Chapter 10

Water (Including Hydrology and Flood Risk)

Contents

10. Water (Including Hydrology & Flood Risk)

10.1. Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) identifies, describes and presents an assessment of the likely significant effects of the proposed Project on the water environment including hydrology, drainage and water environment. The findings of the Flood Risk Assessment are also provided which is provided under separate cover.

The assessment examines the potential impacts during the construction and operational phases of the Proposed Project.

This chapter should be read in conjunction with the following chapters, which present related impacts arising from the proposed Project:

- Chapter 8: Biodiversity
- Chapter 9: Land and Soils
- Chapter 11: Hydrogeology

10.2. Legislation, Policy and Guidance

The key legislation and guidance referenced in the preparation of the EIAR is outlined in Chapter 1 (Sections 1.5, 1.6 and 1.7). Specific to Water (including Hydrology and Flood Risk), the following legislation, guidance and planning framework relevant to the consideration of hydrology has informed the assessment as outlined below.

10.2.1. Legislation

The assessment was undertaken with consideration of the principal legislation as outlined below:

European Union (EU) Legislation

- Directive 2011/92/EU as amended by Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment ("the EIA Directive");
- Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013, amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy;
- Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks; and
- Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration (daughter to 2000/60/EC) (Groundwater Daughter Directive); and
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive).

National Legislation

- The Transport (Railway Infrastructure) Act 2001 (as amended and substituted);
- The European Union (Railway Orders) (Environmental Impact Assessment) (Amendment) Regulations 2021 (S.I. No. 743/2021) which gives further effect to the transposition of the EIA Directive by amending the Transport (Railway Infrastructure) Act 2001;
- European Communities (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014);
- European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011) as amended;
- European Communities Environmental Objectives (Groundwater) Regulations 2009 (S.I. No. 9 of 2010);
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009);
- European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007); and
- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003).

10.2.2. Policy

The assessment has had due regard to relevant policy that include the following:

- Department of Housing, Planning and Local Government (April 2018), The River Basin Management Plan for Ireland (2018-2021) and 3rd cycle in preparation;
- Strategic Flood Risk Assessment (SFRA) Volume 7
- Dublin City Development Plan 2022-2028
- SFRA for South Dublin County Council Development Plan 2022-2028; and
- SFRA of the Kildare County Development Plan 2017-2023 (and draft plan 2023-2029 as available).

10.2.3. Guidance

The assessment had had due regard to relevant guidelines that include the following:

- Transport Infrastructure Ireland (TII) (December 2017), Strategy for Adapting to Climate Change on Ireland's Light Rail and National Road Network;
- Transport Infrastructure Ireland (TII 2008), Guidelines for the crossing of watercourses during the construction of National Road Schemes;
- TII (March 2015), Road Drainage and the Water Environment, DN-DNG-03065;
- TII (March 2015), Drainage Systems for National Roads, DN-DNG-03022;
- Inland Fisheries Ireland (IFI) (2016), Guidelines on protection of fisheries during construction works in and adjacent to waters;

- Department of Environment, Heritage and Local Government (DEHLG) / Office of Public Works (OPW) (2009), The Planning System and Flood Risk Management – Guidelines for Planning Authorities;
- TII (2009), Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Construction Industry Research and Information Association (CIRIA) (2015), The SuDs Manual C753;
- CIRIA C689 Culvert Design and Operation Guide (CIRIA, 2010); and
- CIRIA (2001), Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors (CIRIA C532).

10.3. Methodology

10.3.1. Study Area

To understand the nature of the water regime relevant to the proposed Project, the spatial scope of the study area must be sufficiently large to inform the general environmental setting.

The primary study area includes lands within 250m of the proposed Project as shown in Figure 10-1below. Consideration is also given to the surface waterbodies that are potentially hydrologically linked to the study area, this includes the Royal Canal, the River Liffey and its tributaries. Further description of the hydrological features in the study area is provided in Section 10.4.1.1. The most immediate hydrological features in the vicinity of the proposed Project are also presented in Figure 10-1.

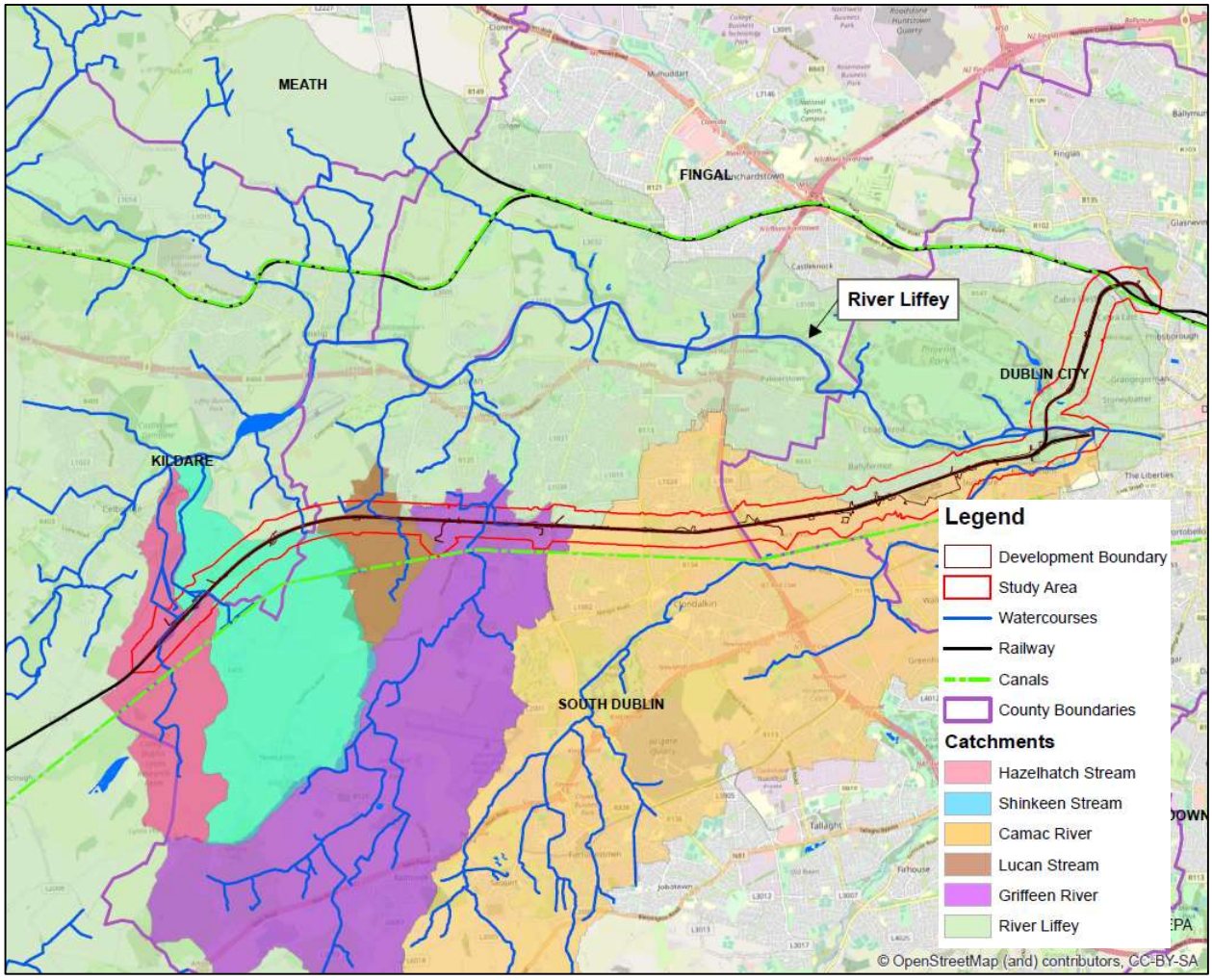


Figure 10-1 Study Area

10.3.2. Survey Methodology

The assessment for this chapter has been undertaken following guidance and criteria outlined in the 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (NRA, 2009) and the 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports' (EPA, 2022). The assessment presents baseline information on the local hydrology and assesses the likely significant effects of the proposed Project on the receiving water environment. Hydrological impacts can be either quantitative in the form of increased flood risk or qualitative in the form of water quality impacts on the receiving environment. The chapter assesses both the flood risk and qualitative impacts of the proposed Project .

The assessment included a review of relevant available hydrological and water quality literature and web-based material. This assessment was also prepared by using information, datasets and models provided by the OPW. The use of the data is subject to the Terms and Conditions agreed with the OPW.

Site specific topographical information, hydrometric information, existing flood mapping, historical mapping and aerial imagery were reviewed to locate any potential features of hydrological interest in order to assess the significance of any likely environmental impacts from the proposed Project. All

relevant watercourses within the study area which could be affected directly or indirectly were assessed by a detailed desk study and hydrological assessment.

Water quality sampling data for the receiving waterbodies was collected from a desktop review of available existing sources (EPA, Local Authority information) to inform the baseline assessment. A Site-Specific Flood Risk Assessment (SSFRA) was prepared for the proposed Project in line with 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' DEHLG/OPW (2009). The SSFRA was carried out to assess the risk of flooding and to inform the design of the proposed Project. The SSFRA details the existing flood risk within the vicinity of the proposed Project. Hydrological flow estimates were generated for key watercourses within the study area and hydraulic models were built to assess their flood risk to the proposed Project .

10.3.2.1. Desk Surveys

Desktop information on existing water bodies, areas with environmental designations and flood risk history was collected through a detailed review of existing studies and datasets as summarised below.

- Online databases of the EPA https://gis.epa.ie/EPAMaps/ and https://catchments.ie for information on:
  - Hydrometric data;
  - Surface watercourses in the area and their respective water quality status;
  - Special Areas of Conservation (SAC) & Special Protected Areas (SPAs);
  - Water Framework Directive (WFD) data; and
  - EPA Water Quality Reports and Water Quality Monitoring Database.
- OPW; www.opw.ie, www.floodinfo.ie and for Flood Studies Update (FSU) Web Portal http://opw.hydronet.com/ for information on:
  - Eastern Catchment Flood Risk Assessment and Management (CFRAM) Study and Further Hazelhatch Study Hydrology and Hydraulics Reports;
  - Eastern CFRAM Study Flood and Further Hazelhatch Study hydraulic models and hydrological flow estimations;
  - Topographical and Bathymetric Survey Data;
  - Predictive flood mapping;
  - CFRAM Predictive Fluvial & Coastal Flood Mapping;
  - National Indicative Fluvial Flood Mapping;
  - Arterial Drainage Schemes, Drainage Districts & Benefitting Areas;
  - FSU Gauged and Ungauged Catchment Physical Catchment Descriptors (PCDs);
  - Irish Coastal Wave and Water Level Modelling Study; and
  - Irish Coastal Protection Strategy Study.
- Met Éireann www.met.ie for historic rainfall and evapotranspiration data;

- CORINE Land Cover 2018 https://land.copernicus.eu/pan-european/corine-land-cover;
- Light Detection and Ranging (LiDAR) surveys https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=b7c4b0e763964070ad69bf8c1572c9f5
- Ordnance Survey Ireland (OSi) aerial photographs and historical mapping https://www.osi.ie/;
- Teagasc Soil Maps http://gis.teagasc.ie/soils/map.php;
- National Parks and Wildlife Services (NPWS) http://webgis.npws.ie/npwsviewer/ for designated sites; and
- Land Use Zoning Maps, Development Plans & SFRAs for:
  - Dublin City https://www.dublincity.ie/residential/planning;
  - South Dublin https://www.sdcc.ie/en/services/planning/; and
  - County Kildare https://kildarecoco.ie/AllServices/Planning/.

10.3.2.2. Field Surveys

Detailed topographical surveys were used to inform the hydraulic assessment of the key watercourses where hydrological impacts were likely to occur. The topographic survey was combined with LiDAR surveys of the wider study area to investigate potential floodplains and wider catchment impacts.

No water quality sampling was carried out. Water quality sampling data for the receiving waterbodies was collected from a desktop review of available existing sources (EPA, Local Authorities) to inform the baseline assessment.

10.3.2.3. Models / Tools Used in Assessment

The assessment was undertaken utilising the following software packages:

- ArcGIS Desktop Version 10.8.1 for spatial analysis, mapping and data preparation for flow estimates and hydraulic model inputs;
- QGIS Version 3.14.0-Pi1 for spatial analysis, mapping and data preparation for flow estimates and hydraulic model inputs;
- Auto CAD 2019 for data preparation for hydraulic model inputs;
- Infoworks ICM Version 10.5 was used to perform One Dimensional Model / Two-Dimensional (1D/2D) Model hydraulic modelling; and
- HEC-RAS Version 6.2 was used to perform 1D/2D Model hydraulic modelling.

10.3.3. Assessment Methodology

10.3.3.1. Key Parameters for Assessment

The following key parameters were examined as those having the potential to result in likely significant hydrological effects on an identified receptor or receptor group:

- Surface Water Quality (WQ);

- Drinking Water Resources (DWR);
- Flood Risk (FR); and
- Sediment Transport (ST).

The key activities that have potential to result in likely significant effects on hydrological regime are outlined below:

Construction Phase

- Accidental emission / release of potentially hazardous substances (principally hydrocarbons), resulting in a short-term localised effect on surface water quality;
- Accidental emissions and release of potentially hazardous substances during construction that may affect the quality of surface waters, most notably associated with cement, concrete materials (high alkalinity run-off), temporary oils and fuel particularly where works are required in or adjacent to watercourses;
- Impacts on surface waters as a result of stormwater run-off causing soil erosion and sedimentation to surface waterbodies;
- Increased suspended sediment levels due to the accidental release of sediment to the water during construction works;
- General water quality impacts associated with potential contaminated run-off works machinery, infrastructure and on-land operations including the temporary storage of construction materials, oils, fuels and chemicals;
- Potential for localised flooding due to disrupting local drainage systems during construction works associated with changes in the elevation of the track related to the electrification works, location of new infrastructure such as substations or extending the footprint of existing infrastructure.
- Potential impacts to the hydromorphology of watercourses where works take place adjacent to water channels, (rivers and streams). Physical damage can impact on the hydromorphology of the watercourse and therefore affect the ecological status;
- Potential hydrological modifications which may alter the current flows, discharges and the location of outfalls; and
- Potential for changes in the natural hydrological regime due to discharges to watercourses arising from track drainage.

Operation Phase

- General water quality impacts associated with potential accidental release from the storage of hydraulic oils, fuels and chemicals, and associated with the operation and maintenance of the mechanical and electrical equipment in substations;
- Potential for impacts on surface waters from accidental release of oils, fuel, chemicals, hydraulic fluids etc. from road service vehicles, trains and maintenance activities; and

- Potential for localised flooding due to additional increase in hardstanding areas, removal of floodplains, additional crossing of watercourses.

10.3.3.2. Assessment Criteria and Significance

The criteria for determining the significance of effects is a two-stage process that involves defining the magnitude of the impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors.

The importance of hydrology attributes (rating criteria) is defined in accordance with the National Roads Authority (NRA) Guidelines (NRA, 2009) which is the most relevant for assessment of river catchments in Ireland. These are listed in Table 10.1. The criteria for rating the impact significance at EIA stage are listed in Table 10.2:

Table 10.1: Rating Criteria for Importance of Hydrology Attributes

Importance/ Sensitivity	Criteria	Typical Examples
Extremely high	Attribute has a high quality or value on an international scale.	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very high	Attribute has a high quality or value on a regional or national scale.	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale.	Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities Railway Services partially suspended due to flooding
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding

Importance/ Sensitivity	Criteria	Typical Examples
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Table 10.2: Rating Criteria for Impact on Hydrology Attributes

Magnitude	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Loss or extensive change to a waterbody or water dependent habitat Increase in predicted peak flood level >100 mm Extensive loss of fishery Calculated risk of serious pollution incident >2% annually Extensive reduction in amenity value
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50 mm Partial loss of fishery Calculated risk of serious pollution incident >1% annually Partial reduction in amenity value
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10 mm Minor loss of fishery Calculated risk of serious pollution incident >0.5% annually Slight reduction in amenity value
Negligible	Results in an impact on attribute but not of sufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level Calculated risk of serious pollution incident <0.5% annually
Minor Beneficial	Results in minor improvement of attribute quality	Reduction in predicted peak flood level >10 mm Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually
Moderate Beneficial	Results in moderate improvement of attribute quality	Reduction in predicted peak flood level >50 mm Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100 mm

The significance of the effect upon Water is determined by correlating the significance of the impact and the importance of the receptor. The method employed for this assessment is presented in Table

10.3. For the purposes of this assessment, any effects with a significance level of slight or less have been concluded to be not significant in terms of the EIA Regulations.

The magnitude of effects is defined in accordance with the criteria provided in the EPA publication Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (2022). Accordingly, the significance of these impacts, which may be positive, neutral or negative/adverse are described in terms of the ratings outlined in Table 10.3.

Table 10.3: Matrix Used for the Rating of Significant Environmental Impact

Importance of Attribute	Magnitude of Potential Impact			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/Moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

A description of the impact assessment criteria is listed in Table 10.4 below.

Table 10.4: Impact Assessment Criteria

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

10.3.4. Consultation

The overall project stakeholder and public consultation undertaken in respect of the Project is set out in the Public Consultation No. 1 Findings Report (for PC1) and Public Consultation No. 2 Findings Report (for PC2) which are included in Volume 4, Appendix 1.3 and 1.4. All feedback was collated, including feedback specific to the EIAR topic 'Water'. This feedback has informed this chapter including the baseline and impact assessment presented.

Specific consultation was also undertaken with key stakeholders in relation to EIA Scoping. A summary of the issues raised in relation to the scope of the EIA is included in Volume 4, Appendix 1.2. Feedback on the scope and level of detail of the assessment, data sources and methodologies as they pertain to the EIAR topic 'Water' have been reviewed and have influenced this chapter of the EIAR.

Specific consultation was also undertaken with representatives of various Departments in Kildare, South Dublin and Dublin City Councils. This included a combination of presentations, workshops and meetings to discuss the project, technical design issues and environment and planning matters.

Nine pre-application meetings were held with ABP to explain the project and present technical and environmental information. A summary of the information presented and the environmental issues discussed at the nine meetings is provided in Volume 4, Appendix 1.6. Feedback relevant to the topic 'Water' has been reviewed and has influenced this chapter of the EIAR.

In addition to this broader consultation, topic specific consultation was also undertaken in the form of formal data requests, meetings and workshops. Those related to 'Water' are listed below in Table 10.5.

Table 10.5: Topic-Specific Consultation Summary regarding Water (Hydrology and Flood Risk)

Consultee	Date	Summary of Consultation
Kildare County Council	August 2021	Outputs from Further Hazelhatch Study including hydraulic models and hydrological flow estimations; Information was provided from KCC and utilised in the SSFRA subject to data usage agreement.
Office of Public Works	July 2021, September 2021 & Jan 2022	Outputs from Eastern CFRAM Study and Further Hazelhatch Study Hydrology and Hydraulics Reports; Outputs from Further Hazelhatch Study including hydraulic models and hydrological flow estimations; Data request for additional data required for local hydraulic models. Information was provided by the OPW and utilised in the SSFRA subject to data usage agreement.
Waterways Ireland	October 2021	Historical flooding and water level information for the Royal Canal. Meeting was held between TTA JV and Waterways Ireland to discuss flooding mechanisms along the Royal Canal and also potential works to the Royal Canal and Luas Twin Arch (OBO8) which traverses under the canal.
Iarnród Éireann	July 2021 to May 2022	A series of communications including emails and workshops (September 2021 & December 2021) with Iarnród Éireann to discuss historical flooding, surface drainage networks and flood risk operational procedures. All available information related to flood risk was provided.

10.3.5. Difficulties Encountered / Limitations

This chapter of the EIAR has been prepared based upon the best available information and in accordance with current best practice and relevant guidelines.

There were no technical difficulties or otherwise encountered in the preparation of this chapter of the EIAR.

Most of the information used in preparing this assessment was obtained from existing available information, online resources and desktop study recommended in the relevant standards and guidelines listed in Section 10.2.3. Topographic surveys from the CFRAM models were completed in 2011 or earlier and while there have been changes to land use and significant development in the parts of the wider catchment areas for the watercourses, a review of the hydraulic model extents used for

the Flood Risk Assessment (FRA) did not show any significant changes to the watercourses or floodplains that would not have been surveyed previously.

10.4. Receiving Environment

10.4.1. Current Baseline

The proposed Project has been divided into four distinct geographic zones along the length of the corridor (Zones A to D) as outlined in Chapter 4 Project Description and summarised below. The proposed Project is described from west to east along the railway corridor.

- Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station (refer to Section 4.6);
- Zone B - Park West & Cherry Orchard Station to Heuston Station (incorporating Inchicore Works) (refer to Section 4.7);
- Zone C – Heuston Yard & Station (incorporating New Heuston West Station) (refer to Section 4.8);
- Zone D - Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line) (refer to Section 4.9).

In terms of the hydrological assessment for the proposed Project , a breakdown of the receiving environment by project zone has not been carried out. The baseline environment described in this section includes hydrological features in the region surrounding the study area, with reference to the project zones where relevant.

10.4.1.1. River Catchments

The proposed Project is located within the lower reaches of the River Liffey catchment Hydrometric Area (HA) 09, as shown in Figure 10-1, and traverses the following sub catchments, namely from west to the east of the railway route:

- Hazelhatch Stream;
- Shinkeen Stream;
- Coneyburrow Stream;
- Lucan Stream;
- Griffeen River;
- Blackditch Stream; and
- River Camac, which is culverted beneath Heuston Station.

The River Liffey catchment drains a catchment of approximately 1340.5 km² from the Wicklow & Dublin Mountains discharging into the Irish Sea. Overall, the most significant pressures in the catchment are (from 3rd Cycle Draft Liffey and Dublin Bay Catchment Report, EPA, August 2021):

- Excess nutrients, mainly phosphates, are major issues in rural areas of the catchment primarily in the Ryewater catchment;

- Diffuse urban pressures in the developed areas of Dublin City where nutrient and organic pollution can occur due to industrial activity, stormwater runoff and overflows;
- Urban waste water combined sewer overflows;
- Changes in hydromorphological conditions leading to channel modification or flood relief works;
- Organic pollution associated with farmyard runoff and wastewater discharges.

Table 10.6 below details the Physical Catchment Descriptors (PCDs) for the watercourses upstream of the hydraulic model boundaries assessed in the SSFRA. For some of the watercourses the PCDs for the entire catchment may differ compared to what is presented in Table 10.6. The 50% Annual Exceedance Probability (AEP) (or 1 in 2 year) flow estimated for each catchment is also shown in Table 10.6. The table does not include PCDs for the Coneyburrow and Blackditch Streams. The flood risk from these streams was deemed to be very low and hence they were not examined in detail in the SSFRA.

Table 10.6: Catchment Characteristics of the River Liffey and its Tributaries Examined for this Assessment

Physical Catchment Descriptors	Hazelhatch Stream	Shinkeen Stream*	Lucan Stream	Griffeen River	River Camac	River Liffey
Area* (km^2):	6.77	12.661	3.067	27.476	60.681	1149.835
Standard Average Annual Rainfall (SAAR) (mm):	731.17	731.16	726.12	759.67	774.54	804.48
Flood Attenuation from Reservoirs and Lakes (FARL):	1	1	0.998	1	0.998	0.982
Baseflow Index of Soils (BFISOIL):	0.59	0.69	0.6243	0.6387	0.581	0.568
Drainage Density (DRAIND) km per km^2:	1.33	0.972	1.227	1.059	0.959	0.912
Channel Flood Slope S1085 (m/km):	4.55	9.67	5.379	10.392	11.384	1.822
Arterial Drainage Factor (ARTDRAIN2):	0.5463	0.8715	0	0	0	0.035
URBEXT (Urban Extent):	0.054	0.09	0.15	0.333	0.61	0.084
Qmed (m^3/s)	1.604	5.134	0.678	6.502	21.185	113.185

* Includes overflows from the Cornerpark Stream in the River Griffen catchment that occur during flooding events (see HA09 Hydraulics Report, Baldonnel Chapter, available on the www.floodinfo.ie website).

10.4.1.2. Royal Canal

The salient hydrological feature for the study area between Heuston Station and Glasnevin Junction is the Royal Canal (Zone D). The Royal Canal links the River Liffey in Dublin to the River Shannon in Longford. It is 145 kilometres in length and has an 8 kilometre branch line into Longford Town. The canal winds its way through the North Dublin suburbs, the green pastures of Kildare, Meath and Westmeath, through the town of Mullingar and on through Co. Longford and down into Richmond Harbour in the village of Clondra. Rising out of Dublin through a series of 26 locks it reaches the summit level (a height of about 94 m above sea level) near Mullingar and then descends a further 20 locks to its destination in Richmond Harbour. Lough Owel in Co. Westmeath is the main water supply for the canal.

The canal is an artificial waterbody. The canals risk status is currently under review (3rd WFD cycle) but for all monitoring periods up to the present (1st and 2nd WFD cycle) this section of the canal has achieved “Good Ecological Potential”. Figure 10-2 illustrates the location of the Royal Canal crossing over the proposed Project.

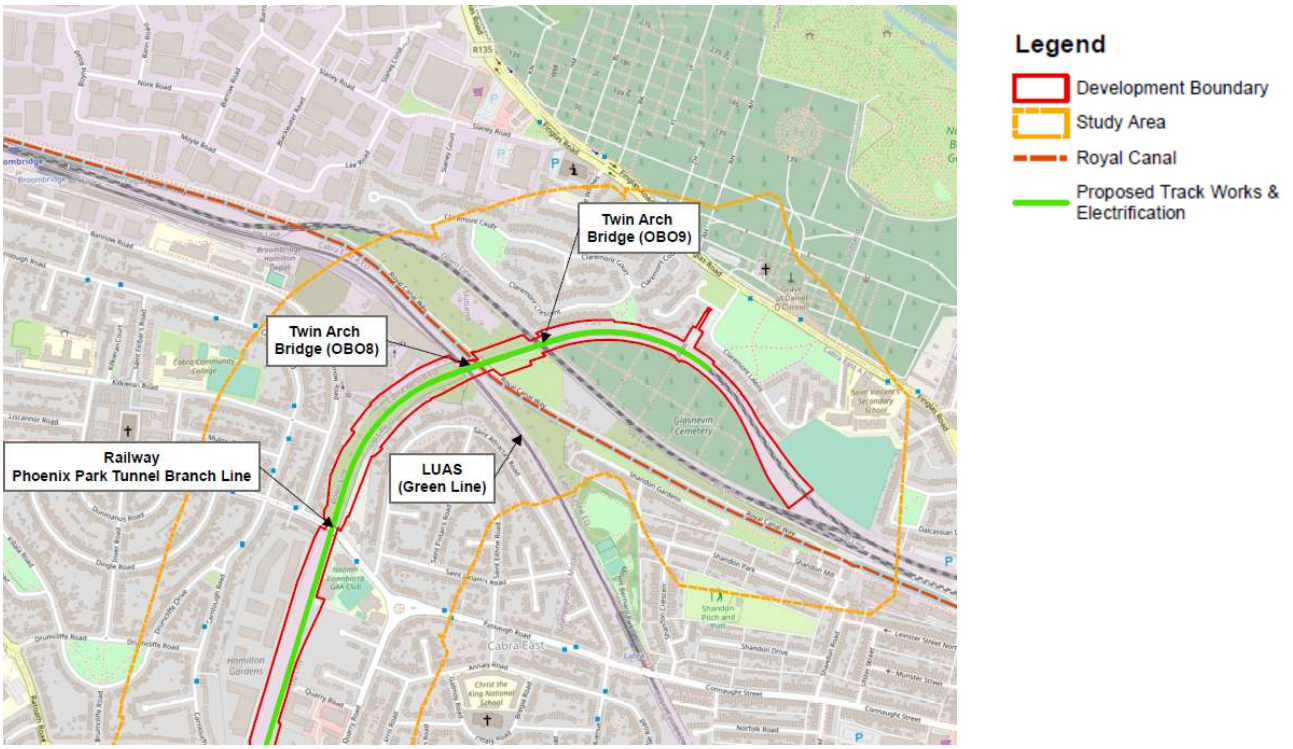


Figure 10-2 Location of Royal Canal (Zone D) Adjacent to the Study Area

10.4.1.3. Flood Risk Identification

A SSFRA has been prepared for the proposed Project and is provided under separate cover. The SSFRA was prepared in accordance with the DEHLG / OPW (2009), The Planning System and Flood Risk Management – Guidelines for Planning Authorities. Key areas with potentially elevated level of flood risk have been identified. These are discussed in the following sections:

- Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station;

- Zone B - Park West & Cherry Orchard Station to Heuston Station (incorporating Inchicore Works);
- Zone C - Heuston Yard and Station (incorporating New Heuston West Station); and
- Zone D - Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line).

10.4.1.3.1. Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

Records of historical flooding and flood extent mapping generated for the study area (Eastern CFRAM HA 09 Study along with the Hazelhatch Further Study[1]) indicate that Zone A of the proposed Project is potentially at risk from fluvial flooding. In the vicinity of Hazelhatch & Celbridge Station, flooding to the proposed Project is predicted to occur from the Hazelhatch and Shinkeen Streams, which locates the proposed Project in the 1% and the 0.1% AEP events, with and without an allowance for climate change. In Zone A near Adamstown station, flooding to the proposed Project is predicted to occur from the River Griffeen in the 0.1% AEP event inclusive of an allowance for climate change.

1D/2D combined hydraulic models were built to assess the existing and proposed flood risk to the railway in Zone A at Hazelhatch Co. Kildare and Adamstown Co. Dublin. The primary rivers in the Hazelhatch area are the Shinkeen and Hazelhatch, while in Adamstown they are the Lucan and Griffeen. The design flood flows were estimated using the FSU and Institute of Hydrology (IH) recommended flood estimation methodologies. The models were calibrated against the results from the relevant Eastern CFRAM Study flood extent mapping. The modelling for the SSFRA agreed with the previous studies.

The analysis of the existing scenario found that the railway at Hazelhatch is at risk of flooding from both the 1% AEP and 0.1% AEP flooding events as shown in Figure 10-3 (Refer to drawing DP-04-23-DWG-EV-TTA-23785 of Volume 3A of this EIAR), while the Adamstown area is not at risk. However, the railway is at risk at Adamstown during the 0.1% AEP High End Future Scenario (HEFS) climate change scenario, as shown in Figure 10-4 (Refer to drawing DP-04-23-DWG-EV-TTA-23786-v01-S3 of Volume 3A of this EIAR). The proposed compound and substation at Hazelhatch are also at risk of flooding from the 1% AEP and 0.1% AEP flooding events. To mitigate against flooding along the railway, mitigation measures were considered and modelled. The potential measures included additional culverts at Hazelhatch while at Adamstown options included a flood embankment or upsizing a culvert.

Hydraulic modelling of possible mitigation measures to remove or reduce flooding at the Hazelhatch & Celbridge Station would increase flood risk to the surrounding area. Therefore, the SSFRA recommended that no mitigation measures are included with this application for a Railway Order (RO) and that Iarnród Éireann (IÉ) engage with the OPW who are currently progressing a flood relief scheme for the wider Hazelhatch area. This scheme could reduce flooding to the railway station and its infrastructure. The upgrading of infrastructure at Hazelhatch to facilitate the electrification will not increase flood risk to the surrounding area as the proposed ground levels will be maintained at the current levels to ensure that displacement of floodwaters does not occur and cause a residual risk to the surrounding areas.

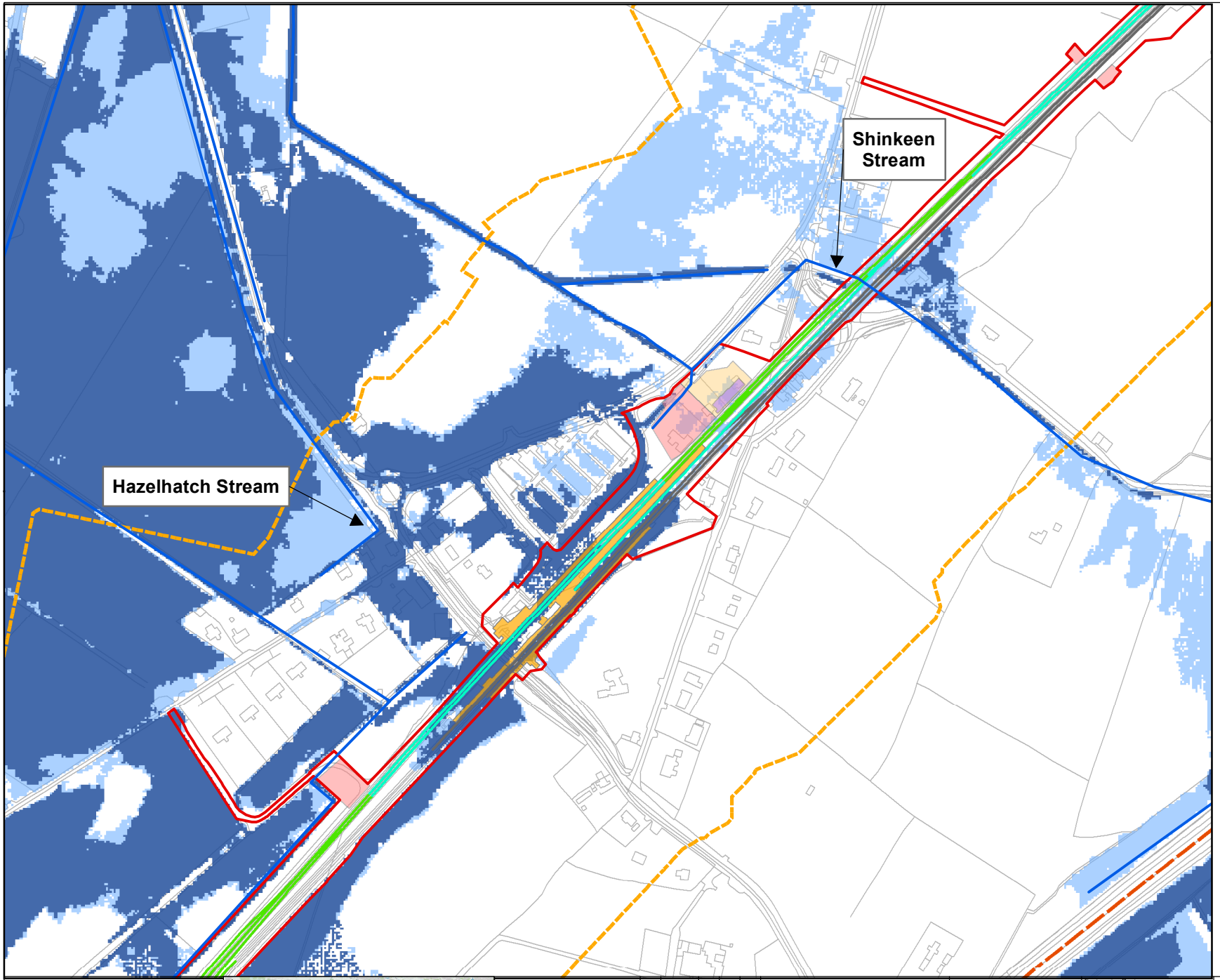
[1] Kildare County Council appointed RPS, to undertake the Strategic Flood Risk Assessment for the Hazelhatch area (Hazelhatch Further Study) with technical support provided by the OPW.

It is recommended that Iarnród Éireann should update their operational procedures, as listed in Section 10.6.2, which would ensure that Hazelhatch is not utilised during an extreme flooding situation. The EMU rolling stock would be able to access part of the station during a flood as the flooding depths are within the operational flood depth limits for an EMU however there would be no safe access or egress from the station itself during an extreme flooding event.

Hydraulic modelling of mitigation measures included at Adamstown showed that they remove flooding from the railway track. However, depending on the solution employed, it increases (flood embankment) or reduces (culvert upgrade) flooding depths and extents upstream of the railway line. There are no increases for either mitigation measure downstream of the railway.

Having considered the hydraulic analysis of the existing scenario for the HEFS 0.1% AEP event, which identified the approximate depth of flood water on the track as 120mm for an approximate duration of 12 hours, the EMU (the rolling stock of primary concern) is within the recommended operating limits passing over flooded track as outlined within Iarnród Éireann's operating procedure.

The risk and probability of the HEFS 0.1% AEP occurring is low and the railway is not at risk during the 1% AEP event. TTA have presented the analysis of the modelling to Iarnród Éireann and Iarnród Éireann has determined that hard mitigation measures are not warranted at this time. Risk reduction associated with the HEFS 0.1% AEP could be achieved in the future by implementation of the proposed mitigation measures by Iarnród Éireann, if warranted.



Legend

- Development Boundary
- Study Area
- Watercourses
- Royal Canal
- Flood Zone A
- Flood Zone B
- Existing Track to be Retained
- Proposed Railway Electrification
- Proposed Track Works & Electrification
- Proposed Parapet Modifications
- Proposed Temporary Compound
- Proposed Permanent Compounds
- Proposed Electrical Substation
- Existing Railway Station

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DART+ South West

NTA | Project Ireland 2040

Rev	Date	Drn	Ch'k'd	App'd	Description
v02	11/11/2022	NR	UM	CR	Water (Including Hydrology & Flood Risk)
v01	08/09/2022	NR	UM	CR	Water (Including Hydrology & Flood Risk)

Client: Iarnród Éireann Irish Rail

Engineering Designer: ITYPSA | ATKINS | TYC RAIL — Supported by: rps

Date	Scale	Drawn	Checked	Approved
11/11/2022	1:5,500 @ A4	NR	UM	CR

Project Code	Issuer	QMS Code
5195886	TTA	

Project Title: DART + SOUTH WEST

Drawing Title: **Figure 10-3: Flood Zones in Hazelhatch**

Drawing File Name	Version	Status
DP-04-23-DWG-EV-TTA-23785	v02	S3

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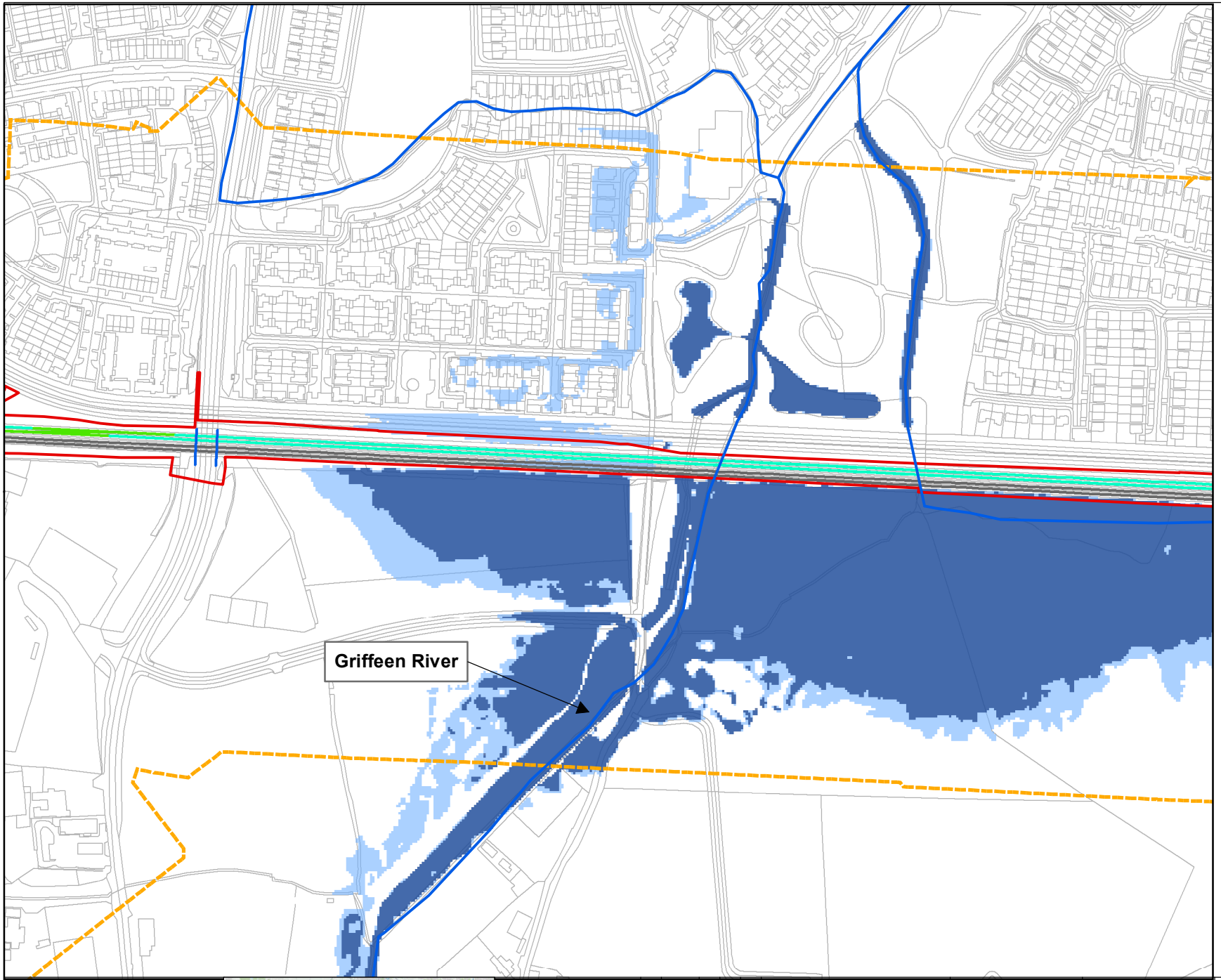

Legend

- Development Boundary
- Study Area
- Watercourses
- 1% AEP HEFS
- 0.1% AEP HEFS
- Existing Track to be Retained
- Proposed Railway Electrification
- Proposed Track Works & Electrification
- Proposed Parapet Modifications

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DART+ South West

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Rev	Date	Drn	Ch'k'd	App'd	Description
v02	11/11/2022	NR	UM	CR	Water (Including Hydrology & Flood Risk)
v01	08/09/2022	NR	UM	CR	Water (Including Hydrology & Flood Risk)

Client: Iarnród Éireann Irish Rail

Engineering Designer: ITYPSA | ATKINS | TYC RAIL — Supported by: rps

Date: 11/11/2022 | Scale: 1:4,500 @ A4 | Drawn: NR | Checked: UM | Approved: CR

Project Code: 5195886 | Issuer: TTA | QMS Code:

Project Title: DART + SOUTH WEST

Drawing Title: **Figure 10-4: HEFS Flood Extents in Adamstown**

Drawing File Name: DP-04-23-DWG-EV-TTA-23786 | Version: v02 | Status: S3

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10.4.1.3.2. Zone B - Park West & Cherry Orchard Station to Heuston Station (Incorporating Inchicore Works)

Records of historical flooding along with flood extent mapping generated for the study area, through the Interreg IVB flood risk management good practice project known as the 'FloodResilienCity' indicate that the proposed Project in Zone B is potentially at risk from pluvial flooding.

An assessment of the existing surface water regime was undertaken to assess any risk of pluvial flooding to the Project. A new surface drainage system for the railway track is proposed for Zone B in order to meet the increased runoff volumes generated by the new four-tracking layout, as well as the attenuation requirements needed to comply with the allowable discharge rates.

The new drainage system is based on three independent drainage networks (Network 1, Network 2 and Network 3, shown in Figure 10-5) with three outfall locations and there are existing open areas along the track that are suitable for locating the required attenuation structures.

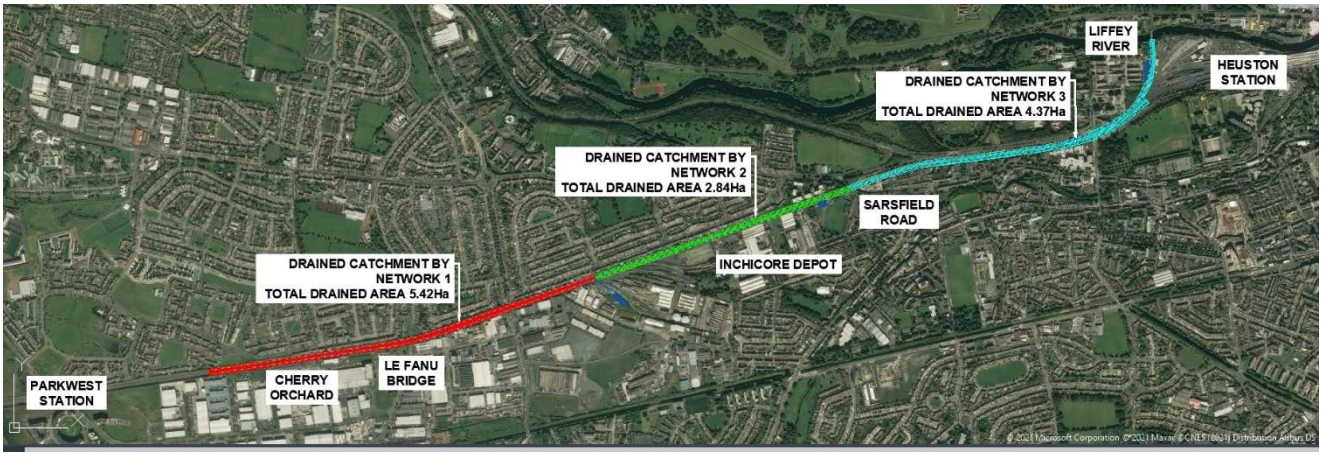


Figure 10-5 Proposed Network Delimitation

The proposed drainage network consists of two main branches running parallel to the track with filter drains above carrier pipes. Runoff water percolates through the ballast up to the low points of the ballast layer where the filter drains are placed. Water is then collected by the perforated drains and discharged into the carrier pipes that convey runoff flows through the drainage network. The collected runoff is attenuated in the attenuation ponds before discharging to outfalls (existing storm sewers or surface watercourses). The attenuation systems have been designed to retain storm water volumes up to 1 in 100-year return period plus 30% climate change allowance. Table 10.7 below provides a summary of the proposed drainage systems for Zone B. The below mentioned drainage systems will be adequate to avoid any pluvial flooding on the railway track in Zone B.

Table 10.7: Summary of the Proposed Drainage Systems for Zone B

	Network 1 Cherry Orchard to Inchicore Works (Ch. 11+740 to Ch. 13+500)	Network 2 Inchicore Depot to Sarsfield Road (Ch. 11+740 to Ch. 10+600)	Network 3 Sarsfield Road Underbridge to Heuston Station (Ch. 10+600 to Ch. 8+900)
System description	Network 1 drains the track length from Cherry Orchard up to Inchicore Depot and conveys collected runoff waters up to a proposed attenuation tank (Ch. 11+740) located west of Inchicore Depot by pumping. A new pumping system is proposed downstream of the attenuation tank to pump surface water flows up to the discharge level and into the existing SW sewer. The proposed pump rate to comply with Dublin City Council (DCC) requirements and is set at a maximum flow of 14.3 l/s.	Network 2 drains the track section from Inchicore Depot up to Sarsfield Road Underbridge (Ch.10+650). The proposed attenuation tank is located east of Inchicore Depot at Ch. 10+650. The discharge point for Network 2 is at the existing storm water sewer (Ch. 10+550) that crosses the track south to north at Sarsfield Road.	The third network drains the new track arrangement from Sarsfield Road Underbridge to Heuston West by following the vertical profile of proposed track. The drainage network downstream of the attenuation tank will discharge by gravity to the outfall location at the Liffey (Ch. 8+900) (next to Heuston West Station) and will include a flow control unit to restrict outgoing flows to the agreed rate.
Drainage Area (m^2)	52,180	27,705	44,623
Attenuation pond Volume (m^3)	4172.16	1780.8	3222.4
Outfall Invert Level (mOD)	The invert level of the attenuation tank is approximately 31.9mOD and the invert level of the existing sewer at the proposed connection point of 33.8mOD. In order to save this level difference a storm water pumping station is required.	21.579mOD	3.528mOD (1% AEP Flood level in River Liffey)

10.4.1.3.3. Zone C - Heuston Yard and Station (Incorporating New Heuston West Station)

Records of historical flooding and flood extent mapping generated for the study area (Eastern CFRAM HA 09 Study) indicate that Zone C of the proposed Project is potentially at risk from fluvial flooding. In Zone C near Heuston station, flooding to the proposed Project is predicted to occur from the River Camac for the 0.1% AEP event.

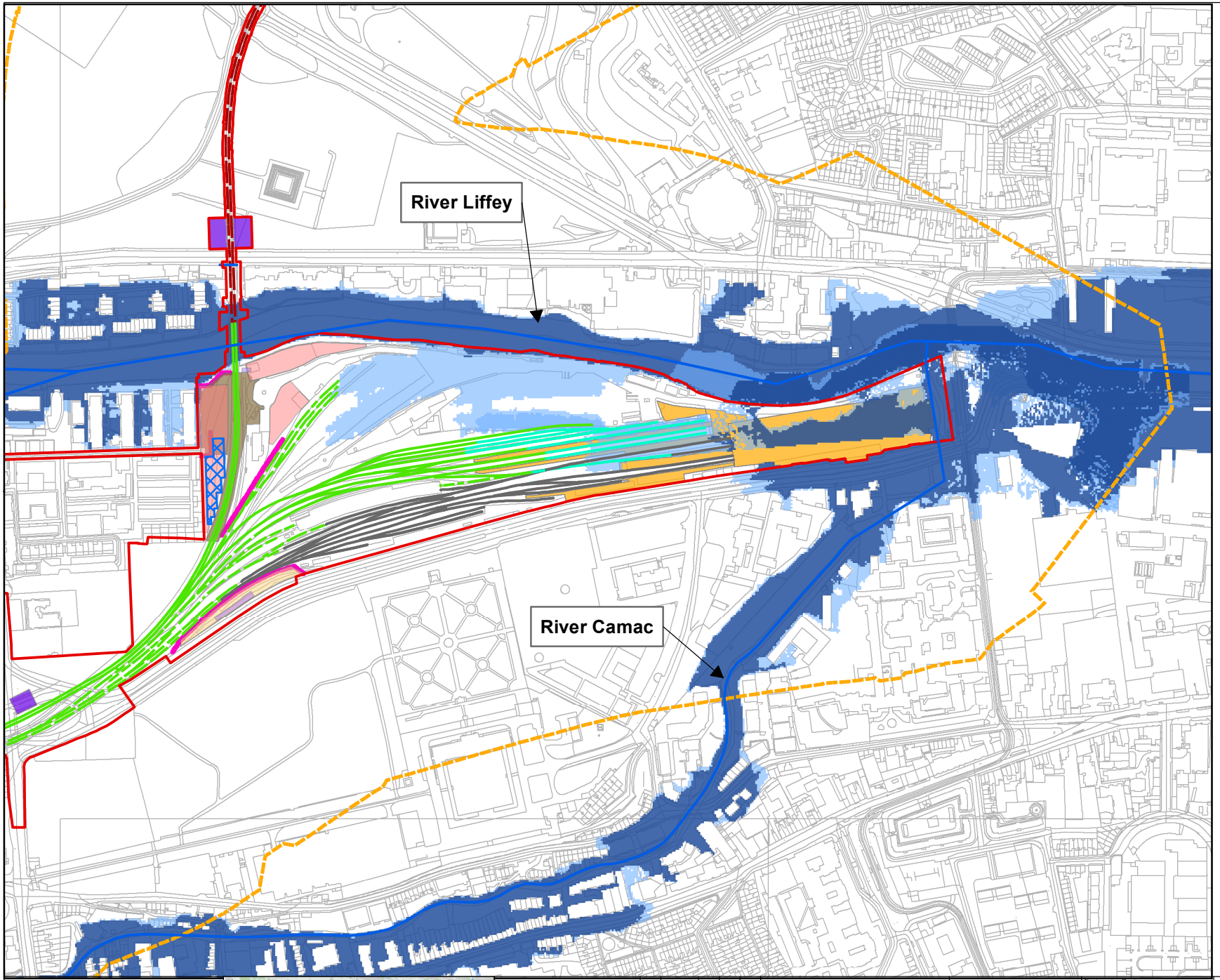
1D/2D combined hydraulic models were built to assess the existing and proposed flood risk to the railway and proposed Heuston West station in Zone C at Heuston Station. The primary rivers in the region are the River Liffey and River Camac. The design flood flows were estimated using the FSU and IH recommended flood estimation methodologies. The models were calibrated against the results from the relevant Eastern CFRAM Study flood extent mapping. The calibration analysis found that the

flows and flood extents for the River Camac were less than the CFRAM study. The primary reason for the difference was the value of the growth factors used. The CFRAM study used generalised regional growth factors based on the catchment size for the entirety of the River Liffey HA. This approach was conservative and used in order to expediate hydrological calculations due the volume of them being undertaken for the CFRAM Study.

The analysis of the existing scenario found that the railway and Heuston station are not at risk of flooding from both the 1% AEP and 0.1% AEP flooding events, as shown in Figure 10-6 (Refer to drawing DP-04-23-DWG-EV-TTA-23787 of Volume 3A of this EIAR). However, the railway track and car park are at risk during the HEFS 0.1% AEP climate change scenario from the River Liffey and River Camac. There is no flooding predicted at the proposed Heuston West Station. There is predicted flooding to the Heuston Station Terminal Building from the River Camac, however any mitigation measures for that scenario are outside the scope of this EIAR.

Potential mitigation measures to alleviate flooding along the railway track were investigated including a flood wall and flood barrier placed along its perimeter. The predicted flooding was removed from the railway track and contained within the car park which is a flood compatible area and in other areas under CIÉ ownership.

The risk and probability of the HEFS 0.1% AEP occurring is low and the railway is not at risk during the 1% AEP event. TTA JV have presented the analysis of the modelling to Iarnród Éireann. Having considered the hydraulic analysis of the existing scenario for the HEFS 0.1% AEP event, Iarnród Éireann has determined that hard mitigation measures are not warranted at this time. Risk reduction associated with the HEFS 0.1% AEP could be achieved in the future by implementation of the proposed mitigation measures by Iarnród Éireann if warranted.



Legend

- Development Boundary
- Study Area
- Watercourses
- 1% AEP HEFS
- 0.1% AEP HEFS
- Proposed Attenuation Tanks
- Proposed Concrete Slab Track and Electrification
- Existing Track to be Retained
- Proposed Railway Electrification
- Proposed Track Works and Electrification
- Proposed Track Works, Not Electrified
- Proposed Parapet Modifications
- Proposed Boundary Wall
- Proposed Temporary Compound
- Proposed Retaining Wall Anchors / Soil Nailing
- Proposed Permanent Compounds
- Proposed Electrical Substation
- Existing Railway Station
- Hueston West

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DART+ South West

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Rev	Date	Drn	Ch'k'd	App'd	Description
v02	11/11/2022	NR	UM	CR	Water (Including Hydrology & Flood Risk)
v01	08/09/2022	NR	UM	CR	Water (Including Hydrology & Flood Risk)

Client: Iarnród Éireann Irish Rail

Engineering Designer: ITYPSA | ATKINS | TYPSA | Supported by: rps

Date	Scale	Drawn	Checked	Approved
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Project Code	Issuer	QMS Code
5195886	TTA	

Project Title: DART + SOUTH WEST

Drawing Title: **Figure 10-6: HEFS Flood Extents at Heuston Station**

Drawing File Name	Version	Status
DP-04-23-DWG-EV-TTA-23787	v02	S3

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10.4.1.3.4. Zone D - Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line)

Records of historical flooding along with flood extent mapping generated for the study area, through the Interreg IVB flood risk management good practice project known as the 'FloodResilienCity' indicated that the proposed Project in Zone D is potentially at risk from pluvial flooding.

The main risk to the proposed Project would be the pluvial flooding from the Royal Canal in the vicinity of the Royal Canal and LUAS Twin Arch Bridge (OBO8) and the Maynooth Line Twin Arch Bridge (OBO9). Figure 10-2 (in Section 10.4.1.2) illustrates the locations of lock gates in the vicinity of the Royal Canal and LUAS Twin Arch Bridge (OBO8) crossing over the Royal Canal.

The Royal Canal burst its banks in the vicinity of the Royal Canal and Luas Twin Arch Bridge (OBO8) on a number of occasions in the past. Analysis carried out for the SSFRA found that during an extreme rainfall event (i.e. during 1% & 0.1% AEP events) coupled with any blockages at the downstream canal lock gates, flood water could potentially overtop and cause flooding on to the surrounding lands and railway track between the bridge structures OBO8 and OBO9.

To reduce the risk of future flooding along the track and to cater for the runoff volume likely to be generated from 1% AEP rainfall event (inclusive of 30% increase in rainfall due to future climate change) the following track drainage systems in Zone D (Liffey Bridge to Glasnevin Junction) are proposed:

1. **Phoenix Park Tunnel:** The existing collection system (perforated pipe) will be replaced by an in situ concrete channel drain 400mm wide by 500mm deep placed between tracks, to collect any surface water runoff on the track and convey flows from the upstream drainage network up to the existing outfall at The River Liffey (Figure 10-7 and Figure 10-8). The current catchment area at the tunnel and its portals will not be modified by the proposed track works and therefore, the generated runoff volumes will not increase. The People's Park (within Phoenix Park) is located directly above the tunnel. There is an existing pond overflow pipe which enters the Phoenix Park Tunnel structure and discharges into the existing track drainage. As part of the slab track works within the tunnel, a new connection manhole and pipework is proposed within the tunnel. This will then direct the overflow into a channel, located within the structure of the proposed slab track. The channel will transport storm water runoff from the track drainage catchment north of the tunnel and continue to accommodate the existing pond overflow discharge. The proposed minimum depth of channel will be 500mm, with a maximum depth of 800mm. The channel will have removable covers along its length, for safety and ease of maintenance.

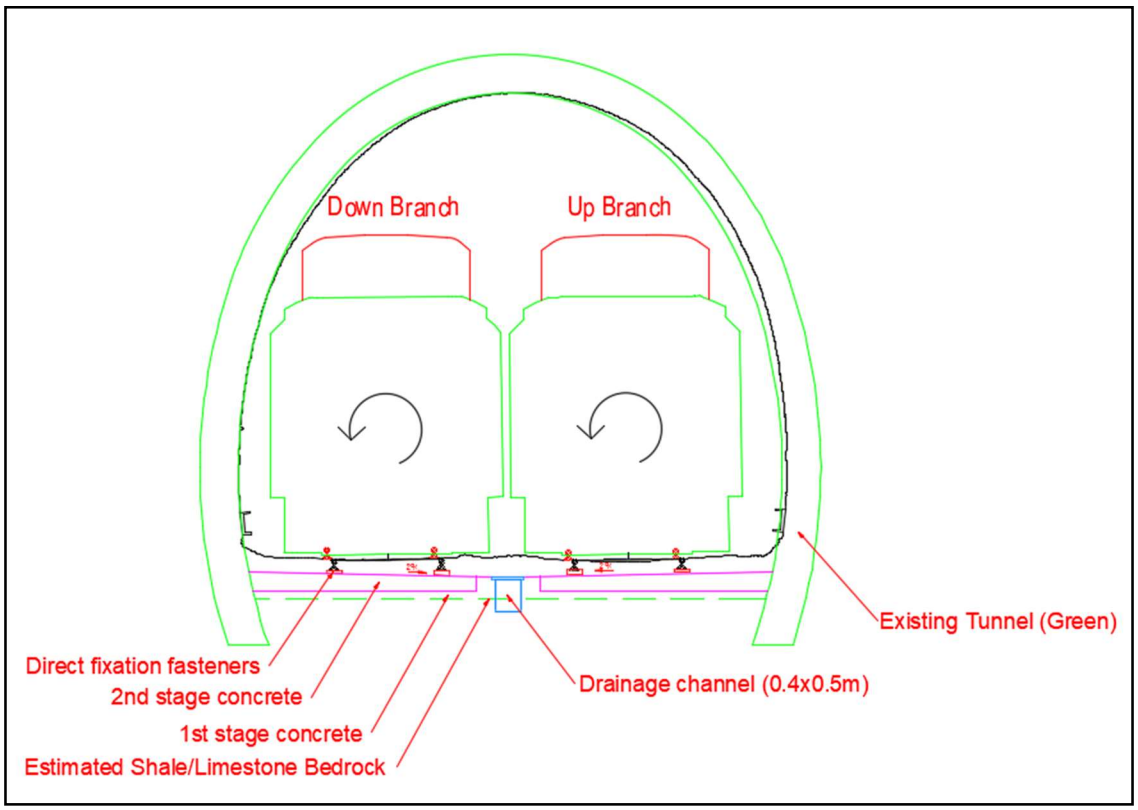

Figure 10-7 Proposed Cross Drainage System at Phoenix Park Tunnel

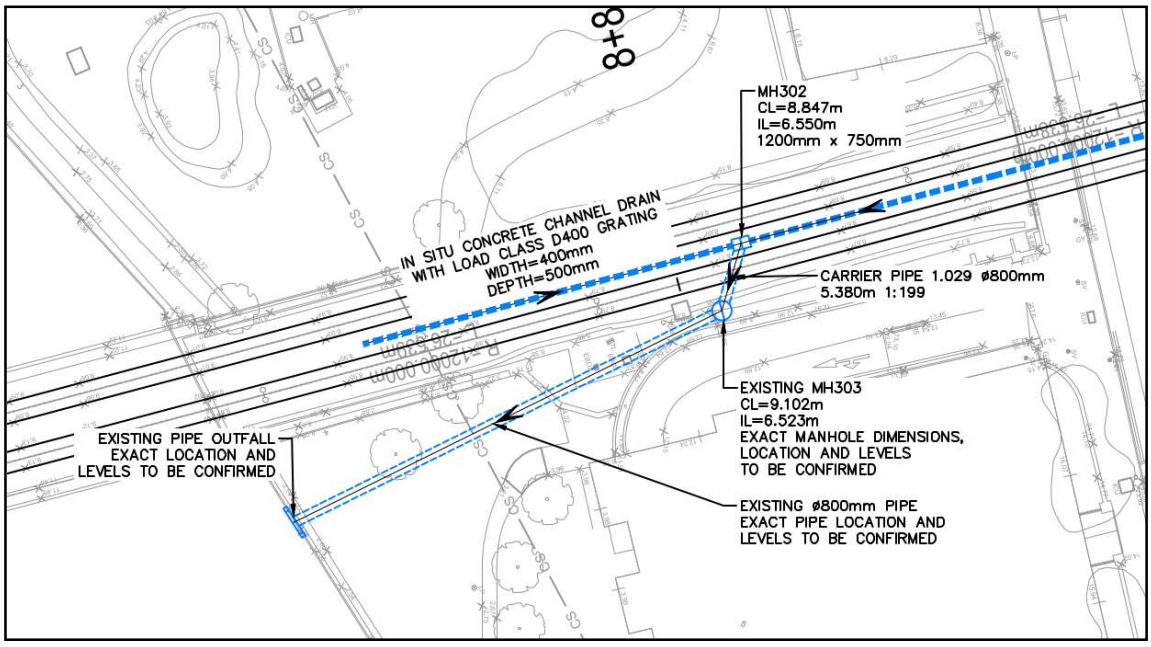

Figure 10-8 Proposed Drainage Works at Liffey River Outfall

2. **North Portal of Phoenix Park Tunnel to Glasnevin Junction:** The drainage catchment between PPT and Twin Arch Bridges (OBO8 and OBO9) will remain as existing, and therefore, runoff flows will not be increased as result of the proposed works. Although track lowering is proposed at a number of locations along this route, no changes to the drainage system are proposed, apart from re-adjusting the current pipe and chamber levels to the new track profile.

However, due to the proposed track level changes, lowering the existing pumping station would be required with an increase of the existing wet well chamber dimensions. This increase in size will allow holding the additional volumes collected by the drainage system in order to keep the water levels within operating limits required by the EMU's. The proposed wet well will deal with the extra volume collected by the system whilst maintaining current pumping flows. Accumulated storm water will be pumped to the existing infiltration basin similar to the existing arrangement. Figure 10-9 illustrates the proposed drainage layout plan between structures OBO8 and OBO9.

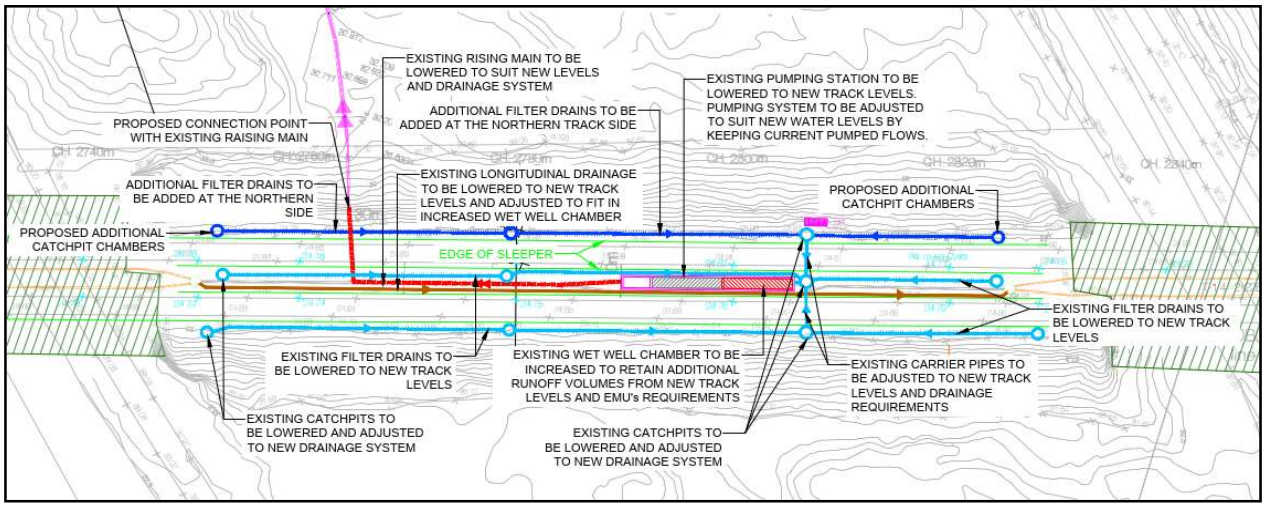

Figure 10-9 Proposed Drainage Upgrade Between OBO8 and OBO9

10.4.2. Water Quality

10.4.2.1. Water Framework Directive (WFD) Status

The EPA assigns a WFD Status and Risk Status to waterbodies based on physio-chemical, biological and hydromorphological monitoring data. WFD environmental objectives aim to achieve at least Good status in all waterbodies.

A waterbody is Not At Risk when it is achieving its environmental objective of either High or Good Status and that there is no evidence indicating a trend towards status decline. A waterbody At Risk is either not achieving its WFD environmental objectives or is trending towards a decline in status. Waterbodies that are At Risk are prioritised for implementation of measures.

The overall statuses of the waterbodies in the Study Area are derived from the 3rd WFD Cycle, which is based on monitoring data for the period 2013-2018. Table 10.8 shows the WFD ecological and risk statuses of the waterbodies in the Study Area.

Where waterbodies have been classed as At Risk, by water quality or survey data, significant pressures have been identified. The ecological status and risk status of the watercourses within the study area have been summarised in Table 10.8 below and are shown in Figure 10-10 (Refer to drawing DP-04-23-DWG-EV-TTA-23788-v01-S3 of Volume 3A of this EIAR). The 2nd WFD cycle data, based on monitoring data from 2010-2015, is included for reference. Also included are the identified significant pressures for the watercourses and the River Liffey estuary.

Table 10.8: Summary of Waterbodies' WFD Status (2013-2018)

Watercourse / Transitional Waterbody	EPA Name	Status (2nd Cycle)	Risk (2nd Cycle)	Status (3rd Cycle)	Risk (3rd Cycle)	Pressures
Hazelhatch	Castletown 09	Unassigned	Unassigned	Good	Review	Likely include Agriculture, Urban Run-off
Shinkeen	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned, likely include Agriculture, Urban Run-off
Coneyburrow	Coneyburrow 09	Poor	Review	Good	Review	Urban Run-off
Lucan Stream	Lucan Stream	Moderate	At Risk	Moderate	At Risk	Urban Run-off, Urban Waste Water
Griffeen	Griffeen	Moderate	At Risk	Moderate	At Risk	Urban Run-off, Urban Waste Water
Camac	Camac	Poor	At Risk	Poor	At Risk	Hydromorphology , Urban Run-off, Urban Waste Water
Blackditch Stream	Unassigned	Unassigned , likely Poor as it is a tributary of the Camac	Unassigned , likely Poor as it is a tributary of the Camac	Unassigned , likely Poor as it is a tributary of the Camac	Unassigned , likely Poor as it is a tributary of the Camac	Unassigned, likely include Urban Run-off, Urban Waste Water
Liffey	Liffey Estuary Upper	Moderate	At Risk	Good	Under Review	Urban Waste Water

Some waterbodies listed have a WFD status “Review” which may be for the following reasons:

1. The waterbodies have shown some slight evidence or improvement, but more evidence is needed before they can be considered as Not At Risk.
2. Measures are planned or have already been implemented for the waterbodies and no further measures should be applied until there is enough time to assess if these measures are working.

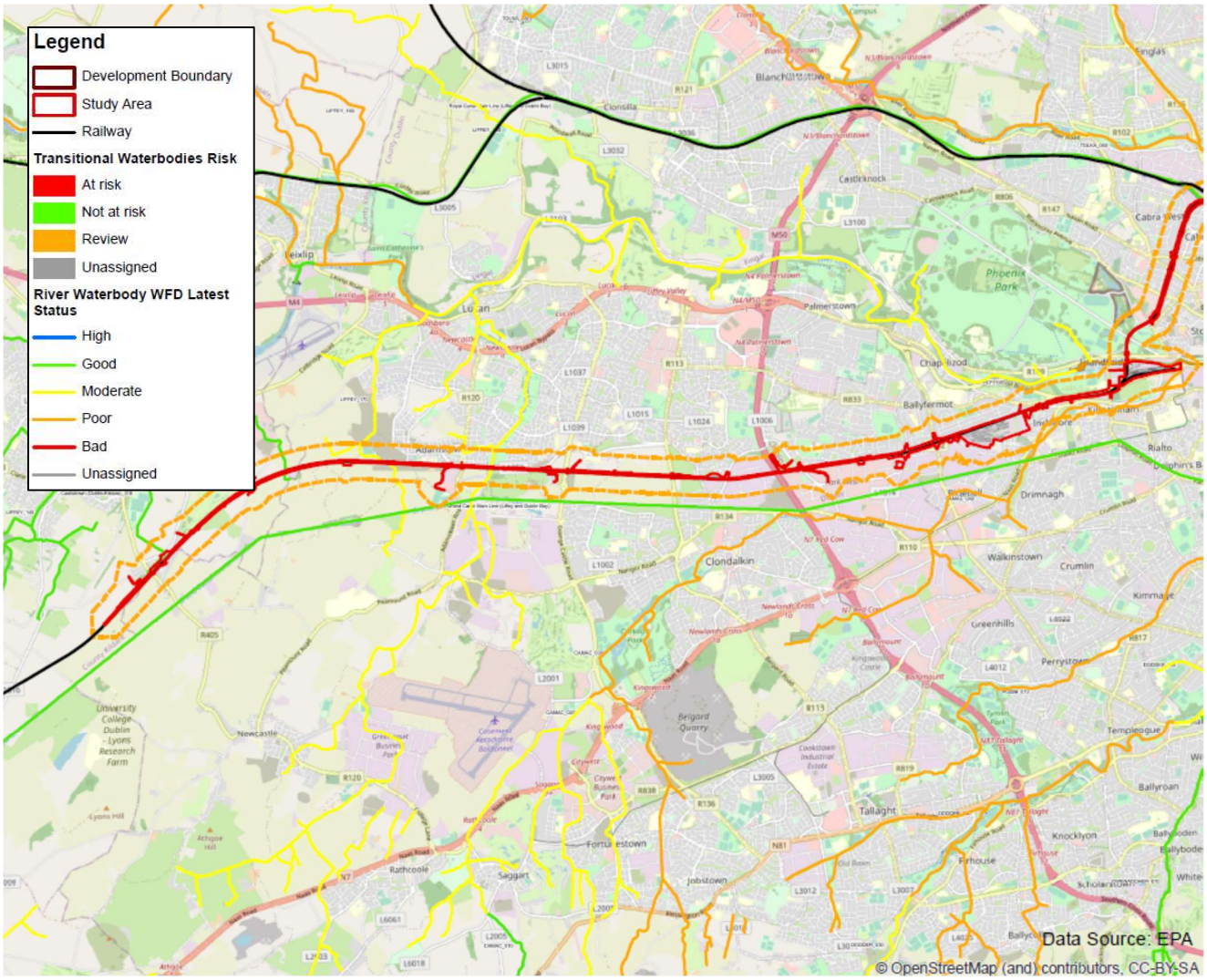

Figure 10-10 Waterbody WFD Risk

10.4.2.2. Physio-Chemical and Biological Status

The EPA carries out water quality assessments of rivers as part of a nationwide monitoring programme. Data is collected from physio-chemical and biological surveys, sampling both river water and the benthic substrate (sediment) in contact with the water. Monitoring data was extracted from EPA monitoring stations on the River Griffeen, River Camac and River Liffey located within the vicinity of the Study Area.

The classification for biological water quality assigns a Q-value based on the macroinvertebrate community composition. The Q-values for the watercourses within the Study Area, along with the most recent year of assessment, are presented in Table 10.9.

Table 10.9: Q-Values for Watercourses in the Study Area

Watercourse	Station Code	Year	Q Value	Status
Griffen	RS09G010500	1991	3	Poor
Camac	RS09C020500	2019	3	Poor
Liffey	RS09L012400	1991	3	Poor

10.4.2.3. Estuaries

Heuston station is located on the banks of the River Liffey Estuary. The Eastern CFRAM Hydraulics Report HA09 (OPW, 2017) states that the Islandbridge weir on the River Liffey restricts the extent of tidal influence during higher probability coastal events reducing the potential flood risk due to extreme coastal water levels. However, the influence of low probability tidal events can be seen to propagate upstream past the weir. Table 10.8 lists the WFD status and significant pressures associated with the Liffey Estuary adjacent to Heuston Station.

10.4.2.4. Lakes

The only lake body in the vicinity of the study area is the Leixlip Reservoir, as shown in Figure 10-11. It is approximately 1.7km downstream of the proposed Project and has an area of 0.304km^2. The reservoir feeds the Leixlip Water Treatment Plant (WTP) which provides water for approximately 600,000 people in the greater Dublin area, including parts of Kildare and Meath. The WTP is currently undergoing upgrades to modernise the existing facilities and improved the quality, reliability and resilience of the water supply serving the Greater Dublin Area.

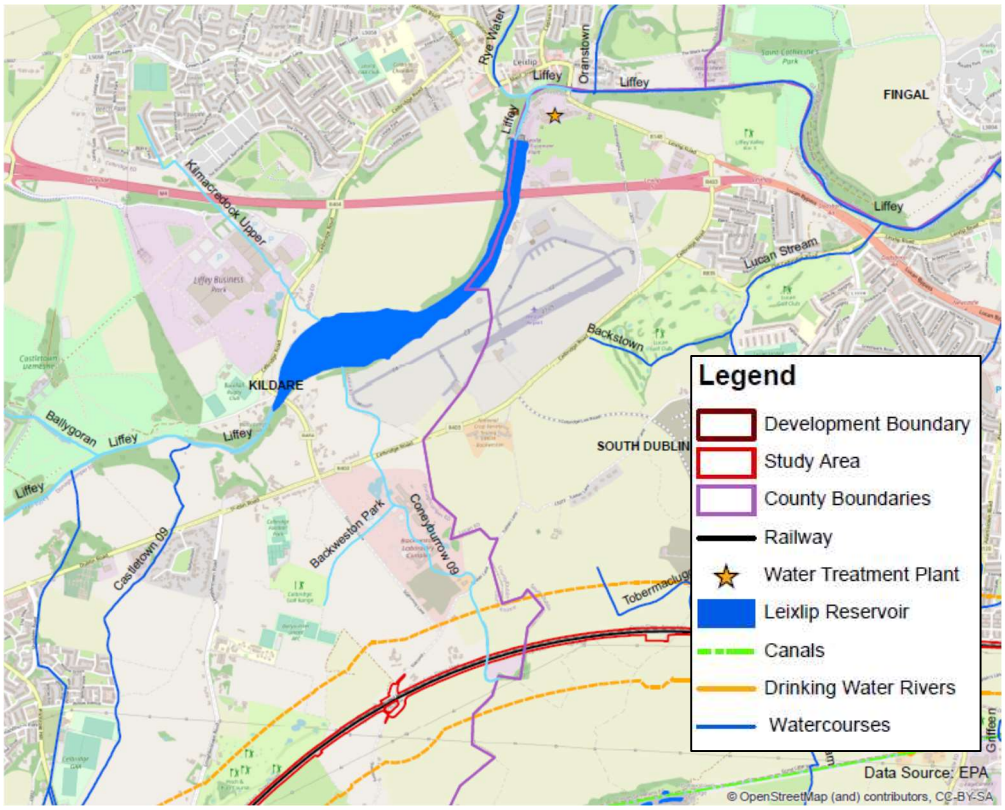

Figure 10-11 Location of Drinking Water Protected Stream Coneyburrow, Leixlip Reservoir and Leixlip WTP

10.4.2.5. Wastewater

Figure 10-12 below (Refer to drawing DP-04-23-DWG-EV-TTA-23790 of Volume 3A of this EIAR) illustrates the locations of multiple storm water overflows in the study area along with the location of some of the facilities from which they can occur. The overflows are primarily located in the River Camac catchment but there is also one upstream of the study area in the River Griffeen catchment coming from the Grange Castle industrial district.

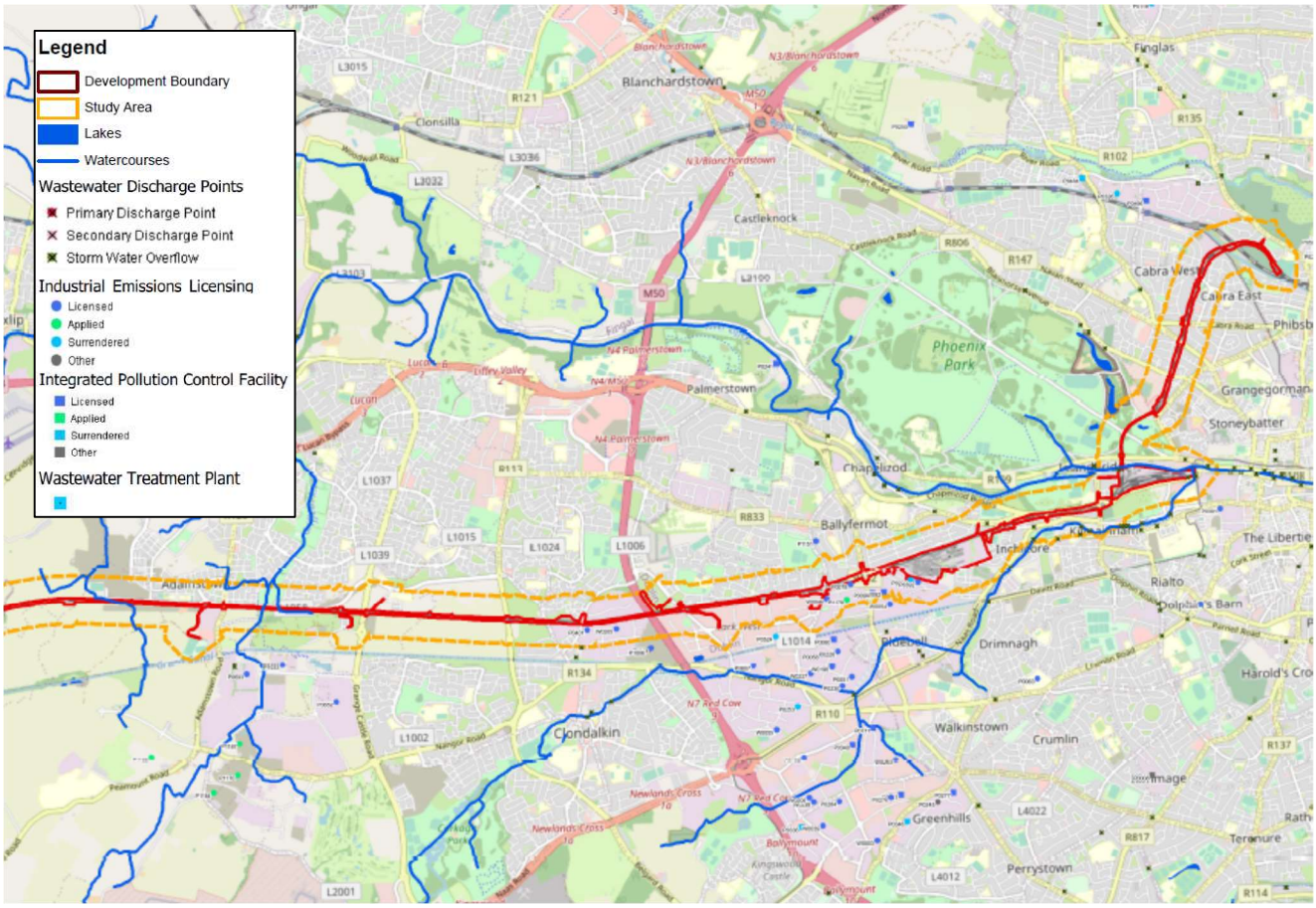

Figure 10-12 Storm Water Overflows within or nearby the Study Area

10.4.2.6. Surface Water Drainage Network

A preliminary drainage assessment and design was carried out for the proposed Project in order to design, optimize and allocate the proposed drainage infrastructures associated to the expansion works of the existing railway line, as well as the drainage requirements. The drainage assessment was subdivided into 7 drainage zones. The location and extent of each zone defined as part of the drainage assessment is as follows:

- Zone 1: Heuston Yard North.
- Zone 2: Islandbridge Junction to North Portal of Phoenix Park Tunnel.
- Zone 3: North Portal of Phoenix Park Tunnel to Great Southern & Western Railway (GSWR) Junction (Glasnevin).
- Zone 4: Heuston Yard South.
- Zone 5: Kylemore Road to South Circular Road.
- Zone 6: Le Fanu Road to Kylemore Road.
- Zone 7: Hazelhatch Station to Park West & Cherry Orchard Station.

The proposed drainage works are outlined in Chapter 4 Project Description (Refer to Section 4.6 to 4.9).

10.4.2.7. Potable Water

There is one protected drinking water stream, as shown in Figure 10-11, (Coneyburrow Stream also designated as Liffey_150) within the study area which feeds the Leixlip Reservoir. The protected stream from the most recent available EPA water quality reporting has achieved "Good Ecological Potential". The stream has seen an improvement in water quality as historical reporting designated it as "Poor".

10.4.3. Evolution of the Environment in the Absence of the Project (Do Nothing)

Annex IV of the EIA Directive sets out the information required to be included in an EIAR. This includes:

> *"a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge".*

In the event that the proposed Project does not proceed, an assessment of the future baseline conditions has been carried out and is described within this section.

If the Project does not proceed, the current hydrological regime within the study area is not expected to change significantly. Further detail is provided in the section below.

10.4.3.1. Flood Risk

10.4.3.1.1. Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

The baseline for Zone A in Hazelhatch is that the station and track is at risk of flooding from the 1% AEP and 0.1% AEP flooding events. Climate change flooding scenarios show an increase in flood risk to the proposed Project at Hazelhatch and the surrounding area. As described in Section 10.4.1.3.1 the OPW is currently progressing a flood relief scheme for the wider Hazelhatch area which would reduce the risk of flooding to the proposed Project, however this scheme has not yet been finalised or approved for planning and construction.

The risk to Zone A at Adamstown is much less, while there is flooding on the railway it is for the most conservative HEFS 0.1% AEP flooding event and flood depths are less than 150mm.

To manage potential future flood risk in Zone A, Iarnród Éireann will follow its operating procedures, as listed in Section 10.6.2, which will assist in safely managing flood risk for rolling stock during inclement weather and flooding events. These operational procedures would ensure that Hazelhatch is not utilised during an extreme flooding situation and that operations in Adamstown are managed fully safely to avoid damage to critical on- board equipment and to mitigate against the risk of a train becoming disabled in a flooded area.

10.4.3.1.2. Zone B - Park West & Cherry Orchard Station to Heuston Station (Incorporating Inchicore Works)

Zone B was identified as being at risk from pluvial flooding. This risk may increase due to climate change scenarios. In the absence of the scheme, Iarnród Éireann may have to develop operational procedures and mitigation measures which would ensure that flood risk to the existing railway is reduced.

10.4.3.1.3. Zone C - Heuston Yard and Station (Incorporating New Heuston West Station)

The baseline scenario for Zone C, as discussed in Section 10.4.1.3.3, is that the railway and Heuston Station are not at risk of flooding from either the 1% AEP and 0.1% AEP flooding events. However, the railway track and car park are at risk during the HEFS 0.1% AEP climate change scenario from the River Liffey and River Camac. There is predicted flooding to the Heuston Station Terminal Building from the River Camac, however any mitigation measures for that scenario are outside the scope of this EIAR.

Similar to previous sections, to manage potential future flood risk in Zone C, Iarnród Éireann will follow its operating procedures, as listed in Section 10.6.2, which will assist in safely managing flood risk for rolling stock during inclement weather and flooding events.

DCC and SDCC in partnership with the OPW are currently progressing a flood alleviation scheme for the wider River Camac catchment area which would reduce the risk of flooding to the proposed Project. The River Camac FAS is currently at Stage 1 – Scheme Development and Preliminary Design and as such this scheme has not yet been finalised or approved for planning and construction.

10.4.3.1.4. Zone B - Park West & Cherry Orchard Station to Heuston Station (Incorporating Inchicore Works)

Zone D was identified as being at risk from pluvial flooding due to the risk of the Royal Canal overflowing on the tracks. This risk may increase due to climate change scenarios. In the absence of the scheme Iarnród Éireann may have to develop operational procedures and mitigation measures which would ensure that flood risk to the existing railway is reduced.

10.4.3.2. Water Quality

The watercourses and estuaries in the study area are expected to maintain their current water quality, pressures and ecological status designations. They may see improvement overtime due to:

- Local government planning polices such implementation of SuDS features in the Development Plans for DCC, South Dublin City Council (SDCC) and Kildare County Council (KCC);
- SDCC Dublin Urban Rivers LIFE Project aimed at improving the overall environmental quality of rivers in South Dublin;
- As part of the River Camac Flood Alleviation Scheme DCC are implementing a rehabilitation of the Camac River to achieve WFD improved status.
- Improved wastewater management infrastructure along with future strategic infrastructure identified by Irish Water.

However, while these are positive projects which should improve the overall water quality and ecological status of rivers in the study area, it is premature to rely on their complete implementation.

10.5. Description of Potential Impacts

The potential impacts on each of the previously mentioned hydrological attributes both during the construction and operation stages of the scheme are provided in the following sections. The key construction activities are listed in Section 5.1.2 of Chapter 5 Construction Strategy of this EIAR.

10.5.1. Potential Construction Impacts

10.5.1.1. Impact on Flood Risk

Flooding risks to the construction workers, works locations as well as adjacent private lands and properties during the construction stage of the proposed Project could result from the following construction stage activities:

- Flooding to the tracks and construction works areas due to potential floods at Hazelhatch Station and along the railway between the Royal Canal and Luas Twin Arch Bridge (OBO8) and the Maynooth Line Twin Arch Bridge (OBO9).
- Blockage to overland flow paths during construction works could cause flooding to the lands and properties located upstream of the Salient Hydrological Features;
- Inadequately sized flow diversion channels and over pumping equipment could cause flooding to the adjacent lands and properties;
- Temporary paved surfaces or roofed areas of site compounds may increase the rate of runoff;
- Temporary bunding or material stockpiles may alter runoff or flooding flow paths from; and
- Large areas stripped of vegetation can discharge runoff at a much higher rate than if grassed.

Flood events during the construction phase have the potential to have a negative, temporary, moderate to significant impact on hydrological receptors.

10.5.1.2. Impact on Potable Water

Construction activities could lead to increased runoff of contaminants and fuel spillages entering the Coneyburrow Stream which is a protected drinking water stream within the study area which feeds the Leixlip Reservoir and subsequently the Leixlip WTP. The WTP is downstream of the Leixlip Reservoir and potential contamination of the water supply is unlikely as any impacted water would be treated however it could add to strain on the WTP plant. These events have the potential to have a negative, temporary, slight to moderate impact.

10.5.1.3. Impact on Water Quality

Possible impacts on the water environment that may arise during the construction stage of the proposed Project are discussed below. The impacts can be a significant risk to the hydrological environment particularly works within or adjacent to watercourses or contaminated surface water runoff from construction activities entering watercourses. These activities can impact water quality and the hydromorphology of watercourses. Such activities could include earthworks, sheet piling, concreting, fuel / lubricant spillages, pollution from human and nonhuman waste materials and temporary watercourse diversions. The main impacts likely to arise from construction include:

- Elevated silt/sediment loading within watercourses from construction site runoff due to site earthworks. This most likely in areas where track lowering and track widening will occur;
- Spillage of concrete, grout, chemicals and other cement-based products, in particular for the construction of the track slab, secant piles, Heuston West access infrastructure (ramps and stairs) and support structures such as plinths for the electrification infrastructure;

- Accidental spillage of hydrocarbons from construction plant and refuelling operations at construction compounds, which can reach watercourses;
- Faecal contamination from inadequate treatment of on-site welfare facilities;
- Dewatering may be required where track lowering and other construction excavations (e.g. underground attenuation tanks) occur and a temporary drainage sump could be constructed to drain all water locally and then use a pump to remove water; and
- Stormwater and wastewater pipe diversions will require over pumping and operational interruptions.

In the absence of mitigation measures, the potential impact is negative, temporary, moderate to significant.

10.5.2. Potential Operational Impacts

10.5.2.1. Impact on Flood Risk

The potential impacts on flood risk due to changes in the hydrological regime during the operational phase are discussed below. The widening and lowering of the tracks can alter the surface water drainage and flood relief measures for the proposed Project. This may result in:

- An increase in flood levels along the track due to ponding;
- The amount of runoff can increase as a greater area is hardstanding, and without attenuation, there will be an increase in the rate at which runoff reaches the receiving water bodies; and
- Widening of tracks into a potential floodplain area can reduce the available flood storage and have impacts locally as well upstream and downstream.
- Installation of proposed noise barriers along the railway track in the vicinity of the residential/urban development areas could causes obstruction to flood water flow paths, which consequently could cause an increase in flood levels in the upstream vicinity. Refer to Chapter 14 Noise & Vibration of this EIAR for the details of the proposed noise barriers along the railway track.

The SSFRA, as discussed in Section 10.4.1.3, found that the vast majority of the proposed Project is located in Flood Zone C. Hydraulic models were built to investigate flooding at Hazelhatch, Adamstown and Heuston Station. These areas are discussed below detailing the flood risk management measures inherent in their design.

Overall, with the proposed control procedures and mitigation measures in place the magnitude of the impact is deemed to be slight to moderate.

10.5.2.1.1. Zone A - Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

The analysis of the existing scenario found that the railway and proposed substation at Hazelhatch is at risk of flooding from both the 1% AEP and 0.1% AEP flooding events as show in Figure 10-3 while the Adamstown area is not at risk. However, the railway is at risk at Adamstown during the 0.1% AEP HEFS climate change scenario, as show in Figure 10-4.

Hydraulic modelling of possible hard mitigation measures included at Hazelhatch would increase flood risk to the surrounding area and would not reduce flooding below the Iarnród Éireann flood depth operational limits. Therefore, it was recommended that no hard mitigation measures are implemented for this planning application and that Iarnród Éireann engage with the OPW which is currently progressing a Flood Relief Scheme for the wider Hazelhatch area. This scheme could reduce flooding to the railway station and its infrastructure. Hard mitigation measures developed solely for the railway station would increase flood risk to the surrounding area.

The upgrading of infrastructure at Hazelhatch to facilitate the electrification will not increase flood risk to the surrounding area as the proposed ground levels will be maintained at the current levels to ensure that displacement of floodwaters does not occur and cause a residual risk. The predicted flooding for the HEFS 0.1% AEP event at the location of the proposed substation is 57.559 mOD. All critical equipment can be set at a minimum of 300mm above this flood level while the substation site ground level can be maintained at existing levels.

Noise barriers are proposed at a number of locations within Zone A to mitigate operational noise impact (Refer to Chapter 14 Noise & Vibration for further details). It was identified that the proposed noise barriers in the Hazelhatch area are located within the 1% AEP and 0.1% AEP flood extents. A hydraulic model simulation showed that, these proposed noise barriers would cause a slight increase in flood level, particularly in the north-eastern vicinity of the railway culvert crossing on the Shinkeen River. The causes of this flood level rise can mainly be attributed to the obstruction to flood water flow paths caused by the proposed noise barriers. In order to mitigate this impact to the flood level, an 83m long and 2m wide conveyance channel was proposed along the railway track along the north-eastern vicinity of the railway culvert crossing on the Shinkeen River. This channel will help in conveying the increased flood volume from the adjacent flooded land areas into the Shinkeen river and maintain the status quo flooding regime. Refer to Drawing No. DP-04-23-DWG-EV-TTA-23897 and DP-04-23-DWG-EV-TTA-23898 in Volume 3A of this EIAR for further details of the flood extents and proposed conveyance channel location. Further details of the hydraulic modelling results are provided in the Flood Risk Assessment Report. No impacts on the existing flooding regimes of the Lucan and Griffin Rivers in the Adamstown areas, due to the installation of the proposed noise barriers, are expected, since the proposed noise barriers are not located within the design flood extents.

To manage potential future flood risk in Zone A, Iarnród Éireann will follow its operating procedures, as listed in Section 10.6.2, which will assist in safely managing flood risk for rolling stock during inclement weather and flooding events.

10.5.2.1.2. Zone B - Park West & Cherry Orchard Station to Heuston Station (Incorporating Inchicore Works)

Zone B was identified as being at risk from pluvial flooding. The construction and implementation of the proposed drainage strategy as discussed in Section 10.1.1.1 will reduce the risk of pluvial flooding and mange surface water runoff from the proposed Project.

10.5.2.1.3. Zone C - Heuston Yard and Station (Incorporating New Heuston West Station)

The analysis of the existing scenario found that the railway and Heuston Station are not at risk of flooding from both the 1% AEP and 0.1% AEP flooding events, as shown in Figure 10-6.

However, the railway track and car park are at risk during the HEFS 0.1% AEP climate change scenario from the River Liffey and River Camac. There is no flooding predicted at the proposed Heuston West Station. There is predicted flooding to the Heuston Station Terminal Building from the River Camac, however that any mitigation measures for that scenario are outside the scope of this EIAR.

To manage potential future flood risk in Zone C, Iarnród Éireann will follow its operating procedures, as listed in Section 10.6.2, which will assist in safely managing flood risk for rolling stock during inclement weather and flooding events.

Noise barriers are proposed within Zone C to mitigate operational noise impact (Refer to Chapter 14 Noise & Vibration for further details). No impacts on the existing flooding regimes of the River Liffey and River Camac in the vicinity of the Heuston Station, due to the installation of proposed noise barriers, are expected, since the proposed noise barriers are not located within the design flood extents.

10.5.2.1.4. Zone D - Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line)

To reduce the risk of existing flooding along the track, as discussed in Section 10.1.1.1, and to cater for the runoff volume likely to be generated from 1% AEP rainfall event (inclusive of 30% increase in rainfall due to future climate change) the following proposed track drainage systems in Zone D (River Liffey Bridge to Glasnevin Junction) are proposed:

- **Phoenix Park Tunnel:** The existing collection system (perforated pipe) will be replaced by an in situ concrete channel drain 400mm wide by 500mm deep placed between tracks, to collect any surface water runoff on the track and convey flows from the upstream drainage network up to the existing outfall at The River Liffey. The current catchment area at the tunnel and its portals will not be modified by the proposed track works and therefore the generated runoff volumes will not increase.
- **North Portal of Phoenix Park Tunnel to Glasnevin:** The drainage catchment between PPT and Twin Arch Bridges (OBO8 and OBO9) will remain as existing and therefore runoff flows will not be increased as result of the proposed works. However, due to the proposed track level changes, lowering the existing pumping station will be required with an increase of the existing wet well chamber dimensions. This increase in size will cater for the additional surface water volumes collected by the drainage system to ensure that water level depths remain within the operational allowances required by the EMUs. The proposed wet well will deal with the extra volume collected by the system whilst maintaining current pumping flows. Accumulated storm water will be pumped to the existing infiltration basin similar to the existing arrangement.

10.5.2.2. Impact on Potable Water

While the status of the Coneyburrow Stream is noted as being Poor, operational activities are unlikely to alter the existing drainage from the railway that could enter the stream. These events have the potential to have a negative, temporary, Imperceptible impact.

10.5.2.3. Impact on Water Quality

As discussed in Section 10.4.2.6 the proposed surface water strategy either maintains existing drainage networks (Drainage Zones 1, 4 and 7) or includes mitigation measures to improve surface

water treatment for runoff from the railway. Runoff treatment measures include cellular attenuation tanks (for a full description of surface water drainage measures refer to Section 5.2.5.3 in Chapter 5 Construction Strategy of this EIAR. This will limit the potential for impacts to the water quality of receiving waterbody and has the potential to have a positive, long term, not significant to slight impact.

Stormwater, foul and combined sewer diversions are required in several locations (Le Fanu Bridge, Inchicore Works, Blackhorse Avenue Bridge, Cabra Road Bridge). These works will be designed and constructed using Irish Water Standards, therefore the impact is likely to imperceptible with little risk to the water environment.

10.5.2.3.1. Water Framework Directive Assessment

Any works which could affect the biological, physiochemical or hydromorphological quality of a waterbody requires an assessment in line with the WFD to demonstrate how the proposed works will not lead to a degradation status and where possible, enhance waterbody status in order to achieve the required Good status target as set out in the directive. An assessment of likely impacts to water bodies within the study area has been completed and is provided in Table 10.10 below. The assessment concludes that the proposed Project will have negligible impact on waterbody status.

Table 10.10: Water Framework Directive Assessment Summary

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
Castletown 09 / 09C50 (IE_EA_09C500830)	Good	No EPA Identified Pressures. Pressures likely include Agriculture and Urban Run Off.	Actions to address Agricultural pressures are set out in section 7.1.6 of the 2nd Cycle RBMP. Actions to address Domestic Waste Water pressures are set out in section 7.1.2 of the 2nd Cycle RBMP. Actions to address pollution from urban waste-water and urban runoff are set out in section 7.2.3 of the 2nd Cycle RBMP.	The existing rail line crosses the Hazelhatch stream and Shinkeen Streams adjacent to the Hazelhatch & Celbridge station. No works are required to the existing culvert crossing. Works will be limited to the provision of Over Headline Equipment (OHLE), and associated works required for electrification and a turnback at Hazelhatch Station. There are no attenuation tanks or pumping stations proposed in this section of the route. The drainage catchments of the railway track remain as existing, and therefore, no additional drainage system is required for this section. The SSFRA identified this location as liable to flood during the 1% AEP and 0.1% AEP events. No hard mitigation measures are proposed as they could
Shinkeen	Not delineated as WFD Waterbody	No EPA Identified Pressures. Pressures likely include Agriculture and Urban Run Off.	Actions to address Agricultural pressures are set out in section 7.1.6 of the 2nd Cycle RBMP. Actions to address Domestic Waste Water pressures are set out in section 7.1.2 of the 2nd Cycle RBMP. Actions to address pollution from urban waste-water and urban runoff are set out in section 7.2.3 of the 2nd Cycle RBMP.	

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				cause impacts downstream by displacing floodwaters. The upgrading of infrastructure at Hazelhatch to facilitate the electrification will not increase flood risk to the surrounding area as the proposed ground levels will be maintained at the current levels to ensure that displacement of floodwaters does not occur and cause a residual risk. To address future flood risk IÉ may have to develop operational procedures which would ensure that Hazelhatch is not utilised during an extreme flooding situation. The proposed Project will not hinder implementation of measures outlined in the 2nd Cycle RBMP. The proposed works will have a negligible effect on the subject waterbodies significant pressures and will not prevent the attainment of Good Status.

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
Coneyburrow 09 / 09C54 (IE_EA_09L011900)	Good	Urban Run-off	Actions to address pollution from urban waste-water and urban runoff are set out in section 7.2.3 of the 2nd Cycle RBMP.	The existing rail line crosses the Coneyburrow Stream in rural Co. Kildare. Works in this area will be limited to the provision of OHLE and associated works required for electrification. No works are required to the existing culvert crossing. There are no attenuation tanks or pumping stations proposed in this section of the route. The drainage catchments of the railway track remain as existing, and therefore, no additional drainage system is required for this section. The SSFRA did not identify this location as liable to flood during the 1% AEP and 0.1% AEP events. The upgrading of infrastructure to facilitate the electrification will not increase flood risk to the surrounding area as the proposed ground levels will be maintained at the current levels to ensure that displacement of

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				floodwaters does not occur and cause a residual risk. The proposed Project will not hinder implementation of measures outlined in the 2nd Cycle RBMP. The proposed works will have a negligible effect on the subject waterbodies significant pressures and will not prevent the attainment of Good Status.
Lucan Stream / 09L08 (IE_EA_09L012100)	Moderate	Urban Run-off, Urban Waste Water	Actions to address pollution from urban waste-water and urban runoff are set out in section 7.2.3 of the 2nd Cycle RBMP. Actions to address industrial pressures are set out in section 7.7 and 7.8 of the 2nd Cycle RBMP.	The existing rail line crosses the Lucan Stream to the west of the Adamstown Station Stream. Works in this area will be limited to the provision of OHLE and associated works required for electrification. No works are required to the existing culvert crossing or the bridges in the area. There are no attenuation tanks or pumping stations proposed in this section of the route. The drainage catchments of the railway track remain as existing, and therefore, no additional

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				drainage system is required for this section. The SSFRA did not identify this location as liable to flood during the 1% AEP and 0.1% AEP events. The upgrading of infrastructure to facilitate the electrification will not increase flood risk to the surrounding area as the proposed ground levels will be maintained at the current levels to ensure that displacement of floodwaters does not occur and cause a residual risk. The proposed Project will not hinder implementation of measures outlined in the 2nd Cycle RBMP. The proposed works will have a negligible effect on the subject waterbodies significant pressures and will not prevent the attainment of Good Status.
Griffeen / 09G01 (IE_EA_09L012100)	Moderate	Urban Run-off, Urban Waste Water	Actions to address pollution from urban waste-water and urban runoff are set out in section 7.2.3 of the 2nd Cycle RBMP.	The existing rail line crosses the Griffeen River to the east of the Finnstown R120 Road Bridge

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
			Actions to address industrial pressures are set out in section 7.7 and 7.8 of the 2nd Cycle RBMP.	(OBC19). Works in this area will be limited to the provision of OHLE and associated works required for electrification. No works are required to the existing culvert crossing. There is localised track lowering required at OBC19 however this lies outside the River Griffeen floodplain. The localised track lowering is up to of 0.1m in depth and it is not anticipated that any alterations to the existing drainage systems are required. The drainage catchments of the railway track remain as existing, and therefore, no additional drainage system is required for this section. The SSFRA identified this location as liable to flood HEFS 0.1% AEP event. The upgrading of infrastructure to facilitate the electrification will not increase flood risk to the surrounding area as the proposed ground levels will be maintained at the current levels to ensure that displacement of floodwaters does not occur and cause

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				a residual risk. To address future flood risk IÉ may have to develop procedures that would ensure operations in Adamstown are managed safely to avoid damage to critical on-board equipment and to mitigate against the risk of a train becoming disabled in a flooded area. Alternatively, they could develop hard mitigation measures to protect the track however, any mitigation measures would need to ensure they do not increase flood risk in the surrounding area. The proposed Project will not hinder implementation of measures outlined in the 2nd Cycle RBMP. The proposed works will have a negligible effect on the subject waterbodies significant pressures and will not prevent the attainment of Good Status.
Camac / 09C02 (IE_EA_09C020500)	Poor	Hydromorphology, Urban Run-off, Urban Waste Water	Actions to address pollution from urban waste-water and urban runoff are set out in section 7.2.3 of the 2nd Cycle RBMP. Actions to address hydromorphology are set	The existing rail line does not cross the Camac River; however, it does flow through the study area for this

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
			out in section 7.6.2 of the 2nd Cycle RBMP. Actions to address industrial pressures are set out in section 7.7 and 7.8 of the 2nd Cycle RBMP.	assessment and outfall to the River Liffey to the east of Heuston Station. The SSFRA identified the River Camac is susceptible to flooding during the HEFS 0.1% AEP event and the floodplain inundates a section of Heuston Station where works will be limited to the provision of OHLE and associated works required for electrification. The upgrading of infrastructure to facilitate the electrification will not increase flood risk to the surrounding area as the proposed ground levels will be maintained at the current levels to ensure that displacement of floodwaters does not occur and cause a residual risk. To address future flood risk IÉ may have to develop operational procedures which would ensure that sections of Heuston Station are not utilised during an extreme flooding situation and that operations are

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				managed safely to avoid damage to critical on-board equipment and to mitigate against the risk of a train becoming disabled in a flooded area. Alternatively, it could develop hard mitigation measures to protect the track however, any mitigation measures would need to ensure they do not increase flood risk in the surrounding area. Hydraulic modelling for proposed flood defences indicates that the residual risk of flooding is limited to lands owned by IÉ. The proposed Project will not hinder implementation of measures outlined in the 2nd Cycle RBMP. The proposed works will have a negligible effect on the subject waterbodies significant pressures and will not prevent the attainment of Good Status.
Blackditch Stream	Not delineated as WFD Waterbody	No EPA Identified Pressures. Pressures likely include Urban Run Off, Urban	Actions to address pollution from urban waste-water and urban runoff are set out in section 7.2.3 of the 2nd Cycle RBMP. Actions to address industrial pressures are	The existing railway line crossed the culverted Blackditch Stream in the vicinity of Park West and Cherry Orchard. The proposed works in this

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
		Waste Water and Industry.	set out in section 7.7 and 7.8 of the 2nd Cycle RBMP.	area include widening to 4 tracks, track lowering, installation of retaining walls along sections of the route and installation of OHLE and associated works required for electrification for the 2 new DART lines. The SSFRA identified this area being susceptible pluvial flooding and to mitigate this this risk and to accommodate the proposed Project works, an upgraded surface water drainage system is proposed. The drainage network drains the track length from Cherry Orchard up to Inchicore Depot and conveys collected runoff waters up to a proposed attenuation tank located west of Inchicore Depot by pumping. Attenuation for the network comprises an attenuation tank facility designed to retain storm water volumes up to 1 in 100-year return period plus 30% climate change allowance. Due to level differences discharge to the existing

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				Blackditch Steam storm water sewer that crosses the track between Kylemore Road Bridge and Inchicore Depot is not achievable by gravity. Therefore a new pumping system from the attenuation tank to pump surface water flows up to into the existing Blackditch Stream SW sewer. The proposed Project will not hinder implementation of measures outlined in the 2nd Cycle RBMP. The proposed works will have a slight positive effect on the subject waterbodies significant pressures and will not prevent the attainment of Good Ecological.
Liffey Estuary Upper / 09L01 (IE_EA_090_0400)	Good	Urban Waste Water	Actions to address pollution from urban waste-water and urban runoff are set out in section 7.2.3 of the 2nd Cycle RBMP.	The existing railway crosses the River Liffey at the Liffey Bridge (UBO1), there is no proposal to alter the structural elements of bridge but installation of OHLE and associated works required for electrification is required on the bridge. A new dedicated DART station located at Heuston West will be constructed adjacent to the River

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				Liffey, on the approach to Conyngham Road Bridge (OBO2) the track will be lowered by approximately 0.4m and lastly installation of OHLE and associated works required for electrification in parts of the existing Heuston Station. The SSFRA identified parts of the existing Heuston station as liable to flood during the HEFS 0.1% AEP event. The upgrading of infrastructure to facilitate the electrification will not increase flood risk to the surrounding area as the proposed ground levels will be maintained at the current levels to ensure that displacement of floodwaters does not occur and cause a residual risk. To address future flood risk IÉ may have to develop procedures that would ensure operations in Heuston Station are managed safely to avoid damage to critical on- board equipment and to mitigate against the risk of a train becoming disabled in a flooded area. Alternatively, they could

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				develop hard mitigation measures to protect the track however, any mitigation measures would need to ensure they do no increase flood risk in the surrounding area. Hydraulic modelling for proposed flood defences indicates that the residual risk of flooding is limited to lands owned by IÉ. As part of the drainage system for this area of the proposed Project, it is proposed to install a new underground attenuation tank between Clancy Quay and the tracks. The network drains the new track arrangement from Sarsfield Road Underbridge to Heuston West by following the vertical profile of proposed track. The proposed outfall for the new attenuation tank between Heuston West Station and Clancy Quay is the Liffey River. Attenuation includes an attenuation tank facility designed to retain storm water volumes up to 1 in 100-year flooding level of

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				Liffey River (3.47m), plus 30% climate change allowance. An upgrade to slab track is proposed in the Phoenix Park Tunnel, which will require a dedicated drainage system. The current catchment area at the tunnel and its portals will not be modified by the proposed track works and therefore, the generated runoff volumes will not increase. Based on this, the existing drainage strategy along the track will be retained but the current water collection system will be upgraded for the proposed slab section. In line with the above, the existing discharge rate and outfall location of this drainage network at the River Liffey will be retained. The proposed Project will not hinder implementation of measures outlined in the 2nd Cycle RBMP. The proposed works will have a slight positive effect on the subject waterbodies significant

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				pressures and will not prevent the attainment of Good Ecological.
Royal Canal Main Line (Liffey and Dublin Bay) (IE_09_AWB_RCMLE)	Good	No EPA Identified Pressures. Pressures likely include Urban Run Off, Urban Waste Water and Industry.	Actions to address pollution from urban waste-water and urban runoff are set out in section 7.2.3 of the 2nd Cycle RBMP. Actions to address industrial pressures are set out in section 7.7 and 7.8 of the 2nd Cycle RBMP.	The main risk to the proposed Project would be the pluvial flooding from Royal Canal in the vicinity of the Twin Arch Bridges (OBO8 and OBO9). The railway crosses underneath the Royal Canal in Cabra, Dublin. There is proposed track lowering in this location. The existing drainage catchment between the Phoenix Park Tunnel and Royal Canal and Luas Twin Arch (OBO8) and Maynooth Line Twin Arch (OBO9) will remain as existing, and therefore, runoff flows will not be increased as result of the proposed works. There is no need for additional attenuation structures and the existing drainage strategy will be retained in the area. Therefore, the only drainage works for this track section include reinstating the existing drainage

EPA River Waterbody Name (EPA River Waterbody Code)	Ecological Status	Significant Pressures1	River Basin Management Plan (RBMP) Measures	Does the proposed DART+ South West Project prevent the achievement of the subject watercourses WFD Objectives?
				elements according to the new track levels. The existing pumping station located between the Royal Canal and Luas Twin Arch (OBO8) and Maynooth Line Twin Arch (OBO9) will be upgraded by increasing the existing wet well chamber dimensions. This increase in size will allow holding the additional volumes collected by the drainage system. The proposed wet well will deal with the extra volume collected by the system whilst maintaining current pumping flows. The proposed Project will not hinder implementation of measures outlined in the 2nd Cycle RBMP. The proposed works will have a negligible effect on the subject waterbodies significant pressures and will not prevent the attainment of Good Ecological Potential.

10.5.2.4. Impact on Hydromorphology

The River Camac was noted to be under hydromorphological pressures due to channelisation in the 2nd Cycle WFD assessment. However, the proposed Project will not directly impact on the main river channel. Similarly, there are no proposals to alter or divert any culverts or have instream works in the Study Area. Impacts to hydromorphology of the Camac and other watercourses are deemed to be imperceptible.

10.6. Mitigation Measures

The following mitigation measures have been identified which form part of the Construction Environmental Management Plan (CEMP) (see Volume 4, Appendix 5.1). The CEMP presents the approach and application of environmental management and mitigation for the construction phase of the proposed Project. Prior to any demolition, excavation or construction, the CEMP will be updated by the successful contractor.

10.6.1. Construction Phase

During construction the following mitigation measures are proposed to mitigate the potential for sediment or other pollutants to enter watercourses and drainage systems. These are based on the CIRIA Guideline Document C532 Control of Water Pollution from Construction Sites (CIRIA, 2001) and Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016), which the contractor is required to adhere to during the construction phase.

- Site works will be minimised and managed insofar as possible to prevent silty runoff from entering watercourses and drainage systems;
- Surface water drainage on site will be controlled by construction of temporary berms and drainage channels;
- There will be no direct discharge of surface water from any element of the works without suitable attenuation and treatment;
- Settlement tanks/ponds, silt traps/bags and bunds will be used to control sediment loading to watercourses;
- Where pumping of water or dewatering occurs, temporary sumps will be installed with filters at inlets and discharged through a sediment trap which would desilt water before discharging to an outfall;
- The Contractor will ensure protection measures will be put in place to ensure that all hydrocarbons used are appropriately handled, stored and disposed of; the Contractor will prepare and adhere to a Fuel Management Protocol and communicate the contents to all staff (via induction / toolbox talks);
- Storage of fuel, oils and chemicals on an impermeable base, away from drains and watercourses. Fuel storage areas should be bunded to provide adequate retention capacity in the event of a leak or spillage occurring e.g. bund to 110% of volume of the largest container for static tanks or a drip tray for mobile stores. All ancillary equipment such as hoses, pipes are contained within the bund;.

- Foul drainage from all welfare facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution.
- Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water;
- When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used;
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Project Ecologist (Ecological Clerk of Works (ECoW));
- The contractor will monitor weather forecasts for heavy rain and where required, certain works and in particular excavations or concrete pours will cease to minimise contaminants entering surface water run-off.
- Wheel wash or similar washing facilities are installed, these will be located on an impermeable surface, and water will be passed through a silt buster or other appropriate surface water management mechanism prior to discharge;
- Refuelling of plant and vehicles on impermeable surfaces, away from drains and watercourses; provision of spill kits at high risk and/or sensitive sites;
- The Contractor will provide method statements for weather and tide/storm surge forecasting and continuous monitoring of water levels in all watercourses (in particular the Hazelhatch and Shinkeen streams which have the highest probability of flooding). The Contractor will also provide method statements for the removal of site materials, fuels, tools, vehicles, and persons from flood zones in order to minimise the risk to persons working on the site as well as potential input of sediment or construction materials into the river during flood events.

The Contractor is responsible for pollution prevention for the duration of the contract and until such time as permanent measures, such as permanent drainage and silt mitigation controls, are deemed to be adequate and appropriately constructed.

Prior to works commencing on site, the Contractor will prepare a Pollution Prevention Plan (PPP) in line with the below requirements (as a minimum) and will communicate the contents to all staff (induction / toolbox talks). The PPP covers all potentially polluting activities, considering good practice standards. The Contractor is to provide the PPP to the Employer prior to start of works on site.

The Contractor will also prepare an Environmental Incident and Emergency Response Plan which will detail the controls to be adopted to manage the risk of pollution incidents and procedures to be followed in the event of any pollution incidents based on mitigation from the EIAR and NIS and implementation of best practice.

10.6.2. Operational Phase

During the operational stage the drainage strategies and infrastructure as previously described in Section 10.4.2.6 and Table 10.10 will limit the risk to watercourses and the hydrological environment from flooding and runoff contamination.

Iarnród Éireann will also follow and implement its flood risk management operational procedures which assist in managing flood risk for rolling stock during inclement weather and flooding events, these include:

- CCE-TMS-311 - Irish Rail Weather Management Procedures (2017)
- CCE-TEB-2014-05 - Guidance On Alerts And Service Restrictions During Adverse Weather Events; and
- CME-TMS-001-008 - Operation Of IE RU Rolling Stock On Flooded Track (2016)

These procedures specify how Iarnród Éireann:

- Monitors and disseminates applicable weather warnings from Met Éireann;
- Prepares and implements local weather management plans for predicted adverse weather events;
- Set out recommended flood level limits for their rolling stock passing over flooded tracks; and
- Set out actions to be undertaken by duty managers, drivers, signallers etc when high water alerts are issued.

Operational limits have been specified for the different rolling stock (i.e. types of trains) within their fleet, as shown in Figure 10-13. The limits have been set in order to avoid damage to critical onboard equipment and to mitigate against the risk of a train becoming disabled in a flooded area. The limits are also such to change depending on the track and weather conditions. It is important to note that no trains may operate over flooded track until permitted to do so by Iarnród Éireann's Infrastructure Department. The EMU is the type of rolling stock of primary concern for this study. The maximum limit identified within the procedure for the EMU is the top of the railway track. A typical railway track is approximately 170mm deep from ground level.

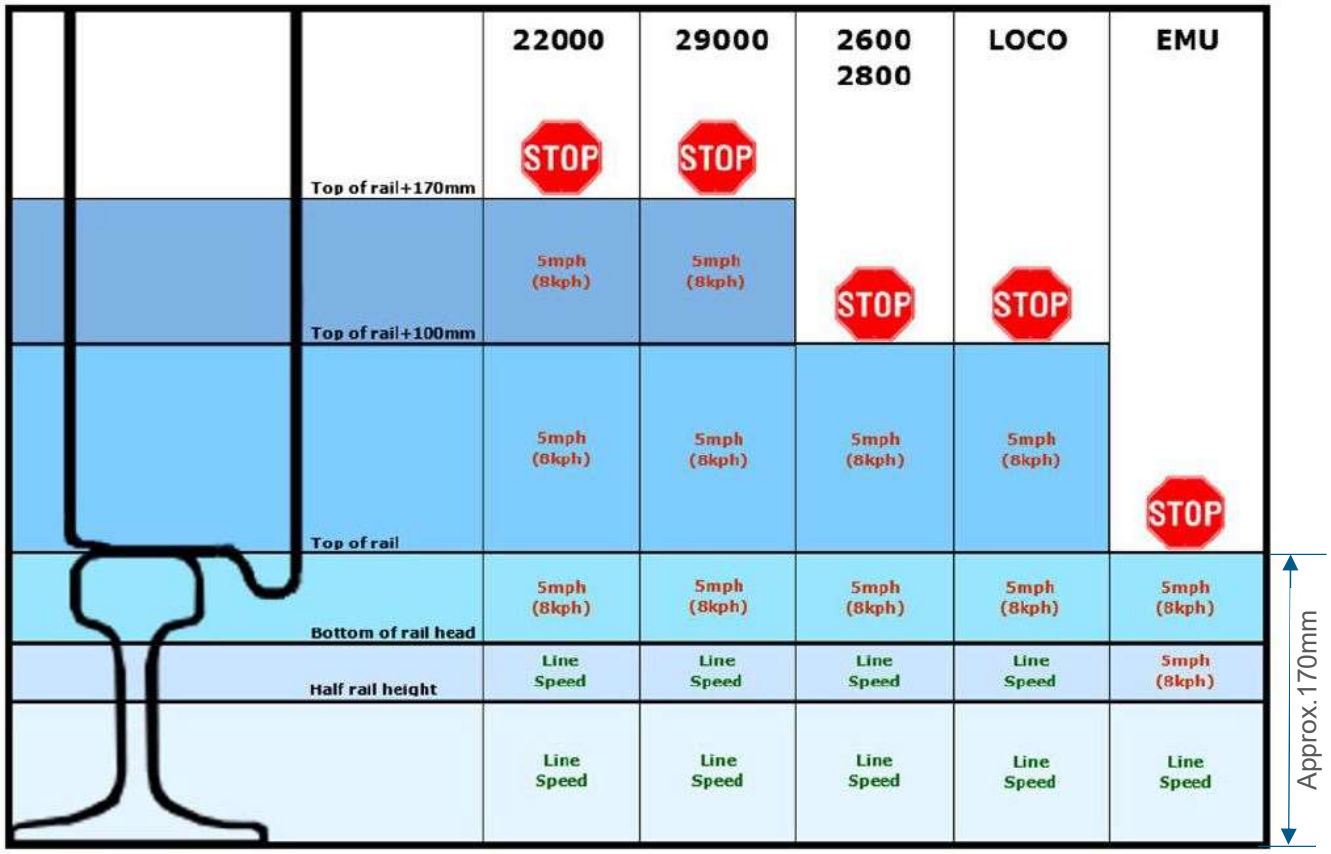

Figure 10-13 Iarnród Éireann RU Rolling Stock Operating Procedure on Flooded Track Condition

10.7. Monitoring

Water quality monitoring should be undertaken in the Royal Canal and all watercourses within the Study Area, with monthly samples being taken from at least 12 months prior to commencement of construction until at least 24 months post-completion. Additional sampling points if required can be determined by the Site Environmental Manager. The results of the water quality monitoring programme will be reviewed by the Site Environmental Manager and ECoW on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken were the this is deemed to be associated with the proposed Project.

It is expected that the OPW and EPA will continue to monitor water levels in the Hazelhatch Stream, Griffeen River and River Camac. The Marine Institute also has a tidal gauge at Dublin Port which can be monitored. Any unforeseen changes in extreme water levels or increased frequency can be risk assessed in the context of the scheme design.

The drainage systems including new underground attenuation tanks serving the proposed Project must continue to function as designed. Maintenance of the new underground attenuation tanks and other drainage features will be in accordance with manufacturer recommendations.

10.8. Residual Effects

The residual hydrological impacts associated with the Project following the implementation of the mitigation measures are outlined below.

10.8.1. Water Quality

During the operational and construction stages the project drainage design, mitigation measures and infrastructure will limit the risk to watercourses and the hydrological environment from flooding and runoff contamination. Therefore any residual effects will be a negative, slight, temporary residual impact on water quality.

10.8.2. Flood Risk

Similar with the flood risk management mitigation measures and operational procedures in place during the construction and operational phases, it is expected they will limit flood risk and any residual risks will be a negative, slight, temporary impact.

10.9. Cumulative Effects

The cumulative assessment of relevant plans and projects is undertaken separately in Chapter 26 of this EIAR.

10.10. References

CIRIA (2001). *Control of Water Pollution from Construction Sites. Guidance for Consultants and Contractors*. CIRIA C532. London.

Environment Agency UK (2020). *Land contamination risk management (LCRM): How to assess and manage the risks from land contamination*.

Department of Environment, Heritage and Local Government (DEHLG) (2009). *The Planning System and Flood Risk Management – Guidelines for Planning Authorities*..

Department of Housing, Local Government and Heritage.(DHLGH) (2021). *Draft River Basin Management Plan 2022 – 2027*.

Environmental Protection Agency (EPA) (2017) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports..

Inland Fisheries Ireland (IFI) (2016) *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*..

National Roads Authority (2009). *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*..

National Roads Authority (2008). '*Environmental Impact Assessment of National Road Schemes – A Practical Guide'*.

Office of Public Works (OPW) (2017). *Eastern CFRAM Study, HA09 Hydraulics Report IBE0600Rp0027*

Office of Public Works (OWP) (2009). *The Planning System and Flood Risk Management Guidelines for Planning Authorities*.