

Environmental Impact Assessment Report (EIAR)

Volume 6 of 6: Appendices

(Appendix 4.1) Operational Strategy

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Acronyms and Abbreviations

Acronym	Meaning
AOD	Above Ordnance Datum
BPS	Booster Pumping Station
BPT	Break Pressure Tank
CP	Cathodic Protection
CWT	Clear Water Tank
CWST	Clear Water Storage Tank
DAF	Dissolved Air Flotation
EIAR	Environmental Impact Assessment Report
ESB	Electricity Supply Board
FCV	Flow Control Valves
GDA WRZ	Greater Dublin Area Water Resource Zone
HLPS	High Lift Pumping Station
Mld	Megalitres per day
mAOD	Metres Above Ordnance Datum
NOMC	National Operations Management Centre
PLC	Programmable Logic Controller
PSSR	Pressure Systems Safety Regulations
PWWC	Passive Wedge-wire Cylinder
RWI&PS	Raw Water Intake & Pumping Station
RWBT	Raw Water Balancing Tank
RWPS	Raw Water Pumping Station
RWRM	Raw Water Rising Mains
SAC	Special Area of Conservation
SCADA	System Control and Data Acquisition
SIL	Safety Integrity Level
SPF	Set Point Flow
SuDS	Sustainable Drainage Systems
TPR	Termination Point Reservoir
TWL	Top Water Level
UPS	Uninterrupted Power Supply
UV	Ultra Violet
UWWEST	Used Washwater Equalisation and Settlement Tank
WTP	Water Treatment Plant
WwTP	Wastewater Treatment Plant

1. Introduction

1. This Appendix (A4.1) to Chapter 4 Proposed Project Description of this Environmental Impact Assessment Report (EIAR) provides a high-level outline of the Operational Strategy and Control Philosophy for the Water Supply Project Eastern and Midlands Region (the 'Proposed Project') post construction and commissioning.
2. This Appendix should be read in conjunction with Chapter 4 of this EIAR. Figures which are referenced in the text are provided in Volume 5 of this EIAR.
3. The aims of the Proposed Project, taking account of the Regional Water resources Plan – Eastern and Midlands, (the Eastern and Midlands Plan) (Irish Water 2022) are to:
 - Provide a sustainable water supply from a New Shannon Source
 - Address critical supply issues in the Greater Dublin Area with provision for future supplies to multiple Water Resource Zones in the Region
 - Increase resilience of supplies and Levels of Service
 - Deliver a flexible, future-proofed solution that is responsive to change.
4. To achieve these aims the Proposed Project has been developed to deliver a long-term sustainable water supply source for the Eastern and Midlands Region, to meet the water demand from residential and commercial development until the year 2050. A raw water abstraction consent of 300Mld is being sought to cover the operational requirements of providing up to 280Mld of treated water in 2050, with a provision of a further 20Mld to allow for potential future sustainability reductions from existing supply volumes.

2. Proposed Project Overview

5. The Proposed Project is a water supply pipeline involving the abstraction and pumping of raw water from the Lower River Shannon at Parteen Basin; treatment of the water nearby at Birdhill, County Tipperary; and pumping of the treated water to a high point near Cloughjordan, County Tipperary and on through the Midlands to a termination point at Peamount, in County Dublin (within the administrative area of South Dublin County Council), where it would connect into the existing Greater Dublin Area Water Resource Zone (GDA WRZ) network.
6. In total the pipeline would be approximately 172km in length and would be supported by six permanent Infrastructure Sites, of varying sizes and purposes. The pipeline would traverse the administrative areas of Tipperary County Council, Offaly County Council, Kildare County Council and South Dublin County Council. In addition, the works needed to provide power to two of the Infrastructure Sites (referred to as the 38kV Uprate Works and described in Section 4.14) would cross Clare County Council, Limerick City and County Council, (as well as Tipperary). Therefore, six Local Authorities are partly within the Planning Application Boundary.
7. The Proposed Project includes the following:
 - Abstraction of raw water from Parteen Basin on the Lower River Shannon downstream of Lough Derg and the towns of Ballina and Killaloe
 - A Raw Water Intake and Pumping Station (RWI&PS) on the eastern shore of Parteen Basin would facilitate a maximum abstraction of up to 300Mld, during peak demand periods from the Lower River Shannon, downstream of Lough Derg
 - Two steel pipelines, approximately 2km in length, and each 1,500mm in diameter, referred to as the Raw Water Rising Mains (RWRMs). These would transfer raw water from the RWI&PS to a Water Treatment Plant (WTP) near Birdhill, County Tipperary and each pipe would be capable of transferring raw water up to a maximum throughput of 300Mld
 - The WTP would provide the infrastructure needed to clean the water to drinking standards and the capacity to pump the water through the Treated Water Pipeline
 - Approximately 170km of 1,600mm diameter single steel pipeline, comprising:
 - Treated Water Pipeline from the WTP to a Break Pressure Tank (BPT) near Cloughjordan, County Tipperary, approximately 37km long
 - Treated Water Pipeline from the BPT to the Termination Point Reservoir (TPR) at Peamount, County Dublin, approximately 133km in length.¹
 - The TPR would have a capacity of 75 megalitres (MI) and would provide the location for the Proposed Project to connect into the existing drinking water network
 - Pipeline infrastructure including a Break Pressure Tank (BPT) near Cloughjordan, County Tipperary; a Booster Pumping Station (BPS) east of Birr, County Offaly; and a Flow Control Valve (FCV) south of Newtown in County Kildare, approximately 5km west of the TPR
 - Operational ancillary infrastructure at frequent intervals along the length of the pipeline including Line Valves, Air Valves, water discharge points (referred to as “Washouts”), access points (referred to as Manways), parking Lay-Bys for maintenance access and power connections to the Line Valves.

¹ A combination of pumping and gravity would be used to transfer water through the pipeline. Water would be pumped from the RWI&PS to the WTP and from the WTP to the BPT which is the high point along the pipeline. From the BPT, the water would usually flow by gravity along the remaining 133km to the TPR. However, at times when the volume of water needed is higher than approximately 165Mld, the water would be pumped through the whole length of the pipeline. The BPS provides the capacity to do this additional pumping when it is required.

- Power connections to the Infrastructure Sites² and Line Valves, including upgrading of the existing Ardnacrusha – Birdhill 38 kilovolt (kV) overhead line to deliver adequate electrical power to the RWI&PS and WTP and providing a new connection from a sub-station at Birr to the BPS
8. In addition to this infrastructure provision has been made for take-off points at strategic locations between the WTP and TPR. These would facilitate future potential connections to supply communities in the Midlands within the Water Supply Area³ without disruption to the operation of the pipeline. The location of these future potential connections align with the Eastern and Midlands Plan (Irish Water 2022). The connecting pipelines and associated infrastructure would be delivered by Uisce Éireann through separate projects, yet to be designed, and would be subject to their own separate consenting processes.
9. A graphical overview of the Proposed Project, including the locations of the water supply infrastructure and routing of the pipeline, is shown in Image 1.1. More detailed plans of the Proposed Project design are included in Volume 5 (Drawings and Figures) of this EIAR.

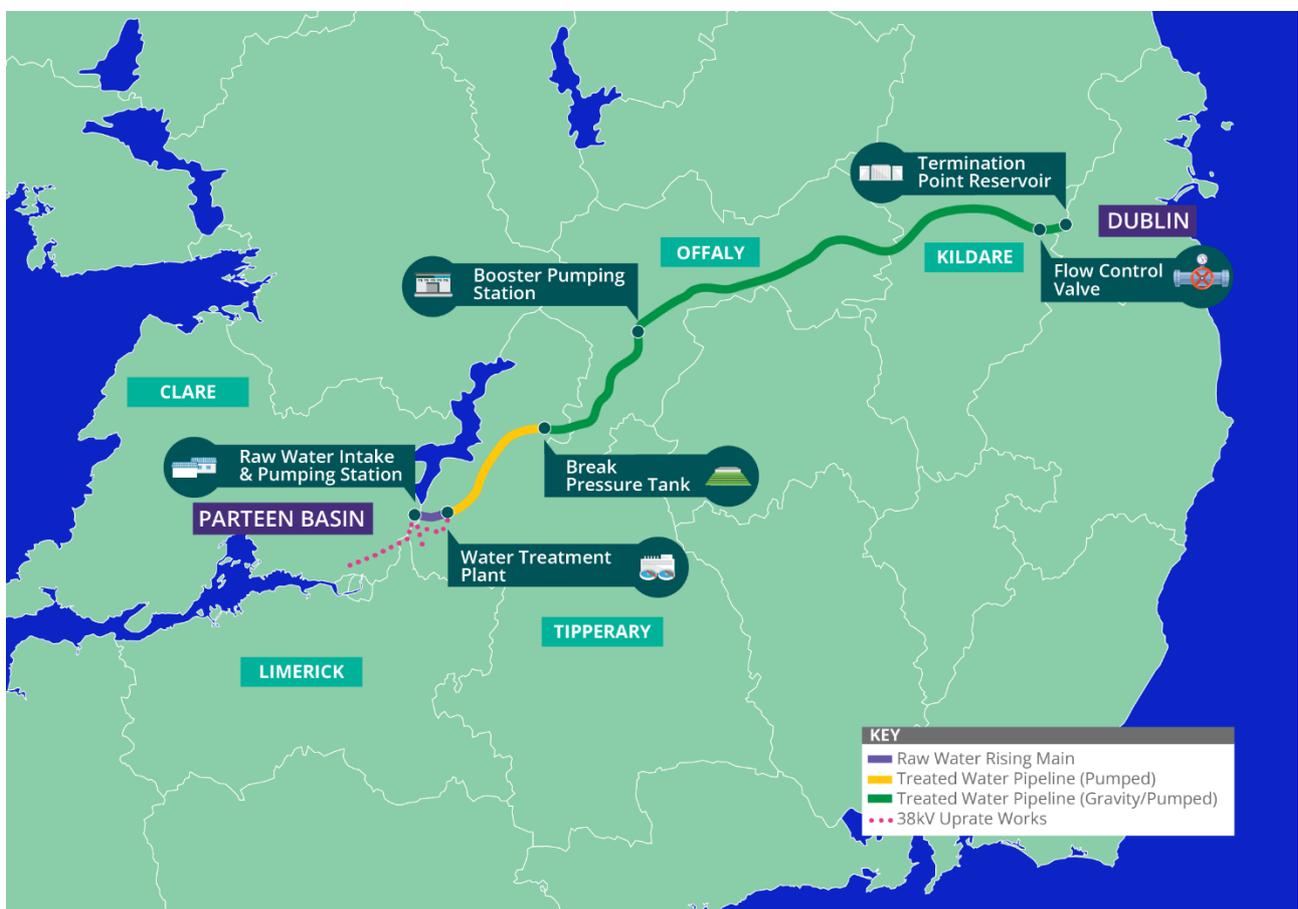


Image 1.1: Graphical Overview of the Proposed Water Supply Infrastructure

² Infrastructure sites' is the collective term that has been used for the RWI&PS, WTP, BPT, BPS, FCV and TPR.

³ The Water Supply Area is an area defined by the infrastructure and transfer pipeline, where the proximity of treated water supplies from the Proposed Project offers opportunities for potential future consolidation of existing smaller and more vulnerable public water supply schemes, in a resilient, well-supported configuration. Potential future connecting infrastructure would be subject to separate consenting processes.

10. Water would be pumped through the RWRMs from the RWI&PS to the WTP via the pumping station at the RWI&PS. After treatment the water would be stored in the Clear Water Storage Tanks (CWSTs) at the WTP. It would then be pumped approximately 37km through the Treated Water Pipeline to the BPT using the high lift pumps at the WTP. The BPT would be the high point along the pipeline and from there the water would usually flow by gravity along approximately 133km of the Treated Water Pipeline from the BPT to the TPR. However, at times when the volume of water needed is higher than approximately 165Mld supplementary pumping would be needed to achieve the required supply. The BPS would provide this additional pumping capacity to increase the flow within the Treated Water Pipeline between the BPT and the TPR.
11. Table 2.1 outlines a summary of the principal project infrastructure.

Table 2.1: Summary of Principal Project Infrastructure

Proposed Project Infrastructure	Outline Description of Proposed Project Infrastructure*
Permanent Infrastructure	
Raw Water Intake and Pumping Station (RWI&PS) (Infrastructure Site) County Tipperary	<ul style="list-style-type: none"> The RWI&PS would be located on a permanent site of approximately 4ha on the eastern shore of Parteen Basin in the townland of Garrynatineel, County Tipperary. In addition, approximately 1ha of land would be required on a temporary basis during construction. The RWI&PS has been designed to abstract enough raw water from the River Shannon at Parteen Basin to provide up to 300Mld of treated water by 2050. The RWI&PS site would include a bankside Inlet Chamber, the Raw Water Pumping Station Building, two Microfiltration Buildings, an Electricity Substation and Power Distribution Building, and Dewatering Settlement Basins. The tallest building on the RWI&PS site would be the Microfiltration Buildings which would be 10.9m above finished ground level. Additionally, there would be a telemetry mast, the top of which would be 14m above finished ground level. Power for the RWI&PS would be supplied via an underground connection to the existing Birdhill 38 kV electricity substation. A new permanent access road from the R494 would be constructed to access the proposed RWI&PS site. This access road would be 5m in width and 670m in length. The RWI&PS site boundary would be fenced with a stock proof fence and a 2.4m high paladin security fence 5m inside the boundary. The site would be landscaped in line with the surrounding environment to reduce its visual impact.
Raw Water Rising Mains (RWRMs) (Pipeline) County Tipperary	<ul style="list-style-type: none"> The RWRMs would consist of two 1,500mm underground pipelines made from steel that would carry the raw water approximately 2km from the RWI&PS to the Water Treatment Plant (WTP) at Incha Beg, County Tipperary. The water would be pumped from the pumping station at the RWI&PS to the WTP. Twin RWRMs have been proposed so that one RWRM can be taken out of service for cleaning and maintenance while still providing an uninterrupted flow of raw water through the other RWRM. The RWRMs would include Line Valves, a Lay-By, Air Valves and Cathodic Protection. A 20m wide Permanent Wayleave would provide Uisce Éireann with operational access to the RWRMs.

Proposed Project Infrastructure	Outline Description of Proposed Project Infrastructure*
<p>Water Treatment Plant (WTP) (Infrastructure Site) County Tipperary</p>	<ul style="list-style-type: none"> The WTP would be located on a permanent site of approximately 31ha at Incha Beg, County Tipperary, 2.6km north-east of the village of Birdhill, and 2km east of the proposed RWI&PS. In addition, approximately 2.5ha of land would be required on a temporary basis during construction. The WTP would treat the raw water received from the RWI&PS via the RWRMs. Once treated, the High Lift Pumping Station (HLPS) would deliver the treated water onwards from the WTP to the Break Pressure Tank (BPT) at Knockanacree, County Tipperary, via the Treated Water Pipeline. The WTP would comprise of a series of tanks and buildings including the Raw Water Balancing Tanks, Water Treatment Module Buildings, Sludge Dewatering Buildings, Sludge Storage Buildings, Clear Water Storage Tanks and HLPS, an Electricity Substation and Power Distribution Building, and the Control Building. The tallest building on the WTP site would be the Water Treatment Module Buildings which would be up to 15.6m above finished ground level. Additionally, there would be a telemetry mast, the top of which would be 14m above finished ground level. There would also be a potential future water supply connection point at the junction between the permanent access road and the R445. Power for the WTP would be supplied via an underground connection to the existing Birdhill 38 kV electricity substation. Solar panels would be placed on the roofs of the Chemical Dosing Manifold Building, the Water Treatment Module Buildings, Clear Water Storage Tanks and Sludge Storage Buildings, and at a number of locations on the ground to supplement the mains power supply. A new permanent access road from the R445 would be constructed and would be 6m in width and 640m in length. The WTP site boundary would be fenced with a stock proof fence and a 2.4m high palisade security fence 5m inside the boundary. The site would be landscaped in line with the surrounding environment to reduce its visual impact.
<p>Treated Water Pipeline from the WTP to the BPT (Pipeline) County Tipperary</p>	<ul style="list-style-type: none"> The Treated Water Pipeline from the WTP to the BPT would consist of a single 1,600mm underground steel pipeline which would be approximately 37km long. The water would be pumped through this section of the Treated Water Pipeline by the HLPS. The Treated Water Pipeline would include Line Valves, Washout Valves, Air Valves, Manways, Cathodic Protection and Lay-Bys. A 20m wide Permanent Wayleave would provide Uisce Éireann with operational access to the pipeline (this Wayleave has been extended to approximately 30m at some Line Valves to provide access between the Lay-Bys and Line Valves). There would be an additional 10m wide Permanent Wayleave at certain locations for operational access to smaller pipes connecting Washout Valves with permanent discharge locations.
<p>Break Pressure Tank (BPT) (Infrastructure Site) County Tipperary</p>	<ul style="list-style-type: none"> The BPT would be located on a permanent site of approximately 7ha in the townland of Knockanacree, County Tipperary. In addition, approximately 0.8ha of land would be required on a temporary basis during construction. The BPT would be located at the highest point of the pipeline. It marks the end of the Treated Water Pipeline from the WTP to the BPT and the start of the Treated Water Pipeline from the BPT to the Termination Point Reservoir (TPR) in the townland of Loughtown Upper, at Peamount, County Dublin. It would act as a balancing tank and would be required to manage the water pressures in the entire Treated Water Pipeline during flow changes, particularly during start-up and shut-down. The BPT site would include the BPT and a Control Building. The BPT would be a concrete tank divided into three cells covered with an earth embankment. The BPT tanks would be 5m in height and partially buried below finished ground levels. The Control Building would be 7.5m over finished ground level. Additionally, there would be a telemetry mast, the top of which would be 14m above finished ground level. Access to the BPT site would be via a new permanent access road from the L1064 which would be 5m wide and 794m in length. Power for the BPT would be supplied via an underground connection from the existing overhead power line. Solar panels would be placed on the south facing side of the control building roof, on the BPT and at ground level to the south of the site to supplement the mains power supply. The BPT site boundary would be bounded by the existing hedgerow / tree line with a 2.4m high palisade security fence around the permanent infrastructure. The site would be landscaped in line with the surrounding environment to reduce its visual impact.

Proposed Project Infrastructure	Outline Description of Proposed Project Infrastructure*
<p>Treated Water Pipeline from the BPT to the TPR (Pipeline)</p> <p>Counties Tipperary, Offaly, Kildare and Dublin (within the administrative area of South Dublin County Council)</p>	<ul style="list-style-type: none"> The Treated Water Pipeline from the BPT to the TPR would consist of a single 1,600mm underground steel pipeline, approximately 133km long. The water would normally travel through the Treated Water Pipeline by gravity; however, flows greater than approximately 165Mld would require additional pumping from the Booster Pumping Station (BPS) in the townland of Coagh Upper, County Offaly. The Treated Water Pipeline would include Line Valves, Washout Valves, Air Valves, Manways, Cathodic Protection, Lay-Bys and potential future connection points. A 20m wide Permanent Wayleave would provide Uisce Éireann with operational access to the pipeline (this Wayleave has been extended to approximately 30m at some Line Valves to provide access between the Lay-Bys and Line Valves). There would be an additional 10m wide Permanent Wayleave at certain locations for operational access to smaller pipes connecting Washout Valves with permanent discharge locations.
<p>Booster Pumping Station (BPS)</p> <p>(Infrastructure Site)</p> <p>County Offaly</p>	<ul style="list-style-type: none"> The BPS would be located on a permanent site of approximately 2.6ha in the townland of Coagh Upper, County Offaly. It would be located approximately 30km downstream from the BPT. In addition, approximately 3ha of land would be required on a temporary basis during construction. The BPS would be required when the demand for water causes the flow through the pipeline to exceed approximately 165Mld. The BPS site would consist of a single-storey Control Building with a basement below. It would have a finished height of 7.6m above finished ground level. There would also be a separate Electricity Substation and Power Distribution Building. Additionally, there would be a telemetry mast, the top of which would be 14m above finished ground level. Power to the BPS would be supplied from an existing 38 kV electricity substation at Birr, through cable ducting laid within the public road network. There would be ground mounted solar panels on the southern side of the BPS site to supplement the mains power supply. The site would be accessed directly from the L3003. The BPS site boundary would be fenced with a stock proof fence and a 2.4m high palisade security fence between 5m -12m inside the boundary. The site itself would be landscaped in line with the surrounding environment to reduce its visual impact.
<p>Flow Control Valve (FCV)</p> <p>(Infrastructure Site)</p> <p>County Kildare</p>	<ul style="list-style-type: none"> The FCV controls the flows in the Treated Water Pipeline from the BPT to the TPR. It would be a small permanent site of approximately 0.5ha in the townland of Commons Upper in County Kildare. In addition, approximately 0.6ha of land would be required on a temporary basis during construction. It would consist of three 700mm diameter FCVs and three flow meters installed in parallel with the Line Valve and housed within an underground chamber. Access to the FCV site would be directly off the L1016 Commons Road Upper. Power supply to the FCV site would be provided from the existing low voltage network via a combination of overhead lines and buried cables. There would be ground mounted solar panels on the north-eastern side of the site to supplement the mains power supply. Kiosks at the FCV site would house the Programmable Logic Controller, telemetry and power supply for the Line Valve. There would also be a telemetry mast, the top of which would be 14m above finished ground level. The site boundary would be fenced with a stock proof fence and a 2.4m high palisade security fence 5m inside the boundary.

Proposed Project Infrastructure	Outline Description of Proposed Project Infrastructure*
<p>Termination Point Reservoir (TPR) (Infrastructure Site) County Dublin (within the administrative area of South Dublin County Council)</p>	<ul style="list-style-type: none"> The TPR would be located on a permanent site of approximately 8.3ha adjacent to an existing treated water reservoir in the townland of Loughtown Upper, at Peamount, County Dublin (within the administrative area of South Dublin County Council) and would have capacity for 75ML of treated water supply. In addition, approximately 1.1ha of land would be required on a temporary basis during construction. It would be located at the downstream end of the Treated Water Pipeline from the BPT to the TPR and would be the termination point for the Proposed Project. It would be at this location that the Proposed Project would connect to the existing water supply network of the Greater Dublin Area Water Resource Zone (GDA WRZ). The TPR would consist of an above-ground storage structure, associated underground Scour Water and Overflow Water tanks and a Chlorine Dosing Control Building. The TPR would be a concrete tank divided into three cells and covered with an earth embankment. The top of the TPR would be 11.2m above finished ground level. The Chlorine Dosing Control Building would be 8.4m over finished ground level. Additionally, there would be a telemetry mast, the top of which would be 14m above finished ground level. Power for the TPR would be supplied via an underground connection to the existing electricity substation at Peamount Reservoir. There would be solar panels on top of a portion of the northern cell of the TPR to supplement the mains power supply. A new permanent access road from the R120 would be constructed and would be 5m wide and 342m in length. The TPR site would be bounded by the existing hedgerow to the west and existing fence to the east with a 2.4m high palisade security fence around the permanent infrastructure. The site itself would be landscaped in line with the surrounding environment to reduce its visual impact.
Proposed 38 kV Uprate Works – Power Supply to RWI&PS and WTP	
<p>Proposed 38 kV Uprate Works Ardnacrusha – Birdhill (Power Supply) Counties Clare, Limerick and Tipperary</p>	<ul style="list-style-type: none"> The proposed 38 kV Uprate Works would be necessary to deliver adequate electrical power to the RWI&PS and WTP. The proposed works would include the uprating of the existing Ardnacrusha – Birdhill Line and the replacement of polesets/structures with an underground cable along a section of the Ardnacrusha – Birdhill – Nenagh Line. There would also be works at the existing Birdhill 38 kV electricity substation including the provision of a new 38 kV Gas Insulated Switchgear Modular Building, new electrical equipment and lighting, together with new fencing and associated works.
Temporary Infrastructure – Required for Construction Phase Only	
<p>Construction Working Width Counties Tipperary, Offaly, Kildare and Dublin (within the administrative area of South Dublin County Council)</p>	<ul style="list-style-type: none"> A Construction Working Width would be temporarily required for the construction of the RWRMs and the Treated Water Pipeline, and the subsequent reinstatement of the land. The Construction Working Width would generally be 50m in width but would be locally wider near features such as crossings, access and egress points from the public road network, Construction Compounds and Pipe Storage Depots.
<p>Construction Compounds Counties Tipperary, Offaly, Kildare and Dublin (within the administrative area of South Dublin County Council)</p>	<ul style="list-style-type: none"> Eight Construction Compounds would be temporarily required to facilitate the works to construct the Proposed Project. Five Construction Compounds would be located along the route of the Treated Water Pipeline at the following Infrastructure Sites: RWI&PS, WTP, BPT, BPS and TPR, with an additional three Construction Compounds located at Lisgarriff (County Tipperary), Killananny (County Offaly) and Drummond (County Kildare). Construction Compounds would act as a hub for managing the works including plant/material/worker movement, general storage, administration and logistical support. The Principal Construction Compound at the WTP would require 30ha of land during construction. The other three Principal Construction Compounds would require land temporarily during construction ranging between approximately 12ha and 16ha. The four Satellite Construction Compounds at the other permanent Infrastructure Sites (excluding the FCV) would require land during construction ranging between approximately 3ha and 12ha.
<p>Pipe Storage Depots Counties Tipperary, Offaly and Kildare</p>	<ul style="list-style-type: none"> Nine Pipe Storage Depots would be temporarily required to supplement the Construction Compounds and would serve the installation of pipe between the WTP and the TPR. Pipe Storage Depots would take direct delivery of the pipe for storage before onward journey to the required location along the Construction Working Width. The Pipe Storage Depots would vary in size and require land temporarily during construction generally ranging between approximately 2ha and 7ha but with one site being larger at 11ha.

* Note all land take numbers in this table are affected by rounding to one decimal place.

2.1 Demand Requirements

12. In Spring 2021, Irish Water (now Uisce Éireann) published the National Water Resources Plan (NWRP) Framework Plan (Irish Water 2021). The NWRP (Irish Water 2021 and 2022) sets out how Uisce Éireann will balance the supply and demand for drinking water over the short, medium and long term. The 25-year strategy aims to ensure the supply of safe, sustainable, secure and reliable drinking water in Ireland.
13. The NWRP (Irish Water 2021 and 2022) consists of:
 - Phase 1: the NWRP Framework Plan (Irish Water 2021) (the 'Framework Plan') which set out the approach to identifying water supply needs and quantifying those needs up to the year 2044 which, following public consultation, was finalised and adopted in Spring 2021
 - Phase 2: comprising the development of four Regional Water Resources Plans to identify the optimal technical solutions (the 'Preferred Approaches') required to address the needs outlined in the Framework Plan (Irish Water 2021).
14. The NWRP Framework Plan (Irish Water 2021) identifies how Uisce Éireann assesses needs across water supplies and the process Uisce Éireann will use to find solutions to address those needs.
15. The NWRP Framework Plan (Irish Water 2021) identified, at a national level, that a new sustainable source of water is necessary to augment supplies in the Eastern and Midlands Region to address deficits in supply, increase the reliability of the current water supply system, and support future growth now and into the future.
16. The Eastern and Midlands Plan (Irish Water 2022) is the Regional Water Resources Plan (Irish Water 2022) relevant to the Proposed Project. The Eastern and Midlands Plan (Irish Water 2022) was adopted by Uisce Éireann in Autumn 2022 following public consultation, and applied the methodologies set out in the NWRP Framework Plan (Irish Water 2021) to identify the water supply needs of the Eastern and Midlands region and develop the preferred approaches to resolve them.
17. The Eastern and Midlands Plan (Irish Water 2022) identified that a New Shannon Source with transfers was the Preferred Approach to address the need of the Greater Dublin Area Water Resource Zone (GDA WRZ). Having identified the New Shannon Source as the Preferred Approach to meet the deficit in the GDA WRZ, the Eastern and Midlands Plan (Irish Water 2022) identified additional Water Resource Zones (WRZs) along the length of the pipeline and also adjacent to the GDA WRZ which had a deficit that could also be met from the New Shannon Source.
18. This establishes the need for the Proposed Project as it would deliver a New Shannon Source to meet the deficit in the GDA WRZ and provide for Take-Off Points along its length allowing for potential future connections into 18 other WRZs in the Eastern and Midlands Region. This would allow those 18 WRZs to be consolidated into four new WRZs. It would also facilitate the potential future supply to 17 other WRZs adjacent to the GDA WRZ through the re-distribution of supply within the GDA WRZ and an expansion of the GDA WRZ by incorporating these WRZs into the GDA Regional WRZ. The Take-Off points are those described in Chapter 4 (Proposed Project Description) and included in the Proposed Project.
19. As a result, the Proposed Project is a significant step towards delivering the Preferred Approach set out in the Eastern and Midlands Plan (Irish Water 2022).

20. Once completed, the Proposed Project infrastructure would provide the capacity to meet the needs of 36⁴ WRZs across the Eastern and Midlands Region in accordance with the Eastern and Midlands Plan (Irish Water 2022) (Irish Water 2022). It would do this by securing a new source of drinking water from the River Shannon at Parteen Basin. This would provide the capacity to supply up to 300Mld to the GDA WRZ and the Proposed Project's wider Water Supply Area. Overall, this volume of water would:
- Immediately meet the identified need for water within the GDA WRZ to 2050 and beyond
 - Enable the future supply to 17 other WRZs by re-directing supplies within the GDA WRZ and expanding the GDA WRZ by incorporating these WRZs into the GDA Regional WRZ, when future projects are brought forward by Uisce Éireann
 - Enable the future supply to a further 18 WRZs across the midlands from take-off points along the pipeline and facilitate the consolidation of those WRZs into four new WRZs, when future projects are brought forward by Uisce Éireann
 - Make provision for potential reductions in existing supply volumes due to sustainability requirements anticipated under the new abstraction licensing regime.
21. The volume of water that the Proposed Project must supply to meet the projected deficit for the Eastern and Midlands Region is referred to as the demand to be met and Image 2.1 shows the forecast demand requirements for the Proposed Project from 2019 to 2050. This was calculated based on the methodology set out in the Framework Plan (Irish Water 2021).

⁴ 37 WRZs were identified in the Regional Water Resources Plan Eastern and Midlands consisting of the GDA WRZ and 36 other WRZs. Subsequently Barndarrig WRZ and Redcross WRZ have been rationalised and combined and so the total is now 36 WRZ consisting of the GDA WRZ and 35 other WRZs.

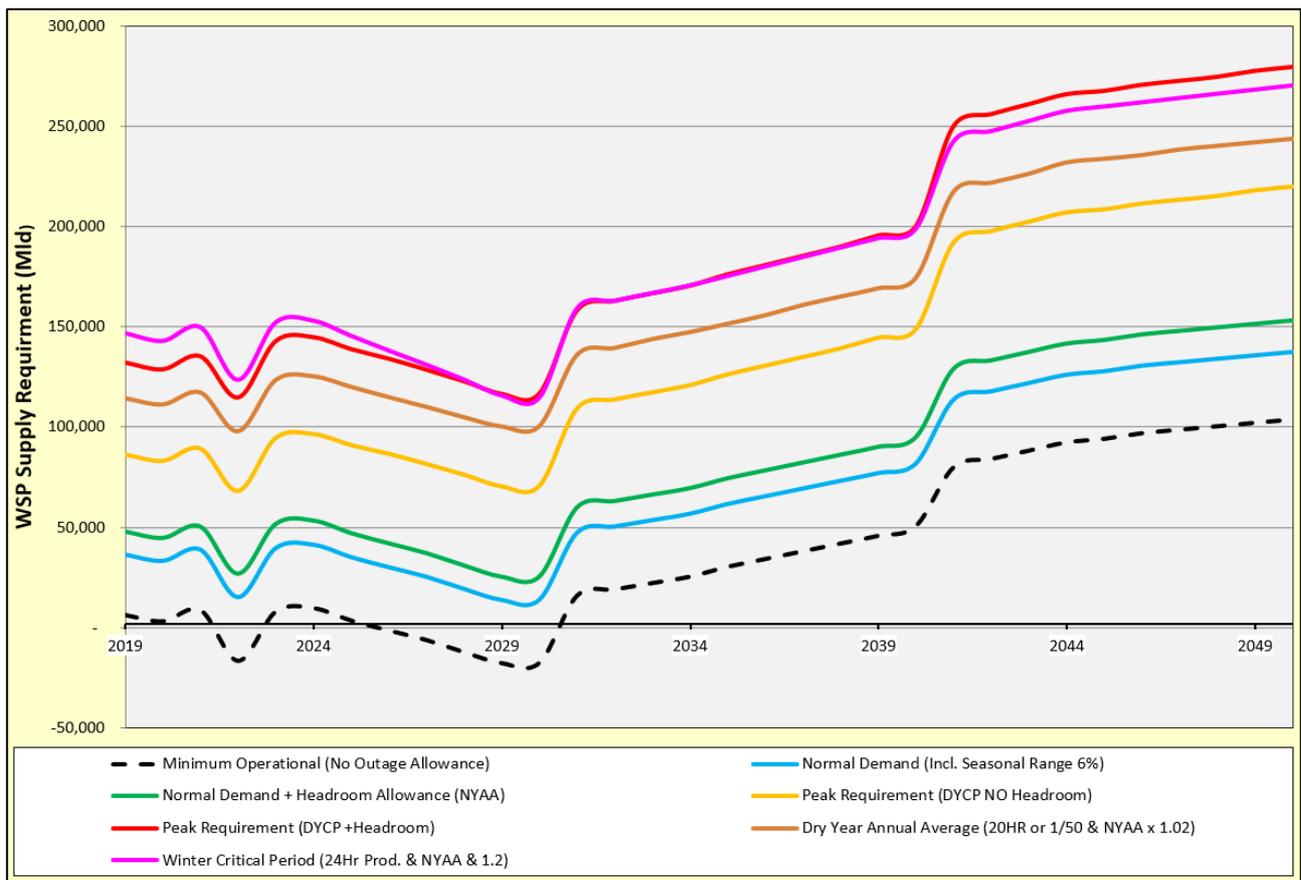


Image 2.1: Demand Forecasts for the Proposed Project

2.2 Control Philosophy

22. The Control Philosophy refers to how the flow of water through the pipeline would be controlled. This would effectively be done using a Set Point Flow (SPF) which determines the volume of water moving through the pipeline.
23. Uisce Éireann would predict the required daily output from the Proposed Project based on a forecast up to a week in advance. Relatively minor adjustments or refinements to the forecast would be made 12 hours in advance. The required output of water determines the SPF for a given day.
24. The Proposed Project output would then be controlled from the WTP however, the level in the BPT would be the active control level for the entire pipeline. The control systems main task would be to keep this level constant.
25. Between the RWI&PS and the WTP, the WTP would control the rate of abstraction and pumping at the RWI&PS and the treatment process at the WTP in order to provide the required SPF into the Clear Water Storage Tanks (CWSTs) at the WTP.
26. The flow between the WTP to the BPT, and then further east would be controlled by the rate of pumping at the HLPS which would also operate at the given SPF (although independently from the WTP, i.e. not trying to match the WTP usual minor fluctuations minor which would be managed using the operating range of the CWSTs). Therefore, the HLPS would pump the SPF to the BPT. It is expected that to optimise costs that the SPF over 24 hours would be achieved by pumping higher during periods of cheaper energy and lower during higher energy prices. It is envisaged that there would only be two or three flow changes in any 24 hour period with the average of all the flows delivering the SPF.

27. From the BPT to the TPR the flow in the pipeline and the level in the BPT would still be influenced by the rate of pumping from the HLPS but would be controlled by very fine adjustments to the opening of the FCV.
28. The BPS, when required at higher SPF rates, merely acts as an input of energy to allow flows greater than the maximum gravity flow to be achieved. The BPS pumps would not be able to control flow as precisely as the FCV. Therefore, the BPS would simply be set at the most efficient rate of pumping for the SPF within a given flow control band.
29. There would be no level control on the TPR (other than automatic shut down of the flows from the BPT in the event of a high-high level alarm), it merely receives water at the SPF rate. It is expected that the TPR level would follow a typical diurnal pattern of dropping during the day and recovering at night.
30. The SPF can be altered at any time but the following needs to then happen:
 - The WTP needs to adjust the abstraction, RWI&PS and WTP output to match the new set point
 - While this is happening the HLPS can be made to match the new SPF
 - The FCV would then notice the change in level in the BPT and adjust to match.
31. The time taken for the flow change to be seen from the HLPS to the TPR may be several minutes and the flow control loop would be set up accordingly to avoid pulsing and uncontrolled transients in the pipeline. The pressure transducers at every Line Valve would help in monitoring that stable conditions have been established.
32. In the event of a shutdown of the high lift pumps at the HLPS, then the flow to the TPR would have to be stopped to prevent the pipeline from draining. The communications to each of the valves to achieve this would be via the telemetry system.

2.3 System Control

2.3.1 Overview

33. The system control refers to how the system would be operated.
34. The overall pipeline system control would be from the central SCADA control. This would be located within the Control Building at the WTP and monitored at Uisce Éireann's National Operations Management Centre (NOMC).
35. The system control philosophy is to default to 'shut down' in the event of a high-water level or overflow at the BPT or TPR, or in the event of a communications failure between the Infrastructure Sites. Similarly, if the RWI&PS or WTP experience difficulties a signal would be sent to the BPT, TPR and BPS (as necessary) to shut down, to ensure the system remains primed.
36. Controls and monitoring of the pumps in operations, valve status, pressures, flow rates, BPT and TPR water levels would be the primary focus for operation. In addition, pressure and flow monitoring would need to be in place to alert SCADA Control Operators if there are sudden pressure drops or high flow peaks indicative of bursts. Image 2.2 outlines the proposed pipeline control system.

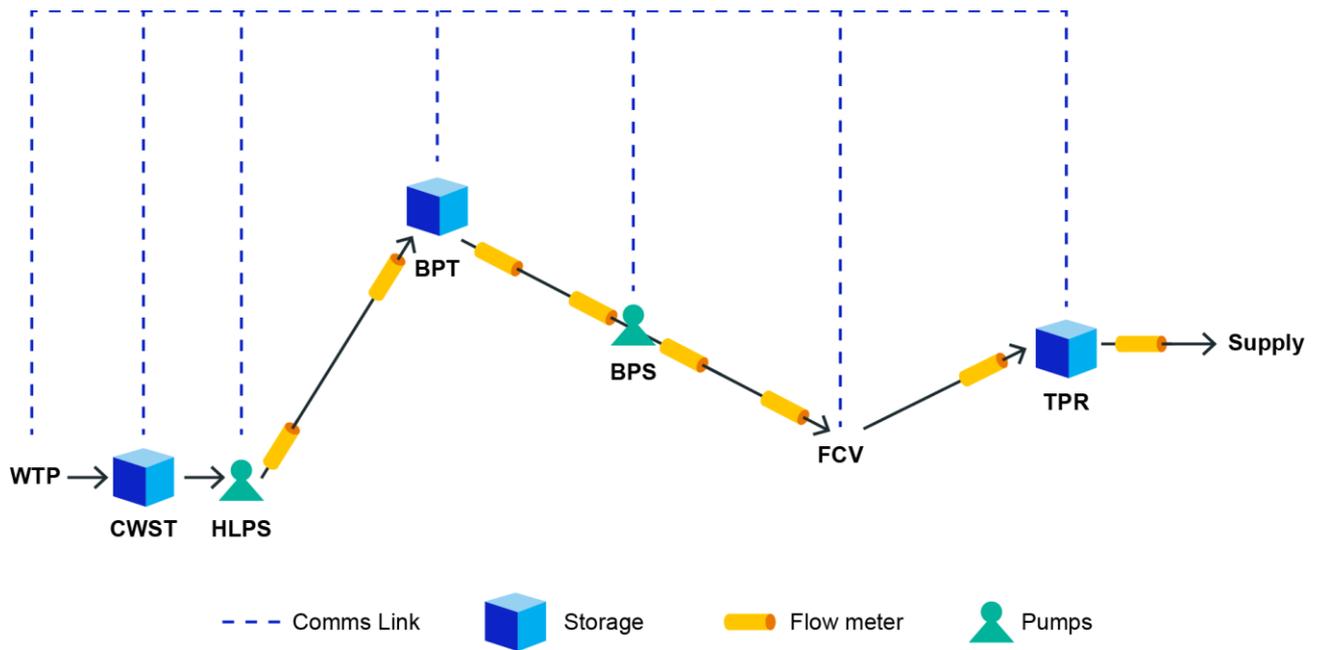


Image 2.2: Typical Pipeline Control System – Overview Schematic Diagram

37. In this system there are two key control loops:

- CWST to High Lift Pumps and Treated Water Pipeline from the WTP to the BPT
- Treated Water Pipeline from the BPT to the TPR.

2.3.2 Shut Down

38. In the event of a major pressure change or flow/levels being tripped (see for example, Section 3.6.3) then a shut down would automatically be initiated. This would also occur if there was a failure in the communications / telemetry system.

39. A controlled shut down of the pipeline from full gravity flow would take around 15 minutes after which the control system would prevent a restart attempt for up to 30 minutes to allow transient pressures to settle in the pipelines.

40. The shut down sequence from full pumped flow would take around 18.5 minutes after which the control system would prevent a restart attempt for up to 30 minutes to allow transient pressures to settle in the pipelines.

41. A start up sequence to the max gravity flow would take around 3 minutes.

42. A start up sequence to full flow would take around 18 minutes.

2.3.3 Electrical Power Supplies and SCADA

43. Mains electricity supply and SCADA would be required for the following sites:

- Intake
- RWPS
- WTP
- HLPS

- BPT
- BPS
- TPR
- Line Valves
- FCV.

44. All critical systems and actuated valves would be equipped with Uninterruptible Power Supplies (UPS) to ensure their continued safe operation and controlled shut down in the event of failure of the mains power supply. A battery back-up would allow safe control, monitoring and shut-down in the event of power failure.

45. Image 2.3 shows an extract from the Uisce Éireann communications strategy document which would inform the decision making for each site.

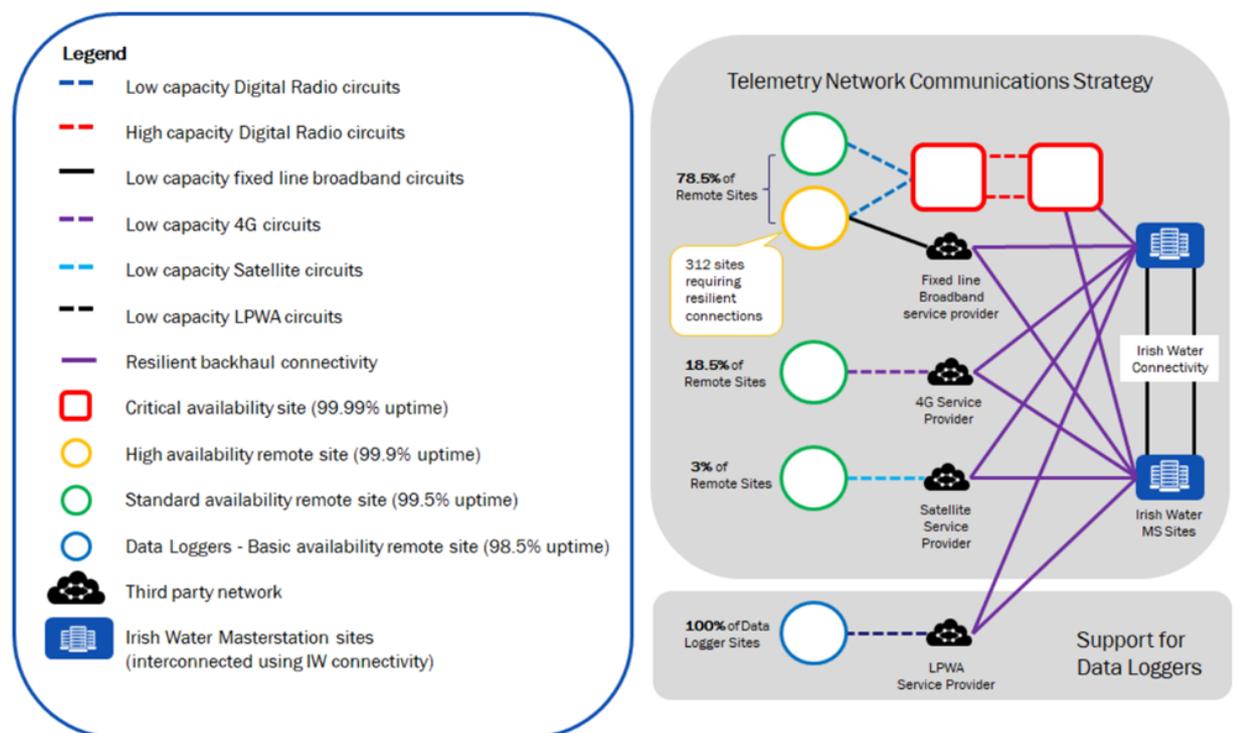


Image 2.3: Uisce Éireann Telemetry Network Communications Strategy

46. All the sites listed with the exception of the Line Valves would be proposed to be designated as “High Availability sites” and would have dual circuits with Digital Radio and broadband.

2.3.4 Flow Measurement

47. All input and output flows would be metered and communicated to the SCADA via a telemetry outstation.

48. Flow measurement of potable water would be obtained with electromagnetic flow meters.

49. Flow meters are required at the following locations:

- The outlet(s) from the HLPS (for delivery of treated water into supply) at the WTP
- Inlet and outlet to BPT
- The BPS

- The FCV
- Inlet to the TPR
- All future connections points from the supply main when they are ultimately brought into service.

50. With the above metering, it is possible to continually monitor for leakages or bursts on the pipeline. In the instance of an imbalance of 'flow in' versus 'flow out', an alarm is raised to alert the operators (located at the WTP and repeated to the NOMC) who can take appropriate action to shut down the pumps and isolate the main as necessary.

2.3.5 Pressure Monitoring

51. Pressure monitoring would be provided at the following:

- Pump suction and delivery
- Up and downstream of all control valves - FCV and potential future connection point valves, where required
- Either side of each Line Valve.

52. The purpose of monitoring pressures is to:

- Provide an integral part of the control system to safeguard the pumps and pipeline from over or under pressure
- Monitor the performance of pumps – check for concurrence with voltages, current and flow rates
- Monitor the performance of control valves – check for concurrence with monitored flow rates
- Monitor the performance of the pipeline – check for concurrence with flow rate
- To check that Line Valves are fully open
- To give early warning of a burst main.

53. In regard to the risk of a burst main, sudden drops in pressures would alert operators in the WTP control room, and repeated to NOMC via the SCADA system, who would then take action to shut down the pumps and pipeline and dispatch a call out for investigation.

2.3.6 Telemetry

54. Communications between the various Infrastructure Sites and the Line Valve sites would be via a telemetry system designed in line with Uisce Éireann's Telemetry Communications Strategy (Irish Water 2019) and would be a combination of the following:

- Digital radio (point to multipoint) – This is the preferred method of communications selected for the Infrastructure Sites and the actuated Line Valves, where the location is within the reach of the nearest digital radio backhaul site
- If digital radio is not suitable then 4G cellular would be used, provided that a signal strength of 'good' or better is available at the location with a 4G provider (suitable to Uisce Éireann)
- If digital radio is unavailable and there is not a suitable 4G signal strength, then a satellite connection would be provided.

2.4 Operational Overview and Management of Water Levels at Parteen Basin

55. ESB manages water levels on Lough Derg and controls the water levels on Parteen Basin by diverting water to Ardnacrusha power station for the production of zero carbon electricity, and by opening gates at Parteen Weir to release water down the old course of the River Shannon.

56. Parteen Basin is a small reservoir, built with earthen Embankment Dams along the south-western and south-eastern perimeter. It is fed from Lough Derg through the narrow river channel at Killaloe. ESB must ensure that the water levels at Parteen Basin do not exceed the maximum or minimum safety levels of those earthen Embankment Dams to avoid the risk of damage to the Dams.
57. ESB controls the water levels in Parteen Basin by closely matching the amount of water taken by Ardnacrusa and the Old River Shannon with the amount of water flowing into Parteen Basin each day.
58. The water levels on Lough Derg are managed within a Normal Operating Band 460mm (18 inches approximately) in depth, across a wide range of flows. It should be noted that 100mm of this operating band is usually reserved for emergency electricity generation and therefore, ESB seek to keep the water level within a 360mm range, above 30.50mAOD Malin Head (33.20mAOD Poolbeg).
59. At present, the normal water level on Lough Derg and on Parteen Basin is managed to be between the following limits:
 - Parteen Basin: Upper level 30.86mOD Malin Head (33.56mAOD Poolbeg). Lower level: 30.00mAOD Malin Head (32.70mAOD Poolbeg)
 - Lough Derg: Upper level 30.86mAOD Malin Head (33.56mOD Poolbeg). Lower level: 30.40mAOD Malin Head (33.10mAOD Poolbeg).
60. Parteen Weir acts as the downstream control structure for water levels in the system. Water levels in Parteen Basin are maintained within the upper and lower levels at all times. During low flow conditions, the lower water level at Parteen Basin (30.0mAOD Malin), must be maintained for dam safety purposes and in doing this ESB ensures that water levels in Lough Derg are within the Normal Operating Band as the waterbodies broadly operate as a combined system, in these conditions.
61. ESB also continually discharges a statutory flow of 10m³/s down the Old River Shannon. By selecting how many turbines are in operation each day, ESB can set how much water is diverted from Parteen Basin to the station daily. To generate its full electrical output, each hydro turbine at Ardnacrusa takes approximately 100m³/s (100 cubic metres per second or tonnes of water per second). With its four turbines at full output, Ardnacrusa can take a flow of up to 400m³/s.
62. When the inflow from Lough Derg into Parteen Basin is higher than 400m³/s, ESB must ensure that the extra water is discharged down the Old River Shannon to prevent the water level in Parteen Basin exceeding 30.86mAOD Malin Head (33.56mAOD Poolbeg). Gates at Parteen Weir are opened gradually to release the excess water to the old course of the River Shannon, to safely pass the excess inflow and return water levels to within the Normal Operating Band.
63. When the inflow from Lough Derg into Parteen Basin is less than 400m³/s, ESB keeps the water level within its Normal Operating Band by controlling how much water passes through the turbines. Using this control of water levels ESB's general practice is to maintain levels at the lower end of the Normal Operating Band in late autumn, in anticipation of higher inflow conditions across autumn and winter.
64. As winter comes to an end, ESB monitors the falling inflows along the length of the River Shannon before cutting back electricity generation in late spring with the general aim to retain water towards the upper end of the Normal Operating Band and to keep it in the upper end of the band through the summer. This is to enable sufficient water for the continual release, (if there is a dry summer), of the statutory flow of 10m³/s down the Old River Shannon alongside further electricity generation, if the inflows rise due to summer rainfall.

65. There are often periods of wet weather in the summer when inflows into Lough Derg will rise and increase the level at Lough Derg. As the inflows from Lough Derg arrives at Parteen Basin, ESB takes that additional water to increase generation at Ardnacrusha (up to 400m³/s). Once the flood flows in the river have passed and the more typical summer flows resume, ESB will normally return to managing water levels in Lough Derg towards the upper end of its Normal Operating Band.
66. In broad scale terms, approximately 90%–95% of the long-term average annual flow in the River Shannon at Parteen Weir (which is approximately 180m³/s), is directed through Ardnacrusha, with the minimum statutory compensation water flow of 10m³/s directed to the lower Shannon at Parteen Weir.
67. The proposed abstraction from the River Shannon would be located on the eastern shore of Parteen Basin, in the townland of Garrynatineel, approximately 3.3km north-east of the Parteen Weir. It is proposed to abstract up to a maximum of 3.47m³/s from Parteen Basin. This represents the projected peak deficit in a drought period, in 2050. Abstraction rates would vary during normal operation up to this maximum; however, more typical abstraction rates would be represented by the average deficit which is projected to be equivalent to 1.78m³/s in 2050.
68. At the maximum rate of abstraction the proposed abstraction of water would equate to a small fraction (approximately 2%) of the long term annual average flow through Parteen Basin.
69. The proposed abstraction of water is in essence, an abstraction from water normally used in the hydro-power plant, using the same existing water level controls, and therefore avoiding having to construct a new impoundment.
70. ESB will continue to maintain water levels as it does today, within its Normal Operating Band and therefore, ESB will facilitate the proposed abstraction of water by the Proposed Project within its current operating practices. As part of an overall agreement with ESB, water will be diverted to the Proposed Project abstraction from the flow that would otherwise have been used for electricity generation on a continuous year round basis. At a practical level, this will mean that ESB, in keeping the water level within the Normal Operating Band on Lough Derg and within the upper and lower water level on Parteen Basin, will take account of, and respond to, the volume of water abstracted for the Proposed Project, alongside other relevant considerations such as, maintaining statutory compensation flow of 10m³/s down the Old Shannon channel, predicted rainfall, the demand for power and operating practices. ESB will maintain the water levels within the Normal Operating Band on Lough Derg and within the upper and lower water levels on Parteen Basin, as it does currently. Over longer periods there would be a generalised adjustment of the flow going to Ardnacrusha by ESB to respond to the volume of water used by the Proposed Project. However, the operation of Lough Derg, post works, will feel and look very similar to the way it currently operates, and there will not be a visible day to day difference.
71. The minimum statutory compensation water of 10m³/s passed through Parteen Weir into the 'Old Shannon River' will remain unchanged and undiminished under this proposal. Navigation and beneficial uses focused on tourism will experience the same operating water level range as normal.

3. Operational Design Philosophy

72. This section sets out the high level operational philosophy for the principal elements of the Proposed Project.

3.1 Raw Water Intake

73. The Raw Water Intake facilitates the abstraction of raw water and therefore, in describing the operational philosophy all the flows referred to in Section 3.1, this section of the report, are raw water abstraction flows only. Subsequent sections refer to treated water flows (for infrastructure east of the WTP).

3.1.1 Raw Water Flows

74. At its full development, the Proposed Project is designed to abstract up to 300Mld from the River Shannon at Parteen Basin.

75. The RWI&PS arrangement is presented in Figure 4.61.

3.1.2 Passive Wedge-Wire Cylinder Intake Screens

76. Raw water would be abstracted through seven openings between the Parteen Basin and the Intake Chamber. There would be a 'bubble curtain' of compressed air on the inner side of that opening to discourage fish from entering the chamber.

77. The Intake Chamber would be fitted with three Passive Wedge-Wire Cylinder (PWWC) Intake Screens. The screens would be on the connection between the Intake Chamber and the Inlet Chamber. The screens would feed into three separate but interconnected Inlet Chambers, from which water would be drawn by the pumps, via a manifold suction pipe. A cross section of the Intake Chamber is shown in Image 3.1.

78. The PWWC Intake Screens would avoid debris and/or fish or eels being taken up into the raw water pumps. Intake velocities through the screen slots would be limited to 0.15m/s, the velocity at which juvenile fish can swim away without being trapped/held by the screen. They would be manufactured in a copper nickel alloy material. This material is unattractive to zebra mussel and would mitigate clogging of the screens through attachment of zebra mussels.

79. It is proposed that the screens and Inlet Chamber would operate on a two duty, one standby basis.

80. With the proposed duty / standby arrangement, it would be possible to take one screen out of service while still maintaining an uninterrupted flow through the pumping station.

81. The PWWC Intake Screens would be cleaned regularly using an air burst system. They can also be removed from the Intake Chamber for maintenance and cleaning. The screens can operate to the required capacity with up to 25% of their surface areas clogged.

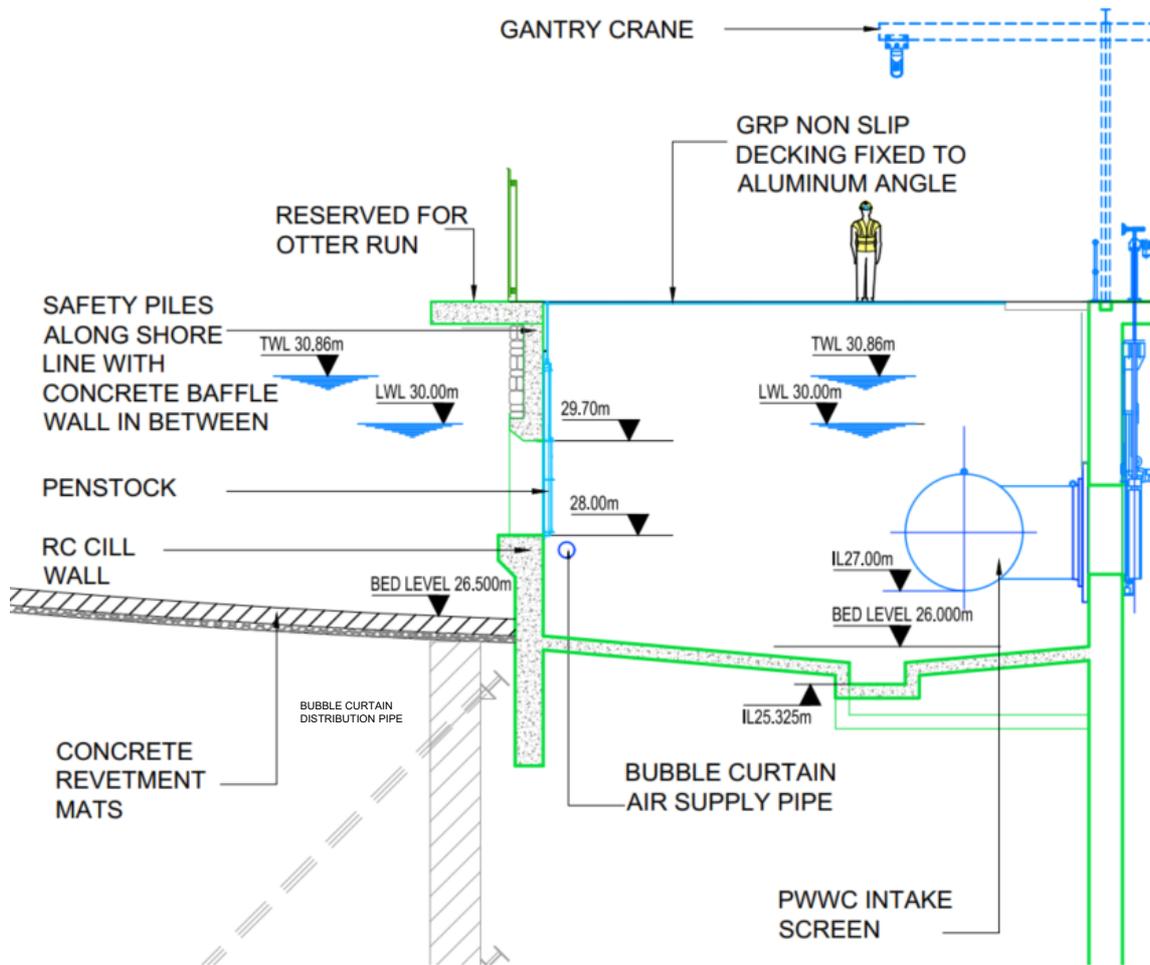


Image 3.1: Cross Section through Raw Water Intake Basin

3.1.3 Raw Water Pumping Station to WTP

82. At the substructure level, the RWI&PS would incorporate three interconnected Inlet Chambers, each of which can be isolated by penstocks. The arrangement of the Inlet Chambers and pump suction pipework would be such that the pumps would be able to draw water from any chamber or combination of chambers, allowing any one Inlet Chamber to be taken out of service for cleaning or maintenance without loss of intake capacity. The arrangement of penstocks, valves and pipework in the RWI&PS is shown in Image 3.2.

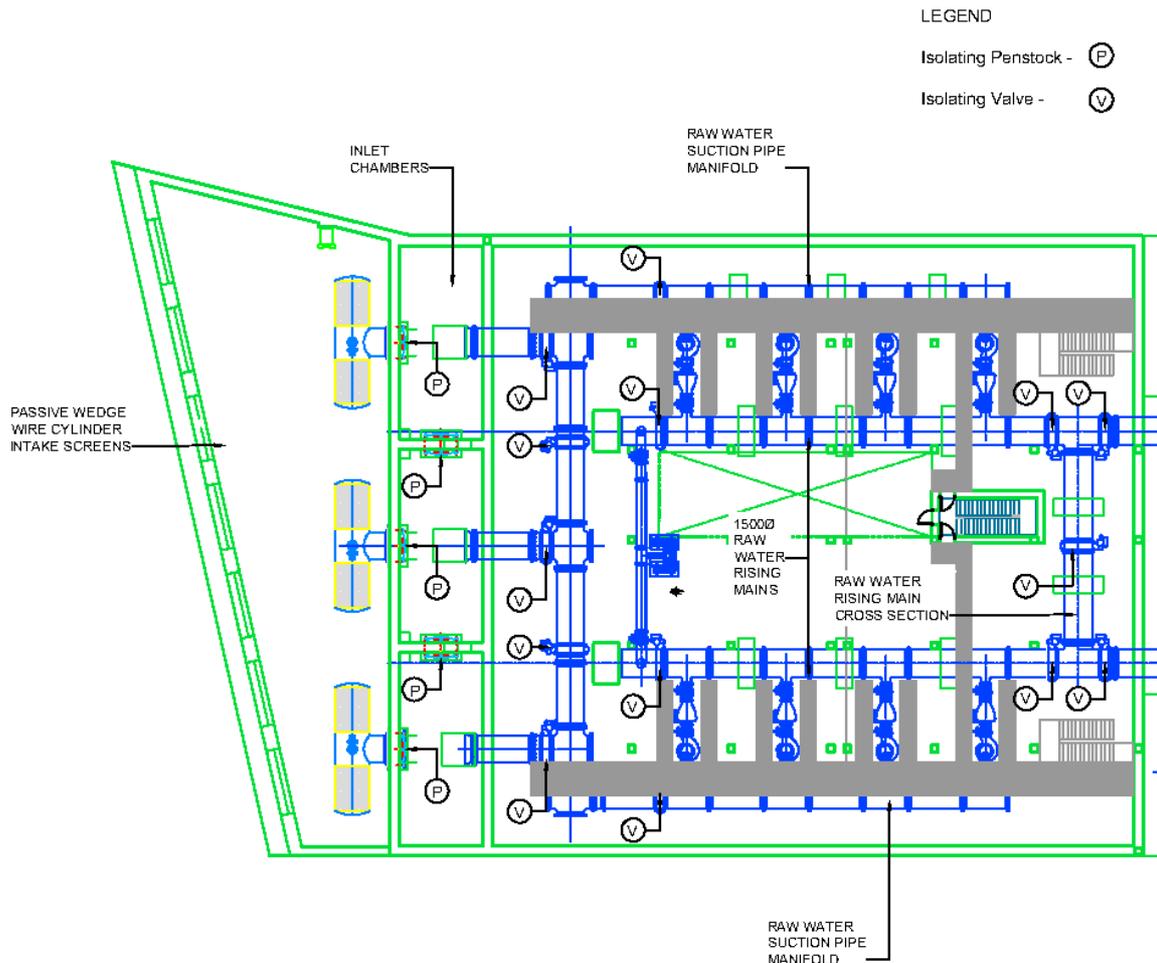


Image 3.2: Layout of Penstocks, Valves and Pipework in RWI&PS

83. The raw water pumps would draw the water from the Inlet Chambers via a suction manifold. Four pumps would be capable of delivering up to 12,500m³/hour.
84. The number of pumps that are operating would vary depending on the volume of water required. A single set of pumps could deliver the required volume of water in 2050 under normal or average demand conditions. However, two sets of pumps would be needed to deliver the peak flow of 300Mld over a 24-hour period. The number of pumps, eight in total would allow for the plant to be rotated, providing downtime for the pumps and avoiding overheating. This would also allow for routine maintenance to take place with no impact on the operation of the Proposed Project. There would always be one pump available on stand-by. The pumps would operate with variable speed drives, allowing pumped flows to be regulated as required.

85. In order to protect from zebra mussel infestation, two microfiltration plants, one on each rising main, housed in separate Microfiltration Buildings, would be provided. Each microfiltration module would incorporate five filter units. The microfiltration size would typically be 40 microns, which is below the size at which the zebra mussel juveniles, called 'veligers', are usually observed to settle. The microfiltration modules would be equipped with protective non-return valves to prevent damage from surge backflows through the units.
86. The microfilters (Amiad Filters or equivalent) would sit on a manifold located on a loop off each RWRM. Raw water would pass through these units and dirt particles and juvenile mussels would be trapped in the unit, forming a 'filtration cake'. This cake would cause a pressure drop across the unit and a self-cleaning process would be triggered. The self-cleaning process would involve the units being flushed regularly to clean away any zebra mussels or other waste material trapped in the filters. A filter flush-out pipe would carry the washwater to an Invasive Species Debris Retention Tank, located to the east of the Microfiltration Buildings. This washwater volume would be approximately 1% of the maximum abstraction volume (i.e. up to 3,000m³/day) based on an output of 300Mld.
87. This washwater would be subject to ultraviolet (UV) treatment to kill mussel juvenile forms (veligers) before being settled in the Invasive Species Debris Retention Tank. A floating-arm draw-off pipe would take supernatant liquid (the clear liquid that lies above the solid residue) from the tank and transfer it back to the raw water intake, from where it would be pumped onwards for treatment at the WTP. Rejected solid material settled out in the Invasive Species Debris Retention Tank would be removed from site to an appropriately authorised facility
88. The volume of water taken into the intake chamber would all be automated and controlled by the rate of pumping in the pumping hall.
89. The RWI&PS site would not be permanently staffed and operatives would only need to be on site intermittently for routine inspection and maintenance.

3.1.4 Surge

90. Four surge protection vessels, each with a volume of 89m³, would be installed at the RWI&PS. There would be two surge vessels for each RWRM with a total capacity per main of 178m³.
91. The surge protection system is passive and requires no active intervention. It would run fully automatically with its own Programmable Logic Controller (PLC) and electrical power supply. The state of all items such as vessels, pressures, levels, compressors and power supplies and would be monitored and recorded via the SCADA system.
92. The surge system is a safety system and the pumps would not be able to be run unless the surge system is in full readiness.
93. The surge vessels would require compressed air with a permanent compressor to maintain the correct air volumes at pressure within the air vessel. The equipment would be subject to the Pressure Equipment Safety Regulations (PESR) and the Pressure Systems Safety Regulations (PSSR) and require annual inspection and re-certification.
94. Any one surge vessel can be taken out of service for maintenance at any time. This would result in the surge vessel's associated RWRM also being out of service. In this scenario, all flows can be pumped through the other raw water main without interruption to or reduction of supply.

95. Following a sudden uncontrolled pump shutdown or pump trip, the surge vessels would act to gradually attenuate pressure transients in the pipeline. Oscillations in pressure and flow within the pipeline would be adequately dissipated before the pumps resumes operation.

3.2 Raw Water Rising Mains

96. The purpose of the RWRMs is to transfer up to 300Mld of raw water from the RWI&PS to the WTP.
97. The design for the RWRMs has been focused on ensuring a reliable supply, taking account of the fact that the RWRMs have to transport raw water.
98. Raw water would be pumped from the Raw Water Intake to the WTP by the Pumping Station at the RWI&PS using a series of variable speed pumping units.
99. The twin pipeline design allows for one RWRM to be taken out of service for cleaning and maintenance while still providing the uninterrupted raw water requirement through the other RWRM.
100. The RWRMs would also be cross connected to allow flow to be diverted into one single rising main if the other is out of service for cleaning or maintenance.
101. Provision has been made to allow each of the twin RWRMs to be emptied to a RWRMs Scour Tank. The RWRMs Scour Tank would be located underneath the microfiltration buildings and it would be possible to return the supernatant etc back to the Inlet Chambers for re-pumping to the WTP. This system would allow the RWRMs to be emptied for maintenance or in emergency without having to discharge any water back to Parteen Basin. The capacity of the RWRMs Scour Tank, at just over 3,000m³, would allow for either RWRM to be emptied in sections. In a situation where a RWRM needs to be emptied, the section between the pumping station and the line valve located adjacent to the R494 public road would be emptied first. Once this has been emptied and the scour tank drawn down, the section between the Line Valve at the R494 and the Air Valve at the Chainage RW - 1590 of the RWRMs would be emptied. The final section between this Air Valve and the WTP site can be scoured to the Tank Draindown Management and Commissioning Lagoons on the WTP site.
102. As part of the mitigation strategy against infestation by zebra mussels or Asian Clam, the following facilities would be provided:
- Swab insertion chambers (at the RWI&PS site)
 - Manway access points along the RWRMs
 - Swab removal chambers (at the WTP site)
 - A scour sump to allow contents of the scoured RWRM to be re-circulated to the head of the WTP via the Inlet Chamber and operational RWRM
 - Facilities to remove settled solids from the scour chambers and for removal of same to landfill.

3.3 Water Treatment Plant

103. The purpose of the WTP is to treat the raw water to a sufficiently high standard to be fit for drinking. This is a complex process involving multiple stages. The WTP has been designed to be able to produce a peak output of 300Mld. The design of certain process units is based on 317Mld to account for the re-circulation of process washwater.

104. The treatment process includes:

- pH correction
- Enhanced coagulant and polyelectrolyte dosing
- Flocculation and clarification
- First stage filtration (Rapid Gravity Filtration (RGF) – enhanced individual filtration)
- Second stage filtration through iron and manganese rapid gravity filters and Granular Activated Carbon (GAC) filters
- Disinfection with UV and dosing of low levels of chlorine into the final water, to prevent build-up of slime in the treated water pipe.

3.3.1 Overview

105. The WTP would be configured as three separate treatment modules, each would be able to deliver up to 100Mld with sufficient operational redundancy and resilience for cleaning and maintenance.

106. The three treatment modules would operate as three discrete process streams, each operating independently and in parallel. This would allow operatives to monitor performance of the plant and, in circumstances where there are water quality issues, it would be possible to isolate one stream of the plant without affecting the operation of the others.

107. Any one treatment module may be isolated for investigation, or taken out of service, and returned to service under proper ramping up and 'run to waste' protocols.

108. The raw water would enter the WTP at the Raw Water Balancing Tanks (RWBTs). The RWBTs would control the flow of the water coming into the WTP and would allow water to be stored temporarily. This would manage the rate of water flowing through the WTP and allow the WTP to operate at a steady continuous pace.

109. The water would then pass through chemical dosing, the water treatment process and the UV Treatment and Post Filtration Chemical Dosing Building.

110. The CWSTs and HLPS sit at the end of the treatment process. The CWSTs store clean water temporarily so that the onward flow of water through the pipeline can be controlled. The HLPS would pump the water through the pipeline from the WTP to the BPT.

111. The WTP would be permanently staffed and would control the operation of the whole of the Proposed Project, on a day to day basis. Therefore, the tasks set out in Section 2.3 will be managed from the WTP. In particular, the WTP will control abstraction, RWI&PS and the WTP processes to provide the SPF into the CWST. Usual minor variations will be accommodated within the operating range of the CWST. It would also control the HLPS and the monitoring / shut down processes.

3.3.2 Inlet Flow Balancing

112. Consideration has to be given to transferring raw water from the abstraction source to the 'head' of the WTP in the most energy efficient way possible. This requirement, however, has to be balanced with the need to operate the WTP continuously, as disruption of flow to the plant, or sudden ramping up or ramping down of flows, would adversely affect the water treatment process. The provision of RWBTs at the head of the WTP would give operators the flexibility to control flows being sent forward through the treatment process and would also give some security against an outage of the raw water pumps.

113. It is proposed that co-settled supernatants, filtrates/centrates, backwash waters and filter run to waste waters would be returned to the head of the works. Therefore, it would be necessary to blend these elements with the incoming raw water. These returns would be pumped to static mixers on the incoming raw water pipelines and thereafter provided with a nominal 15 to 30 minute retention time in the RWBTs at the head of the works.
114. The design has been prepared on the basis of a minimum requirement for two hours balancing at the head of the works.
115. The total volume of the two 65m diameter RWBTs is 29,466m³, giving over two and quarter hours balancing at peak raw water input of 300Mld.

3.3.3 Ability to Ramp up Flows

116. The RWI&PS pumps would operate on a duty/assist/standby basis. The pumps would operate with variable speed drives, allowing pumped flows to be regulated as required. Furthermore, there would be sufficient pumping capacity within the pumping station to deliver the range of flows up to the projected peak requirement of 300Mld as illustrated in Image 2.1.
117. The design capacity of each of the three treatment modules in accordance with Uisce Éireann Specification Document Nos. IW-TEC-900-03 and IW-TEC-900-04 is 100Mld with some units offline for cleaning or maintenance.

3.3.4 Chemicals

118. The following chemical processes would be in place at the WTP:
- Sulphuric acid (H₂SO₄) dosing for pH correction of raw water
 - Aluminium sulphate (Al₂(SO₄)₃) dosing of raw water for coagulation
 - Polyelectrolyte dosing of raw water for flocculation
 - Caustic soda (NaOH) dosing for pH correction of filtered water
 - Chlorine dosing of filtered water using ≤1% w/w Sodium Hypochlorite (NaOCl) generated by On-Site Electrolytic Chlorination
 - Fluorosilicic acid (H₂SiF₆) dosing of filtered water
 - Polyelectrolyte dosing of sludge.
119. All chemicals stored on site would be held in bunded areas, as close as possible to the final dosing points.

3.3.5 Chlorine Dosing

120. In order to maintain the required level of chlorine in the Treated Water further chlorine dosing would be required at the BPT in line with Uisce Éireann technical design standard TEC-900-05-02 (Disinfection: Secondary Chlorination) (Uisce Éireann 2023).
121. Chemical dosing will be undertaken to achieve a chlorine level of 0.68mg/l on point of departure from the site.
122. This will be achieved by dosing sodium hypochlorite at a dose rate of 1.43mg/l.
123. The UV Dosing and Post Filtration Chemical Dosing Building will be used for chemical storage as well as to house the chemical dosing plant. The dosing system would use sodium hypochlorite produced on site by an on-site electro-chlorination system.

124. To ensure that the levels of chlorine residual are accurately controlled, water quality sampling will be automatically undertaken.

3.3.6 Sludge and Sludge Disposal

125. Sludge would be produced at the WTP from the following processes:

- Coagulation sludges produced by the coagulation and settling of natural turbidity (Class 1A)
- Liquid waste produced from the cleaning of the sand filter (Class 1B)
- GAC media would be taken off site periodically for replenishment
- Other chemical additions such as the addition of polyelectrolyte.

126. The sludge draw-off from the sludge blanket clarifiers/Dissolved Air Flotation (DAF) (Class 1A) would drain to Sludge Balancing Tanks before being pumped to picket fence thickeners. Settled sludge would also be pumped from the base of the Used Washwater Equalisation and Settlement Tank (UWWE) to the Sludge Balancing Tanks, before being pumped to picket fence thickeners.

127. Sludge from the picket fence thickeners, at typically 1-3% dry solids, would be pumped via Sludge Storage Tanks to a sludge dewatering plant, which would include plate presses to bring the dry solids content of the sludge cake to 25%. Supernatant from the picket fence thickener and expressate from the sludge dewatering process would be pumped, via the washwater treatment side stream, to the RWBT at the head of the treatment process.

128. At present, it is estimated that the volume of sludge cake that would be produced under normal operation in 2050, i.e. when the treated water output from the WTP is 154Mld, would be up to 9,280m³ over a six-month period. Two Sludge Storage Buildings, sized to accommodate such a volume, and with sufficient space for machinery to access and manoeuvre while handling the sludge, are included in WTP layouts. These buildings would be covered, primarily to prevent contaminated rainwater runoff from the stored sludge being generated, but also to maintain the sludge at the 25% dry solids content produced from the dewatering process.

129. GAC filter media needs to be replenished periodically as it loses its effectiveness over time. Based on pilot trials undertaken at Clareville WTP, the media would require replenishment every 20 months at normal plant output. In practice the replacement of GAC media would not be a single operation taking place every 20 months but would be undertaken on rotation across a number of filters. The total mass of GAC filter media that would be replaced annually would be 420 tonnes. This material would be transported off site and brought to a specialist offsite facility where it would be regenerated by heating it to high temperatures. Following this process the GAC media would be transported back to the WTP for reuse.

3.3.7 Liquid Waste Streams

130. It is proposed not to discharge process wastewater from the treatment process back to the environmentally sensitive Lower River Shannon SAC. Therefore, the process wastewater would be recirculated through the plant. Wastewater would be generated from the following sources:

- Washwater from rapid gravity filters (Class 1B)
- Filter run to wastewater (Class 1D)
- Supernatant returned from sludge thickening (Class 1C)
- Expressate from sludge dewatering process (Class 1C).

131. The volume of recirculated water is variable and depends on such factors as:

- Rate of sludge generation in the sludge blanket clarifiers, and sludge from the UWWEST
- Filter backwash frequency
- Length of Filter Run to Waste Cycle.

132. The treatment options for the liquid residuals applicable to the WTP include the following:

- Class 1B Filtration – equalisation and settlement
- Class 1D Filter Run to Water – equalisation and co-settlement with supernatants, filtrates/centrates and backwash water that are to be returned to the head of the works.

133. Class 1B residuals from the filter backwash process would be equalised and settled prior to return to the head of the works and prior to further thickening of settled solids. An UWWEST would be used to equalise and settle these residuals and would also equalise and co-settle supernatant from the Sludge Thickening Tanks and filtrate/centrate from the sludge dewatering process.

134. The UWWEST is designed to provide equalisation and settlement of the following flows:

- The design daily used backwash water from all filters
- Run to wastewater from filters. The run to waste volumes would, as a minimum, be calculated as the average daily flow to the filters over a fifteen minute period
- The design daily volume of supernatant from the Sludge Thickening Tanks
- The design daily volume of press filtrate and centrifuge centrate where applicable from the sludge dewatering process.

3.3.8 Cleaning of Tanks

135. All tanks in the WTP would need to be drawn down, taken out of service and cleaned at least once per year. The plant has been designed to allow for the planned maintenance and servicing of tanks, where tanks can be taken out of service without reducing the throughput of the plant. The water content of tanks on the WTP site would generally be drained to the Tank Draindown Management and Commissioning Lagoons in the south-east quadrant of the site, which have a combined volume of 30,000m³. The section of the RWRMs from the Air Valve high point onwards to the WTP can also be drained in this way, or by portable pumping directly into the RWBT inlet chamber.

136. The Tank Draindown Management and Commissioning Lagoons have a top water level (TWL) of 44.4mOD, and the adjacent submersible pumping station has a wet well floor level of 38.00mOD. This is lower than the prevailing floor levels of water tankage on site. These levels are, in particular, lower than the floor levels of all tankage in the Water Treatment Module Buildings and consequently the contents of any tank on site can be redistributed to the head of the treatment process, with due allowance for prior drawoff of sludge bleeds from settlement tanks in the normal way.

137. The Water Treatment Module Buildings are, in addition, self-contained parallel treatment streams, each of which can be isolated and taken out of service. Accordingly, the contents of any settlement tank within a Water Treatment Module Building can be pumped to the flow splitting chamber with portable pumps, and thereby distributed over the adjacent operational streams within the same Module building, without resorting to external drainage to the Tank Draindown Management and Commissioning Lagoons.

138. Any sludge thickener or holding tank can be drawn down by isolating it in service in the normal way. Any of the CWST cells, which have a bottom water level of 42.60mOD can be drawn down towards the HLPS by isolating inflows to that tank, in normal service, with lowermost contents below the crown level of the pump station suction manifold emptied using scour pumps to the adjacent operational tank.

139. Discharge from the tank cleaning operations would also be drained to the Tank Draindown Management and Commissioning Lagoons, from where it would be pumped back to the Raw Water Balancing Tanks, via the process wastewater treatment system, for recirculation through the main treatment plant.

3.4 High Lift Pumping Station

140. The HLPS would be the interface between the CWST at the WTP and the Treated Water Pipeline from the WTP to the BPT.

141. The number of pumps running at any given time will be dependent on the flow rate. One backup/standby pump over those necessary to deliver the full flow is included to provide resilience in the case of a pump fault requiring it to be offline. Variable speed pumps would be installed to allow controlled start and shut down of the system as well as the flow output of the HLPS to be matched more precisely to the output of the WTP.

142. Once a flow rate in the pipeline has been established, the level of water in the BPT would be kept constant through controlling the rate of flow to the TPR through the use of the Flow Control Valves (FCVs) located upstream of the TPR. This would be true even if other future connection points were in operation.

143. The HLPS would be fully automated with all alarms and signals being fed back via the SCADA system to the main control room.

144. Since the location of the HLPS is adjacent to and within the site of the WTP, maintenance of all the plant would come under the responsibility of the WTP plant personnel.

145. Automatic duty rotation of the pumps and other plant would ensure reasonably consistent wear; although for large pump installations such as this, it is becoming normal practice to have asymmetric rotation so that not all planned plant replacement falls at the same time, thus improving resilience.

146. Maintenance tasks would include weekly checks of all the main items of plant, but with no expected significant maintenance required for 10 years or more.

3.4.1 Surge

147. An integral part of the HLPS are the surge vessels and the associated control system which actively suppress both extremes of high and low pressures during normal operation.

148. The High Lift Surge Vessels would have a volume of 282m³ and it is proposed to construct five similar 94m³ units, to provide the necessary capacity. This would allow three duty units with two on stand by at peak output which would then facilitate routine maintenance and inspections

149. The system is passive and requires no active intervention, running fully automatically with its own PLC and electrical power supply. This monitors the state of all items such as vessels, pressures, levels, compressors and power supplies and is monitored and recorded via the SCADA system.

150. The surge system is a safety system and the main HLPS pumps would not be able to be run unless the surge system is in full readiness.

151. The surge vessels would require compressed air with a permanent compressor to maintain the correct air volumes at pressure within the air vessel. The equipment would be subject to the PESR and the PSSR and require annual inspection and re-certification.

152. The design provides for one more vessel than is necessary such that a vessel can be taken offline for inspection without compromising the safety of the system and allows pumping to continue uninterrupted.
153. Following a sudden uncontrolled pump shutdown or pump trip, the surge vessels would act to gradually attenuate pressure transients in the pipeline. Oscillations in pressure and flow within the pipeline would be adequately dissipated before the HLPS resumes operation.

3.5 Treated Water Pipeline from the WTP to the BPT

3.5.1 Operation

154. This pipeline connects the HLPS to the BPT.
155. The flow in the pipeline is governed solely by the output of the HLPS which is controlled as part of the wider control system.

3.6 Break Pressure Tank

156. To deliver treated water from the WTP at Birdhill to the TPR at Peamount, the pipeline must traverse an undulating route across hills of varying elevation. To safely and efficiently operate a pipeline capable of transferring up to 300Mld, a BPT is proposed. Its purpose is to provide hydraulic stability and mitigate transient pressures within the system to allow for safe start-up and shut down of the entire pipeline.
157. The BPT would provide a constant head of water within the Treated Water Pipelines. This would largely eliminate the potential for air admission to the Treated Water Pipelines.
158. The BPT also provides the point where the pressure in the pipeline can be managed and would enable the transition to the use of gravity to maintain a flow of water in the pipeline under normal conditions. The water would be pumped from the WTP to the BPT but from the BPT the water would usually be moved through the pipe by gravity pressure.
159. The BPT location has been sited at the proposed location in order to achieve a normal operating water level of 139.44mAOD. The roof level of the BPT would be 142.7mAOD. At this elevation flows from the BPT to the TPR, of up to approximately 165Mld would be achieved without supplementary pumping. Once the flows exceed 165Mld, additional pressure would be required to move the higher flows through the pipe. This would be provided by supplementary pumping from BPS.
160. A suitably sized BPT is an essential component to provide hydraulic stability and prevent air getting into the pipelines upstream or downstream of the BPT.
161. The BPT acts as a large damping device to replace water absorbed by the surge vessels which is necessary to bring the water in the pipeline to a controlled standstill should the pumps trip.
162. It would also be the principal means of avoiding drawing air into the pipeline at such times, since air must be avoided for both water quality reasons and from a pipeline safety point of view. Air in a pipeline can cause uncontrolled pressure oscillations. The larger the pipeline, the more of a concern this becomes.
163. The design incorporates a three-cell arrangement in parallel and this is shown in Figure 4.66. In normal operation, only the two outermost cells would be active. The middle cell provides overflow capacity from either of the other two cells. The size of the cells is determined by the volume of water needed to balance levels in the pipeline and the capacity needed to store water in the event of a shut down.
164. The bottom water level in the tank would be set above the soffit level of the incoming and outgoing pipes, thereby creating submerged conditions.

165. Baffles ensure that there are no 'dead' areas and mitigate potential reduction in water quality.
166. Each cell in the tank would have an overflow and drain to an attenuation/infiltration basin.
167. The controls at the BPT would ensure that the HLPS and FCV would shut down should an overflow to the middle cell occur. Similarly, in the event that the signal to/from the BPT is lost then the system would shut down as a safety precaution.
168. In the event that the high lift pumps at the WTP trip, for whatever reason, the FCV near the TPR would signal to close. During this controlled shut-down, the BPT would play an integral part by ensuring that, in particular, the pipeline downstream of the BPT is always fully charged with water. This is important to avoid air entrainment, i.e. the creation of pockets of air in the two Treated Water Pipelines, which would otherwise have to be bled and sterilised before they could be brought back into service.
169. Safety Integrity Level (SIL) rated valves and instruments with appropriate standby would be installed on the inlet and outlet pipework to the BPT.
170. The BPT would not require a full-time presence during normal operation. Monitoring would be provided by telemetry systems, supported by visits by maintenance operatives.

3.6.1 Chlorine Dosing

171. In order to maintain the required level of chlorine in the Treated Water further chlorine dosing would be required at the BPT in line with Uisce Éireann technical design standard TEC-900-05-02 (Disinfection: Secondary Chlorination) (Uisce Éireann 2023).
172. Water that arrives to the site from the WTP will have an expected free chlorine residual concentration of 0.12mg/l. Chemical dosing will be undertaken to achieve a chlorine level of 0.73mg/l on point of departure from the site.
173. This will be achieved by dosing sodium hypochlorite at a dose rate of 1.48mg/l.
174. The Control Building will be used for chemical storage as well as to house the chemical dosing plant. The dosing system would use sodium hypochlorite produced on site by an on-site electro-chlorination system.
175. To ensure that the levels of chlorine residual are accurately controlled, water quality sampling will be automatically undertaken on the inlet and the outlet to the BPT and will determine the level of dose required at the BPT inlet pipework. To ensure thorough mixing, a static mixer is proposed immediately downstream of the dosing point.

3.6.2 Cleaning

176. The cleaning regime of any BPT depends primarily on the quality of the water entering it. If the water quality carries a large sediment load, then the BPT would need cleaning more often than if the load were small. Experience in the operation of the BPT would therefore dictate the frequency of BPT cleaning. Since this is a potable water pipeline there should be little or no sediment and therefore cleaning requirements would be minimal.
177. Double isolation on the inlet and outlet would permit the cleaning of one of the cells while the others remain in service.

178. Cleaning of the BPT would take place in a carefully controlled and well-planned environment. To minimise risk of disruption to supply, the various dependent parties along the pipeline and those in Uisce Éireann's National Operations Management Centre would be advised well in advance to enable the preparation. This would normally involve ensuring reservoirs are topped up where possible.

179. The actual cleaning process would involve:

- Valving off of a single cell
- Emptying the cell of all water, initially to a residual 100mm above outlet pipe through normal usage with the final volume emptied through the scour drain to the attenuation/infiltration basin
- Manual cleaning of the cell
- Disinfection of the cell
- Refilling.

180. For this to happen, each cell of the reservoir has a scour drain (located in a sump) leading to an attenuation/infiltration basin.

3.6.3 Overflow

181. The final detailed controls of the system will be subject to detailed design and the rigorous Hazard and Operability Study process like the rest of the design. However, the following safety measures are proposed:

- The level in the BPT would be controlled by the FCV upstream of the TPR. If this control fails and the level rises outside the control band then an alarm would be triggered allowing the operator to determine an appropriate course of action.
- If the level reaches the "high level" set point, a further alarm would trigger giving the operators a second warning.
- If the level reaches the "high-high level" set point, an alarm would trigger but this time the system would automatically shut down the HLPS without waiting for action from the operator.
- If the level ever reaches the overflow, flow sensors would trigger and then the system would assume that communication between the BPT and HLPS is compromised and would automatically close the BPT inlet valves. In turn the HLPS would see both a rise in pressure and a drop in flow causing them to shut down.
- In this way, significant overflow of the BPT would be prevented.

182. For any overflow events that do occur, water would spill over into the central cell and as described would be detected by separate independent sensors and initiate the BPT inlet valves to close.

183. The central cell can be drained through a dechlorination chamber prior to discharge to the attenuation/infiltration basin.

3.7 Treated Water Pipeline from the BPT to the TPR

3.7.1 Operation

184. This pipeline connects the BPT to the TPR.

185. The flow in the pipeline would be controlled by the FCV on the pipeline approximately 5km upstream of the TPR. The location and general layout of the FCV complex can be found in Figure 4.69.

186. The primary function of the FCV is to match the pumped flow from the WTP with the flow in the gravity pipeline as it leaves the BPT. This would be achieved by level control on the BPT adjusting the FCV position. In this way the FCV would automatically cater for any flows being drawn by potential future intermediate connection points.
187. It must be noted that the FCV is controlled by the BPT level and not the TPR level. If the TPR requires more or less water, then the operators of the system would instruct the WTP to adjust production, which in turn would:
- Alter the output flow from the HLPS to the BPT
 - Which would cause the BPT level to rise or fall
 - Which would cause the FCV to automatically adjust to maintain the BPT level
 - Which would adjust the flow into the TPR.

3.8 Booster Pumping Station

188. The purpose of the BPS is to facilitate the movement of the water along the Treated Water Pipeline from the BPT to the TPR at the higher flow rates. Flows up to approximately 165Mld can flow without supplementary pumping. However, when the flow increases above 165Mld, pipeline frictional losses increase to the point where additional pressure would be required to overcome this. The BPS contains the pumps that provide the capacity to move flows up to 300Mld through the Treated Water Pipeline.
189. To achieve this, the pumps in the BPS would link to pressure and flow monitors on the pipeline, both upstream and downstream of the site. They would initiate when the pressure in the pipeline started to drop below a set-point. When the pumps activate, they would mechanically increase the water pressure in the pipe.
190. Use of the BPS would be restricted, in any given year, to:
- Periods of routine testing and maintenance of the BPS; or
 - When demand for water increases above 165Mld.
191. In this latter scenario, the BPS would operate for as long as necessary to meet the increased water demand.
192. At all other times during the operation of the pipeline, the BPS would be switched off and the Treated Water Pipeline from the BPT to the TPR would run in gravity mode on a bypass.
193. When required to run, two or three pumps would run in parallel to provide the required additional flow beyond the maximum gravity flow.
194. The pumps would be variable speed and provide coarse control of the flows in the pipeline. It is envisaged that fine control of flows to trim the level in the BPT would continue to be provided by the FCV.
195. When not in service, the BPS would require approximately weekly maintenance runs for each of the pumps to avoid damage to bearings and drive systems. This can be achieved without the need for a full transition to pumped mode since individual pumps can be spun without impacting on the normal gravity flows.
196. Replacement of the pumps would be needed at the end of their life which would typically be 15-25 years.

197. The site is intended for remote operation and would be provided with actuated valves and flow meters to facilitate the transition from gravity to pumped modes of operation. As a result the site would not be permanently staffed and operatives would only attend for routine maintenance and inspection.

198. A SCADA system would communicate with and provide control from the WTP.

3.8.1 Surge

199. Start up and shut down sequences would be fully automated to avoid potential surge issues during the transition from gravity to pumped flow.

200. The system is passive and requires no active intervention, running fully automatically with its own PLC and electrical power supply. This monitors the state of all items such as vessels, pressures, levels, compressors and power supplies and is monitored and recorded via the SCADA system.

201. The surge system is a safety system and the main BPS pumps would not be able to be run unless the surge system is in full readiness.

202. A surge vessel would manage changes in pressure within the water in the pipeline. This would be 10m long, 3m wide and 4.5m high providing a required capacity of 71m³.

203. The surge vessel would require compressed air with a permanent compressor to maintain the correct air volumes at pressure within the air vessel. The equipment would be subject to the PESR and the PSSR and require annual inspection and re-certification.

204. Following a sudden uncontrolled pump shutdown or pump trip, the surge vessel would act to gradually attenuate pressure transients in the pipeline. Oscillations in pressure and flow within the pipeline would be adequately dissipated before the BPS resumes operation.

205. The surge vessel would only be required when the BPS pumps are operating and so any required maintenance would be undertaken when the vessels were not in use.

3.9 Flow Control Valve

206. The FCV is specific valve that would be used to control the flows in the pipeline and specifically it would be used to manage the water level at the BPT and volume of water arriving at the TPR.

207. The FCV would operate 24 hours a day to control water flows through the pipeline. The primary function of the FCV would be to match the pumped flow of water from the WTP with the flow in the Treated Water Pipeline as it leaves the BPT.

208. This would be done remotely and using an automated system.

209. As a result the site would not be permanently staffed and would be visited by operatives for routine inspection and maintenance.

3.10 Termination Point Reservoir

210. The purpose of the TPR is to provide the link between the Treated Water Pipeline and the existing local distribution network in the GDA WRZ. There is an existing drinking water reservoir with a capacity of 40MI and an existing control building operated by Uisce Éireann at this site.

211. The TPR would temporarily store treated water supplied through the pipeline so that it is ready to be used by consumers.

212. The TPR would be of concrete construction and rectangular in plan with a capacity of 75Ml. The layout of the site is shown in Figure 4.70.
213. The TPR would have a nominal TWL of 87.50mAOD, matching the TWL of the existing Peamount Reservoir.
214. Treated water would arrive at the TPR through the pipeline and then be stored in the reservoir. In providing termination point storage capacity, the reservoir would allow the hourly variability in the water demand profile of the distribution network in the GDA WRZ to be served by a stable incoming pressure and flow.
215. If the TPR requires more or less water, then the operators of the system would instruct the WTP to adjust production, which in turn would:
- Alter the output flow from the HLPS to the BPT
 - Which would cause the BPT level to rise or fall
 - Which would cause the FCV to automatically adjust to maintain the BPT level
 - Which would adjust the flow into the TPR.
216. If one of the three cells of the TPR needs to be emptied, this would be done by drawing it down as part of the normal operational service. Each reservoir cell would have a scour valve at floor level to enable maintenance and reservoir cleaning of any fine particle deposits, and a high-level overflow pipe to control the maximum safe storage capacity.
217. The inlet pipe to each cell would be low level to allow recharge of the pipe during transient events and greater hydraulic stability.
218. An Emergency Overflow Tank would be provided on the site as a buffer for scour or overflow from the TPR cells for dechlorination prior to disposal. Due to the 'depth of freeboard' within the TPR design itself and the high-water level alarms within the reservoir, an overflow event would be unlikely to occur. However, should an emergency overflow event occur, the retained volume in the Emergency Overflow Storage Tank would be tankered directly off site from the Emergency Overflow Storage Tank for disposal at a licensed facility.
219. Control of inflow and water levels within the TPR would be provided by telemetry systems, supported by visits by maintenance operatives. A standing maintenance presence would not be required on-site. Maintenance would be mostly planned with regular tank cleaning required, with due regard to the treated water being stored, to support effective operation.

3.10.1 Chlorine Dosing

220. In order to maintain the required level of chlorine in the Treated Water further chlorine dosing would be required at the TPR in line with Uisce Éireann technical design standard TEC-900-05-02 (Disinfection: Secondary Chlorination) (Uisce Éireann 2023).
221. Water that arrives to the site from the BTP will have an expected free chlorine residual concentration of 0.14mg/l. Chemical dosing will be undertaken to achieve a chlorine level of 0.68mg/l on point of departure from the site.
222. This will be achieved by dosing sodium hypochlorite at a dose rate of 1.43mg/l.

223. The Chlorine Dosing Control Building would be used for chemical storage as well as to house the chemical dosing plant. The dosing system would use sodium hypochlorite produced on site by an OSEC system.

224. To ensure that the levels of chlorine residual are accurately controlled, water quality sampling will be automatically undertaken on the inlet and the outlet to the BPT and will determine the level of dose required at the BPT inlet pipework. To ensure thorough mixing, a static mixer is proposed immediately downstream of the dosing point.

3.10.2 Cleaning

225. Cleaning of the reservoir would take place in a carefully controlled and well-planned environment. It is advisable that any planned maintenance ensures supply reservoirs in the Dublin area are topped up, and alternative sources of supply can increase production, if required.

226. A double isolation on inlet and outlet to permit the cleaning of one the cells while the others remain in service.

227. The actual cleaning process would involve valving off a single reservoir cell, emptying the cell of water, initially to a residual 300mm depth of water through normal usage by over pumping into other cells, with the final volume emptied through the scour drain to the emergency overflow storage tank, manual cleaning, disinfection and then refilling. During this operation, the other cells would continue to operate as normal.

3.10.3 Overflow

228. Similar to the BPT, the following safety measures are envisaged for the TPR within this concept design:

- The level in the TPR is influenced by the FCV upstream on the Treated Water Pipeline since this is the only input into the TPR
- If the TPR level reaches the “high level” set point, an alarm would trigger giving the operators at the WTP, and repeated to the National Operations Management Centre (NOMC), a warning to take appropriate action
- If the level reaches the “high-high level” set point, an alarm would trigger but this time the system would automatically shut down the FCV, the HLPS and BPS without waiting for action from the operator
- If the level ever reaches the overflow, flow sensors would trigger and then the system would assume that communication between the HLPS, the FCV, the BPS and the operator is compromised and would automatically close the TPR inlet valves; in turn this may cause the level in the BPT to rise and trigger the alarms and responses outlined in Section 3.5.2
- In this way, significant overflow of the TPR is prevented.

229. In the unlikely event that there is an overflow, the water can be safely captured and stored without it causing flooding or damage. An ‘Emergency Overflow Storage Tank’ would act as a buffer and contact tank for dechlorination prior to disposal, via tankers to a licenced facility.

3.11 Pipeline Features

230. The RWRMs and Treated Water Pipeline would incorporate a number of key pipeline features, including:

- Line Valves, to allow sections of the pipeline to be isolated for operation and maintenance purposes. These would be housed in a chamber and in most instances have an associated lay-by for maintenance access purposes
- Washout Valves, to facilitate the draindown of sub-sections of the pipeline if required

- Air Valves, to facilitate removing air from the pipeline
- Manways, to provide access to the pipe once operational (albeit it would be necessary to excavate down to them)
- Cathodic Protection beds at the Line Valves to monitor the pipeline
- Potential future connection points to the pipeline within the Water Supply Area (in accordance with the Eastern and Midlands Plan (Irish Water 2022)).

231. All chambers would be fitted with high security lids with shrouded padlock housing. All valves would be exercised regularly to check satisfactory operation. It is envisaged that a permanent dedicated team will look after the Treated Water Pipeline checking all valves at least every six months.

232. Suitable Line, Bypass, Washout and Air Valves and other ancillary items would be kept in the strategic stock at suitable locations in case of emergencies.

233. A summary of the number of valves is provided in Table 3.1.

Table 3.1: Valve Types and Number

Valve Type	Treated Water Pipeline (WTP to TPR)	Raw Water Rising Mains	Total
Line Valves (including Washout, Air Valves and Manways)	49	2	51
Washout Valves:			
• Discharge to a watercourse with permanent outfall	39	-	39
• Discharge to a watercourse without a permanent outfall	57	-	57
• Localised discharge to ditch / land	91	-	91
• Incorporated within Line Valve installation (no discharge during operation).	49	-	49
Air Valves			
• Dedicated	287	2	289
• Incorporated within Line Valves installation.	30	2	32
Potential future connection points	3	1 (at the WTP)	4
Manways:			
• Dedicated	64	4	68
• Incorporated within Air Valves and Line Valves	389	-	389
• Co-incident with Washouts.	110	-	110

3.11.1 Line Valves

234. Line Valves are installed within the pipeline to enable sections of the pipeline to be isolated, drained and recharged for maintenance purposes as described in Section 3.12.

235. Line Valves are provided at intervals along the pipe determined by the draindown strategy which uses the topography, the distance between line valves and the assumed repair time to endeavour to keep the total outage time for most routine planned maintenance to less than 36 hours. The resulting spacings are not equal distances and range from 1km to 7km approximately. Where practicable, they are situated adjacent to the public road within the verge. Where this is not practicable, the valve would be sited at a field boundary with an access route identified from the public road to facilitate plant access and maintenance.

236. A typical detail of a Line Valve arrangement is shown in Figure 4.82 to Figure 4.85.

237. Plans of proposed locations of Line Valves can be found in Figure 4.2 to Figure 4.60.
238. Each Line Valve installation incorporates a bypass pipework arrangement and washout facility designed to maximise the potential to pump treated water around the Line Valves to sections not undergoing maintenance works. This reduces the quantity of water to be discharged to the environment during draindown of any pipeline subsection.
239. The Line Valves would be butterfly valves, as these are the most cost-effective valve type for this project application and have a proven track record for robustness and reliability in this regard.
240. All the Line Valves would be actuated. The valves on the bypass pipework would not be actuated.
241. Problems with the Line Valve electrics, actuators or gear boxes, are maintainable without needing to drain the pipeline and can be undertaken within a controlled and scheduled timeframe providing appropriate notice to landowners.
242. Should a problem arise with the butterfly body, spindle or seating, the pipelines can rely on the upstream and downstream Line Valves and operate without interruption until a favourable time is identified to affect the repair.
243. Pressure transducers are provided to monitor water pressure either side of the valve at the given elevation.
244. The Line Valves may be operated either locally or remotely from the WTP control room.
245. An above ground kiosk contains the ESB connection, power, control, isolation and telemetry for the actuator. This kiosk is offset from the pipeline to allow the actuator to be isolated and then, if necessary, the Line Valve to be excavated without requiring isolation by ESB. On the Line Valve layout drawings, the ESB and control kiosk are shown as two separate kiosks but they can be a single unit with dedicated access doors if required.
246. All kiosks would be fitted with an alarm system connected to the SCADA and telemetry to alert the operators at the WTP of unauthorised access.
247. As the Line Valve is actuated, siting adjacent to the public road facilitates access by the power provider, ESB Networks.
248. For safety, where adjacent to a road, access to the Line Valve incorporates a Lay-By.
249. The smaller valved bypass pipework is provided around the main Line Valves to facilitate:
- Draindown of a pipeline section using temporary pumps
 - Filling the main in a controlled manner following draindown
 - Equalising pressures either side of the valve before opening the main pipe valve.

3.11.2 Washout Valves

250. Washout Valves are located at all low points along the Treated Water Pipelines to facilitate the draindown of sub-sections of the pipeline if required.

251. During pipeline operation it is very rare that washouts are used since they are only required for emptying sections of pipeline if required for emergency repairs or for routine maintenance which is typically, perhaps every 20 to 30 years. These are planned events and will be scheduled to suit landowner constraints and weather conditions. Even then, the washouts would only be used to drain short sections of pipe that cannot be drained to either end of the pipeline section due to the topography.

252. The Washouts are divided into five types, namely:

- Washouts which would be part of the Line Valve (49nr.) (The two Line Valves on the RWRMs would not have a Washout)
- Washouts at permanent discharge locations with permanent outfall (39nr)
- Washouts at temporary discharge locations where water can be discharged into a nearby watercourse (including a large ditch or drain) at a controlled rate through temporary pipework (flexible hose) (57 nr)
- Washouts with local discharge to adjacent field drains or small ditches, where no sufficiently sized watercourse is available within 100m of the Washout (51 nr.)
- Washouts with local discharge to adjacent land where there are no field drains or small ditches within 100m of the Washout. In this instance, a local temporary soak away would need to be formed using sandbags or equivalent (40 nr.).

253. Table 3.2 provides a summary of the Washout Valves.

Table 3.2: Valve Types and Number

Washout Valve Type	Number	Used for discharge during operation	Relevant management measures
Washout Valves at Line Valve	49	No	See Chapter 5 (Construction and Commissioning)
Washout Valves discharge to watercourse with permanent outfall	39	Yes	Limit on % of QMED discharged and Limit if river in flood – see Section 3.13.1.1
Washout Valves discharge to watercourse without permanent outfall	57	Yes	Limit on % of QMED discharged and Limit if river in flood – see Section 3.13.1.1
Washout Valves – local discharge to ditch	51	Yes	Rate of discharge limited to 25l/s
Washout Valves – local discharge to land	40	Yes	Rate of discharge limited to 15l/s

254. Annex A includes a schedule of the washouts including the design flow (l/s) and approximate chainage along the pipeline.

255. A typical detail of a Washout Valve chamber and arrangement is shown in Figure 4.87. The principal features are:

- Washout Valves would include a secondary guard valve to ensure reliable operation under a range of conditions including emergencies. This also permits the valves to be 'exercised' to ensure they are fully operational without the need to discharge water since one or other of the valves can remain closed at all times
- The Washout Valves would be gate valves as these are likely to be the most cost-effective valve type for this project application, and have a proven track record for robustness and reliability in this regard
- Washout Valves would not require a permanent power supply to operate. Operation is by a standard 'bar and key' or portable actuator
- Washout Valves would be directly buried and can be re-excavated in the very rare event of a problem that requires the valve to be replaced
- The diameter of the washout outfall pipes to watercourses would vary depending on the size of the watercourse and its capacity. Typically, the washout pipework would be in the 200mm to 600mm diameter range.

256. Any chlorinated water discharges from the pipeline would require dechlorination prior to discharge to the environment. This would be achieved by using sodium sulphite dechlorination tablets inserted into perforated wire mesh baskets at the washout chamber or permanent outfall structure. Dechlorination is achieved almost immediately on contact with the tablets. This method provides the most flexible approach for the removal of low chlorine residual and is suited to the infrequent operation of the washouts. Levels of residual chlorine would be reduced to below <0.005mg/l as required by the Salmonid Regulations.

257. Generally, pipe sections to be drained would discharge around the Line Valve via the bypass pipework under gravity with final volumes pumped as required.

258. In many cases this would be sufficient to undertake the required maintenance. Where this is not the case, the pipeline section can be drained further via the Washout Valves. Some of the pipe section to be drained would discharge under gravity. However, in most instances that final drain would require the use of small portable pumps located at the washout.

259. At permanent discharge washout locations, the headwall adjacent to the river bank would be kept free of vegetation and debris and the riverbank would be checked for scour damage and erosion regularly and defects remedied early.

3.11.3 Air Valves

260. Air Valves are required for a number of purposes on pipelines, principally to:

- Vent air in or out of the pipeline automatically when filling or emptying
- Release air during normal pumping operation, which is entrapped in the water from pumping or comes out of solution at low pressures
- Prevent vacuum pressures from forming by admitting air into the pipeline, when emptying sections for maintenance and during negative pressure surge events.

261. Large orifice (or 'Double orifice') Air Valves are provided at high points for venting air and for pipe filling and emptying. Small orifice Air Valves are provided at significant changes of gradient of the pipeline; and at intermediate points to facilitate recharging.

262. Should an Air Valve need maintenance, repair or replacement, it can be safely worked on by closing the associated isolating valve while the pipeline is live with no interruption to the supply.
263. Typically, Air Valves would be 500m to 800m apart. The Treated Water Pipelines have been designed to be laid at gradients not less than 1:500 rising in the direction of flow and 1:300 falling from the direction of flow to encourage air removal.
264. As far as practicable, Air Valves would be located in verges and near field boundaries to limit the impact on landowners and to permit easy access for maintenance.
265. As topography dictates, Air Valve chambers for potable water mains would be elevated relative to pre-existing ground levels to mitigate the potential for surface water from the surrounding land to submerge the Air Valve in the chamber. This minimises the risk of non-potable water being drawn into a potable water pipeline, should it be necessary to drain the pipe down.
266. In these circumstances, the land would be re-graded around the chamber. The re-grading would be sensitive to the natural topography of the land and existing drainage patterns.
267. A typical detail of an Air Valve chamber is shown in Figure 4.86. The principal features are:
- The Air Valve includes a larger tee beneath it to provide a plenum to prevent air bypassing the Air Valve under filling conditions
 - All Air Valves include an independent manually operated isolating valve to allow for maintenance
 - In addition, small diameter valved tapping points are recommended between the isolation valve and the Air Valve to allow for occasional water quality sampling and the safe relief of pressure prior to removing an Air Valve for maintenance
 - 2 No. large orifice (or 'Double orifice') Air Valves are provided affixed to a single flanged plate
 - This larger tee has a twofold purpose and acts as a manway to facilitate access to the pipeline for maintenance where the flanged Air Valve arrangement can be removed for ease of access. The tee size is typically a minimum of 900mm diameter. It also acts as a plenum (chamber on the crown of the pipe) to catch the air as it travels along the pipe, preventing it from traversing along the pipe before it can be expelled through the Air Valve.

3.11.4 Cathodic Protection

268. As well as the internal and external protective coatings, the steel pipeline would be protected against corrosion by means of a remotely monitored impressed current Cathodic Protection system. This alerts the operators via the SCADA system of changes in system current that indicates possible damage to the coatings.
269. The Cathodic Protection ground beds and monitoring systems would be located co-incident with Line Valve installations.
270. Periodic routine visits to these sites would check all is running as it should.

3.12 Component Resilience

271. This section briefly describes how the design of the each of the major components provides resilience in delivering the required flows set out in Section 2.1

3.12.1 Abstraction, Raw Water Pumping and Treatment

272. The proposed maximum raw water abstraction flow is 300Mld (3.47m³/s over 24 hours) at the year 2050. This maximum abstraction rate would be required in circumstances where the WTP is operating at its maximum output of 300Mld. It would also allow sufficient flexibility to top up the Raw Water Balancing Tanks (RWBT) as required.
273. Since there would be a need to clean the raw water mains periodically, it would be possible, subject to configuration of surge protection, to pump up to 300Mld through one RWRM, if required, without exceeding maximum design velocities. This would permit maintenance and cleaning of one of the RWRMs while maintaining supply to the works through the other.
274. With respect to treatment plant raw water throughput (gross capacity) and treated water throughput (net capacity), the following apply:
- The Raw Water Pumps are designed to pump up to 300Mld, over 24 hours
 - The WTP is designed to handle a peak throughput of raw water and recirculated process wastewater flows up to 317Mld; the recirculated flow rates are calculated in accordance with Uisce Éireann Standard TEC 6909-IW-TEC-900-700-1 (Irish Water 2017)
 - The maximum treated water output at peak flows would be 300Mld
 - The recirculation flow would gradually build up in the system, so there would never be a requirement to pump more than 300Mld to the WTP.
275. Process wastewaters would be treated to a standard which permits return to the head of the main treatment process. There would be no discharge of treated process wastewaters back to the Lower River Shannon Special Area of Conservation (SAC).
276. Clear Water Storage of approximately 27,000m³ capacity would be provided, which represents 2.2 hours at the maximum treated water flow of 300Mld. This would be in two main sections providing duty/standby storage capable of taking the full WTP flow into either tank and to feed any combination of the high lift pumps.

3.12.2 High Lift Pumping Station

277. The HLPS has been designed with six pumps. The number of pumps running at any given time would be dependent on the flow rate. One backup/standby pump over those necessary to deliver the full flow is included to provide resilience in the case of a pump fault requiring it to be offline.

3.12.3 Treated Water Pipeline

278. A single 1600mm diameter steel pipeline is proposed for both the Treated Water Pipeline from the WTP to the TPR.
279. One of the reasons that steel has been selected as the pipeline material is that catastrophic failures on steel pipelines are extremely rare. Further, typical repairs on a steel pipeline may involve pin hole type faults that can usually be repaired quickly without fully draining the pipeline section affected.
280. If an in-situ repair is to be carried out, this would involve a local partial draindown of the pipeline to isolate the area of the problem between Line Valves on either side, with a system shut down of a few hours.
281. Supply to the GDA WRZ during a repair period would be maintained by the TPR along with the existing sources operating temporarily at higher output.

3.12.4 Break Pressure Tank

282. The BPT is designed with two active cells which would normally operate simultaneously to provide water to keep the pipelines filled with water during normal start-up, shut-down and pump trip scenarios at peak flows.

283. However, individually each cell can only provide the necessary storage for safe operation for flows up to around 150Mld. This means that during the rare occasions that a cell is out of service for cleaning or maintenance, this would have to be planned outside peak periods.

284. A third cell would be provided as a safety feature in the event of an overflow.

3.12.5 Booster Pumping Station

285. Flows up to 165Mld can be supplied by gravity pressure from the BPT to the TPR. However, when demand for water increases above 165Mld, frictional losses in the Treated Water Pipeline from the BPT to TPR increase to the point where there would be insufficient gravity head to deliver the water to the TPR. To provide the additional pressure supplementary pumping would be required to deliver flows up to the peak demand of 300Mld. The BPS would provide this additional pumping capacity to increase the flow within the Treated Water Pipeline between the BPT and the TPR.

286. The BPS building is designed as a single storey above basement building with the basement section containing the Pump Hall in which six split case centrifugal pumps (four duty and two-stand by) would be installed.

3.12.6 Termination Point Reservoir

287. The TPR would be formed of three cells providing a total capacity of 75MI. A 5ml Emergency Overflow Storage Tank would also be provided.

288. The inlet of the TPR would receive a constant supply of water from the WTP via the BPT. The outlet flows will be determined by the demand in the GDA WRZ. Therefore, the level in the TPR would not be controlled by the Proposed Project system but would naturally vary based on the difference between the inflows and outflows. This is quite normal with the TPR volume being the buffer between the steady inflow and the variable outflow.

289. The number of cells in the TPR would facilitate the rare occasions that a cell requires cleaning or maintenance allowing the other cells to take up the slack. It would be planned so that such maintenance operations would be undertaken when the daily flows are low and to avoid the peak flow periods.

3.13 Typical Repairs

290. A bulk water transmission main would operate for many years with relatively little maintenance. The operator would periodically:

- open and close Washout Valves
- valve off and service Air Valves.

291. However, essentially any repairs to the pipeline would result from leaks, damage or corrosion.

292. Repairs to strategic pipelines are very rare, especially coated steel pipelines.

293. Most 'repairs' are picked up during commissioning and common issues arise from:

- Leaking flanges
- Valve seats not sealing due to grit.

294. The experience on the current network and previous projects is that once successfully in operation, problems with a pipeline and infrastructure proposed as part of the Proposed Project are very rare, and the most common cause of an issue is third party damage when someone accidentally or deliberately hits the pipeline when excavating too close.

295. Occasionally localised corrosion can occur if a defect in the pipe coating has gone unnoticed during installation. This is rare and would largely be mitigated by the CP system installed which would alert the operator to such a defect long before it became a cause for a leak.

296. Other problems can arise from excessive ground movement or vehicle damage to surface structures and regular inspection and monitoring would be used to manage these risks during operation.

297. The pipeline operators would have appropriate procedures and spare parts in place to deal with all foreseeable incidents. Spares would include:

- Flange bolts and gasket sets
- Valve top bonnet gaskets and seals
- Steel plates and welding equipment
- Repair clamps
- Couplings for smaller diameter pipes (not generally available in larger diameters)
- Spare lengths of pipes, and/or special procurement contracts with framework suppliers to keep adequate stock and be able to provide, as required
- Range of standard Viking Johnson or equivalent mechanical couplings, and/or special procurement contracts.

3.13.1 Draindown

298. If maintenance on the pipeline is required, then it is probable that at least partial draindown would be required.

299. The need to drain a section of the pipeline in operation would be a very rare event, at a typical frequency of perhaps once in every 20 to 30 years, but the design has carefully considered and provided for the circumstances where this could arise.

300. As this would be a planned event it would be scheduled to suit landowner constraints and appropriate weather conditions with adequate advance notice provided to the landowner.

301. Line Valves along the pipelines allow sections ranging from 1km to 7km to be isolated such that they can be drained without the need to drain the entire pipeline.

302. Furthermore, the design of the Line Valves is such that up to 60% of the water from one pipeline section can be pumped forward or backward via the bypass pipework to the adjacent sections thus saving water and reducing discharges to the environment.

303. In many cases this would be sufficient to undertake the required maintenance. Where this is not the case the pipeline section can be drained further via Washout Valves.

3.13.1.1 Draindown Sequence

304. Prior to use of any washout, all pipeline flows would be stopped and the Line Valves at either end of the section to be drained would be closed. If there are any intermediate connection points for the Water Supply Area within this isolated section of pipe these would also be closed.
305. The Washout Valves would be operated locally using the traditional bar and key in a controlled fashion.
306. The pipeline section would then be emptied as far as possible through temporary pumps installed on the bypass of the Line Valve at the lower end of the pipeline section. The water would be pumped into the adjacent pipeline sections and not lost to waste.
307. Once the pumps at the Line Valve have drained as much as they are able, one or more of the several washouts within the section may be used to drain the water now 'standing' in the pipe.
308. When draining a pipeline section, air would be drawn into the pipeline through the Air Valves. A faint 'breathing' noise may be audible from the Air Valve chambers during this time.
309. As set out in Table 3.2, 187 of the 236 Washouts Valves would be used during the operational draindown. This is because the Wash Outs at the Line Valves would not be used during operational draindown. Table summarises the proposed discharges and high level control measures.
310. Which washouts are used and the rate of discharge would depend largely on the prevailing conditions, such as:
- Which sub-sections of the isolated section are required to be drained
 - The environmental sensitivity of the watercourse and environs
 - The ease of access to the particular washout
 - The proximity to a watercourse
 - The size of the watercourse and the existing water levels.
311. The priority order to the use of Washouts would be:
- Not to discharge water (by draining the pipeline through its operation and then pumping water forward or backwards within the pipe)
 - Discharge to a watercourse via permanent outfall
 - Discharge to a local watercourse via a flexible pipe
 - Discharge to land
 - Tanker water away.
312. If a discharge to land is required this would be discussed and agreed with the landowner in advance and water would be managed through a temporary structure such as a temporary pond to allow water to infiltrate in a controlled manner and avoid erosion / scour.
313. The water would be discharged to the adjacent land and would be allowed to soakaway responsibly, taking into account local conditions at that time, including use of a temporary bund/pond where necessary, at rates of up to 15l/s.
314. The water would be clean and would have been dechlorinated (as described in Section 3.11.2) and so there would not be an environmental risk associated with a discharge to land.

315. Due to the topography, some lengths of the pipeline would likely be below the discharge point, and there would likely be a small volume of 'standing' water remaining in the pipe that can only be removed using a temporary portable pump.

316. A discharge to a receiving watercourse would be restricted based on the following:

- Discharge volume limited to <20% Q_{med}
- No discharge if watercourse is in flood (Flow > Q_{30}).

317. Once the draining has been completed and maintenance activities carried out, the washouts would be closed.

3.13.2 Sterilisation and Re-Filling

318. Once any maintenance work has been undertaken, the pipeline section would be re-filled. If the maintenance work involved work inside the pipe, then inside of the pipeline may be treated using a spray disinfectant via access points (Manways and/or Air Valves) spaced approximately every 500m along the pipeline.

319. The pipeline section would then be re-filled at a controlled rate, using the bypasses around the closed Line Valves.

320. Once all the air has been expelled through the automatic float operated Air Valves which are located at every high point, the Line Valves would be opened fully again, and the pumps restarted in the usual manner. A faint hissing may be heard from the Air Valves as the pipeline refills.

4. Surface Water Management – Operational Phase

321. The general approach to the surface water management and drainage design on the Proposed Project has been to incorporate Sustainable Drainage Systems (SuDS) principles as recommended in the SuDS Manual (Construction Industry Research and Information Association (CIRIA) 2015) in order to limit discharges from the site to the equivalent green field site flow rate.

4.1 Raw Water Intake & Pumping Station

322. The RWI&PS access road, and other paved areas have been designed to incorporate Sustainable Drainage Systems (SuDS) principles as recommended in the SuDS Manual (CIRIA 2015) in order to limit discharges from the site to the equivalent green field site flow rate.

323. As part of this strategy rainwater runoff from the roofs of the Raw Water Pumping Station Building and the two Microfiltration Buildings would be harvested and taken into the Raw Water Intake Basin and the RWRMs Scour Tank respectively.

324. Rainfall runoff from roads and impermeable areas would be conveyed via a drainage system to a Stormwater Attenuation Tank, as shown in Figure 4.61. Runoff entering the attenuation pond would be pre-treated in a Class 2 By-Pass Hydrocarbon Interceptor. This allows for any build-up of pollutants on an internal roadway or working surface that would be washed off in the early part of a storm to be treated. The outfall from the attenuation pond would be fitted with a penstock which can be used to isolate the attenuation pond and so contain pollutants in the event of an accidental spillage.

325. The volume of the attenuation tank required to accommodate flows from a 1 in 100-year storm event, with an allowance for climate change is 125m³. A flow control device on the outlet of the tank would limit discharge stormwater flow leaving the tank to a maximum of 17.35l/s, equivalent to the greenfield runoff from the entire RWI&PS site. Flow from the attenuation tank would be conveyed by a 200mm diameter drain along the RWI&PS access road to a local watercourse approximately 350m along the access road from the R494.

326. The site would not be permanently staffed and so foul wastewater generated by operational staff on the site would be less than 1m³/d and would be tankered from the Wastewater Holding Tank shown on Figure 4.61 to a licensed Wastewater Treatment Plant (WwTP).

4.2 Water Treatment Plant

327. The WTP access road, and other paved areas have been designed to incorporate SuDS principles as recommended in the SuDS Manual (CIRIA 2015) in order to limit discharges from the site to the equivalent green field site flow rate. As part of this drainage strategy the CWSTs would have a 'green roof' on top which would have a biodiversity benefit as well as reducing the speed of surface water runoff.

328. There would be two drainage systems in place at the WTP. Firstly, harvested runoff, from roofs of buildings and tanks, would drain to the commissioning lagoons. Secondly, general site runoff from internal roads would be taken to an attenuation pond in the south-eastern corner of the WTP site.

329. Building roofs and tank covers would account for approximately 55% of the impervious area of the WTP site. Rainfall runoff from these particular surfaces is considered to be of sufficiently consistent quality to be harvested as a source of raw water. Therefore, roof and tank cover runoff would be collected in a dedicated, separate pipe network which would outfall into the Tank Draindown Management and Commissioning Lagoons and would ultimately be pumped to the RWBTs. The lagoons and the associated return pumping system have been appropriately sized for the probability of extreme rainfall events (1 in

100 year return event with 30% allowance for climate change, in accordance with a High End Future Scenario set out in Flood Risk Management: Climate Change Sectoral Adaptation Plan (Office of Public Works 2019)) occurring concurrently with commissioning or operational requirements.

330. It is expected that approximately 145,160m³ per year of runoff from roofs and tank covers would be harvested and treated to produce treated water. Harvesting rainwater in this manner would reduce stormwater runoff from the WTP site that would otherwise have to be managed, and would marginally reduce the volume of pumping required from the RWI&PS.
331. The roads and hard-standing working areas within the site would be mainly drained via a gully and pipe system. Two main arterial surface water pipelines are proposed. One arterial pipeline would drain the north and east of the site. The second arterial pipeline would drain the west and south of the site. Both pipelines would range from 300mm diameter at the top of each run to 600mm before the outfall. Both surface water pipelines would terminate at an attenuation pond at the south-east corner of the site (Figure 4.63), adjacent to the access road. The purpose of the attenuation pond is to attenuate runoff to greenfield runoff rates.
332. The attenuation pond has been designed following the guidance of The SuDS Manual (C753) (CIRIA 2015). The length/width ratio of the basin is limited to 3:1, and the maximum depth would be limited to 2m during the most extreme design event, which is a 100-year event with a 30% allowance for climate change. The attenuation pond would be planted with vegetation and the bed slope would be limited to 1:100. The principal water quality benefits of vegetated attenuation ponds are associated with the removal of sediment and buoyant materials, but levels of nutrients, heavy metals, and oxygen-demanding material can also be removed if present.
333. Runoff entering the attenuation pond would be pre-treated in a Class 2 By-Pass Hydrocarbon Interceptor. This allows for any build-up of pollutants on an internal roadway or working surface that would be washed off in the early part of a storm to be treated. The outfall from the attenuation pond would be fitted with a penstock which can be used to isolate the attenuation pond and so contain pollutants in the event of an accidental spillage.
334. A flow control device on the outlet of the pond would limit discharge stormwater flow leaving the pond to a maximum of 239l/s, equivalent to the greenfield runoff from the WTP site as a whole. The flow would then be conveyed by a 600mm diameter stormwater drain running along the route of the WTP access road to discharge into the stream crossed by the proposed access road approximately 220m north of its junction with the R445.
335. The access road to the WTP would be allowed to drain via filter drains running on either side of the road. Pea-gravel is a permeable material and would allow storage of excess rainwater before it infiltrates into the subsoil. This process replicates the existing greenfield drainage regime on the site.
336. Foul wastewater generated on the WTP site, which is estimated to be approximately 1m³/d in normal operation and 2.4m³/d with visitors to the site, would be tankered from a wastewater tank installed at the WTP to a licensed WwTP.

4.3 Break Pressure Tank (BPT)

337. The BPT access road, and other paved areas have been designed to incorporate SuDS principles as recommended by the SuDS Manual (CIRIA 2015) in order to limit discharges of rainwater runoff from the BPT site to the equivalent greenfield site flow rate. As part of this drainage strategy the BPT would also have a 'green roof' on top which would have a biodiversity benefit as well as reducing the speed of surface water runoff.

338. Filter drains within the site boundary fence would collect surface water and direct it to an infiltration basin via small pumps in an underground chamber. Runoff from the roof of the Control Building would also be directed to the infiltration basin.
339. Surface water runoff entering the infiltration basin would be pre-treated in a Class 2 By-Pass Hydrocarbon Interceptor. This allows for any build-up of pollutants on the internal roadway or hard standing working areas that would be washed off in the early part of a storm to be treated
340. The infiltration basin has been designed to hold a volume of 273m³ to accommodate flows from a 1 in 100-year storm, with a 30% uplift for climate change. The infiltration basin would be lined with a permeable geotextile membrane/filter material which would be used to control sediment from the excavation.
341. Based on assessment of the ground investigation data an infiltration rate of 1.26 mm/hr has been used to inform the design.
342. The infiltration basin has been designed with a volume of 273m³, to accommodate :-
- Volumes from a 1 in 100-year storm, with a 30% uplift for climate change. Reduced runoff rates have been considered in the design, due the inclusion of a green roof on the BPT
 - The volume of draining the final 10% of one of the BPT compartments during inspection, maintenance or cleaning. The other 90% would be able to be used for supply to the TPR.
343. Filter drains with soakaways would provide drainage along the access road between the BPT and the L1064. These would collect surface water and direct it to one of four infiltration sumps located along the access road. These sumps have been sized to accommodate flows from a 1 in 100 year rainfall event with a 30% climate change uptake.
344. Foul wastewater generated on the site would be directed to a holding tank with a level sensor to alert when emptying is required. It would then be tankered away for disposal at a licensed WwTP. The site would not be permanently staffed and so foul wastewater generated by operational staff on the site would be less than 1m³/d.

4.4 Booster Pumping Station

345. The BPS access road, and other paved areas have been designed to incorporate SuDS principles as recommended by the SuDS Manual (CIRIA 2015) in order to limit discharges of rainwater runoff from the BPS site to the equivalent greenfield site flow rate.
346. Surface water runoff from impermeable areas would be conveyed via an underground drainage system to a stormwater attenuation basin located to the front of the BPS site. The volume of the attenuation basin has been designed to accommodate flows from a 1 in 100-year storm event plus a 30% uplift in rainfall for climate change in accordance with a High End Future Scenario set out in Flood Risk Management: Climate Change Sectoral Adaptation Plan (Office of Public Works 2019). This volume has been calculated as 600m³.
347. Surface Water runoff entering the attenuation basin would be pre-treated in a Class 2 By-Pass Hydrocarbon Interceptor. This allows for any build-up of pollutants on the internal roadway or hard standing working areas that would be washed off in the early part of a storm to be treated. The outfall from the attenuation basin would be fitted with a penstock which can be used to isolate the attenuation basin and so contain pollutants in the event of an accidental spillage.

348. Water from the attenuation basin would be discharged at greenfield run-off rates via a 200mm diameter underground pipe to the small stream, an un-named tributary of the Camcor River, located approximately 200m east of the BPS site.
349. The head manhole on the discharge pipe would contain a flow control device which would control discharge from the system, limiting it to the maximum flow that would be expected from the greenfield site.
350. Foul wastewater generated by operational staff on the BPS site would be tankered from the wastewater holding tank to a licensed WwTP.

4.5 Flow Control Valve (FCV)

351. The FCV access road, and other paved areas have been designed to incorporate SuDS principles as recommended by the SuDS Manual (CIRIA 2015) in order to limit discharges of rainwater runoff from the FCV site to the equivalent greenfield site flow rate. This would include provision of filter drains to act as an attenuation device and would convey surface and stormwater in a controlled manner to the attenuation basin located to the north-west of the site. The volume of the attenuation basin required to accommodate flows from a 1 in 100-year storm event and a 30% uplift in rainfall for climate change has been calculated as 52m³.
352. Surface water runoff entering the attenuation basin would be pre-treated in a Class 2 By-Pass Hydrocarbon Interceptor. This allows for any build-up of pollutants on the internal roadway or hard standing working areas that will be washed off in the early part of a storm to be treated. The outfall from the attenuation basin would be fitted with a penstock which can be used to isolate the attenuation basin and so contain pollutants in the event of an accidental spillage.
353. Water from the attenuation basin would be discharged at greenfield run-off rates via a 200mm diameter underground pipe to the roadside drain.
354. The head manhole on the discharge pipe would contain a flow control device which would control discharge from the system, limiting it to the maximum flow that would be expected from the greenfield site.

4.6 Termination Point Reservoir (TPR)

355. The TPR access road and other paved areas will be designed to incorporate SuDS principles as recommended in the SuDS Manual (C753) (CIRIA 2015) to limit discharges from the TPR site to the equivalent greenfield site flow rate. This would include provision of filter drains to accept surface water runoff from the proposed access road and paved areas. The filter drains would act as attenuation/infiltration devices and would disperse surface and stormwater in a controlled manner to the attenuation basins located to the south-west of and north west of the site (Figures 4.70 and 4.71).
356. The volume of the attenuation basins has been designed to accommodate flows from a 1 in 100-year storm event plus a 30% uplift in rainfall for climate change in accordance with a High End Future Scenario set out in Flood Risk Management: Climate Change Sectoral Adaptation Plan (Office of Public Works 2019). These volumes have been calculated as 1,329m³ for the attenuation basin located to the south-west of the site and 1,229m³ for the attenuation basin located to the north-west of the site.

357. Surface water runoff entering the attenuation basin would be pre-treated in a Class 2 By-Pass Hydrocarbon Interceptor. This allows for any build-up of pollutants on the internal roadway or hard standing working areas that would be washed off in the early part of a storm to be treated. The outfall from the attenuation basin would be fitted with a penstock which can be used to isolate the attenuation basin and so contain pollutants in the event of an accidental spillage.
358. Stormwater from the attenuation basins would be discharged at greenfield run-off rates via 200mm diameter underground pipework to the network of field ditches/drains located to the north and west of the site.
359. The head manhole on the discharge pipework would contain a flow control device which would control discharge from the system, limiting it to the maximum flow that would be expected from the greenfield site.
360. The existing foul sewer crossing the TPR site would be diverted as part of the Proposed Project.
361. There is no requirement for foul drainage as part of the proposed TPR. The existing facilities would be used by site operatives.

5. References

Construction Industry Research and Information Association (CIRIA) (1996). Infiltration Drainage - Manual of Good Practice (R156).

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Annex A Schedule of Washouts

The 49 Washouts at Line Valves would not be used to discharge water during operation and so are not listed here. They would be used to discharge water during the commissioning phase only and so are detailed in the Commissioning Strategy.

Summary of Permanent Washout Locations (39nr)

Washout ID	Permanent Washout ID	20% of Qmed (m ³ /s)	Watercourse Reference	Washout Design Flow (l/s)	Approximate Chainage
WA-001	WCW001	682	Incha Beg	45*	TW - 700
WA-002	WCW002	668	Roran		TW - 1000
WA-003	WCW003	3,276	Kilmastulla River	35	TW - 2600
WA-004	WCW004	3,276	Kilmastulla River	40	TW - 3400
WA-005	WCW005	608	Burgess	30	TW - 7500
WA-007	WCW007	173	Cloghleigh	35	TW - 10600
WA-008	WCW008	128	Patrickswell	30	TW - 11400
WA-009	WCW009	97	Ardgregane Stream	45	TW - 13500
WA-010	WCW010	736	Ardgregane Stream	100	TW - 15700
WA-011	WCW011	736	Ardgregane Stream	35	TW - 16500
WA-013	WCW013	11,571	Nenagh River	150	TW - 19500
WA-014	WCW014	164	Ardcrony River	115	TW - 26500
WA-015	WCW015	125	Shesheraghmore	60	TW - 30800
WA-017	WCW017	75	Ballyfinboy River	75	TW - 35000
WA-018	WCW018	57	Derrinclare Stream	50	TWA - 4800
WA-019	WCW019	160	Derrinclare Stream	40	TWA - 5600
WA-020	WCW020	98	Shinrone	50	TWA - 8000
WA-021	WCW021	54	Quakerstown	30	TWA - 9400
WA-022	WCW022	4,497	Little Brosna River	200	TWA - 13000
WA-023	WCW023	60	Local drain	30	TWA - 21300
WA-024	WCW024	2,396	Camcor River	150	TWA - 27600
WA-025	WCW025	32	Ditch	30	TWB - 10100
WA-026	WCW026	5,313	Silver River (Kilcormac)	50	TWB - 12600
WA-027	WCW027	50,35	Clodiagh River (Tullamore)	150	TWB - 24900
WA-028	WCW028	96	Unnamed Meelaghans Tributary	30	TWC - 5000
WA-029	WCW029	827	Phillipstown River	30	TWC - 18900
WA-030	WCW030	845	Esker Stream	50	TWC - 20300
WA-031	WCW031	1,925	Figile River	30	TWD - 4200
WA-032	WCW032	692	Figile River	150	TWD - 8900
WA-033	WCW033	133	Figile Drain	50	TWD - 18100
WA-034	WCW034	448	Unnamed Blackwater Tributary	60	TWD - 26400
WA-035	WCW035	215	Aghafullim	100	TWD - 32700
WA-036	WCW036	411	Clonshanbo River	55	TWE - 2400
WA-037	WCW037	86	Lyreen River	30	TWE - 3600
WA-038	WCW038	102	Ardrass Lower	50	TWE - 9100

Washout ID	Permanent Washout ID	20% of Qmed (m ³ /s)	Watercourse Reference	Washout Design Flow (l/s)	Approximate Chainage
WA-039	WCW039	14,383	Liffey River	150	TWE - 9800
WA-040	WCW040	14,383	Liffey River	15	TWE - 11300
WA-041	WCW041	497	Blackwater	150	TWD - 28500
WA-042	WCW042	84.1	Unnamed tributary	15	TWD - 29100

* Note: Of WCW001 and WCW002 only one would be required to be constructed. This will be confirmed at detailed design, however, to assess potential environmental impacts both are assessed.

Summary of Washouts – Temporary Piped Discharges to a Watercourse (via Flexible Hose) (57nr)

Washout ID	Watercourse Reference	Washout Design Flow (l/s)	Approximate Chainage
WB-001	Kilmastulla River	15	TW - 2300
WB-002	Kilmastulla River	15	TW - 3300
WB-003	Large Ditch/Drain	15	TW - 4400
WB-004	Large Ditch/Drain	15	TW - 4900
WB-007	Tributary to Kilmastulla River	15	TW - 8500
WB-007a	Tributary to Kilmastulla River	20	TW - 9000
WB-008	Tributary to Kilmastulla River	25	TW - 10200
WB-009	Adgregane Stream	15	TW - 13000
WB-012	Stream	25	TW - 17100
WB-012a	Tributary to Nenagh	15	TW - 17900
WB-014	Large Ditch/Drain	15	TW - 20500
WB-016	Large Ditch/Drain	20	TW - 31600
WB-018a	Ballyfinboy	15	TW - 34800
WB-022a	Large Ditch/Drain	15	TWA - 12100
WB-027	Rock River	20	TWA - 17500
WB-032	Clareen River	20	TWA - 24800
WB-034	Camcor River	20	TWA - 26100
WB-035	Unnamed Stream	15	TWA - 27200
WB-036	Large Ditch/Drain	40	TWB - 300
WB-037*	Large Ditch/Drain	N/A	TWB - 1400
WB-043	Large Ditch/Drain	20	TWB - 10900
WB-044	Unconf. Large Ditch/Drain	20	TWB - 14200
WB-049	Large Ditch/Drain	15	TWB - 19800
WB-050	Large Ditch/Drain	15	TWB - 20300
WB-051	Large Ditch/Drain	20	TWB - 21800
WB-052	Large Ditch/Drain	20	TWB - 22100
WB-058	Large Ditch/Drain	15	TWC - 1200
WB-059*	Toberfin (Meelaghan) Stream	15	TWC - 3300
WB-060	Tributary to Meelaghan Stream	20	TWC - 4800
WB-062	Tributary to Tullamore River	20	TWC - 5600
WB-064	Tullamore River	20	TWC - 8900
WB-065	Tullamore River	20	TWC - 9700
WB-066	Large Ditch/Drain	15	TWC - 10000

Washout ID	Watercourse Reference	Washout Design Flow (l/s)	Approximate Chainage
WB-070	Rathfeston Stream	20	TWC - 12600
WB-073	Clonad Stream	20	TWC - 13700
WB-075	Large Ditch/Drain	20	TWC - 17600
WB-078	Tributary to Esker Stream	20	TWC - 20600
WB-079	Esker Stream	20	TWC - 21100
WB-080	Esker Stream	15	TWC - 21300
WB-081	Esker Stream	15	TWC - 21700
WB-082	Large Ditch/Drain	20	TWC - 22800
WB-091	Tributary to Figile River	15	TWD - 3500
WB-092	Figile River	15	TWD - 4600
WB-093	Figile River	15	TWD - 4900
WB-094	Figile River	25	TWD - 5300
WB-095	Figile River	25	TWD - 5600
WB-096	Large Ditch/Drain	15	TWD - 5900
WB-097	Figile River	15	TWD - 6200
WB-098	Figile River	15	TWD - 6300
WB-107	Peat land	15	TWD - 14400
WB-117	Large Ditch/Drain	20	TWD - 21000
WB-120	Large Ditch/Drain in Peatland	20	TWD - 23100
WB-122	Unnamed Stream	15	TWD - 24300
WB-130	Large Ditch/Drain	15	TWD - 31900
WB-131	Lyreen River	25	TWE - 700
WB-132	Baltracy tributary to Lyreen River	25	TWE - 1700
WB-137	Friarstown Stream	20	TWE - 10100

* Note: Washouts WB-037 and WB-059 are not required as part of the draindown strategy and a design flow has not been calculated for these. These washouts have been included as they offer flexibility to operators where there are long lengths of pipeline draining to Line Valves locations.

Summary of Washouts – Local Discharges to Small Ditches and Field Drains (51nr)

Washout ID	Discharge Area	Washout Design Flow (l/s)	Approximate Chainage
WB-002a	Small Ditch / Field Drain	15	TW - 3500
WB-005	Small Ditch / Field Drain	15	TW - 6600
WB-006	Small Ditch / Field Drain	15	TW - 6900
WB-010	Kilcolman Stream	15	TW - 13800
WB-012b	Small Ditch / Field Drain	15	TW - 18300
WB-013	Monsea Stream	15	TW - 19200
WB-018	Small Ditch / Field Drain	15	TW - 34200
WB-020	Small Ditch / Field Drain	15	TWA - 3500
WB-020a	Small Ditch / Field Drain	15	TWA - 4000
WB-022	Small Ditch / Field Drain	15	TWA - 8800
WB-024	Small Ditch / Field Drain	20	TWA - 14800
WB-025	Small Ditch / Field Drain	15	TWA - 15300
WB-026	Small Ditch / Field Drain	15	TWA - 16000
WB-028	Small Ditch / Field Drain	15	TWA - 19400
WB-029	Small Ditch / Field Drain	15	TWA - 20300
WB-030	Small Ditch / Field Drain	15	TWA - 23200
WB-031	Tributary to Clareen Stream	15	TWA - 23800
WB-033	Tributary to Camcor Stream	15	TWA - 25700
WB-039	Small Ditch / Field Drain	15	TWB - 5900
WB-040	Unnamed Stream at Kyleboher	15	TWB - 6600
WB-041	Tributary to Silver River (Kilcormac)	15	TWB - 7800
WB-042	Small Ditch / Field Drain	15	TWB - 9100
WB-045	Tributary to Silver River (Kilcormac)	15	TWB - 14700
WB-045a	Small Ditch / Field Drain	15	TWB - 15300
WB-053	Small Ditch / Field Drain	15	TWB - 23300
WB-054	Small Ditch / Field Drain	15	TWB - 23900
WB-057	Clodiagh River (Tullamore)	15	TWC - 1000
WB-061	Small Ditch / Field Drain	15	TWC - 5200
WB-063	Small Ditch / Field Drain	15	TWC - 6900
WB-067	Small Ditch / Field Drain	15	TWC - 11100
WB-068	Small Ditch / Field Drain	15	TWC - 11900
WB-069	Small Ditch / Field Drain	15	TWC - 12000
WB-074	Small Ditch / Field Drain	15	TWC - 15700
WB-077	Small Ditch / Field Drain	15	TWC - 19300
WB-083	Small Ditch / Field Drain	15	TWC - 23200
WB-084	Small Ditch / Field Drain	15	TWC - 23700
WB-085	Small Ditch / Field Drain	15	TWC - 24100
WB-086	Small Ditch / Field Drain	15	TWD - 400
WB-087	Small Ditch / Field Drain	15	TWD - 500
WB-103	Small Ditch / Field Drain	15	TWD - 7900
WB-109	Small Ditch / Field Drain	15	TWD - 15900

Washout ID	Discharge Area	Washout Design Flow (l/s)	Approximate Chainage
WB-110	Small Ditch / Field Drain	15	TWD - 16600
WB-112	Small Ditch / Field Drain	15	TWD - 17800
WB-123	Small Ditch / Field Drain	15	TWD - 24700
WB-125	Small Ditch / Field Drain	15	TWD - 26900
WB-129	Small Ditch / Field Drain	15	TWD - 31200
WB-133	Small Ditch / Field Drain	15	TWE - 4400
WB-134	Small Ditch / Field Drain	15	TWE - 5900
WB-136	Small Ditch / Field Drain	15	TWE - 8200
WB-139	Unnamed Stream	15	TWE - 13900
WB-140	Small Ditch / Field Drain	15	TWE - 14100

Summary of Washouts – Local Discharges Direct to Bunded area of Land (40nr)

Washout ID	Discharge Area	Washout Design Flow (l/s)	Approximate Chainage
WB-011	Adgegane Stream	15	TW - 14300
WB-014a	Agricultural Land	15	TW - 27100
WB-015	Agricultural Land	15	TW - 29300
WB-017	Agricultural Land	15	TW - 32200
WB-019	Agricultural Land	15	TWA - 700
WB-023	Agricultural Land	15	TWA - 14200
WB-036a	Agricultural Land	15	TWB - 1100
WB-038	Agricultural Land	15	TWB - 3500
WB-038a	Agricultural Land	15	TWB - 5600
WB-046	Agricultural Land	15	TWB - 15900
WB-047	Agricultural Land	15	TWB - 16600
WB-048	Agricultural Land	15	TWB - 17700
WB-055	Peat land	15	TWB - 26200
WB-056	Agricultural Land	15	TWB - 28100
WB-071	Peat land	15	TWC - 13200
WB-072	Peat land	15	TWC - 13500
WB-076	Agricultural Land	15	TWC - 18200
WB-088	Agricultural Land	15	TWD - 1100
WB-089	Peat land	15	TWD - 2800
WB-099	Peat land	15	TWD - 6700
WB-100	Peat land	15	TWD - 6900
WB-101	Peat land	15	TWD - 7100
WB-102	Peat land	15	TWD - 7400
WB-104	Peat land	15	TWD - 12200
WB-105	Peat land	15	TWD - 12900
WB-106	Peat land	15	TWD - 14100
WB-111	Peat land	15	TWD - 17300
WB-113	Agricultural Land	15	TWD - 18700
WB-114	Peat land	15	TWD - 19400

Washout ID	Discharge Area	Washout Design Flow (l/s)	Approximate Chainage
WB-115	Peat land	15	TWD - 20300
WB-116	Peat land	15	TWD - 20800
WB-118	Peat land	15	TWD - 21400
WB-119	Peat land	15	TWD - 22700
WB-121	Peat land	15	TWD - 23400
WB-124	Agricultural Land	15	TWD - 25600
WB-128	Agricultural Land	15	TWD - 30400
WB-135	Agricultural Land	15	TWE - 6400
WB-138	Agricultural Land	15	TWE - 8500
WB136a	Agricultural Land	15	TWE - 12300
WB140a	Agricultural Land	15	TWE - 15400

Annex B Generic Environmental Risks and Mitigation Associated with Discharge to Watercourse

Discharge to waterbody – generic risk management							
Risk	Variables	Environmental Objective	Technical Objective	Measure	Performance Target	Mitigation/Prevention Commitment	Monitoring
Loss of habitat due to scour (bank/bed).	<ul style="list-style-type: none"> Location of discharge. Velocity of discharge. 	No scour or damage/loss of habitat.	Maximise flexibility in ability to discharge.	Extent of habitat loss.	No scour to occur.	Discharge at less than 20% Qmed. Preferential discharge via permanent outfalls (if discharging to waterbodies) as these are designed to prevent scour. Location of temporary discharge locations to be agreed with ECoW in line with IFI guidance to reduce risk of scour.	Clerk of Works visual inspection of discharge (frequency to be determined).
Flooding.	<ul style="list-style-type: none"> Water levels. Volume of water being discharged. 	No increase in flood risk/extent.	None.	Flood level.	No increase in flood risk.	Discharge to be restricted to QMed 20%. No discharge in flood event (flow rates >Q30). (to be determined by monitoring and installation of gauge boards based on CFRAM modelling and monitoring cross referenced).	Uisce Éireann – monitor flow levels and install gauge board.
Flooding. (Localised watercourse only)	<ul style="list-style-type: none"> Water levels. Volume of water being discharged. 	No increase in flood risk/extent.	None.	Flood level.	No increase in flood risk.	For localised watercourses the rate of discharge would be no more than 25l/s.	Uisce Éireann – monitor flow levels and install gauge board.
Reduced Dissolved Oxygen levels in discharge (DO).	<ul style="list-style-type: none"> Duration of storing water in pipes. 	No injury/killing of species due to reduced DO.	None.	DO levels in water.	Oxygen in discharge water is the same or greater than that in the river.	Re-oxygenation if required.	Uisce Éireann – quality (as per discharge consent) (Portable DO meter).
Water quality of discharge.	<ul style="list-style-type: none"> Level of chlorine in water 	Water quality of sufficient standard that there would be no likely significant adverse environmental effect on receiving waterbody.	None.	Water quality of discharge	Dechlorination to be undertaken prior to discharge	Level of chlorine to be reduce to <0.005mg/l	Uisce Éireann – quality (as per discharge consent if one is required).

Annex C Generic Environmental Risks and Mitigation Associated with Discharge to Land

Discharge to land – generic risk management							
Risk	Variables	Environmental Objective	Technical Objective	Measure	Performance Target	Mitigation/Prevention on Commitment	Monitoring
Loss of use of land	<ul style="list-style-type: none"> Extent of land required for discharge and temporary structures 	To avoid impact on use of land	None	Landowner satisfaction	None.	Agree arrangements for temporary discharge to land and access / construction arrangements with landowner in advance	Agreement in place.
Scour of soils	<ul style="list-style-type: none"> Location of discharge. Velocity of discharge. 	No erosion of soils. Maximise re-use of water.	Maximise flexibility in ability to discharge.	Visual level of erosion	No erosion of soils	Discharge to land to be managed to avoid erosion of soils. Discharge at greenfield rates equivalent to the area of the field subject to the discharge. (to be determined by monitoring and installation of gauge boards based on CFRAM modelling and monitoring cross referenced).	Clerk of Works / Visual monitoring
Flooding.	<ul style="list-style-type: none"> Water levels. Volume of water being discharged. 	No increase in flood risk/extent.	None.	Flood level.	No increase in flood risk.	No discharge to land that is already subject to high water levels (surface / groundwater) Rate of discharge to be limited to 15l/s, where required.	Uisce Éireann – monitor water levels, discharge rates and infiltration rates.