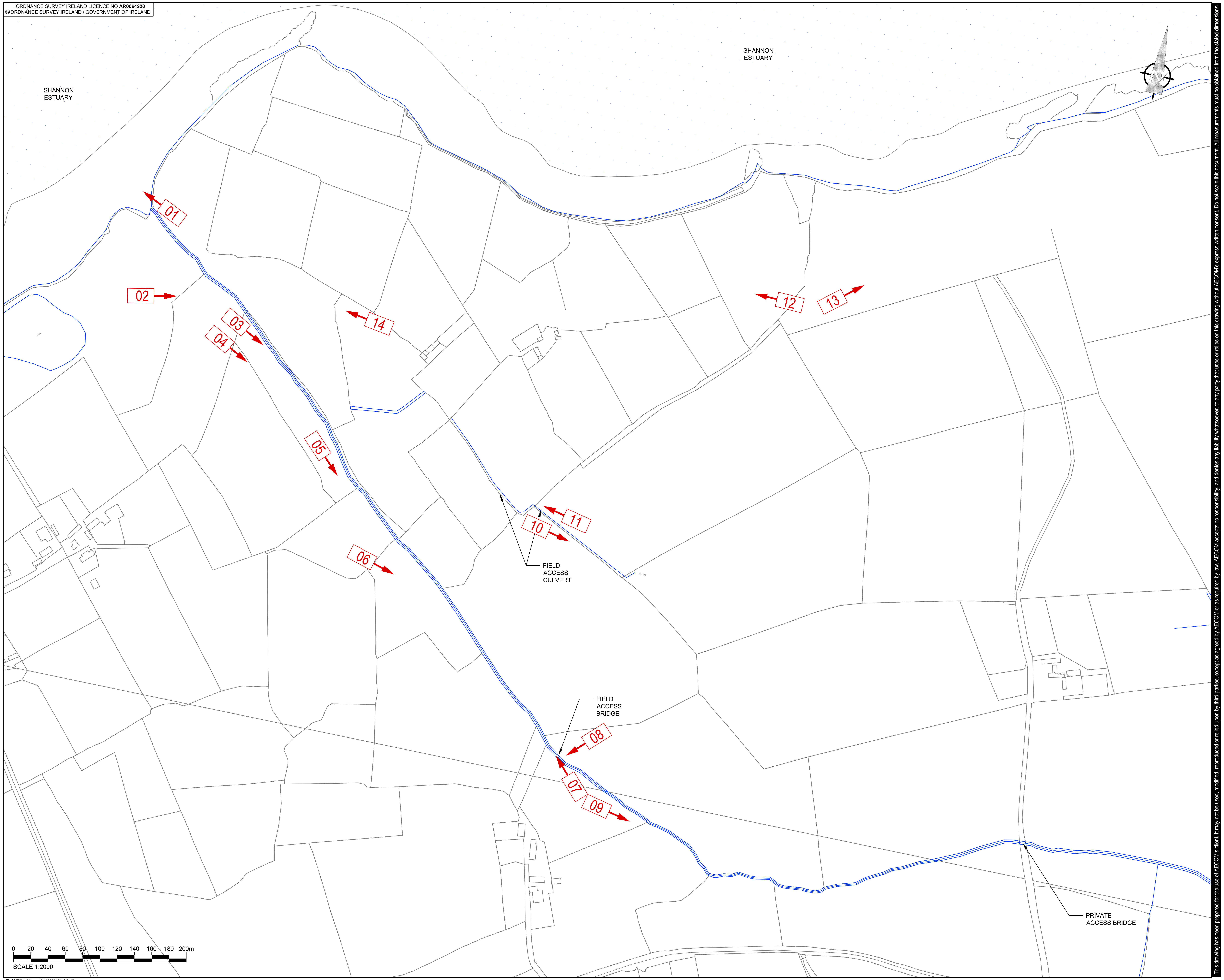

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SHEET TITLE

FLOOD RISK ASSESSMENT
SITE WALKOVER
PHOTO LOCATION REFERENCE

SHEET NUMBER

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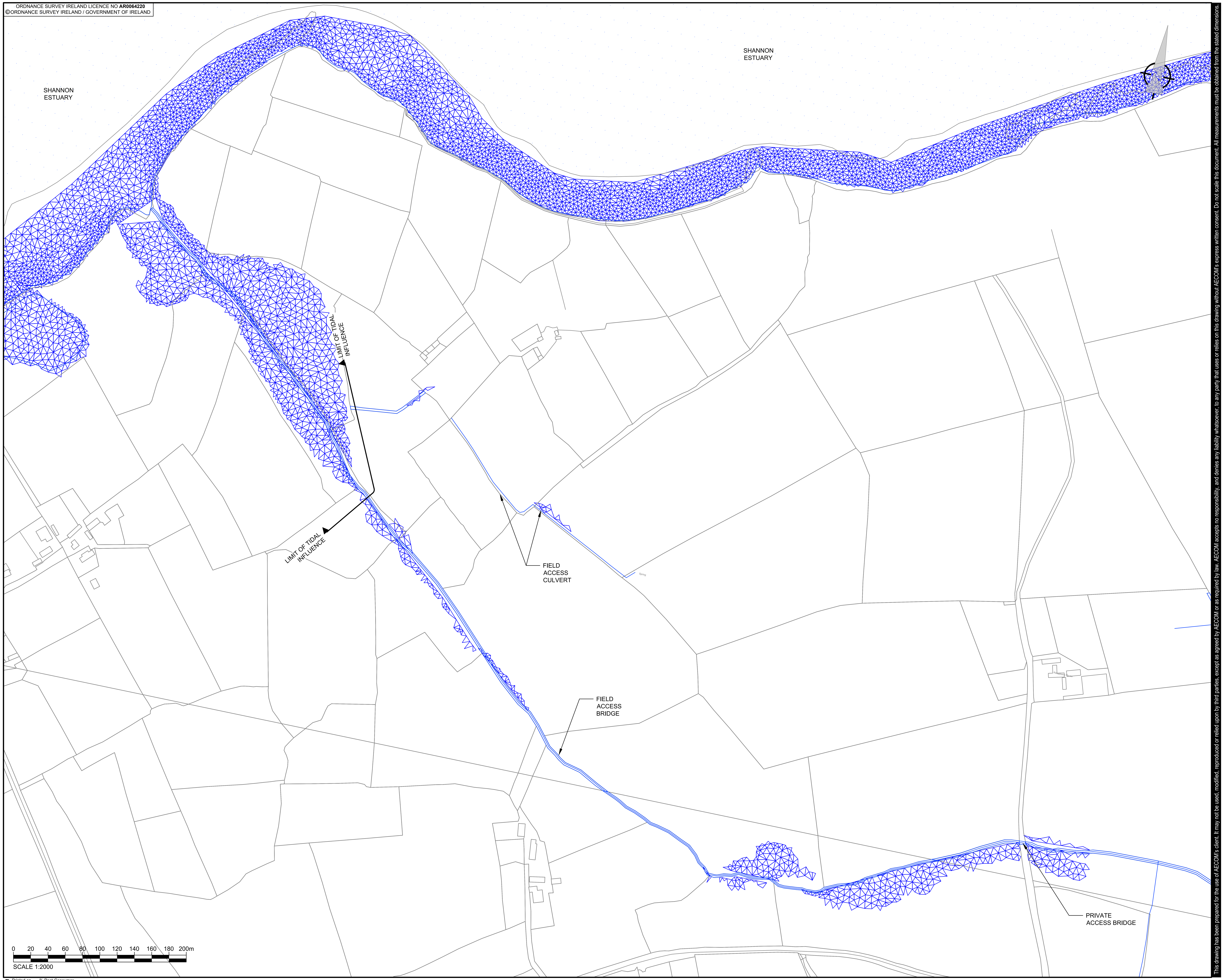

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FLOOD RISK ASSESSMENT
BASELINE FLOOD EXTENTS
1% AEP FLUVIAL PRESENT DAY

SHEET NUMBER

60619377_FRA_SHT_005

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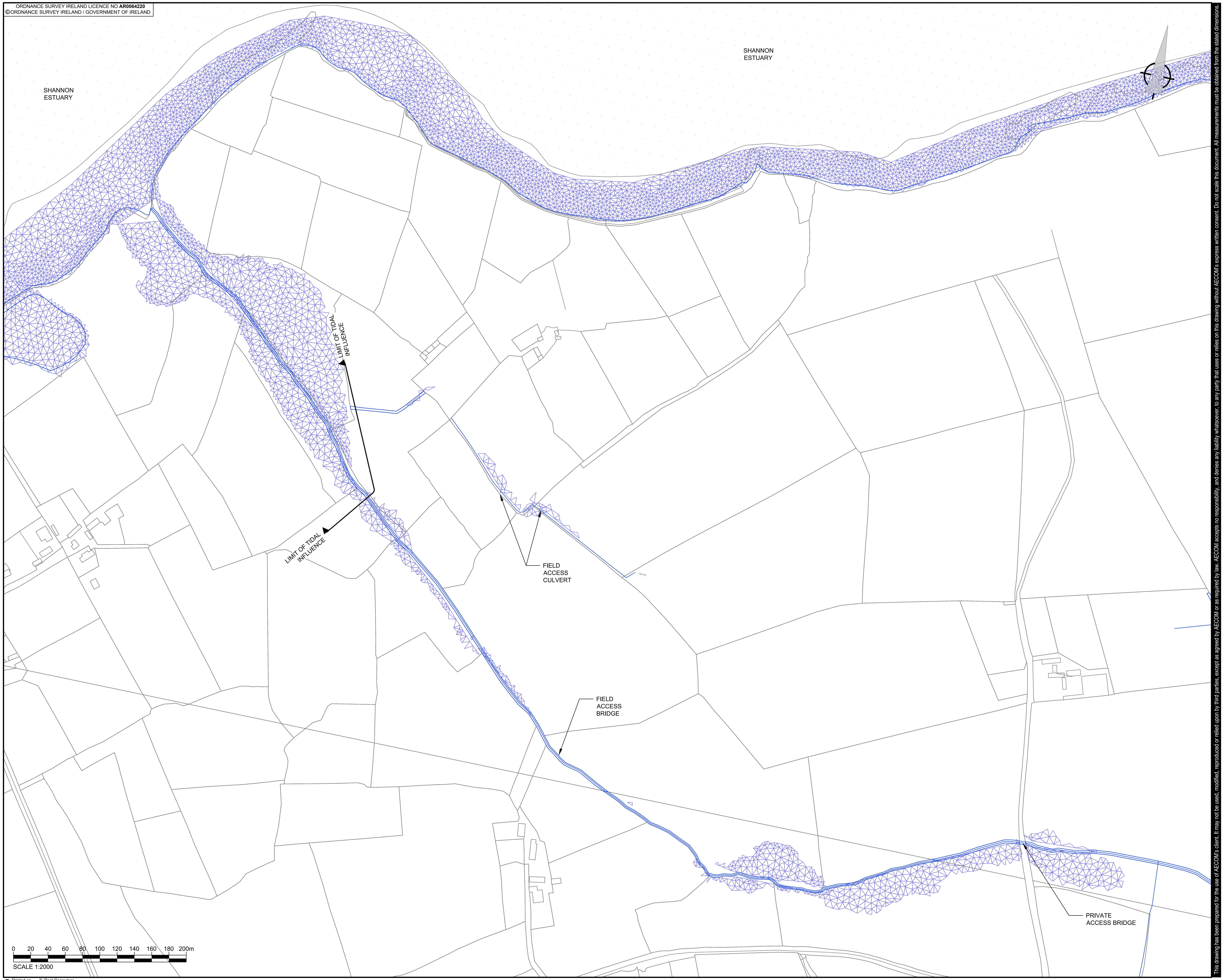

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SHEET TITLE

FLOOD RISK ASSESSMENT
BASELINE FLOOD EXTENTS
0.1% AEP FLUVIAL PRESENT DAY

SHEET NUMBER

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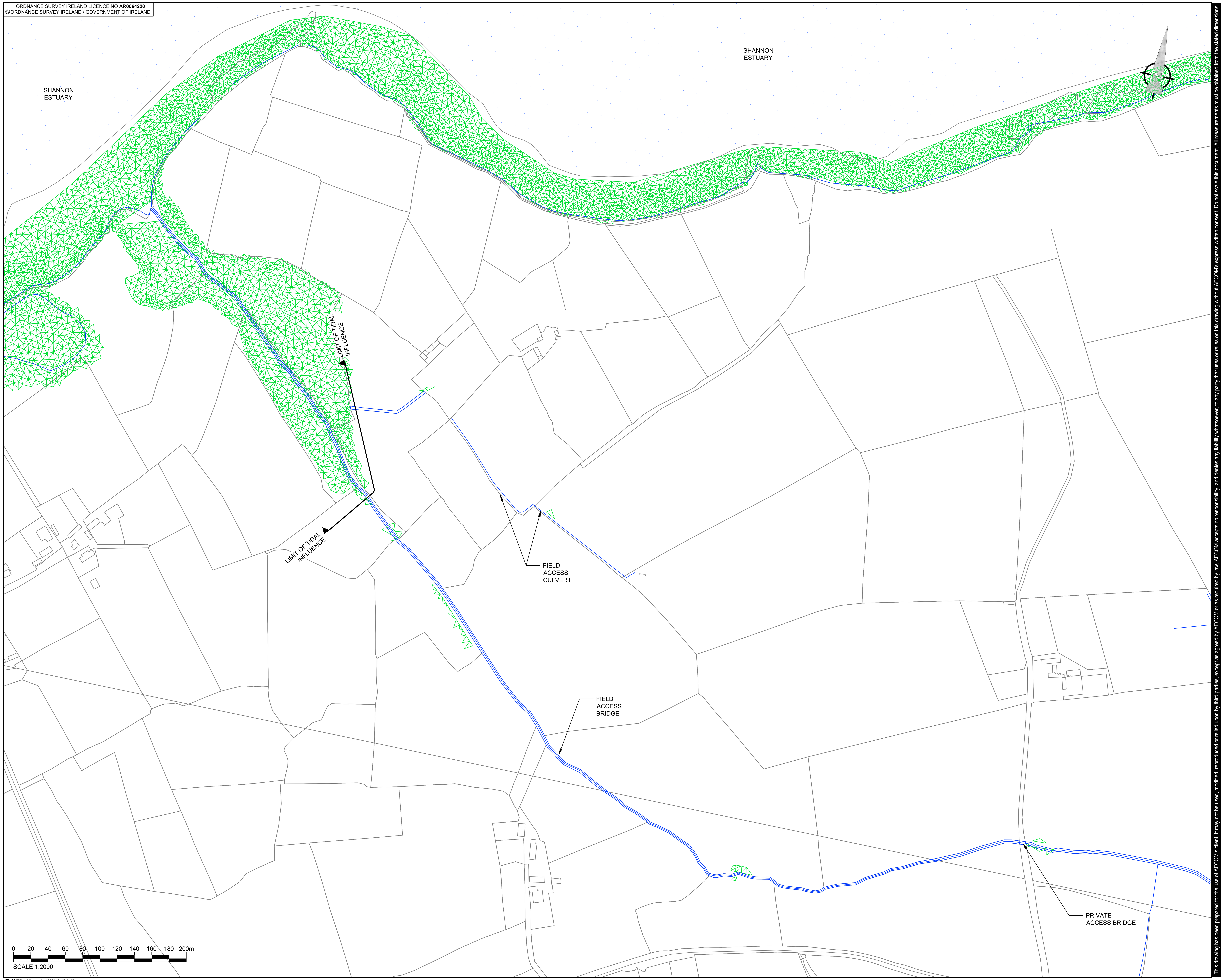

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BASELINE FLOOD EXTENTS
0.5% AEP TIDAL PRESENT DAY

SHEET NUMBER

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BASELINE FLOOD EXTENTS
0.1% AEP TIDAL PRESENT DAY

SHEET NUMBER

60619377_FRA_SHT_008

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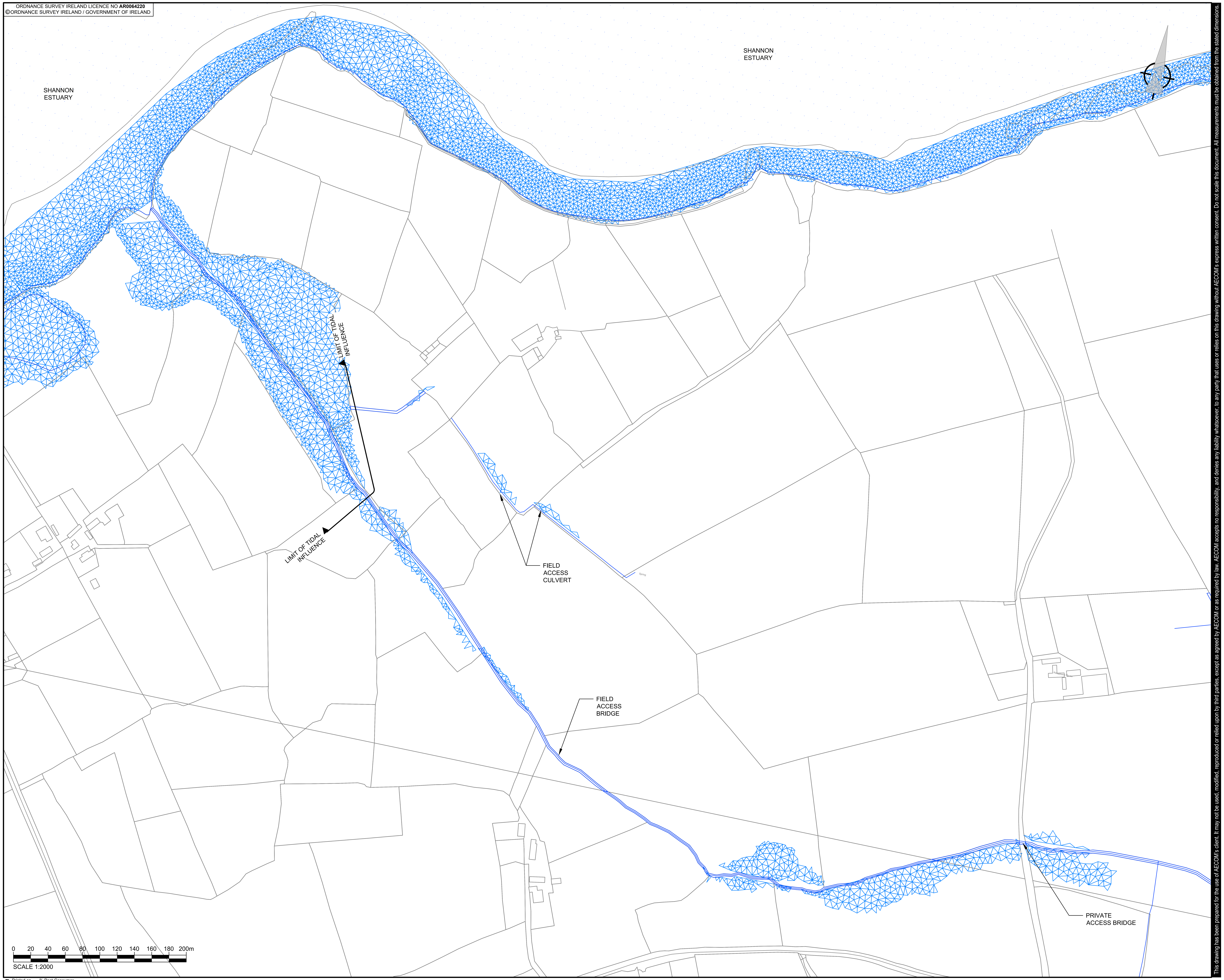

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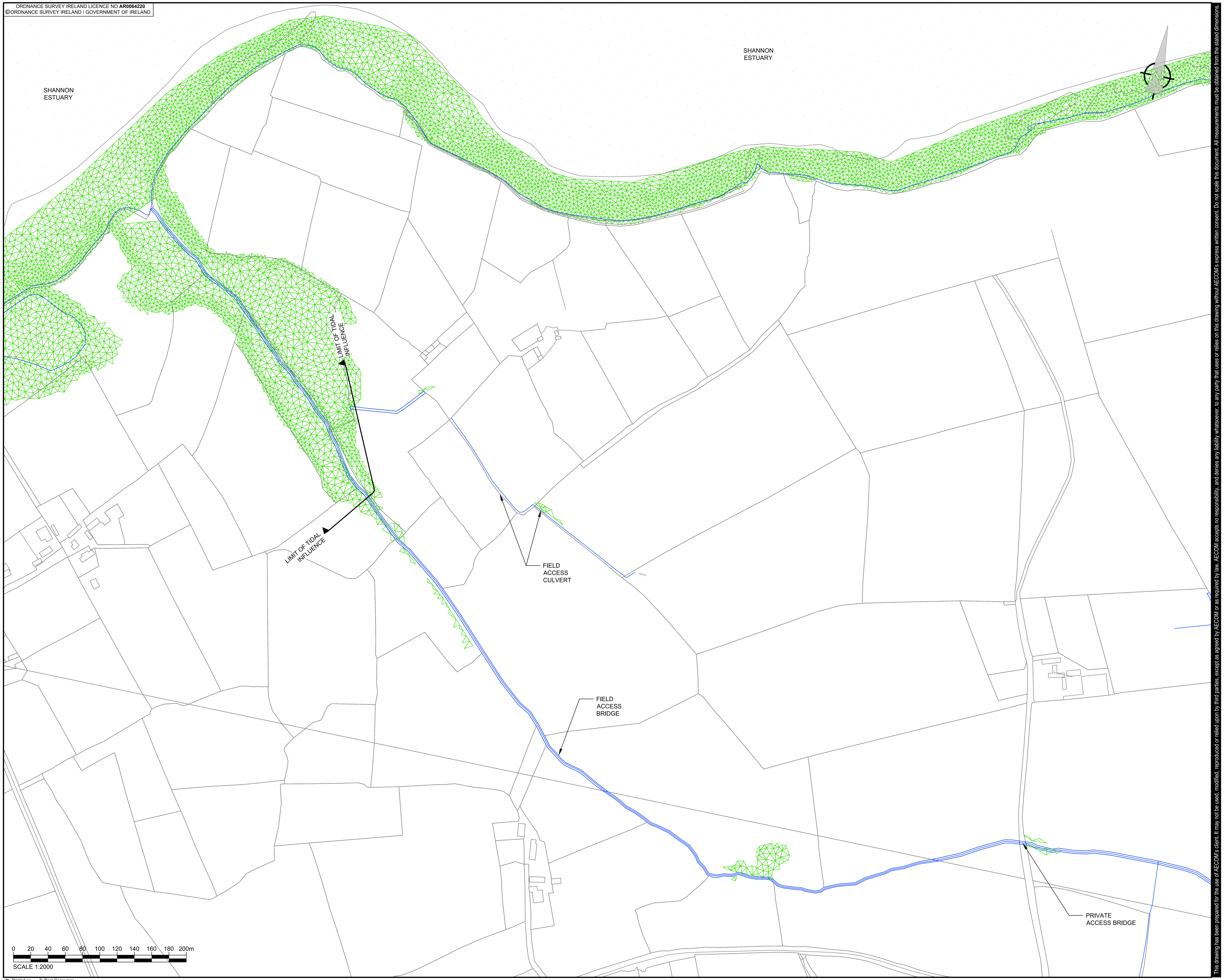

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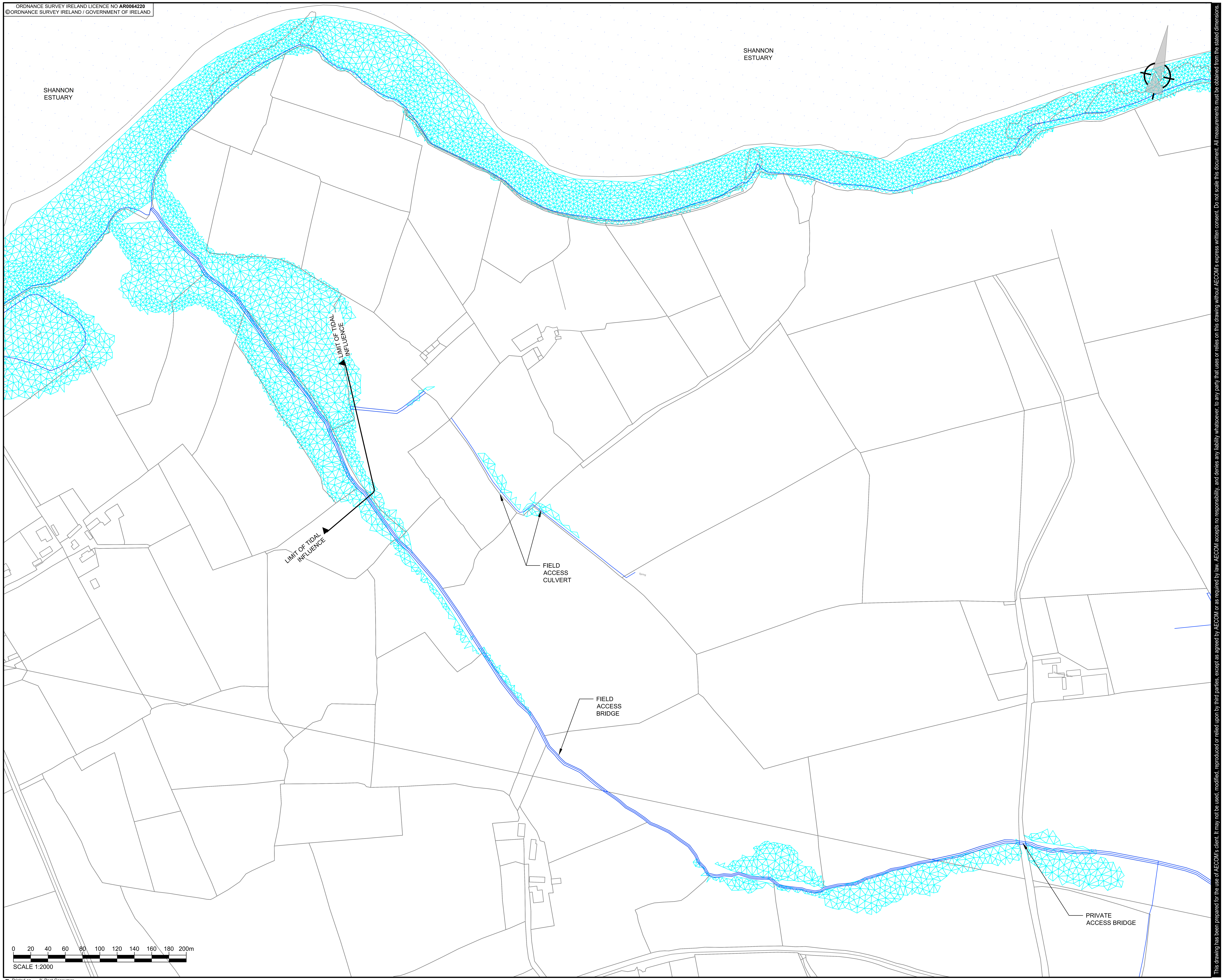

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FLOOD RISK ASSESSMENT
BASELINE FLOOD EXTENTS
1% AEP FLUVIAL HEFS

SHEET NUMBER

60619377_FRA_SHT_015

ISO A1 594mm x 841mm
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FLOOD RISK ASSESSMENT
BASELINE FLOOD EXTENTS
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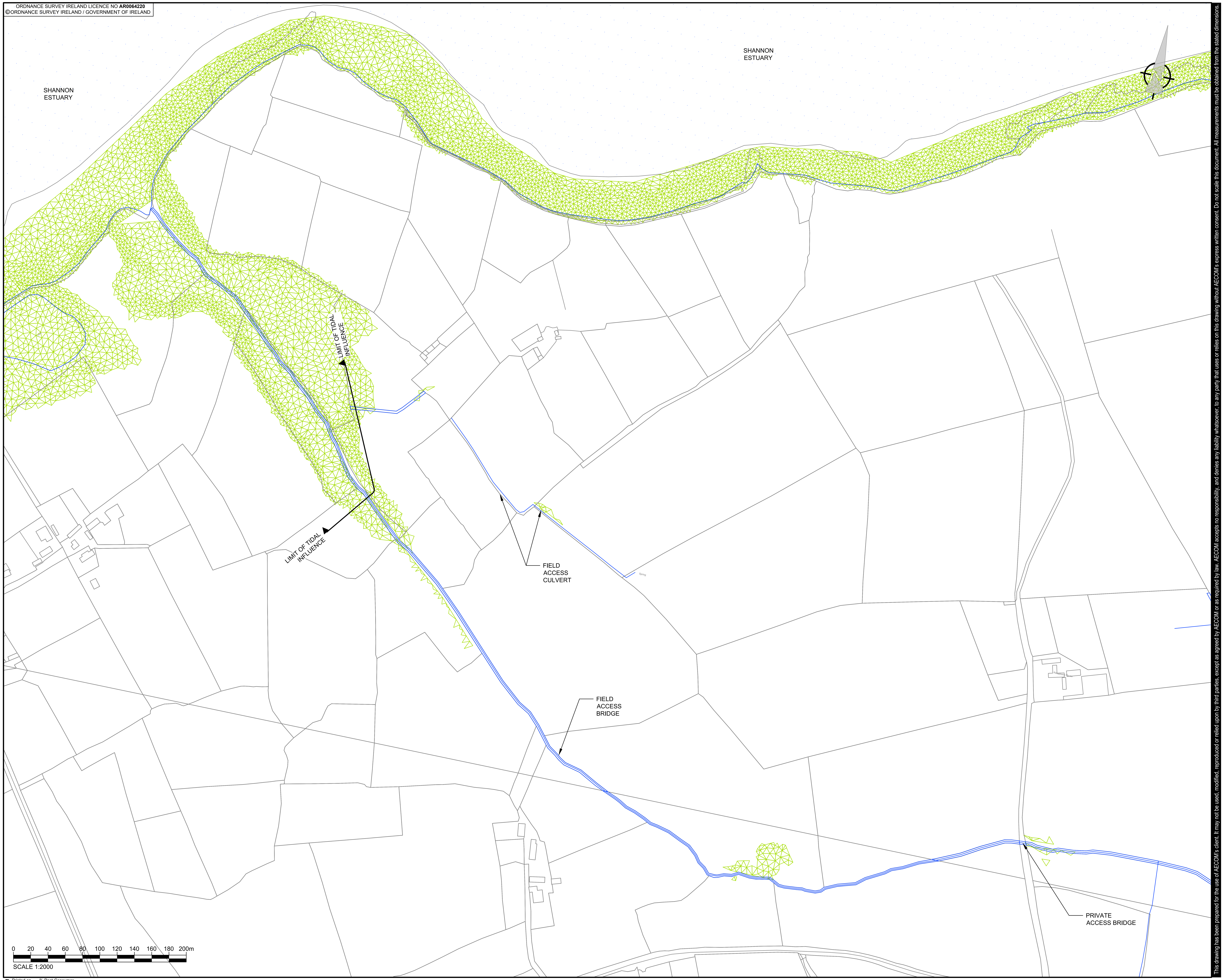

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0.5% AEP TIDAL HEFS

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BASELINE FLOOD EXTENTS
0.1% AEP TIDAL HEFS

SHEET NUMBER

60619377_FRA_SHT_018

Appendix D Model Results

Fluvial Results

Cross Section Reference	1% AEP Present Day (mAOD)	0.1% AEP Present Day (mAOD)	Difference, 1% AEP Present Day (mm)	1% AEP Present Day; Manning's 'n' +20% (mAOD)	Difference, 1% AEP Present Day (mm)	1% AEP MRFS (mAOD)	Difference, 1% AEP Present Day (mm)	0.1% AEP MRFS (mAOD)	Difference, 0.1% AEP Present Day (mm)	1% AEP HEFS (mAOD)	Difference, 1% AEP Present Day (mm)	0.1% AEP HEFS (mAOD)	Difference, 0.1% AEP Present Day (mm)	Comments
SLNG00000	2.826	2.844	18	2.826	0	3.330	504	3.355	511	3.822	996	3.823	979	Tidally Influenced Section
SLNG00010	2.817	2.823	6	2.807	-10	3.335	517	3.352	529	3.840	1023	3.827	1004	
SLNG00040	2.837	2.831	-6	2.830	-6	3.340	503	3.336	505	3.828	992	3.829	997	
SLNG00090	2.824	2.837	13	2.826	2	3.325	501	3.333	496	3.820	995	3.812	975	
SLNG00190	2.839	2.854	15	2.839	0	3.325	486	3.347	492	3.815	976	3.823	969	
SLNG00290	2.847	2.865	17	2.851	3	3.321	474	3.337	472	3.812	965	3.824	959	
SLNG00295	2.849	2.867	18	2.853	4	3.323	473	3.338	470	3.814	965	3.825	958	
SLNG00297	2.849	2.867	18	2.853	4	3.323	473	3.338	470	3.814	965	3.825	958	
SLNG00300	2.860	2.881	20	2.866	6	3.325	464	3.342	462	3.822	961	3.827	946	
SLNG00400	3.545	3.667	122	3.614	68	3.640	95	3.739	72	3.834	289	3.851	184	
SLNG00450	4.091	4.170	80	4.139	49	4.157	66	4.219	49	4.169	78	4.244	74	
SLNG00460	4.201	4.280	78	4.242	40	4.267	65	4.334	54	4.279	78	4.363	84	
SLNG00470	4.330	4.404	74	4.364	34	4.391	62	4.459	55	4.405	75	4.482	78	
SLNG00500	5.104	5.174	70	5.146	42	5.153	49	5.238	63	5.167	63	5.270	96	
SLNG00550	5.499	5.622	123	5.639	141	5.600	101	5.741	119	5.618	119	5.717	95	
SLNG00600	6.115	6.243	127	6.198	83	6.195	79	6.358	115	6.244	128	6.406	163	
SLNG00700	10.201	10.278	77	10.248	47	10.251	50	10.331	53	10.277	76	10.363	85	
SLNG00750	13.304	13.360	56	13.337	33	13.339	35	13.400	40	13.359	55	13.422	62	
SLNG00760	13.566	13.633	67	13.608	42	13.611	44	13.682	49	13.632	66	13.706	73	
SLNG00770.1_DS	13.726	13.808	82	13.729	3	13.777	52	13.863	55	13.806	80	13.893	85	Existing Access Bridge
SLNG00770.1_US	13.877	13.963	86	13.880	3	13.930	54	14.023	60	13.961	84	14.054	91	
SLNG00770	13.906	13.993	86	13.910	3	13.960	54	14.053	60	13.991	84	14.084	91	
SLNG00785	14.075	14.158	83	14.113	38	14.127	52	14.212	54	14.156	81	14.242	84	
SLNG00830	14.489	14.582	93	14.546	57	14.549	60	14.650	68	14.580	91	14.689	107	
SLNG00880	14.934	15.056	122	15.007	73	15.011	77	15.142	86	15.052	118	15.191	135	
SLNG00935	15.291	15.429	137	15.373	82	15.377	86	15.519	90	15.425	134	15.564	135	
SLNG01055	15.606	15.762	156	15.697	91	15.700	94	15.858	96	15.755	148	15.898	136	
SLNG01075	15.828	16.013	185	15.942	115	15.951	123	16.123	111	16.010	182	16.167	155	
SLNG01125	15.932	16.115	184	16.028	96	16.048	116	16.236	121	16.107	175	16.292	176	
SLNG01250	15.977	16.152	175	16.085	108	16.091	114	16.269	117	16.151	174	16.326	174	
SLNG01345	16.244	16.389	145	16.330	86	16.342	98	16.489	101	16.387	143	16.536	148	
SLNG01500	16.400	16.517	117	16.468	67	16.484	84	16.595	78	16.518	118	16.630	113	
SLNG01505	16.395	16.509	114	16.468	73	16.478	83	16.586	76	16.510	115	16.619	110	
SLNG01515.1_DS	16.398	16.513	114	16.470	72	16.481	83	16.589	76	16.513	115	16.623	111	Existing Access Bridge
SLNG01515.1_US	16.460	16.595	135	16.522	62	16.556	96	16.697	102	16.596	136	16.742	146	
SLNG01515	16.469	16.603	135	16.529	60	16.564	96	16.705	101	16.604	136	16.749	146	
SLNG01530	16.533	16.660	127	16.585	52	16.623	89	16.755	95	16.660	127	16.803	143	
SLNG01600	16.570	16.697	127	16.631	60	16.652	82	16.820	123	16.709	139	16.859	162	
SLNG_R1_00000	2.849	2.867	18	2.853	4	3.323	473	3.338	470	3.814	965	3.825	958	Tidally Influenced Section
SLNG_R1_00030	3.379	3.410	31	3.401	21	3.408	28	3.442	32	3.817	438	3.832	422	
SLNG_R1_00060	4.759	4.787	28	4.779	20	4.779	20	4.813	25	4.787	28	4.823	35	
SLNG_R1_00100	5.731	5.770	39	5.757	26	5.757	26	5.803	33	5.770	39	5.819	48	
SLNG_R1_00160	6.332	6.383	51	6.366	35	6.367	35	6.425	43	6.383	51	6.443	61	
SLNG_R1_00220	7.123	7.158	35	7.151	29	7.148	25	7.184	27	7.158	35	7.196	38	
SLNG_R1_00265	7.812	7.820	8	7.839	26	7.819	7	7.824	4	7.820	8	7.825	5	
SLNG_R1_00270	8.427	8.524	97	8.424	-4	8.506	78	8.575	51	8.524	97	8.594	70	
SLNG_R1_00290	8.430	8.523	94	8.428	-2	8.505	76	8.571	48	8.523	94	8.589	66	
SLNG_R1_00311	8.533	8.618	85	8.557	24	8.601	67	8.666	48	8.619	85	8.686	67	
SLNG_R1_00320	9.329	9.378	49	9.328	-2	9.363	33	9.415	36	9.380	51	9.430	52	
SLNG_R1_00370	9.342	9.391	49	9.349	6	9.377	35	9.425	34	9.393	50	9.446	55	
SLNG_R1_00420	9.690	9.738	49	9.723	34	9.725	36	9.770	32	9.739	49	9.787	49	

Tidal Results

Cross Section Reference	0.5% AEP Present Day (mAOD)	0.1% AEP Present Day (mAOD)	Difference, 0.5% AEP Present Day (mm)	0.5% AEP MRFS (mAOD)	Difference, 0.5% AEP Present Day (mm)	0.1% AEP MRFS (mAOD)	Difference, 0.1% AEP Present Day (mm)	0.5% AEP HEFS (mAOD)	Difference, 0.5% AEP Present Day (mm)	0.1% AEP HEFS (mAOD)	Difference, 0.1% AEP Present Day (mm)	Comments
SLNG00000	3.371	3.593	222	3.876	505	4.080	487	4.388	1017	4.586	993	Tidally Influenced Section
SLNG00010	3.397	3.611	215	3.900	504	4.093	482	4.399	1002	4.597	985	
SLNG00040	3.404	3.600	195	3.895	491	4.102	503	4.407	1002	4.604	1004	
SLNG00090	3.375	3.582	207	3.882	508	4.073	491	4.383	1008	4.585	1003	
SLNG00190	3.386	3.586	200	3.880	494	4.081	494	4.381	995	4.590	1004	
SLNG00290	3.376	3.583	207	3.880	504	4.078	495	4.403	1027	4.608	1025	
SLNG00295	3.376	3.576	201	3.884	508	4.084	508	4.391	1016	4.598	1022	
SLNG00297	3.376	3.576	201	3.884	508	4.084	508	4.391	1016	4.598	1022	
SLNG00300	3.377	3.580	203	3.885	508	4.086	506	4.389	1012	4.584	1004	
SLNG00400	3.445	3.594	149	3.883	438	4.085	492	4.382	937	4.583	989	
SLNG00450	3.734	3.751	18	3.930	196	4.092	341	4.386	652	4.581	829	
SLNG00460	3.848	3.853	4	3.983	135	4.113	261	4.389	540	4.583	730	
SLNG00470	4.084	4.086	2	4.124	40	4.150	64	4.346	262	4.561	475	
SLNG00500	4.722	4.724	3	4.783	62	4.785	60	4.823	101	4.824	100	
SLNG00550	5.079	5.080	1	5.125	46	5.126	45	5.153	73	5.155	74	
SLNG00600	5.728	5.728	0	5.776	49	5.776	48	5.801	73	5.801	73	
SLNG00700	10.070	10.070	0	10.097	27	10.097	27	10.109	39	10.110	40	
SLNG00750	13.195	13.195	0	13.215	20	13.215	20	13.225	30	13.226	30	
SLNG00760	13.441	13.441	0	13.467	26	13.467	26	13.478	37	13.478	37	
SLNG00770.1_DS	13.574	13.574	0	13.605	31	13.605	31	13.620	46	13.620	47	Existing Access Bridge
SLNG00770.1_US	13.726	13.726	0	13.756	30	13.756	30	13.770	44	13.771	45	
SLNG00770	13.756	13.756	0	13.785	29	13.785	29	13.800	43	13.800	44	
SLNG00785	13.930	13.930	0	13.959	29	13.959	29	13.972	42	13.973	42	
SLNG00830	14.284	14.284	0	14.330	46	14.330	46	14.351	67	14.351	67	
SLNG00880	14.676	14.676	0	14.731	55	14.731	56	14.753	77	14.753	78	
SLNG00935	15.076	15.076	0	15.122	46	15.122	46	15.143	67	15.144	68	
SLNG01055	15.384	15.384	0	15.428	44	15.428	44	15.446	62	15.447	63	
SLNG01075	15.564	15.564	0	15.617	54	15.618	54	15.641	77	15.641	78	
SLNG01125	15.635	15.635	0	15.695	60	15.695	60	15.722	86	15.723	87	
SLNG01250	15.680	15.680	0	15.743	63	15.743	63	15.768	88	15.769	89	
SLNG01345	15.935	15.935	0	16.008	73	16.008	73	16.040	104	16.041	106	
SLNG01500	16.073	16.072	0	16.156	83	16.157	84	16.193	120	16.195	123	
SLNG01505	16.065	16.065	-1	16.149	84	16.150	85	16.186	120	16.188	124	
SLNG01515.1_DS	16.068	16.067	-1	16.151	84	16.152	85	16.188	120	16.191	124	Existing Access Bridge
SLNG01515.1_US	16.107	16.104	-2	16.191	85	16.193	89	16.231	125	16.236	131	
SLNG01515	16.117	16.115	-3	16.201	84	16.203	89	16.240	123	16.244	130	
SLNG01530	16.177	16.174	-3	16.268	91	16.270	96	16.309	132	16.312	138	
SLNG01600	16.214	16.210	-5	16.307	93	16.308	98	16.348	134	16.348	138	
SLNG_R1_00000	3.376	3.576	201	3.884	508	4.084	508	4.391	1016	4.598	1022	Tidally Influenced Section
SLNG_R1_00030	3.381	3.578	197	3.907	526	4.132	554	4.464	1084	4.667	1090	
SLNG_R1_00060	4.689	4.689	0	4.705	16	4.705	16	4.713	23	4.713	24	
SLNG_R1_00100	5.643	5.643	0	5.662	19	5.662	19	5.671	28	5.671	28	
SLNG_R1_00160	6.210	6.210	0	6.237	27	6.237	27	6.249	39	6.249	39	
SLNG_R1_00220	7.027	7.027	0	7.049	22	7.049	22	7.060	32	7.060	32	
SLNG_R1_00265	7.719	7.719	0	7.738	19	7.738	19	7.747	28	7.747	28	
SLNG_R1_00270	7.870	7.870	0	7.948	78	7.948	78	7.990	120	7.990	120	
SLNG_R1_00290	7.924	7.924	0	7.983	60	7.983	60	8.017	94	8.017	94	
SLNG_R1_00311	8.379	8.379	0	8.399	20	8.399	20	8.408	29	8.408	29	
SLNG_R1_00320	9.063	9.063	0	9.228	165	9.228	165	9.241	178	9.241	178	
SLNG_R1_00370	9.083	9.083	0	9.236	153	9.236	153	9.250	167	9.250	167	
SLNG_R1_00420	9.587	9.587	0	9.606	20	9.606	20	9.615	28	9.615	28	

Fluvial Results

Flow Event	1% Present Day			0.1% Present Day			1% MRFS			0.1% MRFS			1% HEFS			0.1% HEFS			
Cross Section Reference	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Comments
SLNG00000	2.826	2.825	0	2.844	2.829	-15	3.330	3.329	-1	3.355	3.340	-15	3.822	3.814	-8	3.823	3.825	2	
SLNG00010	2.817	2.812	-6	2.823	2.808	-15	3.335	3.327	-8	3.352	3.339	-12	3.840	3.838	-2	3.827	3.827	-1	
SLNG00040	2.837	2.825	-12	2.831	2.824	-7	3.340	3.331	-8	3.336	3.334	-2	3.828	3.840	12	3.829	3.825	-4	
SLNG00090	2.824	2.823	-1	2.837	2.829	-8	3.325	3.329	4	3.333	3.338	4	3.820	3.816	-3	3.812	3.806	-6	
SLNG00190	2.839	2.834	-6	2.854	2.851	-3	3.325	3.328	3	3.347	3.336	-10	3.815	3.812	-4	3.823	3.813	-10	Tidally Influenced Section
SLNG00290	2.847	2.842	-6	2.865	2.867	2	3.321	3.323	2	3.337	3.338	2	3.812	3.812	-1	3.824	3.810	-14	
SLNG00295	2.849	2.844	-6	2.867	2.868	1	3.323	3.323	0	3.338	3.337	0	3.814	3.812	-2	3.825	3.812	-13	
SLNG00297	2.849	2.844	-6	2.867	2.868	1	3.323	3.323	0	3.338	3.337	0	3.814	3.812	-2	3.825	3.812	-13	
SLNG00300	2.860	2.853	-8	2.881	2.883	3	3.325	3.328	3	3.342	3.342	0	3.822	3.818	-4	3.827	3.821	-6	
SLNG00400	3.545	3.560	15	3.667	3.651	-16	3.640	3.611	-29	3.739	3.774	35	3.834	3.836	2	3.851	3.845	-6	
SLNG00450	4.091	4.102	11	4.170	4.170	0	4.157	4.135	-21	4.219	4.256	38	4.169	4.172	3	4.244	4.242	-2	
SLNG00460	4.201	4.212	11	4.280	4.281	1	4.267	4.246	-21	4.334	4.377	43	4.279	4.280	1	4.363	4.361	-3	
SLNG00470	4.330	4.340	10	4.404	4.406	2	4.391	4.366	-25	4.459	4.494	35	4.405	4.410	5	4.482	4.484	1	
SLNG00500	5.104	5.089	-16	5.174	5.173	-1	5.153	5.141	-12	5.238	5.273	35	5.167	5.170	2	5.270	5.270	0	
SLNG00550	5.499	5.517	18	5.622	5.634	12	5.600	5.600	0	5.741	5.805	64	5.618	5.640	22	5.717	5.774	57	
SLNG00600	6.115	6.075	-40	6.243	6.254	11	6.195	6.198	3	6.358	6.417	59	6.244	6.241	-2	6.406	6.428	23	
SLNG00700	10.201	10.201	0	10.278	10.284	6	10.251	10.259	8	10.331	10.344	13	10.277	10.284	7	10.363	10.348	-15	
SLNG00750	13.304	13.304	0	13.360	13.365	5	13.339	13.345	6	13.400	13.409	8	13.359	13.365	6	13.422	13.411	-11	
SLNG00760	13.566	13.566	0	13.633	13.640	6	13.611	13.617	7	13.682	13.692	9	13.632	13.639	7	13.706	13.694	-12	
SLNG00770.1_DS	13.726	13.726	0	13.808	13.815	7	13.777	13.786	9	13.863	13.875	12	13.806	13.814	8	13.893	13.878	-15	Existing Access Bridge
SLNG00770.1_US	13.877	13.877	0	13.963	13.971	8	13.930	13.940	10	14.023	14.035	12	13.961	13.970	9	14.054	14.038	-15	
SLNG00770	13.906	13.907	0	13.993	14.001	8	13.960	13.970	10	14.053	14.065	12	13.991	14.000	9	14.084	14.068	-15	
SLNG00785	14.075	14.075	0	14.158	14.165	7	14.127	14.137	10	14.212	14.224	12	14.156	14.165	8	14.242	14.227	-15	
SLNG00830	14.489	14.493	3	14.582	14.593	11	14.549	14.562	13	14.650	14.669	18	14.580	14.593	12	14.689	14.672	-17	
SLNG00880	14.934	14.943	9	15.056	15.074	18	15.011	15.032	21	15.142	15.181	39	15.052	15.073	21	15.191	15.179	-12	
SLNG00935	15.291	15.304	13	15.429	15.448	20	15.377	15.407	31	15.519	15.546	27	15.425	15.447	22	15.564	15.550	-14	
SLNG01055	15.606	15.624	18	15.762	15.777	15	15.700	15.735	35	15.858	15.874	16	15.755	15.776	21	15.898	15.881	-17	
SLNG01075	15.828	15.853	25	16.013	16.043	30	15.951	15.988	37	16.123	16.144	20	16.010	16.039	29	16.167	16.157	-10	
SLNG01108	N/A	15.983	N/A	N/A	16.204	N/A	N/A	16.140	N/A	N/A	16.308	N/A	N/A	16.199	N/A	N/A	16.319	N/A	
SLNG01125.1_DS	N/A	15.986	N/A	N/A	16.204	N/A	N/A	16.138	N/A	N/A	16.311	N/A	N/A	16.198	N/A	N/A	16.321	N/A	
SLNG01125.1_US	N/A	15.995	N/A	N/A	16.194	N/A	N/A	16.131	N/A	N/A	16.324	N/A	N/A	16.189	N/A	N/A	16.330	N/A	New Access Road
SLNG01125	15.932	15.997	65	16.115	16.193	78	16.048	16.132	84	16.236	16.325	89	16.107	16.190	83	16.292	16.331	39	
SLNG01250	15.977	16.037	61	16.152	16.224	72	16.091	16.168	77	16.269	16.375	106	16.151	16.224	74	16.326	16.370	44	
SLNG01345	16.244	16.285	41	16.389	16.439	50	16.342	16.389	48	16.489	16.561	71	16.387	16.438	51	16.536	16.579	43	
SLNG01500	16.400	16.426	26	16.517	16.547	29	16.484	16.509	25	16.595	16.634	39	16.518	16.547	29	16.630	16.653	23	
SLNG01505	16.395	16.422	27	16.509	16.540	31	16.478	16.503	25	16.586	16.627	41	16.510	16.541	31	16.619	16.644	25	
SLNG01515.1_DS	16.398	16.425	27	16.513	16.543	31	16.481	16.506	24	16.589	16.631	42	16.513	16.543	30	16.623	16.647	24	Existing Access Bridge
SLNG01515.1_US	16.460	16.483	23	16.595	16.620	25	16.556	16.575	19	16.697	16.739	43	16.596	16.621	25	16.742	16.756	14	
SLNG01515	16.469	16.490	22	16.603	16.627	24	16.564	16.583	19	16.705	16.746	41	16.604	16.628	24	16.749	16.763	14	
SLNG01530	16.533	16.549	16	16.660	16.679	19	16.623	16.640	17	16.755	16.792	37	16.660	16.681	21	16.803	16.815	12	
SLNG01600	16.570	16.589	19	16.697	16.719	21	16.652	16.663	11	16.820	16.847	27	16.709	16.720	12	16.859	16.878	20	
SLNG_R1_00000	2.849	2.844	-6	2.867	2.868	1	3.323	3.323	0	3.338	3.337	0	3.814	3.812	-2	3.825	3.812	-13	Tidally Influenced Section
SLNG_R1_00030	3.379	3.379	0	3.410	3.411	1	3.408	3.409	1	3.442	3.444	2	3.817	3.821	4	3.832	3.819	-12	
SLNG_R1_00060	4.759	4.759	0	4.787	4.789	1	4.779	4.779	0	4.813	4.813	0	4.787	4.789	1	4.823	4.823	0	
SLNG_R1_00100	5.731	5.731	0	5.770	5.772	2	5.757	5.758	1	5.803	5.803	0	5.770	5.772	2	5.819	5.819	0	
SLNG_R1_00160	6.332	6.331	0	6.383	6.385	2	6.367	6.367	1	6.425	6.425	0	6.383	6.385	2	6.443	6.444	1	
SLNG_R1_00220	7.123	7.123	0	7.158	7.164	7	7.148	7.151	3	7.184	7.193	9	7.158	7.164	6	7.196	7.206	10	
SLNG_R1_00265	7.812	7.812	0	7.820	7.819	-1	7.819	7.818	-1	7.824	7.823	-1	7.820	7.819	-1	7.825	7.825	0	
SLNG_R1_00270	8.427	8.424	-4	8.524	8.526	1	8.506	8.506	1	8.575	8.573	-2	8.524	8.526	1	8.594	8.591	-3	
SLNG_R1_00290	8.430	8.426	N/A	8.523	9	N/A	8.505	9	N/A	8.571	9	N/A	8.523	9	N/A	8.589	9	N/A	
SLNG_R1_00311	8.533	8.521	-13	8.618	8.604	-14	8.601	8.583	-17	8.666	8.652	-14	8.619	8.604	-15	8.686	8.672	-13	
SLNG_R1_00320	9.329	8.599	-731	9.378	8.666	-713	9.363	8.647	-716	9.415	8.712	-702	9.380	8.665	-715	9.430	8.732	-699	
SLNG_R1_00337	N/A	8.766	N/A	N/A	8.816	N/A	N/A	8.802	N/A	N/A	8.860	N/A	N/A	8.815	N/A	N/A	8.879	N/A	New Access Road
SLNG_R1_00370	9.342	9.136	-206	9.391	9.216	-175	9.377	9.190	-187	9.425	9.282	-144	9.393	9.216	-177	9.446	9.313	-132	
SLNG_R1_00420	9.690	9.688	-2	9.738	9.737	-2	9.725	9.722	-3	9.770	9.768	-2	9.739	9.736	-3	9.787	9.784	-3	

Tidal Results

Flow Event	0.5% Present Day			0.1% Present Day			0.5% MRFS			0.1% MRFS			0.5% HEFS			0.1% HEFS			
Cross Section Reference	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Baseline Scenario (mAOD)	Proposed Scenario (mAOD)	Difference, Baseline vs Proposed (mm)	Comments
SLNG00000	3.371	3.385	14	3.593	3.585	-8	3.876	3.882	6	4.080	4.073	-7	4.388	4.394	6	4.586	4.600	15	Tidally Influenced Section
SLNG00010	3.397	3.392	-5	3.611	3.595	-17	3.900	3.892	-8	4.093	4.104	11	4.399	4.407	8	4.597	4.583	-13	
SLNG00040	3.404	3.406	2	3.600	3.604	4	3.895	3.896	1	4.102	4.072	-30	4.407	4.409	3	4.604	4.599	-5	
SLNG00090	3.375	3.375	1	3.582	3.579	-3	3.882	3.880	-2	4.073	4.070	-3	4.383	4.387	5	4.585	4.593	8	
SLNG00190	3.386	3.385	-1	3.586	3.584	-2	3.880	3.892	13	4.081	4.076	-5	4.381	4.393	12	4.590	4.601	11	
SLNG00290	3.376	3.375	0	3.583	3.579	-4	3.880	3.888	8	4.078	4.077	-1	4.403	4.396	-6	4.608	4.604	-5	
SLNG00295	3.376	3.373	-3	3.576	3.575	-1	3.884	3.886	2	4.084	4.083	-1	4.391	4.390	-1	4.598	4.590	-8	
SLNG00297	3.376	3.373	-3	3.576	3.575	-1	3.884	3.886	2	4.084	4.083	-1	4.391	4.390	-1	4.598	4.590	-8	
SLNG00300	3.377	3.375	-1	3.580	3.580	0	3.885	3.882	-3	4.086	4.082	-4	4.389	4.389	0	4.584	4.591	7	
SLNG00400	3.445	3.423	-22	3.594	3.591	-2	3.883	3.885	1	4.085	4.084	-1	4.382	4.383	2	4.583	4.592	9	
SLNG00450	3.734	3.731	-3	3.751	3.747	-4	3.930	3.933	3	4.092	4.089	-4	4.386	4.380	-6	4.581	4.591	11	
SLNG00460	3.848	3.846	-2	3.853	3.849	-3	3.983	3.986	3	4.113	4.111	-2	4.389	4.383	-5	4.583	4.595	12	
SLNG00470	4.084	4.083	-1	4.086	4.082	-4	4.124	4.120	-4	4.150	4.147	-3	4.346	4.342	-5	4.561	4.577	16	
SLNG00500	4.722	4.719	-2	4.724	4.718	-6	4.783	4.774	-10	4.785	4.776	-8	4.823	4.824	1	4.824	4.829	5	
SLNG00550	5.079	5.076	-3	5.080	5.076	-4	5.125	5.120	-5	5.126	5.121	-5	5.153	5.157	4	5.155	5.158	3	
SLNG00600	5.728	5.724	-4	5.728	5.725	-3	5.776	5.771	-6	5.776	5.771	-5	5.801	5.809	8	5.801	5.809	9	
SLNG00700	10.070	10.068	-2	10.070	10.068	-2	10.097	10.093	-3	10.097	10.093	-3	10.109	10.114	4	10.110	10.114	4	
SLNG00750	13.195	13.194	-1	13.195	13.194	-1	13.215	13.213	-2	13.215	13.213	-2	13.225	13.229	4	13.226	13.229	3	
SLNG00760	13.441	13.439	-2	13.441	13.439	-2	13.467	13.464	-3	13.467	13.464	-3	13.478	13.482	4	13.478	13.482	4	
SLNG00770.1_DS	13.574	13.572	-2	13.574	13.572	-2	13.605	13.601	-4	13.605	13.602	-4	13.620	13.625	6	13.620	13.626	5	Existing Access Bridge
SLNG00770.1_US	13.726	13.724	-2	13.726	13.724	-2	13.756	13.752	-3	13.756	13.752	-4	13.770	13.775	5	13.771	13.775	4	
SLNG00770	13.756	13.754	-2	13.756	13.754	-2	13.785	13.782	-3	13.785	13.782	-3	13.800	13.804	5	13.800	13.804	4	
SLNG00785	13.930	13.928	-2	13.930	13.928	-2	13.959	13.956	-3	13.959	13.956	-3	13.972	13.977	5	13.973	13.977	4	
SLNG00830	14.284	14.283	-1	14.284	14.283	-1	14.330	14.328	-2	14.330	14.328	-2	14.351	14.360	9	14.351	14.360	9	
SLNG00880	14.676	14.679	3	14.676	14.679	3	14.731	14.732	1	14.731	14.732	1	14.753	14.767	14	14.753	14.767	13	
SLNG00935	15.076	15.084	8	15.076	15.084	8	15.122	15.129	7	15.122	15.129	7	15.143	15.161	18	15.144	15.161	17	
SLNG01055	15.384	15.395	11	15.384	15.395	11	15.428	15.437	9	15.428	15.437	9	15.446	15.467	21	15.447	15.467	20	
SLNG01075	15.564	15.579	15	15.564	15.579	15	15.617	15.630	13	15.618	15.630	13	15.641	15.667	26	15.641	15.667	25	
SLNG01108	N/A	15.667	N/A	N/A	15.667	N/A	N/A	15.726	N/A	N/A	15.727	N/A	N/A	15.768	N/A	N/A	15.768	N/A	New Access Road
SLNG01125.1_DS	N/A	15.670	N/A	N/A	15.670	N/A	N/A	15.730	N/A	N/A	15.730	N/A	N/A	15.771	N/A	N/A	15.771	N/A	
SLNG01125.1_US	N/A	15.679	N/A	N/A	15.679	N/A	N/A	15.740	N/A	N/A	15.740	N/A	N/A	15.782	N/A	N/A	15.783	N/A	
SLNG01125	15.635	15.680	44	15.635	15.680	44	15.695	15.741	46	15.695	15.741	46	15.722	15.784	62	15.723	15.784	61	
SLNG01250	15.680	15.721	41	15.680	15.721	40	15.743	15.784	41	15.743	15.784	41	15.768	15.826	57	15.769	15.826	57	
SLNG01345	15.935	15.961	26	15.935	15.961	26	16.008	16.035	27	16.008	16.035	27	16.040	16.073	33	16.041	16.072	31	
SLNG01500	16.073	16.093	21	16.072	16.093	21	16.156	16.178	22	16.157	16.177	21	16.193	16.218	26	16.195	16.218	23	
SLNG01505	16.065	16.087	21	16.065	16.087	22	16.149	16.171	22	16.150	16.171	21	16.186	16.212	27	16.188	16.212	23	
SLNG01515.1_DS	16.068	16.088	21	16.067	16.088	22	16.151	16.173	22	16.152	16.173	21	16.188	16.214	26	16.191	16.214	23	Existing Access Bridge
SLNG01515.1_US	16.107	16.122	15	16.104	16.122	18	16.191	16.209	18	16.193	16.209	15	16.231	16.251	20	16.236	16.252	16	
SLNG01515	16.117	16.131	14	16.115	16.131	16	16.201	16.218	17	16.203	16.217	14	16.240	16.258	18	16.244	16.259	15	
SLNG01530	16.177	16.188	11	16.174	16.188	14	16.268	16.279	11	16.270	16.279	9	16.309	16.320	11	16.312	16.320	8	
SLNG01600	16.214	16.221	7	16.210	16.221	12	16.307	16.315	8	16.308	16.317	9	16.348	16.362	14	16.348	16.368	20	
SLNG_R1_00000	3.376	3.373	-3	3.576	3.575	-1	3.884	3.886	2	4.084	4.083	-1	4.391	4.390	-1	4.598	4.590	-8	Tidally Influenced Section
SLNG_R1_00030	3.381	3.376	-5	3.578	3.578	0	3.907	3.907	0	4.132	4.112	-20	4.464	4.488	24	4.667	4.653	-15	
SLNG_R1_00060	4.689	4.690	1	4.689	4.690	1	4.705	4.705	0	4.705	4.705	0	4.713	4.713	0	4.713	4.714	0	
SLNG_R1_00100	5.643	5.644	1	5.643	5.644	1	5.662	5.662	0	5.662	5.662	0	5.671	5.671	0	5.671	5.671	0	
SLNG_R1_00160	6.210	6.212	2	6.210	6.212	2	6.237	6.237	0	6.237	6.237	0	6.249	6.250	0	6.249	6.250	0	
SLNG_R1_00220	7.027	7.028	1	7.027	7.028	1	7.049	7.050	0	7.049	7.050	0	7.060	7.060	0	7.060	7.060	0	
SLNG_R1_00265	7.719	7.720	1	7.719	7.720	1	7.738	7.738	0	7.738	7.738	0	7.747	7.747	0	7.747	7.747	0	
SLNG_R1_00270	7.870	7.874	4	7.870	7.874	4	7.948	7.948	1	7.948	7.948	1	7.990	7.991	0	7.990	7.991	0	
SLNG_R1_00290	7.924	7.926	N/A	7.924	8	N/A	7.983	8	N/A	7.983	8	N/A	8.017	8	N/A	8.017	8	N/A	
SLNG_R1_00311	8.379	8.380	1	8.379	8.380	1	8.399	8.401	3	8.399	8.401	3	8.408	8.413	5	8.408	8.413	5	
SLNG_R1_00320	9.063	8.481	-582	9.063	8.481	-582	9.228	8.502	-725	9.228	8.502	-725	9.241	8.514	-727	9.241	8.514	-727	
SLNG_R1_00337	N/A	8.654	N/A	N/A	8.654	N/A	N/A	8.680	N/A	N/A	8.680	N/A	N/A	8.692	N/A	N/A	8.692	N/A	New Access Road
SLNG_R1_00370	9.083	8.979	-105	9.083	8.979	-105	9.236	9.011	-225	9.236	9.011	-225	9.250	9.027	-223	9.250	9.027	-223	
SLNG_R1_00420	9.587	9.587	0	9.587	9.587	0	9.606	9.606	0	9.606	9.606	0	9.615	9.615	0	9.615	9.615	0	