

**An Bord Pleanála Oral Hearing**

**Irish Water**

**Greater Dublin Drainage**

**Brief of Evidence**

**Hydrology and Hydrogeology**

**Kieran O'Dwyer**

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**Qualifications and Role on the Proposed Project**

- 1 My name is Kieran O'Dwyer, I hold a degree in civil engineering from University College Dublin (1981).
- 2 I have over 35 years' experience in environmental and hydrogeological consultancy (J. B. Barry and Partners (JBB), WYG and K. T. Cullen) and I am currently an Associate Director with JBB with responsibility for the environment side of the business.
- 3 I worked with Kevin T Cullen and Co. Ltd (Hydrogeological and Environmental Services consultants) from graduation (1981) becoming a director and shareholder until the company was acquired by WYG in 2001. I was a regional director of WYG Ireland and was responsible for the groundwater development branch (Hydrogeology) of the environmental consultancy. In 2007, I joined J B Barry and Partners as an associate director. I have managed the environmental element of numerous infrastructure projects throughout Ireland (including the Ringsend Wastewater Treatment Plant (WwTP) Upgrade Project and the Associated Regional Biosolids Facility, The Lesotho Highlands Water Project, the N81 Route Selection Study and Merville Greencastle Sewerage Scheme Planning Application and EIAR)
- 4 I have been responsible for the groundwater element and hydrological element of numerous Environmental Impact Assessments (including TII Tranche 4 Motorway Service Areas (3 No.), NRA Tranche 2 Motorway Service Areas (5 No. oral hearings) and Ringsend WwTP Upgrade Project) and have presented specialist evidence on hydrogeology/groundwater at numerous oral planning hearings. I have also provided expert witness testimony relating to hydrogeology and hydrology in the High Court and District Court.
- 5 I have presented technical papers on hydrogeology to Engineers Ireland and the International Association of Hydrogeologists as well as providing workshops on groundwater vulnerability to various local authorities and the Environmental Protection Agency (**EPA**).
- 6 I am directly responsible for the hydrological and hydrogeological aspects of the Environmental Impact Assessment Report (EIAR). I was assisted by my colleague Anne Marie Conibear for the hydrology aspect.

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**Relevant Environmental Impact Assessment Report References**

- 7 Impacts and mitigation relating to hydrogeology and hydrology for the terrestrial elements of the Proposed Project excluding the Regional Biosolids Storage Facility (RBSF) are addressed in Chapter 17 Hydrology and Hydrogeology in Volume 3 Part A of the EIAR.
- 8 Flood Risk Assessment has been carried out and was submitted as part of the planning application.
- 9 Other documents submitted as part of the planning application relevant to Hydrology and Hydrogeology are.
- Greater Dublin Drainage Project - Outline Construction Environmental Management Plan; and
  - Greater Dublin Drainage -Outline Construction Environmental Management Plan Appendix 3: Surface Water Management Plan.
- 10 The detailed methodology adopted for the hydrological and hydrogeological impact assessment is described in Section 17.2 in Chapter 17 in Volume 3 Part A of the EIAR and the general approach adopted for the assessment is summarised as follows:
- The existing baseline environment was described in terms of its attributes. Data were gathered from desk studies, site visits, public consultation and domestic well surveys;
  - Importance criteria were selected for attributes that reflect the hydrological and hydrogeological environments;
  - The attribute importance was evaluated on the basis of the existing baseline data and the selected importance criteria;
  - The magnitude of impacts of the Proposed Project (during both the Construction Phase and Operational Phase) on these attributes were determined on the basis of duration, the proportion of the attribute that was impacted
  - The likely significance of the impact was assessed on the basis of the magnitude of the impact and the importance of the attribute being assessed;
  - Mitigation measures to minimise these impacts were proposed; and
  - The residual and cumulative impacts were then reassessed.
- 11 The assessment considered the potential impacts on the hydrological (surface water excluding coastal) and hydrogeological (groundwater) environments during the Construction Phase and Operational Phase, through desk based studies, field surveys, questionnaires, and public consultations. The main watercourses relevant to the Proposed Project are:
- Tolka River;
  - Santry River;
  - Mayne River (and its tributary the Cuckoo Stream); and
  - Sluice River.

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- Baldoyle Estuary.
- 12 The potential impact on groundwater aquifers was also assessed. The aquifers underlying the Proposed Project area are classified (by the Geological Survey of Ireland) as poor to locally important. There are no regionally important aquifers in the vicinity of the project.
- 13 The existing quality of the surface water in the vicinity of the Proposed Project is generally poor to moderate.
- 14 The assessment found that a number of potential impacts are possible during both the Construction Phase and Operational Phase of the Proposed Project. The potential Impacts, proposed mitigation and residual impacts of the proposed project on hydrology and hydrogeology are summarised in Tables 17.9 and 17.10, Chapter 17 Hydrology and Hydrogeology in Volume 3 Part A of the EIAR.
- 15 During the Construction Phase, the water quality of some of the watercourses could potentially be affected from surface water runoff containing fine sediments, river crossing activities required for installation of the pipeline, dewatering activities, and accidental spillages and leakages of construction materials.
- 16 During the Operational Phase, potential impacts on the quality of surface water and groundwater are associated with the potential for accidental spillages of wastewater or chemicals, and leakages or pipe bursts.
- 17 A number of measures are proposed for the Construction Phase and Operational Phase to reduce or avoid quality impacts to surface water and groundwater receptors, namely:
- Careful planning and implementation of best practice measures for the avoidance of pollution and implementation of the Construction Environmental Management Plan;
  - Avoiding construction works in the main watercourses identified for the purposes of pipeline installation and tunnelling underneath them instead ;
  - The placement of barriers along sewers and watercourse crossings to prevent physical damage to the banks and beds of watercourses; and
  - The tunnel for the proposed outfall pipeline beneath the Portmarnock peninsula will be in rock. The bedrock is overlain by impermeable boulder clay which prevents any hydraulic connection between the shallow sand/gravel aquifer and the bedrock. The tunnel/pipe will be sealed to prevent quality impacts on groundwater. There will be no impact on the wells abstracting from the shallow aquifer.
  - Adherence to the measures in the outline Construction Environmental Management Plan (incorporating CIRIA's (2006) Control of water pollution from linear construction project, Technical Guidance (C648)).
- 18 Flood risk was also considered within the assessment and flood risk assessment reports were provided as part of the application for permission.
- 19 The flood risk assessment concluded that neither the Construction nor Operational Phase of the proposed WwTP or Abbotstown pumping station will affect flooding risk, for the following reasons:
- Vulnerable infrastructure (i.e. the proposed WwTP and proposed Abbotstown pumping station sites) will be located within Flood Zone C – low risk, and thus are not at flood risk.

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- The proposed WwTP and Abbotstown pumping station will be located in an area of low fluvial flood risk (referred to as Flood Zone C) and consequently the sites will not alter the storage or conveyance characteristics of potentially affected water courses.
- All construction site compounds, storage areas and launch pits (for trenchless technologies) will be located, where possible, within Flood Zone C – low risk. The shafts/construction fronts for any trenchless technologies will be located beyond the floodplain of the summer peak flood of an appropriate return period (1 in 20 years).
- Sustainable Urban Drainage Systems (SUDS) principles for the appropriate management of surface water runoff. attenuation will restrict the runoff to the existing greenfield rate.
- The flow regime in nearby water courses will not be altered. The rates of runoff will remain the same after construction. The Proposed Project will not exacerbate flooding in the surrounding area.

20 On the basis that all the above mitigation measures will be effectively implemented, the development of the project will result in there being no remaining negative direct indirect or cumulative impacts.

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**Table 17.9 Summary of Impacts and Mitigation – Hydrology**

Impacts and Mitigation – Hydrology							
	Potential Impact	Attribute Importance	Impact Duration and Quality	Impact Magnitude	Impact Significance	Mitigation Proposed	Residual Impact
Proposed WwTP	Flooding of site	Low	-	None	None (site in Flood Zone C – low risk)	-	None
Proposed Abbotstown Pumping Station	Flooding of site	Low	-	None	None (site in Flood Zone C – low risk)	-	None
Proposed Orbital Sewer Route	Flooding of site	Low	-	None	None. Pipelines are not vulnerable to flooding	Construction sites/launch pits will be located beyond the floodplain of the summer peak flood of 1:20 return period.	None
Cuckoo Stream Tolka, Santry, Mayne and Sluice Rivers	Increased risk of flooding (Construction)	Medium	Negative temporary	Small adverse	Slight	<p>During the Construction Phase, pipeline installation in known floodplains and near water courses will follow the below procedures:</p> <ul style="list-style-type: none"> <li>• Immediately remove/dispose of surplus material off-site,</li> <li>• Provide drainage within soil bunds to reduce the influence upon the surface runoff pathways of flood water,</li> <li>• Avoid direct discharge of surface water from any temporary impervious area to the nearby watercourse without proper attenuation,</li> <li>• Provide temporary attenuation ponds if the stream to which surface water from the construction area is discharged has limited capacity.</li> <li>• Not disturb ground or construction within Flood Zones A and B.</li> </ul> <p>Embedded mitigation:</p> <p>SUDS principles for management of surface water runoff at the proposed WwTP and Abbotstown pumping station sites will be located in Flood Zone C. Trenchless crossings of the main watercourses. Proposed pipeline routes located below river/stream bed levels so not to cause an obstruction to flow</p>	Imperceptible
	Increased risk of flooding (Operational)	Medium	-	None (embedded mitigation)	None	None	None
Cuckoo Stream, Tolka, Santry, Mayne and Sluice Rivers	Possible surface water contamination due to accidental spillage or contaminated site runoff	Low	Negative permanent	Moderate adverse Increased risk of possible impact on part the attribute	Slight	<p>Strict compliance with CIRIA's (2006) <i>Control of water pollution from linear construction projects. Technical Guidance (C648)</i>.</p> <p>PCP, SECP, ERP and MS will be drafted in agreement with Inland Fisheries Ireland and other relevant authorities and having regard to relevant pollution prevention guidelines.</p> <p>Puddle clay or other impermeable barriers at intervals shall be installed along the proposed orbital sewer route, particularly either side of a watercourse and launch pit.</p>	Imperceptible
Baldoyle Estuary SAC	Possible surface water contamination due to accidental spillage or contaminated site runoff	Very high	Negative permanent	Negligible	Imperceptible.	Strict compliance with CIRIA's (2006) <i>Control of water pollution from linear construction projects. Technical Guidance (C648)</i> .	Imperceptible

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**Table 17.10 Summary of Impacts and Mitigation - Hydrogeology**

Impacts and Mitigation – Hydrogeology							
	Potential Impact	Attribute Importance	Impact Duration and Quality	Impact Magnitude	Impact Significance	Mitigation Proposed	Residual Impact
<b>Aquifer Classification – importance of the groundwater resource to a given area</b>	Reduction in the resource available. Aquifer is poor or locally important throughout	Low to medium	None	None	None	-	None
<b>Public Supply Wells</b>	Deterioration of yield and quality	-	-	-	None. No public supply wells or Zones of Contribution nearby	-	None
<b>Domestic and Private Wells</b>	Deterioration of yield and quality due to alteration in the groundwater flow regime or accidental spillages migrating to aquifer due to construction dewatering (temporary) or the development of preferential pathways along proposed pipeline routes.	Low/very low	Negative and temporary	Negligible The area is supplied by mains water.  Only a small proportion of the aquifer will be affected.	No permanent abstraction from or discharge to groundwater as part of proposed scheme.  Slight/Imperceptible impact in the unlikely event of a domestic well being contaminated. However, domestic wells in the area are generally not used as there is mains water supply throughout.	Puddle clay or other impermeable barriers at intervals shall be installed along the proposed pipeline routes, particularly either side of a watercourse. Monitoring of local wells during any short-term construction dewatering during pipeline installation.  Strict compliance with the CIRIA's (2006) <i>Control of water pollution from linear construction projects. Technical Guidance (C648)</i> .  PCP, SECP, ERP and MS will be drafted in agreement with relevant authorities and having regard to relevant pollution prevention guidelines  The pipeline will be constructed of ductile steel or high-density polyethylene with welded joints which will reduce the risk of leaks and failure. Concrete pipes will not be used.	Imperceptible
<b>Portmarnock Peninsula Irrigation Wells</b>	Saline intrusion compromising water quality. Interference with the flow regime and water table compromising yields.	Medium	Negative permanent	None (embedded mitigation)	None	Embedded mitigation by design (avoidance). Proposed outfall pipeline route (marine section) will be tunnelled beneath Baldoyle Estuary and Portmarnock Golf Club. Tunnelling will be carried out in the bedrock only. There is a layer of clay between the bedrock aquifer and the sand gravel aquifer from which the irrigation wells abstract. Pipe will be grouted to prevent the possibility of preferential flow pathways. As there will be no abstraction or discharge along the line of the pipe, there will be no alteration the flow regime or quality.  Drive shaft at Portmarnock will be constructed using piling to avoid the necessity to dewater.	None
<b>Baldoyle Estuary SAC</b>	Contamination	Very high	-	-	None in terms of hydrogeology. Addressed under hydrology.	-	None

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**Responses to Issues Raised in Submissions/Observations**

- 21 The submissions made in relation to Hydrology and Hydrogeology and the response to each submission are detailed in Chapter 17 of Irish Water's "Response to An Bord Pleanála dated January 2019" document.
- 22 The principal Issues in the submissions received by An Bord Pleanála were related to flooding and the contamination of water bodies.

**Issues Raised by Prescribed Bodies**

- 23 Two of the submissions from prescribed bodies (HSE and Fingal County Council) made references to hydrology and hydrogeology issues.

**Submission**

- 24 The submission from the HSE states that the possibility of accidental spillage needs to be considered, particularly of fuel and oil that can enter the groundwater system and that mitigation measures for such spillages should be included in the EIAR.
- 25 The HSE also submitted a review report by Roughan O'Donovan in which they state that the Flood Risk Assessment has not made any allowance for the Abbotstown Stream. 2 confirmed flood events at the location of the Unit 8 centre and proposed construction compound. The compound and access shaft are therefore vulnerable to flooding during the approx. 1-year period of construction. When St. Francis' was constructed this stream was diverted through 2 sharp bends which has constricted it. A I-D hydraulic model of the Abbotstown Stream previously assessed by Roughan O'Donovan indicates that the water levels in the stream will exceed the bank levels at a number of locations resulting in flooding to the adjacent lands during the 1 in 1000-year fluvial event, including a 20% allowance for climate change. Due to the limitations of I-D modelling and the complex nature of the floodplain within the hospital campus, the full extent and depth of flooding in the campus; they request a detailed 2-D flood risk assessment should be carried out as noted above or the culvert should be significantly upgraded.

**Response**

- 26 Accidental spillages are addressed in the EIAR. The mitigation measures are listed in Volume 3 Part A Chapter 24, Table 24.13. An Outline Construction Environmental Management Plan (CEMP) has been submitted with the planning application. Proposals to manage surface water and groundwater are described in Chapter 4.2. and Appendix 3: Surface Water Management Plan. Site operation will conform strictly to CIRIA's (2006) Control of water pollution from linear construction project, Technical Guidance (C648). On the basis that the proposed mitigation will be implemented there are no impacts on water quality.
- 27 With regard to the flooding issues identified,
- Irish Water met with HSE following its submission and confirmed that trenchless techniques will be employed in the vicinity of the hospital.
  - A mitigation by avoidance approach was adopted in relation to Connolly Hospital. The pipeline will be tunnelled for 1 Km in the vicinity of the hospital to the Abbottstown Pumping Station. This will ensure that there is no effect on the flow in the water courses in the vicinity.

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- The temporary (6 months) shafts/construction fronts for any trenchless technologies will be located beyond the floodplain of the summer peak flood of an appropriate return period (1 in 20 years) (*Flood and Reservoir Safety* (Institute of Civil Engineers UK 2015));
- The proposed Abbotstown pumping station site is located in an area which is significantly higher than the water surface level of the Tolka River (in excess of 6m). All compounds will be situated in Flood Zone C (above the 1 in 1000-year fluvial event) and will incorporate stormwater runoff attenuation.

28 The construction of the pipeline and Abbottstown Pumping Station will have no effect on the surface water flow regime in the area and consequently there will be no increase in flooding risk. Consequently, there is no requirement for any additional modelling as interaction with the surface water flow regime has been avoided.

Submission

The Fingal County Council submission recommended 6 no. conditions relating to Hydrology and Hydrogeology.

- (a) *The Proposed Projects at Abbotstown PSI OCU @ MH07 and the treatment works at Clonsaugh shall incorporate SUDS (Sustainable Urban Drainage Systems) in the surface water design. Applicants are referred to the "Greater Dublin Region Code of Practice for Drainage Works. Version 6.0, April 2006", Section 16. Prior to construction, the applicant shall submit details of the proposal, including details of the SUDS devices (soakaways, swales, permeable paving, filter drains, storage ponds, roof gardens, etc.), drainage pipework details, with calculations as appropriate.*
- (b) *All culverts shall be designed in accordance with "Culvert Design Guide" Report 168 by CIRIA, latest revision or its replacement, and shall also comply with the recommendations of the OPW. Design calculations are to be submitted.*
- (c) *The Developer shall apply to the OPW to obtain permission under Section 50, Arterial Drainage Act 1945, for culverting of any watercourse.*
- (d) *The applicant will examine his proposals for the River Mayne crossing headwalls and submit revised details which include safety features.*
- (e) *No surface water/rainwater shall discharge into the foul sewer system under any circumstances.*
- (f) *The surface water drainage shall be in compliance with the "Greater Dublin Regional Code of Practice for Drainage Works Version 6.0" FCC April 2006.*

Response

29 Irish Water has no difficulty should the Board decide to attach the conditions recommended by Fingal County Council in this regard.

General Issues Raised in Submissions

30 6 no. submissions received from the public referred to Hydrology and Hydrogeology. Of these, 3 submissions were of a very general nature and 3 were more specific.

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Issue #1 – Risk of Flooding

31 Meakstown Community Council raised the general issue of flooding:

Issue #2 – Contamination of Water Bodies

32 Submissions made by Dolores Higgins and Gillian Cleary raised the general issue of possible contamination of water bodies.

Response to General Issues

33 Impacts and mitigation relating to hydrogeology and hydrology for the terrestrial elements of the GDD are addressed in Volume 3 Part A Chapter 17 - Hydrology and Hydrogeology.

34 Flood Risk Assessment (FRA) has been carried out and was submitted as part of the planning application.

35 Other documents submitted as part of the planning application relevant to Hydrology and Hydrogeology are.

- Greater Dublin Drainage Project - Outline Construction Environmental Management Plan;
- Greater Dublin Drainage -Outline Construction Environmental Management Plan (CEMP). Appendix 3: Surface Water Management Plan.

36 The mitigation measures are detailed in Chapter 17.5 and 17.7 of the EIAR and the outline Construction Environmental Management Plan and summarised in Sections 17 and 19 above..

37 The planning application and EIAR has addressed the general issues of groundwater body contamination and flooding and on the basis that the mitigation measures in the EIAR and the Outline Construction Management Plan are adopted there will be no increase in the risk of flooding and no discernible impact on groundwater bodies.

Specific Issues Raised in Observers Submissions

Flooding and the Proposed WwTP

38 The submission of Thomas. P. Broughan T.D. contends that that the area "immediately east of the proposed WwTP site is a region which ranges from a moderate to an extreme vulnerability classification" and that the Mayne River catchment is already prone to flooding and that sites marked for historical flooding incl. Stockhole Lane and Balgriffin are only a few hundred metres north east and directly east of the proposed WwTP site. The submission does not agree with the conclusion that no discernible impacts will result from the Proposed Project on the existing flood regime as the Cuckoo Stream and the Mayne River are hydrological linked.

*Response*

39 The moderate to extreme vulnerability classification in Chapter 3.2 of the Flood Risk Assessment refers to the vulnerability of the underlying groundwater aquifer to potential contamination and not to flooding. Irish Water wishes to clarify that the EIAR and flood risk assessment was focused on whether the construction of the Proposed Project would result in any perceptible impact on the existing Hydrological Environment. It is acknowledged that Stockhole Lane and Balgriffin are only a few hundred metres north east and directly east of the proposed WwTP site and that they are prone to flooding and that the Cuckoo Stream and the Mayne River are hydrologically linked. As a result of the site selection process, the proposed WwTP site

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is restricted to Fluvial Flood Zone C (above the 1000-year flood level) and consequently will not affect the conveyance channel or flood plain storage during a flood event. Note that Flood Zone C is where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Zone C is all parts of the country that lie outside Zones A and B. Accordingly, the development of the Proposed Project will not affect the existing flood risk in the vicinity of the WwTP as there will be no change to the channel cross section and flood plain.

- 40 Sustainable Urban Drainage Systems principles will be implemented for the appropriate management of surface water runoff. The drainage systems will be designed in accordance with the "Greater Dublin Region Code of Practice for Drainage Works. Version 6.0, April 2006", Section 16. Surface drainage from the proposed WwTP and the proposed Abbotstown pumping station will be attenuated to greenfield runoff rates and will make allowance for climate change.
- 41 Attenuation will restrict the runoff to the existing greenfield rate and consequently the Proposed Project will not exacerbate flooding in the surrounding area. There will be no discernible impacts from the Proposed Project on the existing flood regimes. The response of the Cuckoo Stream and the Mayne River to specific storm events will be the same in the future as it is now.
- 42 The application documentation and the Environmental Impact Assessment Report has fully addressed the issues raised and it is concluded that there will be no significant adverse flooding impacts as a result of the Proposed Project.

[Flooding and the Proposed Construction Compounds](#)

*Submissions*

- 43 The submission from Philip Swan outlined that flooding is an issue in the area already and many could not get house insurance in the past due to living on a flood plain. Flooding stops cars entering Portmarnock from Station Road and Baldoyle Road. The submission also states that the FRA only refers to areas where construction will be carried and does not consider surrounding areas including Baldoyle Bay SPA and SAC.
- 44 The submission from Sabrina Joyce Kemper states that "the areas where it is proposed to place the construction compounds at the coast will be built are subject to flooding. The flood prediction maps in the event of a 0.1% AEP and 0.5% AEP, the area where the compounds will be, would be subject flooding during a storm surge during high tide. In this event compound 10 which are extensive in size would become flooded" and that in the event of such a flooding event the escape of bentonite or hydrocarbons could result in pollution of the Baldoyle estuary.

*Response*

- 45 The application documentation addresses the issues raised in the documents and sections listed in paragraph 33, 34 and 35 above.
- 46 The EIAR and flood risk assessment was focused on whether the construction of the Proposed Project would result in any perceptible impact on the existing Hydrological Environment.
- 47 The construction of proposed temporary construction compound no. 10 within the coastal flood plain will not exacerbate coastal flooding in the vicinity. Coastal flooding is dictated by sea level in extreme events. Removal of coastal flood storage will not increase the flood levels. Predicted flood levels will remain the same.

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- 48 It is acknowledged that proposed temporary construction compound no. 10 (east of Baldoyle Bay in Portmarnock) is located in an area that is subject to coastal flooding. The construction compound is temporary and will only be used for 12 months. The excavation of the tunnel drive/receptor shaft in Portmarnock will be excavated using piling techniques which will hydraulically seal off the shaft from the shallow water bearing sands/gravels. In order to prevent flooding of the receptor shaft the piles will be cut off above the 0.1% AEP level (3.44 mOD). This will prevent flood waters from a 1 in a 1000 year flooding event from entering the shaft.
- 49 The storage of bentonite, solvents fuel and hydrocarbons on the compound 10 site will strictly comply with the mitigation measures proposed in the planning documents. In addition, all bentonite, solvents fuel and hydrocarbons will be stored above the 0.1% AEP (1 in a 1000 year) level. Raised areas for storage will be created if required.
- 50 The mitigation measures in Section, 17.6.1 and Table 17.7 in Chapter 17 in Volume 3 Part A of the Environmental Impact Assessment Report and those outlined above will protect the water quality in surrounding water bodies.

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**Conclusion**

51 The mitigation of the potential impacts on the hydrological and hydrogeological environments has been considered in the site selection, the design and the construction and site management elements of the project.

- Vulnerable infrastructure (i.e. the proposed WwTP and proposed Abbotstown pumping station sites) will be located within Flood Zone C – low risk, and thus are not at flood risk.
- The proposed WwTP or Abbotstown pumping station and temporary construction compounds will be located in an area of low fluvial flood risk (referred to as Flood Zone C) and consequently the sites will not alter the storage or conveyance characteristics of potentially affected water courses.
- The proposed WwTP or Abbotstown pumping station and temporary construction compounds shall incorporate Sustainable Urban Drainage Systems (SUDS) principles for the appropriate management of surface water runoff as per "Greater Dublin Region Code of Practice for Drainage Works. Version 6.0, April 2006", Section 16. Attenuation (including allowance for climate change) will restrict the runoff to the existing greenfield rate. The rates of runoff will remain the same after construction. The Proposed Project will not exacerbate flooding in the surrounding area.
- River crossings and the construction of the pipeline for 1 km in the vicinity of Connolly Hospital will be carried out using trenchless technology. This will ensure that the pipeline is isolated from the nearby watercourses below the river/stream bed thus preventing any obstruction to flow.
- The shafts/construction fronts for any trenchless techniques will be located beyond the floodplain of the summer peak flood of an appropriate return period (i.e. 1 in 20 years) as per *Flood and Reservoir Safety* (Institute of Civil Engineers UK 2015));
- The tunnel for the proposed outfall pipeline beneath the Portmarnock peninsula will be in rock, The bedrock is overlain by impermeable boulder clay which prevents any hydraulic connection between the shallow sand/gravel aquifer and the bedrock. The tunnel/pipe will be sealed to prevent quality impacts on groundwater. There will be no impact on the wells abstracting from the shallow aquifer..
- The outline Construction Environmental Management Plan details best practice measures for the avoidance of pollution and management of water on the construction sites and incorporates measures outlined in the CIRIA publication *Control of water pollution from linear construction projects. Technical Guidance (C648)* (CIRIA 2006);
- The temporary Construction Compound No.10 at Portmarnock incorporating the drive shaft for the outfall tunnel is within the costal flood plain. In order to prevent pollution in the event of a tidal flood the storage of bentonite, solvents fuel and hydrocarbons on the compound 10 site will strictly comply with the mitigation measures proposed in the planning documents. In addition, all bentonite, solvents fuel and

I have reviewed the submissions relating to hydrology and hydrogeology and reiterate the conclusions and assessments in the Environmental Impact Assessment Report. On the basis that the mitigation measures described in the EIAR and Outline Construction Environment Management Plan are incorporated there will be no significant impacts on the hydrological and hydrogeological environments during the Construction and Operation of the Proposed Project.