Greater Dublin Drainage

Alternative Sites Assessment and Route Selection Report (Phase 4):
Final Preferred Site and Routes

Appendix 10
Preliminary Engineering Design

June 2013

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1 Introduction

1.1 Introduction

A key recommendation of the GDSDS Final Strategy as amended by its SEA was for a single regional wastewater treatment plant (WwTP) to be located in North County Dublin with the treated effluent to be discharged to the marine environment of the Irish Sea.

A key recommendation of the SEA of the GDSDS was that a comprehensive Alternative Sites Assessment (ASA) study be undertaken, with the overall objective of selecting a preferred site for the proposed Regional WwTP, a preferred location for the marine outfall and preferred routes for the associated orbital pipelines.

The selection of the optimum location for the proposed Regional WwTP, marine outfall and orbital pipeline corridors has entailed an assessment of the means to minimise potential adverse environmental impacts and to optimise environmental benefits.

1.2 ASA Process

The ASA/Route Selection was undertaken having regard to the recommendations set out in the Strategic Environmental Assessment (SEA) on the GDSDS, which envisaged a process comprising four distinct phases, as outlined hereunder comprising:

Phase 1 - Alternative Sites Identification (Preliminary Screening)

This phase involved the identification of a number of land parcels of suitable size within which the proposed Regional WwTP could be located, corridors for routing of the orbital drainage network and potential marine outfall locations. The Phase 1 - Alternative Sites Identification included Public Consultation, desktop studies, mapping of constraints and a screening of the study area. Full details of this phase are provided in the *ASA Phase One – Preliminary Screening Outcomes Report* which was published in October 2011. This report recommended that nine land parcels, associated potential pipeline corridors and marine outfall study areas be brought forward for further consideration against a range of technical and environmental criteria under Phase 2 of the ASA.

Phase 2 - Alternative Sites Assessment

Phase 2 of the ASA process consisted of an assessment of the performance of each of the nine alternative land parcels, transfer pipeline routes and marine outfalls shortlisted in Phase 1 against a range of environmental and technical criteria leading to the identification of three emerging preferred sites for the regional WwTP, marine outfall location and transfer pipeline routes. The Alternative Sites Assessment (ASA) – Phase 2 included Public Consultation on the nine short listed land parcels, pipeline corridors and marine outfall study areas, desk-top studies, windshield surveys, site visits and impact assessments by the project consultants including various engineering and environmental specialists. It also included consideration of issues and concerns identified during the consultation period.

Full details of this phase are provided in the *Alternative Sites Assessment and Route Selection Report (Phase 2): Emerging Preferred Sites and Routes* which was published in May 2012. This report recommended that the three emerging preferred site options be brought forward for further consideration under Phase 3 and Phase 4 of the ASA process.

Phase 3: - Consultation stage

Following completion of Phase 2 and publication of the *Alternative Sites Assessment and Route Selection Report (Phase 2): Emerging Preferred Sites and Routes*, the three emerging preferred site options were brought through Public Consultation held over an eight week period from 14th May 2012 to 6th July 2012. The primary objective of this phase was to gather any additional information on the three emerging preferred site options, (i.e. WwTP site, its associated pipeline corridors and marine outfall locations). Full details of this Phase are provided in the *Public Consultation Report on Alternative Site Assessment Phase Two: Emerging Preferred Sites and Routes*, which was published in October 2012.

Phase 4: - Selection of the Preferred Site, Pipeline Routes and Outfall Location

Phase 4 constitutes the final identification of the preferred site option (i.e. WwTP site, its associated pipeline corridor and marine outfall location), and consists of the following steps:

Step 1 Review of the assessment findings from the ASA Phase 2 process which is reported in the Alternative Sites Assessment and Route Selection Report (Phase 2): Emerging Preferred Sites and Routes, May 2012.

Step 2 Consideration of the submissions received during ASA Phase 3 (Public Consultation) of the ASA process which was held over an eight week period from 14th May 2012 to 6th July 2012. Full details of this phase are provided in the *Public Consultation Report on Alternative Site Assessment Phase Two: Emerging Preferred Sites and Routes*, which was published in October 2012.

Step 3 Undertake further investigative studies to supplement the data collected and assessed during the ASA Phase 2 and which were also informed by consideration of submissions received.

Step 4 Assessment of the findings of the further investigative studies to determine whether anything of such significance was identified which made the development of any of the three emerging preferred site options unfeasible.

Step 5 Assessment of the individual components of the site options (WwTP site, marine outfall locations and associated orbital sewers and outfall pipelines) against the findings of *Step 1 to Step 3* above. Identification of constraints for the individual components and the identification of potential mitigation measures where the ASA Phase 4 assessment indicated that it was not possible to avoid impacts.

Step 6 Preparation of preliminary cost estimates

Step 7 Combine the assessment of the individual components from *Steps 5 and 6* into one overall emerging preferred site option assessment matrix. Through a comparative assessment assign 'more' and 'less' favourable classifications to the identified constraints.

Step 8 Selection of final preferred site option based on the relative performance of each of the site options against the Environmental, Technical and Cost criteria considered.

1.3 Emerging Preferred Site Options

On completion of the ASA Phase 2 process, as reported in the *Alternative Sites Assessment and Route Selection Report (Phase 2): Emerging Preferred Sites and Routes; May 2012,* three preferred site options emerged to be taken forward for further consideration under Phase 3 and Phase 4 of the ASA process.

A site option is defined as a site for the proposed Regional WwTP, its associated marine outfall, orbital sewers and outfall pipeline.

The three emerging preferred site options, indicated on **Figure 1.1** are:

- Annsbrook site option, with a proposed WwTP site located in the townland of Annsbrook, a marine outfall located in the Northern marine outfall study area and orbital sewers pipeline corridors connecting the load centres to the WwTP site and outfall pipeline corridors connecting the WwTP site to the northern outfall location.
- Clonshagh (Clonshaugh) site option, with a proposed WwTP site located in the townland of Clonshagh, a marine outfall located in the Southern marine outfall study area and orbital sewers pipeline corridors connecting the load centres to the WwTP site and outfall pipeline corridors connecting the WwTP site to the southern outfall location.
- Newtowncorduff site option, with a proposed WwTP site located in the townland of Newtowncorduff, a marine outfall located in the Northern marine outfall study area and orbital sewers pipeline corridors connecting the load centres to the WwTP site and outfall pipeline corridors connecting the WwTP site to the northern outfall location.

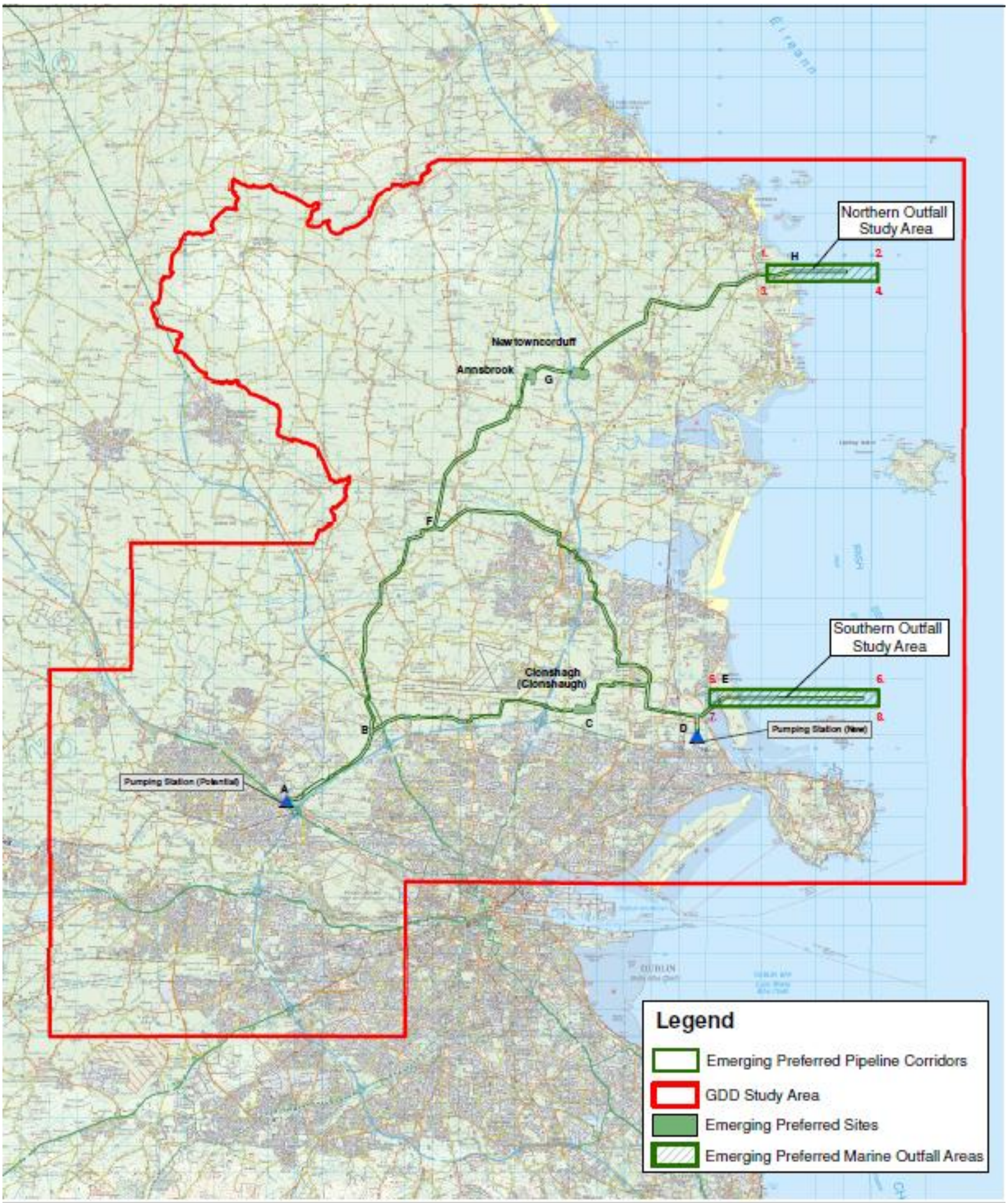

Figure 1.1: - Emerging Preferred Site Options

1.4 Summary of ASA Phase 2 Engineering Design Assessment

The pipeline corridors associated with each of the 'Emerging Preferred Site Options' were previously evaluated during ASA Phase 2 assessment under the following Engineering Design technical criteria:

- Topography
- Engineering Design
- Health and Safety
- Access / Rights of Way / Wayleaves
- Crossings – Waterways, Rail, etc.
- Physical Infrastructure
- Strategic Utility Services
- Land Ownership and Titles
- Route Traffic Management
- Construction Risk

These technical criteria were brought into the overall Alternative Site Assessment (ASA) matrix as sub-criteria under the Engineering Design criteria and used in the identification of the emerging preferred site options (i.e WwTP site, its associated marine outfall location, orbital sewer and outfall pipeline corridors).

Of the above criteria Topography and Engineering Design were found to have the most significant influence in the Engineering Design assessment process.

A Summary of the key Engineering Design constraints and technical differentiators for the three 'Emerging Preferred Site Options' is set out in the following sub-sections.

1.4.1 Summary of ASA Phase 2 Engineering Design Assessment of Annsbrook Site Option

There are no identified technical constraints to the construction of the WWTP on the Annsbrook site. A WWTP located on this site would outfall to the northern outfall area.

The orbital sewer to the Annsbrook site from the Route 9C Sewer Catchment would be either:

- A gravity sewer constructed in tunnel, or
- A pumped rising main and gravity sewer constructed in open cut and tunnelled section.

The orbital sewer to the Annsbrook site from the North Dublin Catchment would be a pumped rising main and gravity sewer laid in open cut and tunnelled section.

The outfall pipe from the Annsbrook site to the northern outfall area would be a gravity sewer laid in open cut and tunnelled section.

The total length of pipeline (orbital sewer, transfer pipeline to coast and marine outfall) is approximately 49,700m.

Total power required to pump flows to the Annsbrook site is in the order of 6,600kW – 9,100kW depending on final selection of orbital sewer from the Route 9C Catchment.

It is feasible to route the orbital sewers from the load centres to the WWTP and from the WWTP to the outfall within the pipeline corridors to generally avoid impacts on designated sites and significant areas of habitat.

The following potential negative construction impacts have been identified for the pipeline corridors:

- Potential impact on the Broadmeadow/Swords Estuary SPA and Malahide Estuary SAC from routing of pipeline along corridor 'D' east of Swords and adjacent to the Broadmeadow Estuary.
- Potential impact on the Skerries to Rush Geological Heritage Site at the northern outfall area.

These impacts would be avoided by constructing these sections of pipeline using tunnelling methodologies.

1.4.2 Summary of ASA Phase 2 Engineering Design Assessment of Clonshagh Site Option

There are no identified technical constraints to the construction of the WWTP on the Clonshagh site. A WWTP located on this site would outfall to the southern outfall area.

The orbital sewer to the Clonshagh site from the Route 9C Sewer Catchment would be either:

- A gravity sewer constructed in tunnel, or
- A pumped rising main and gravity sewer constructed in open cut and tunnelled section.

The orbital sewer to the Clonshagh site from the North Dublin Catchment would be a pumped rising main and gravity sewer laid in open cut and tunnelled section.

The outfall pipe from the Clonshagh site to the southern outfall area would be a gravity sewer laid in open cut and tunnelled section.

The total length of pipeline (orbital sewer, transfer pipeline to coast and marine outfall) is approximately 31,600m.

Total power required to pump flows to the Clonshagh site is in the order of 3,300kW – 4,800kW depending on final selection of orbital sewer from the Route 9C Catchment.

It is feasible to route the Orbital sewers from the load centres to the WWTP and from the WWTP to the outfall within the pipeline corridors to generally avoid impacts on designated sites and significant areas of habitat.

The following potential negative construction impacts have been identified for the pipeline corridors:

- Potential impact on the Baldoyle Bay SPA/SAC resulting from pipeline corridor crossing Baldoyle Estuary on route to southern outfall location.

These impacts would be avoided by constructing this section of pipeline using tunnelling methodologies

1.4.3 Summary of ASA Phase 2 Engineering Design Assessment of Newtowncorduff Site Option

There are no identified technical constraints to the construction of the WWTP on the Newtowncorduff site. A WWTP located on this site would outfall to the northern outfall area.

The orbital sewer to the Annsbrook site from the Route 9C Sewer Catchment would be either:

- A gravity sewer constructed in tunnel, or
- A pumped rising main and gravity sewer constructed in open cut and tunnelled section.

The orbital sewer to the Annsbrook site from the North Dublin Catchment would be a pumped rising main and gravity sewer laid in open cut and tunnelled section.

The outfall pipe from the Annsbrook site to the northern outfall area would be a gravity sewer laid in open cut and tunnelled section.

The total length of pipeline (orbital sewer, transfer pipeline to coast and marine outfall) is approximately 49,700m.

Total power required to pump flows to the Annsbrook site is in the order of 6,600kW – 9,100kW depending on final selection of orbital sewer from the Route 9C Catchment.

It is feasible to route the Orbital sewers from the load centres to the WWTP and from the WWTP to the outfall within the pipeline corridors to generally avoid impacts on designated sites and significant areas of habitat.

The following potential negative construction impacts have been identified for the pipeline corridors:

- Significant impact on the Broadmeadow/Swords Estuary SPA and Malahide Estuary SAC from routing of pipeline along corridor 'D' east of Swords and adjacent to the Brodmeadow Estuary.
- Significant impact on the Skerries to Rush Geological Heritage Site at the northern outfall area.

These impacts would be avoided by constructing these sections of pipeline using tunnelling methodologies.

1.5 ASA Phase 4 Engineering Design Assessment

With respect to engineering design of the WwTP, its associated orbital sewers and outfall pipelines Topography and Engineering Design were identified in ASA Phase 2 as having the most significant influence on the selection of the optimum WwTP site. Therefore this ASA Phase 4 Preliminary Engineering Design Report examines in more detail the Engineering Design associated with the transfer of flows to the emerging preferred sites from already developed drainage catchments located in the north, west and north-west of the overall Ringsend WwTP drainage catchment, whose flows are currently being passed to Ringsend.

Preliminary cost estimates are also included for the various options for load transfer to each of the Emerging Preferred Sites.

The Engineering Design outputs are considered and further details, where relevant, were incorporated into the overall final selection matrix in order to identify the preferred site option.

2 Assessment of Projected Load on Proposed Regional WwTP

2.1 Introduction

The treatment capacity needs for the GDA identified in the GDSDS were predicated on population projections based on the 2002 Census, with industry and commercial wastewater data built up from considerations of sub-catchment planning potential. However in the intervening time since publication in March 2003 of the GDSDS Population & Landuse Report, there was a period of significant inward migration post 2004 following the expansion of the EU but in more recent years a shrinking of the national economy with associated reductions in industry and commercial loads together with outward migration.

It was therefore deemed prudent to undertake a review of the load projections by the GDSDS to identify the treatment capacity required to facilitate continued growth within the Greater Dublin Area.

In particular, the release of results from Census 2011 and the December 2010 update of the Regional Planning Guidelines (RPG) for the GDA, presented an ideal opportunity to confirm existing population and non-domestic loads on the various wastewater treatment plants in the GDA. It also permitted a re-examination of the population and non-domestic growth rates in the GDA, up to and beyond the redefined design year horizon of 2040 for the Greater Dublin Drainage project, with particular emphasis on the catchment contributing to Ringsend WwTP. It should be noted that the GDSDS originally identified a design year horizon of 2031 for the proposed Regional WwTP; however the design year horizon has been redefined as 2040 based on the current proposals for the GDD project.

The determination of the required treatment capacity for the proposed Regional WwTP is closely linked to the capacity of the existing plant at Ringsend (currently operating on a regional basis) and the requirement to divert load away from this plant when the ceiling on treatment capacity is reached at Ringsend. Therefore, the required treatment capacity at the Regional WwTP has been determined in the context of the firm treatment capacity of 2.1 million PE to be provided at Ringsend WwTP.

2.2 Existing Loadings on Ringsend WwTP

Loading on a wastewater treatment plant arises from residential, commercial, institutional and industrial sources. Census figures are the primary source for residential load estimation. The contributing catchment to Ringsend WwTP is shown in **Figure 2.1**. The 2011 population in the Ringsend catchment is estimated at 1,098,470 persons.

The load contribution from commercial and institutional sources is difficult to accurately assess due to the lack of legislation in place to provide complete monitoring and licensing of this sector. The load contribution from commercial and institutional sources in the Ringsend WwTP catchment have been estimated by deducting known residential and industrial contributions from the total load measured at the treatment plant. In this manner the commercial and institutional load contribution to Ringsend WwTP in 2011 has been estimated at 420,660 PE

The accuracy of industrial loadings is thought to be very good since these users generally discharge to the public sewer under licence and therefore their effluent quality is monitored and the discharge from the larger users is generally metered. The measured industrial load on Ringsend WwTP is equivalent to 220,870 PE.

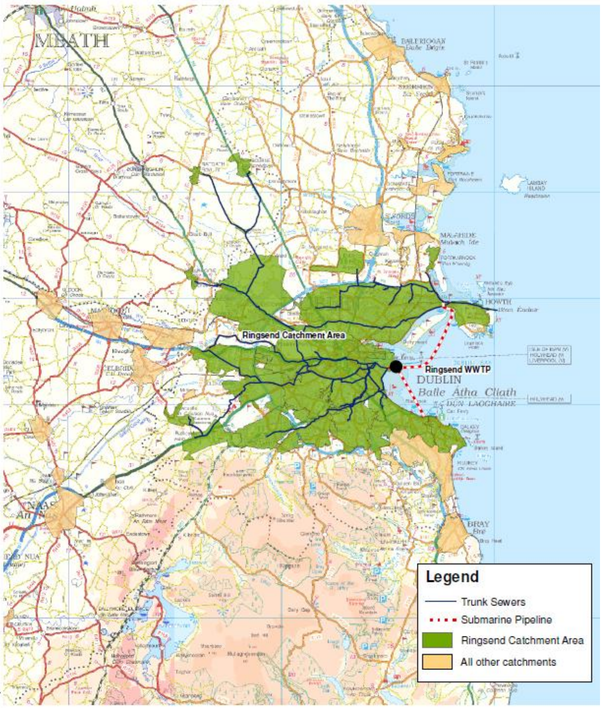

Figure 2.1 – Ringsend WwTP Catchment

The loadings on the Ringsend WwTP over the past four years have been stable at approximately 1.8 million PE as shown in Table 2.1 below.

Year	Load (millions)
2008	1.79 PE
2009	1.74 PE
2010	1.81 PE
2011	1.74 PE

Table 2.1 Measured Loads to Ringsend WwTP

(Source: Ringsend Wastewater Treatment Works Extension Environmental Impact Statement; March 2012)

2.3 Total PE Projections on Ringsend WwTP

The projected population equivalent (PE) loadings for the Ringsend WwTP Catchment under the three growth scenarios examined are summarised in Table 2.2 and illustrated in **Figure 2.3** below. The maximum operational treatment capacity at Ringsend WwTP of 2.1 million PE average daily load is also shown.

Growth Scenario	Base Year	Design Year			Future Consideration
	2011	2020	2031	2040	2050
Scenario 1.	1,740,000	2,042,106	2,435,585	2,760,535	3,167,592
Scenario 2.	1,740,000	1,962,919	2,229,093	2,470,706	2,770,001
Scenario 3.	1,740,000	1,911,635	2,076,987	2,225,523	2,405,967

Table 2.2 Summary of Projected PE Loadings – Ringsend WwTP Catchment

Under Growth Scenario 1 the maximum treatment capacity of 2.1 million PE is exceeded from year 2022. Under Growth Scenario 2 the maximum treatment capacity of 2.1 million PE is exceeded from year 2026. Under Growth Scenario 3 the maximum treatment capacity of 2.1 million PE is exceeded from year 2033

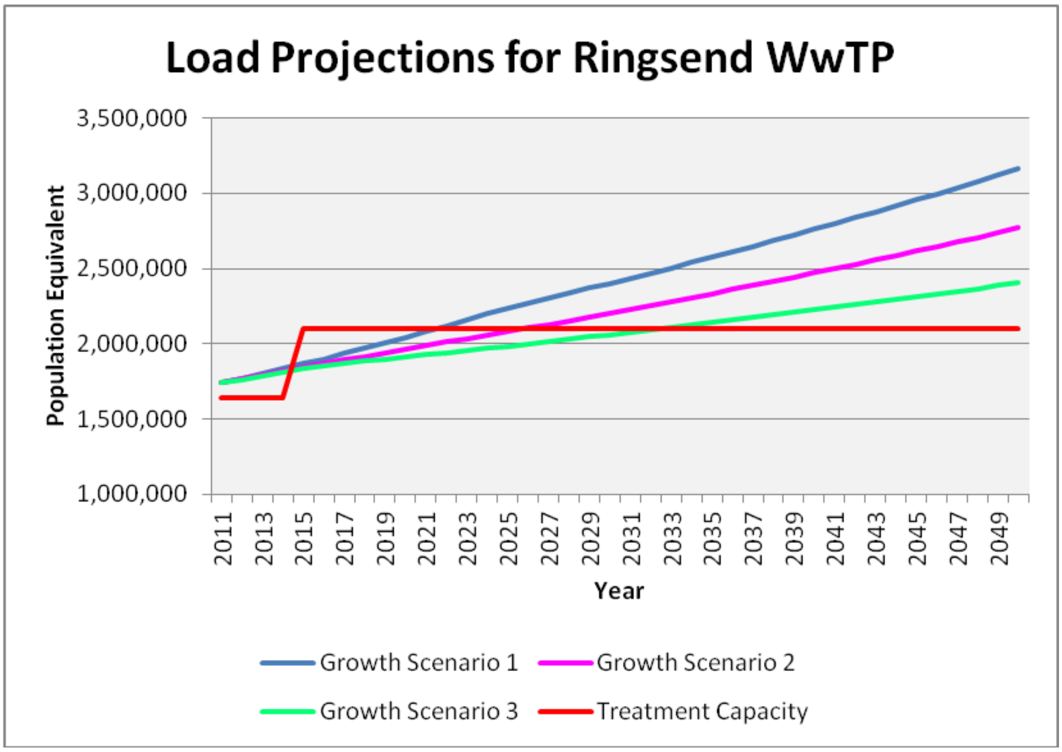

Fig. 2.3 Loading Projections for Ringsend WwTP.

2.4 Catchments

The GDSDS and its SEA identified the critical drainage catchments in the GDA, which have an influence on the required treatment capacities of both the upgraded Ringsend WwTP and the proposed Regional WwTP, as those which are located in the north, west and north-west of the existing catchment of Ringsend WwTP. These catchments are indicated in **Figure 2.2** and comprise;

- The existing catchment of Ringsend WwTP;
- The Blanchardstown (Route 9C Sewer) sub-catchment of Ringsend WwTP (includes the Meath towns & villages of Ashbourne, Ratoath, Kilbride, Dunboyne & Clonee);
- The North Dublin (North Fringe Sewer & NDDS Sewer) sub-catchment of Ringsend WwTP; and
- The South Dublin – Lucan/Clondalkin (Route 9B Sewer) sub-catchment of Ringsend WwTP.

Figure 2.2: - Primary Load Centres

It should be noted that diversion of part or all of the above catchments from the Ringsend WwTP will free up capacity at the expanded Ringsend WwTP which will allow for future growth in the Dublin City, Dun-Laoghaire Rathdown and South Dublin catchments, which will continue to discharge to Ringsend WwTP.

Additional catchments in the GDA, which may also influence future required treatment capacity of the new Regional WwTP, through diversion of flows and load in excess of ultimate treatment capability of the individual wastewater treatment plants in these catchments are indicated in **Figure 2.3** and comprise:

- Lower Liffey Valley (Leixlip WwTP) Catchment (Includes Leixlip, Celbridge, Maynooth, Kilcock and Straffan);

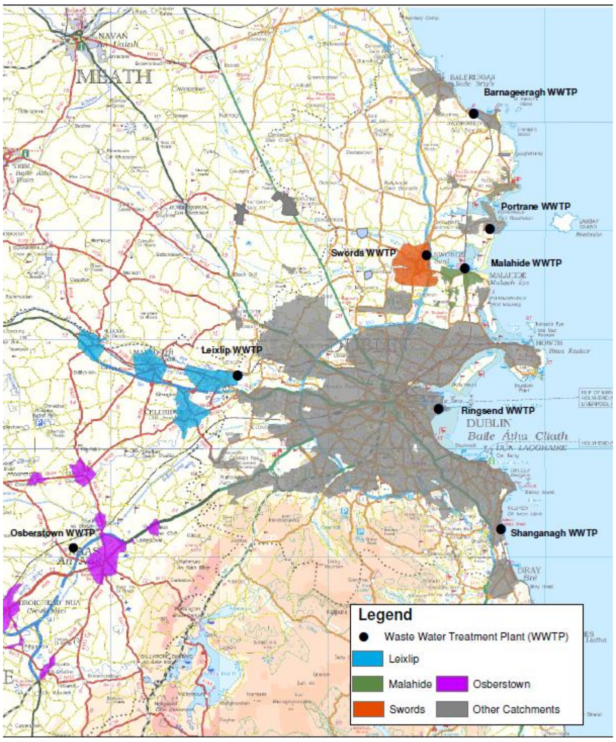

Figure 2.3: - Secondary Load Centres

- Upper Liffey Valley (Osberstown WwTP) Catchment (Includes Naas, Prosperous, Clane, Sallins, Kill, Johnstown, Newbridge, Athgarvan and Kilcullen);
- Swords WwTP Catchment; and
- Malahide WwTP Catchment.

2.5 Projected Loadings on the Regional WwTP

Analysis of the projected loadings to Ringsend WwTP discussed above demonstrates that it will be necessary under all three Growth Scenarios to divert some of the loadings from the Ringsend catchment to the new Regional WwTP in order to maintain the loading on Ringsend WwTP below its firm treatment capacity of 2.1 million PE.

In developing the load transfer to the proposed Regional WwTP for planning purposes it is recommended that Growth Scenario Two, which combines median residential population growth rates with the median commercial load projection and median to low industrial load projections, be used.

Prudent planning suggests that load diversion from Ringsend WwTP commences before its treatment capacity is exceeded. Therefore, it is recommended that flow diversions commence as set out hereunder:

- Route 9C Catchment upstream of the M50 at 2020
- North Fringe Sewer (NFS) Catchment at 2020
- North Dublin Drainage Scheme (NDDS) Catchment at 2035

The required load diversions from the Ringsend Catchment would be satisfied at all stages up to 2040 (the design year horizon) by diverting the wastewater load generated in each of the above catchments. These catchments are the ‘primary’ load centres for the proposed Regional WwTP.

Post 2045 it may be necessary, depending on actual growth realised, to divert additional wastewater loads from the Ringsend Catchment and this requirement could be satisfied by diverting wastewater load generated in the Route 9B (Lucan/Clondalkin) Catchment of South Dublin to the Regional WwTP.

When the installed or planned treatment capacity at their respective wastewater treatment plants is exceeded diversions would also be required from:

- Lower Liffey Valley (Leixlip WwTP) Catchment in Kildare in 2020;
- Upper Liffey Valley (Osberstown WwTP) Catchment in Kildare post 2035;
- Malahide Catchment in Fingal post 2035; and

- Swords Catchment in Fingal post 2045.

The above catchments, including the Route 9B (Lucan/Clondalkin) Catchment of South Dublin are considered as ‘secondary’ load centres for the proposed Regional WwTP.

The required treatment capacity of the new Regional WwTP is therefore estimated at approximately 334,000 PE at 2020 rising to approximately 720,000 PE at 2040 as indicated in Table 2.3

Year	Sub - Catchment	Load Diverted (PE)	Cumulative Load (PE) on Regional WwTP
2020	Route 9C Sewer	166,700	334,000
	North Fringe Sewer	132,300	
	Leixlip WwTP	35,000	
2035	NDDS Sewer	262,100	670,000
	Osberstown WwTP	2,000	
	Malahide	1,500	
2040	‘-	‘-	720,000

Table 2.3 **Potential Load Diversions to Regional WwTP**

3 Wastewater Treatment Technologies

3.1 Introduction

A key recommendation of the GDSDS Final Strategy as amended by its SEA was for a single regional wastewater treatment plant (WwTP) to be located in North County Dublin with the treated effluent to be discharged to the marine environment of the Irish Sea.

The Urban Wastewater Treatment Regulations, 2001 to 2010; require that an effluent discharging to the Irish Sea off the North Dublin coast from the proposed Regional WwTP be treated in a treatment plant which provides for secondary treatment.

A conventional secondary treatment WwTP is commonly defined as a combination of Preliminary (or Pre-) treatment processes + Primary treatment processes + Secondary treatment processes.

There is no legislative requirement for the provision of nutrient (nitrogen and phosphorous) reduction in addition to secondary treatment for the treated wastewater. Therefore, the provision of nutrient reduction in addition to secondary treatment is not considered necessary for the new Regional WwTP at this time.

However, Three Dimensional Hydrodynamic modelling of a treated wastewater discharge from the proposed Regional WwTP at the outfall location will assess whether nutrient reduction and/or UV treatment is required for the treated wastewater prior to final discharge.

Various treatment processes are currently available which would satisfy the proposed final effluent emission limits for the proposed Regional WwTP as set out in the *Key Effluent Design Standards Report, July 2012*. This report identified that the proposed new works will be required to achieve a secondary treatment level with key quality requirements of 25mg/l Biochemical Oxygen Demand, 125mg/l Chemical Oxygen Demand and 35mg/l Total Suspended Solids.

In accordance with current Government policy, it is likely that the project will be procured as a Design/Build/Operate (DBO) contract. Detail design will be undertaken by the DBO Contractor. The waste water treatment process proposed by the tendering contractors will be required to comply fully with specified Performance Requirements (e.g. effluent discharge standards) including such Development Consent Approval as may be granted by An Bord Pleanála (ABP).

An Environmental Impact Statement (EIS) is required for this project. In developing the EIS ‘worst case’ impact under each section of the EIS must be considered and addressed. Therefore, a range of potentially suitable treatment technologies must be examined to determine the ‘worst case’ impact in each case for appropriate consideration in the EIS.

Assessment is currently ongoing into the range of suitable processes for the proposed plant which include the following secondary treatment processes:

- Conventional Activated Sludge Plant (ASP)
- ASP in Sequencing Batch Reactors (SBR)
- Submerged Attached Growth Processes (e.g. BAFF)
- Integrated fixed film activated sludge processes (e.g. IFAS)
- Membrane bioreactors (MBR)

In construction of a new WwTP, key opportunities exist for installation of a compact, energy efficient process which overcomes existing issues experienced at other WwTP and takes into account future considerations of population growth, regulatory and sustainability requirements.

Key considerations associated with the identification of the optimum technologies include the following:

- Efficient footprint
- Odour considerations
- Proven processes
- Process staging
- Required scale
- Future proofing
- Sludge impacts and options
- Carbon footprint and greenhouse gas reduction
- Climate Change

3.2 Sludge Hub Centre

The review of Fingal's Sludge Management Plan has recommended that Fingal develop a single Sludge Hub Centre (SHC) to treat all wastewater sludges arising in Fingal and that this SHC should be co-located with the proposed Regional WwTP. Full details of this review are available in the draft report entitled *'Review of Sludge Management Plan for Fingal County Council; March 2013.'*

The proposed Fingal SHC will accept sludges from other WwTP's within the administrative area of Fingal. In addition, the plant will be required to accept sludge from private property owners within the administrative area of Fingal who are currently served by septic tank. It is estimated that sludge imports to the proposed Regional

WwTP from Fingal would only increase the total sludge arisings at the plant by approximately 20-25%.

The ASA process has accounted for, where relevant, impacts associated with the proposed Sludge Hub.

3.3 Indicative Site Layout

In order to provide a visual reference for the proposed WwTP, an indicative site layout for each of the three emerging preferred sites. These layouts have been generated based on a Conventional Activated Sludge Plant (ASP), which would be expected to require the largest footprint. The indicative layouts also allow for the co-located Sludge Hub Centre and are shown on **Figures 3.1 – 3.3**. It is technically feasible to construct the proposed Regional WwTP on all three emerging preferred sites.

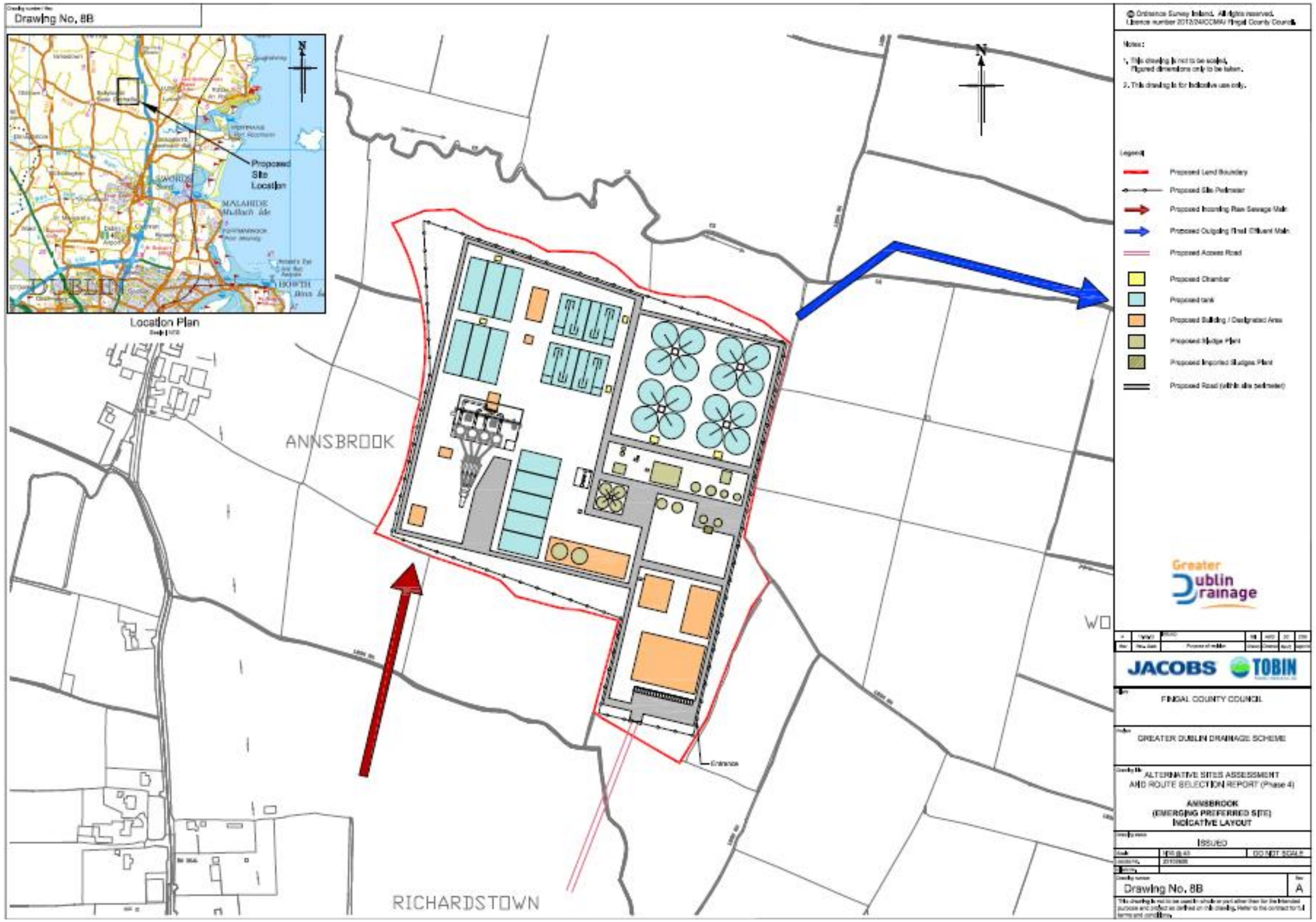

Figure 3.1: - Indicate Arrangement of WwTP at Annsbrook

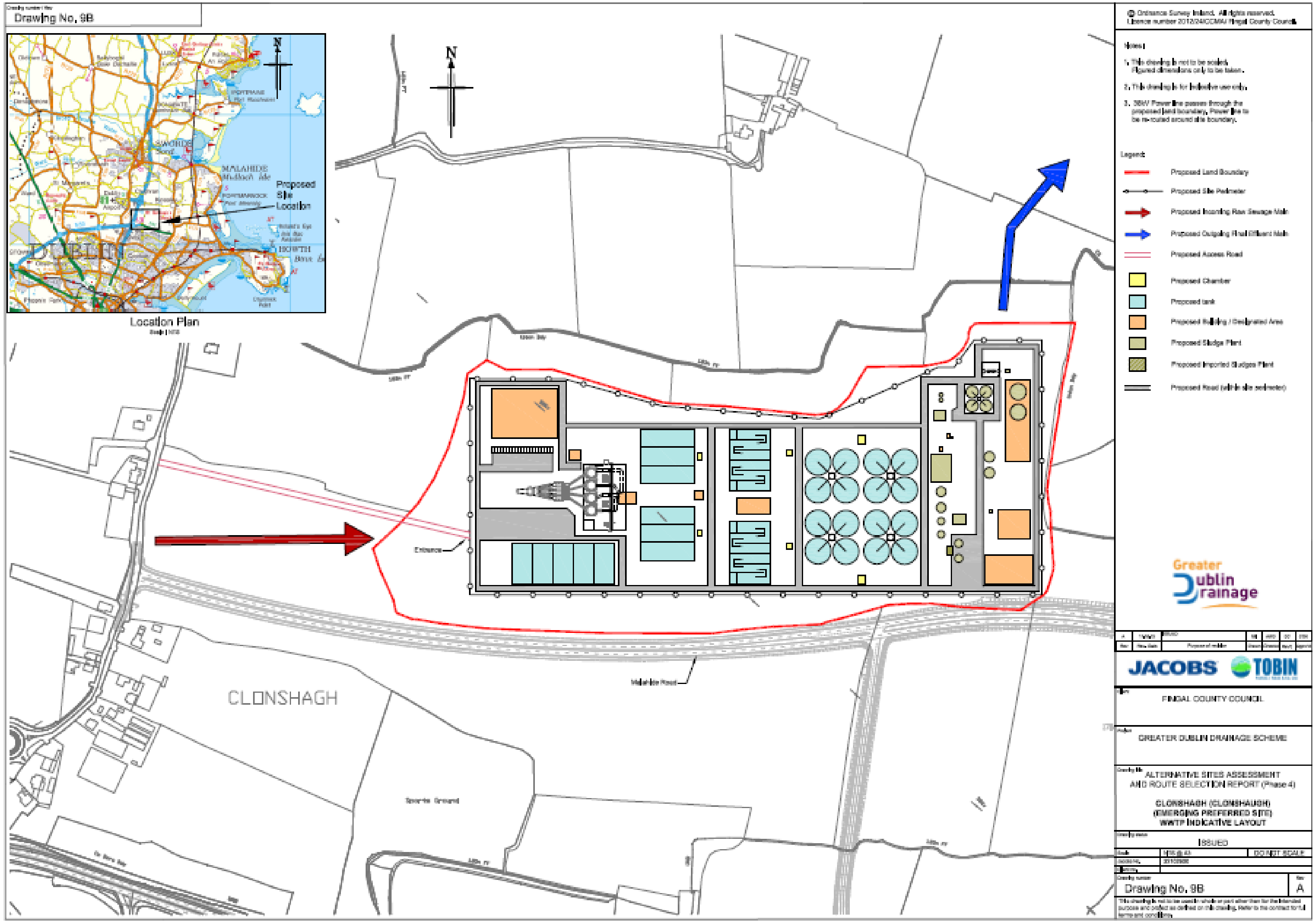

Figure 3.2: - Indicate Arrangement of WwTP at Clonshagh

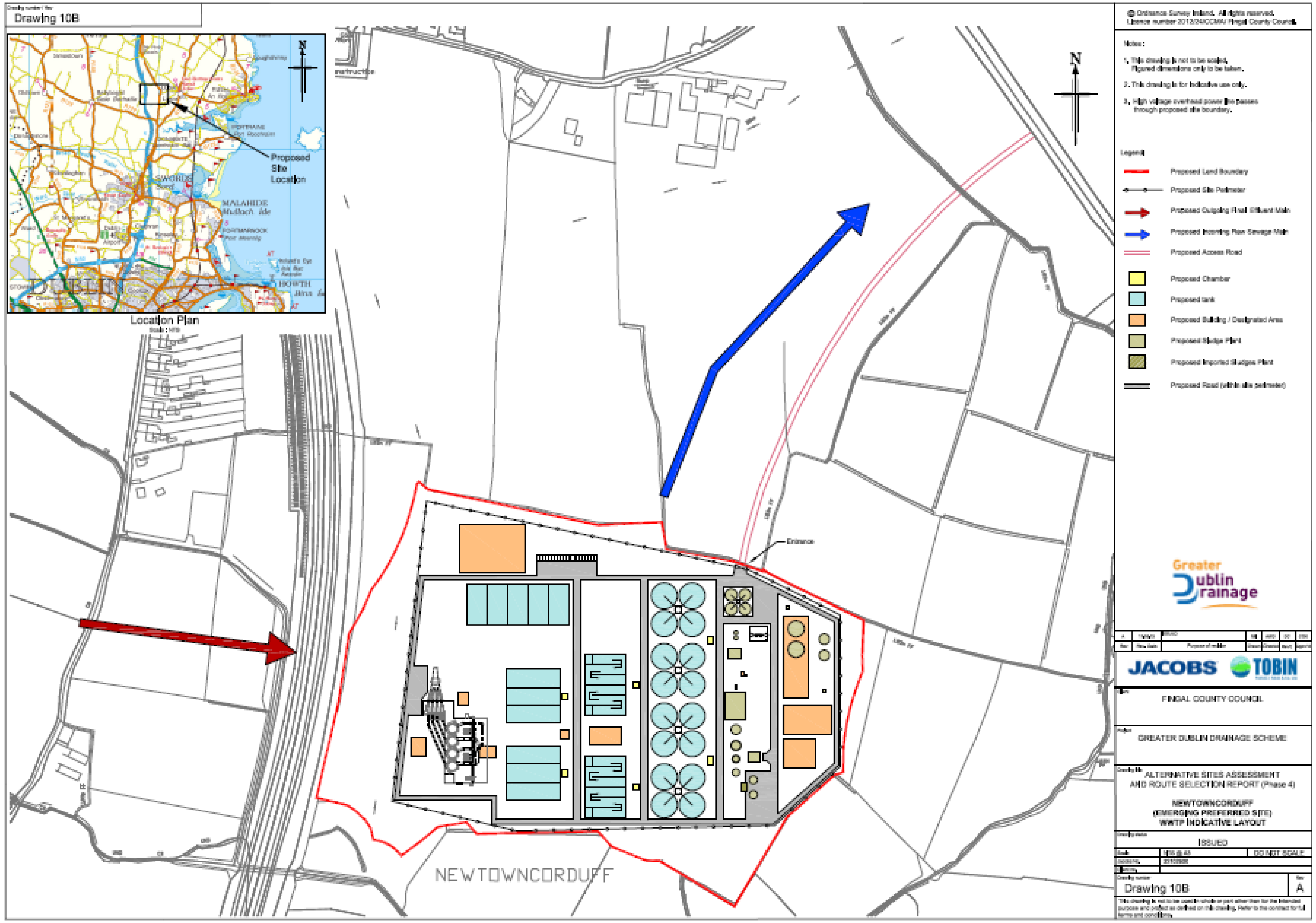

Figure 3.3: - Indicate Arrangement of WwTP at Newtowncorduff

4 Flow Transfer to Emerging Preferred Sites

4.1 Introduction

As discussed in Section 2.4 above the drainage catchments to be transferred to the proposed Regional WwTP are:

- Route 9C Sewer at Blanchardstown;
- Ashbourne / Ratoath / Kilbride;
- North Fringe Sewer;
- North Dublin Drainage Sewer;
- Lower Liffey Valley Catchment.

4.2 Flow Transfer Options – Route 9C Sewer at Blanchardstown

The proposed point of interception/diversion of the 9C sewer in Blanchardstown lies north of the River Tolka in the front grounds of the James Connolly Memorial (JCM) Hospital, as illustrated in **Figure 4.1**.

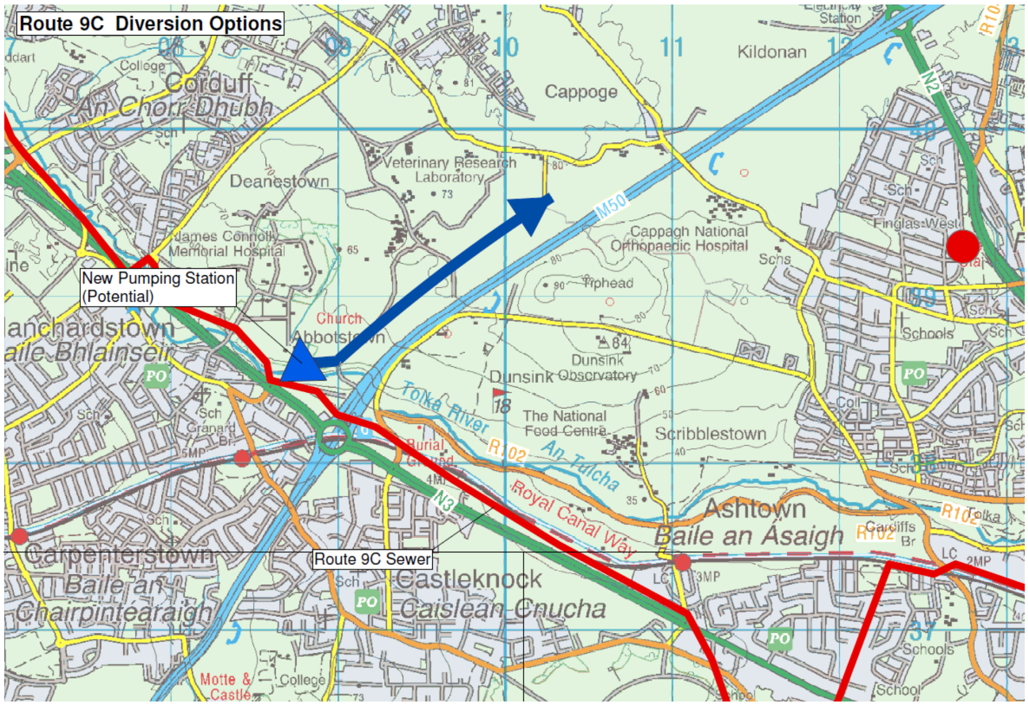

Figure 4.1 – Proposed Interception / Diversion Point of Route 9C Sewer

The Blanchardstown Regional Drainage Scheme (BRDS) Preliminary Engineering Report (PER), recommends the duplication of the existing Route 9C Sewer. The proposed routing of this new 9C sewer generally lies in the Tolka River valley and crosses through the front grounds of the JCM Hospital. As part of the duplication works the existing pipe bridge crossing the M50 was to be replaced by twin siphons, with drive shafts located in the front grounds of JCM Hospital.

The GDD now proposes to intercept/divert the 9C sewer at these proposed drive shafts. At this point, the ground level is 50.33mOD and the Invert Level of the 9C sewer is 44.7mOD, (where all levels are referred to OS Malin Head Datum).

The topography of the northern environs of Blanchardstown, illustrated in **Figure 4.2**, rises from the valley of the Tolka River, to ground level of approximately 85mOD, before falling away towards the valley of the Broadmeadow River. The high point is a ridge lying just south of a line extending from the axis of the main runway at Dublin Airport to the west.

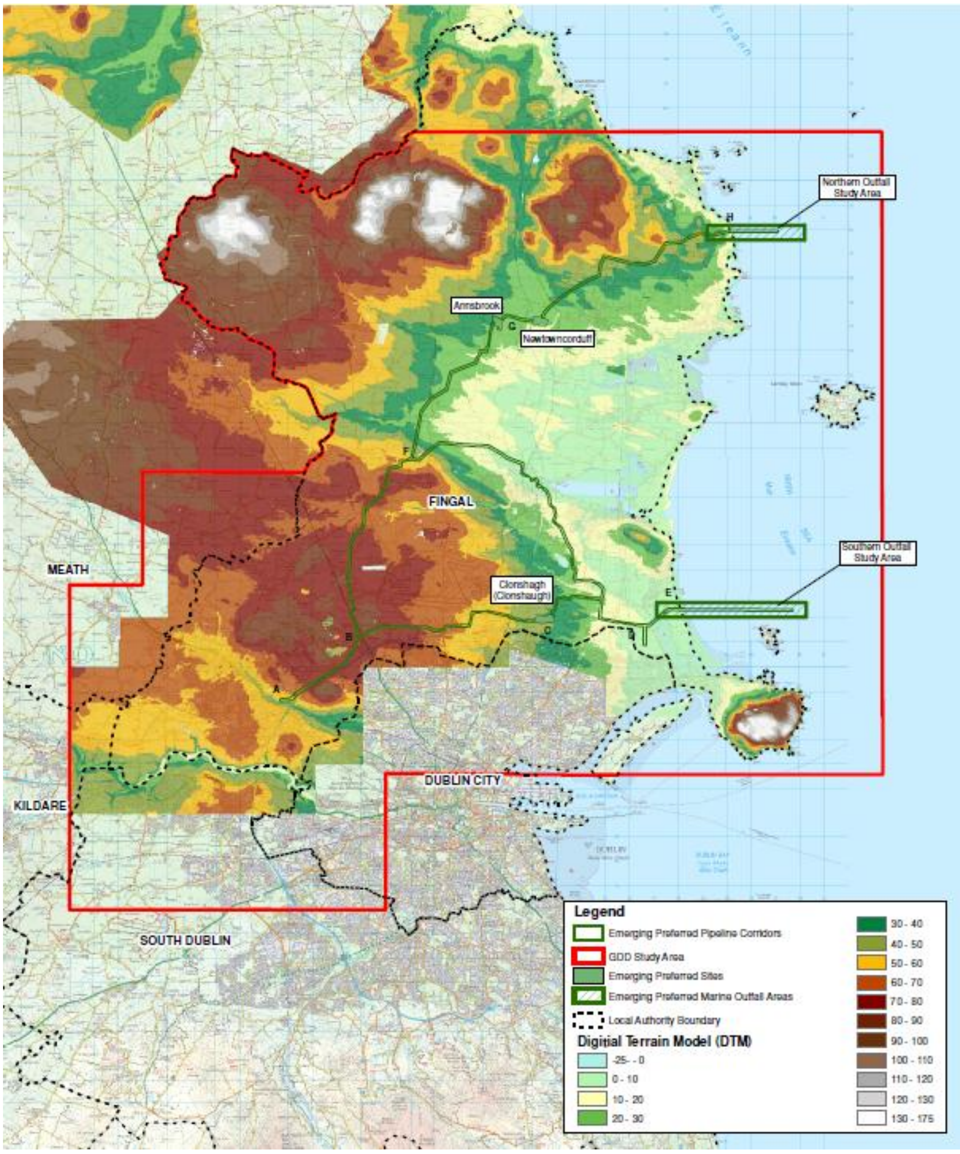

Figure 4.2: - Topography of North County Dublin

The impact of the topography in the northern environs of Blanchardstown on the diversion of flows to the proposed sites for the Regional WwTP requires consideration of the following design options:

a) Diversion of Route 9C Sewer flows to either of the proposed WwTP sites at Annsbrook and Newtowncorduff' will require either:

- a pumped solution, which will require the construction of a pumping station as indicated in Figure 1.1, to pump flows to the top of the ridge through some 11.5km of rising main followed by a gravity sewer constructed using open cut and/or tunnelling techniques.
- alternatively a gravity sewer driven through the ridge using tunnelling techniques at significant depths (of the order of 40m deep)

In addition it will be necessary to provide an inlet lift pumping station at the head of the treatment works at both WwTP sites.

b) Diversion of Route 9C Sewer flows to the proposed WwTP site at Clonshagh will require either:

- a pumped solution, which will require the construction of a pumping station as indicated in Figure 1.1, to pump flows to the top of the ridge through some 3.5km of rising main followed by a gravity sewer constructed in part using open excavation and in part using tunnelling techniques
- alternatively a gravity sewer driven through the ridge using tunnelling techniques at significant depths

In addition it will be necessary to provide an inlet lift pumping station at the head of the treatment works.

4.2.1 Assessment of Flows to be Transferred from Route 9C

Permanent Flow Monitor FM02 is located in the 9C Sewer Catchment and its location is shown on **Figure 4.3**.

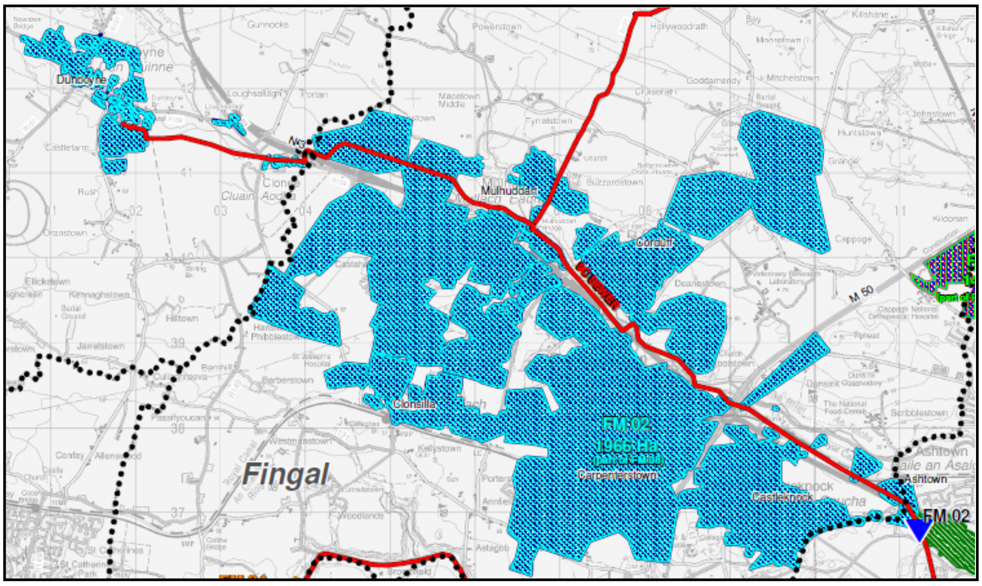

Figure 4.3: - Location of Permanent Flow Monitor (FM02)

The recorded flows for this monitor, for the period 2009 to 2011, are summarised in Table 4.1

	FM 2
Minimum Daily Flow	14,305 m^3/d
Maximum Daily Flow	125,415m^3/d
Average Daily Flow	37,327m^3/d
Estimate of Average Base Flow	27,000m^3/d
Maximum Daily Flow as Multiple of Estimated Average Base Flow	4.65

Table 4.1: - Summary of Recorded Flows at FM02 (2009 – 2011)

The average base flow or dry weather flow (DWF) is estimated at 27,000m^3/d (0.32m^3/s)

The 2011 load from the Route 9C Sewer Catchment is estimated at 153,985p.e. (including Ashbourne/Ratoath and Kilbride)

Therefore the average base flow (DWF) of 27,000m^3/d represents an average wastewater flow of 175l/p.e/day.

The 2040 projected load from the Route 9C Sewer Catchment is estimated at 210,355p.e. (including Ashbourne/Ratoath and Kilbride). Using the average wastewater flow of 175l/p.e./day the projected DWF at 2040 is estimated at 36,812m^3/d (0.43m^3/s)

In addition Kildare County propose to transfer a dry weather flow of 13,737m³/d (0.159m^3/s) to the 9C Sewer Catchment by 2040 with a potential for this to rise to 27,475m^3/d (0.318m^3/s) post 2040.

Therefore the total DWF to be transferred from the Route 9C Sewer (including Kildare inputs) at 2040 is estimated at 50,550m^3/d (0.60m^3/s).

The peak flow proposed for transfer is 1.85m^3/s, which is approximately 3 x DWF.

4.3 Flow Transfer Options – Ashbourne / Ratoath / Kilbride

Wastewater from the towns of Ashbourne and Ratoath and the village of Kilbride in County Meath currently drain to the Route 9C Sewer in Blanchardstown.

The options for the transfer of flows from this sub-catchment to the proposed Regional WwTP will depend on a number of issues, including:

- The location of the final preferred WwTP site,
- Proximity of the transfer pumping station, in Kilbride, to the optimum route for the Orbital Sewer;
- The preferred form of the Orbital Sewer, i.e. gravitational sewer or pressurised rising main;
- The relative cost of the upgrade of the existing rising main, the upgrade of the existing gravity sewer in Blanchardstown and the provision of capacity in the Orbital Sewer from Blanchardstown onwards to the WwTP against the cost of a new rising main to the Orbital Sewer and the provision of capacity in the Orbital Sewer from the connection point onwards to the WwTP.

4.3.1 Assessment of Flows to be Transferred from Ashbourne / Ratoath / Kilbride

The 2011 load from Ashbourne/Ratoath and Kilbride is estimated at 24,660p.e.

The average base flow or dry weather flow (DWF) is estimated at 4,316m^3/d (0.05m^3/s) based on an average wastewater flow of 175l/p.e/day

The 2040 projected load from Ashbourne/Ratoath and Kilbride is estimated at 35,480p.e. Using the average wastewater flow of 175l/p.e./day the projected DWF at 2040 is estimated at 6,210m^3/d (0.07m^3/s)

Flows from Ashbourne /Ratoath /Kilbride are accounted for in the assessment of flows from Route 9C Sewers discussed in Section 4.2.1 above.

4.4 Flow Transfer Option – North Fringe Sewer (NFS)

The proposed point of interception / diversion of the North Fringe Sewer Catchment is at the Grange in Stapolin. At this point the Invert Level of the North Fringe Sewer is approximately 0.70mOD.

The topography between the North Fringe Sewer (NFS) and the proposed WwTP sites at Annsbrook and Newtowncorduff will require:

- a pumped solution, which will require the construction of a pumping station as indicated in Figure 1.1, with some 15.2km of rising main connecting to the gravity sewer conveying the Blanchardstown flow diversion

The topography between the NFS and the proposed WwTP site at Clonshagh will require:

- A pumped solution, which will require the construction of a pumping station as indicated in Figure 1.1, with some 5.6km of rising main connecting to the gravity sewer conveying the Blanchardstown flow diversion

Therefore the only option for flow diversion from the North Fringe Sewer is to intercept the trunk sewer near the Grange storm tank at Stapolin and divert flows to a new Grange Pumping Station for transfer to the proposed Regional WwTP.

The only option for transferring flows to the proposed Regional WwTP is to pump direct to the WwTP, or to a point where a gravitational inflow can be achieved.

It is proposed that the North Dublin Catchment be diverted in two stages – initially only the North Fringe Sewer and then, when load conditions at Ringsend require it, the NDDS Sewer. This could be achieved by constructing a Pumping Station at the Grange Tank and diverting the North Fringe Sewer into it, and the existing tank (5,000m3) would be able to provide emergency storage. Diversion of the NDDS Sewer could be achieved by diverting the delivery pipe from Sutton Pumping Station to pump to this new Pumping Station at Grange Tank, using the existing 1,600mm dia. section of the now defunct North Fringe Sewer between the Grange Tank and Sutton Pumping Station, operated in the reverse direction. This pipe may have to be relined with a structural liner to increase its pressure rating for the new duty and the reversed hydraulic gradient. These proposals are illustrated in **Figure 4.4**.

Figure 4.4: - Proposed Diversion of North Fringe Sewer and NDDS Sewer

There are a number of scenarios to be examined in terms of transfer of flows from the NFS to the proposed Regional WwTP sites as follows:

Scenario 1 - Pumped flow to the proposed Regional WwTP located at either the Annsbrook or Newtowncorduff site options for existing and future hydraulic loads (i.e. assuming that future development north of the M50 will be diverted to the NFS or an equivalent).

- Scenario 2 - Pumped flow to the proposed Regional WwTP located at the Clonshagh site option for existing hydraulic load (i.e. assuming that the majority of future development north of the M50 would be diverted to a gravity sewer that will serve diverted flows from Blanchardstown);

4.4.1 Assessment of Flows to be Transferred from the NFS

There are 7nr. Permanent Flow Monitors in the North Fringe Sewer Catchment, references FM16, FM17, FM18, FM19, FM20, FM21 and FM23. The location of these permanent flow monitors is illustrated in **Figure 4.5**

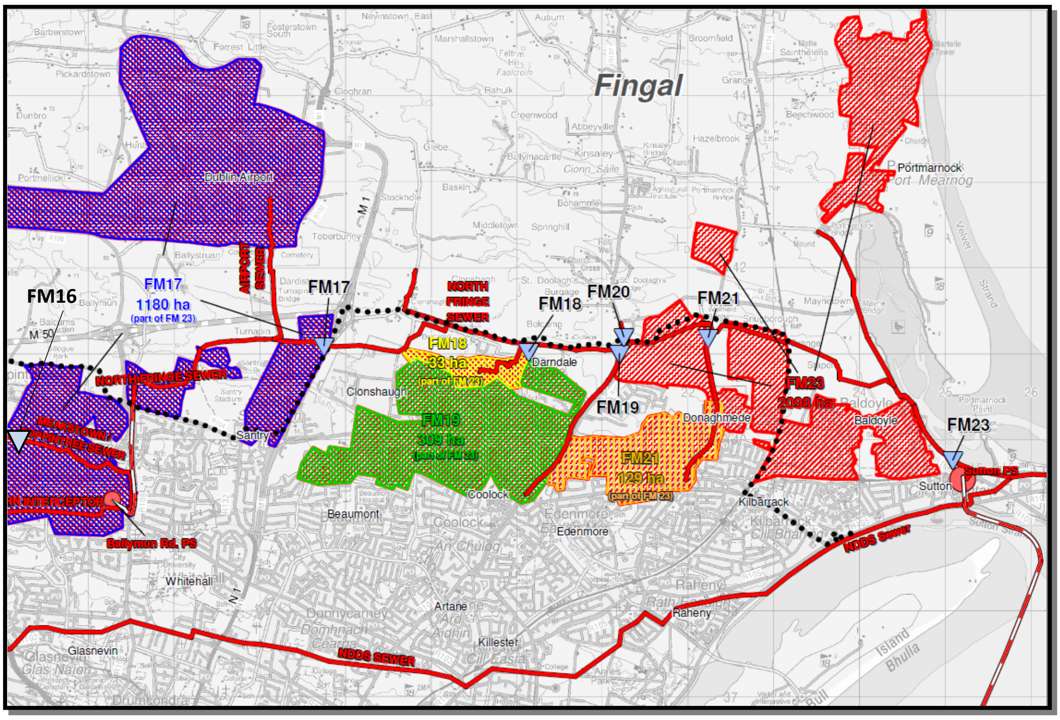

Figure 4.5: - Location of Permanent Flow Monitors on North Fringe Sewer

The recorded flows for 5nr of the permanent flow monitors, for the period 2009 to 2010, is summarised in Table 4.2. Monitors FM20 and FM23 were problematic during this period and data is not available for these monitors.

	FM16	FM17	FM18	FM19	FM21
Minimum Daily Flow	1,187m³	6,898m³	187m³	1,419m³	1,954m³
Maximum Daily Flow	12,793m³	52,167m³	5,372m³	20,397m³	13,669m³
Average Daily Flow	2,951m³	13,679m³	915m³	6,874m³	5,437m³
Estimate of Average Base Flow	2,400m³	11,000m³	700m³	5,750m³	4,100m³
Maximum Daily Flow as Multiple of Estimated Average Base Flow	5.33	4.74	7.67	3.55	3.33

Table 4.2: - Summary of Recorded Flows for the NFS Permanent Flow Monitors (2009 – 2011)

The estimated existing DWF in the NFS at the Grange is 22,590m³/d (0.26m³/s). The 2011 load from the NFS Catchment is estimated at 117,890p.e.

Therefore the average base flow (DWF) of 22,590m³/d represents an average wastewater flow of 190l/p.e/day.

The 2040 projected load from the NFS Catchment is estimated at 166,470p.e. Using the average wastewater flow of 190l/p.e./day the projected DWF at 2040 is estimated at 31,630m^3/d (0.40m^3/s)

The peak flow proposed for transfer is 1.125m^3/s, which is approximately 3 x DWF

4.5 Flow Transfer Options – North Dublin Drainage Scheme (NDDS) Sewer

There is only one option for the transfer of flows from the NDDS Sewer to the proposed Regional WwTP sites as follows:

- Pumped flow from NDDS Sewer (via Sutton P.S.):

Under this option there are two sub-options for flow transfer as follows:

- Pump to the proposed Grange Pumping Station for onward transfer to a Regional WwTP;
- Pump direct to a Regional WwTP.

4.5.1 Assessment of Flows to be Transferred from the NDDS

Daily flows are recorded at Sutton Pumping Station. These flows are the combination of the NFS and NDDS sewer flows. The minimum, maximum and average daily flows recorded in 2010 were 46,275m^3, 162,000m^3 and 79,451m^3 respectively. The daily base flow to Sutton Pumping Station is estimated at 70,000m^3 and the maximum recorded flow is equivalent to 2.3 times the estimated daily base flow.

The split in base flow between the two catchments is as follows:

- North Fringe Sewer 22,590m^3/d
- North Dublin Drainage Sewer 47,410m^3/d

The 2011 load from the NDDS Sewer Catchment is estimated at 212,000p.e.

Therefore the average base flow (DWF) of 47,410m^3/d represents an average wastewater flow of 225 l/p.e/day.

The 2040 projected load from the NDDS Sewer Catchment is estimated at 275,450p.e. Using the average wastewater flow of 225 l/p.e./day the projected DWF at 2040 is estimated at 61,975m^3/d (0.70m^3/s)

The peak flow proposed for transfer is 1.66m^3/s, which is approximately 2.5 x DWF

4.6 Flow Transfer Options – Lower Liffey Valley

Flow transfer from Kildare will ultimately be to the proposed point of interception/diversion of the 9C sewer in Blanchardstown and this load transfer must be accounted for in the sizing of the pipework from this location onwards to the WwTP.

Kildare County propose to transfer a dry weather flow of 13,737m^3/d (0.159m^3/s) by 2040 to the 9C Sewer Catchment by 2040 with a potential for this to rise to 27,475m^3/d (0.318m^3/s) post 2040. These flows are accounted for in the assessment of flows from Route 9C Sewers discussed in Section 4.2.1 above.

4.7 Summary of Flow Transfers

Table 4.3 provides a summary of the flow transfers proposed from the three primary sewer catchments (load centres) identified for transfer/diversion to the proposed Regional WwTP.

Catchment	Estimated DWF at 2011	Predicted DWF at 2040	Peak Flow proposed for Transfer
Route 9C	0.31m^3/s	0.60m^3/s	1.85m^3/s
NFS	0.26m^3/s	0.40m^3/s	1.125m^3/s
NDDS	0.55m^3/s	0.70m^3/s	1.66m^3/s

Table 4.3: - Summary of Proposed Flow Transfers.

4.8 Infrastructure for Transfer of Flows to the Emerging Preferred WwTP Sites

Tables 4.4, 4.5 and 4.6 provide a summary of pipe diameters required to transfer the predicted wastewater volumes discussed in Sections 4.2 to 4.7 above for the flow transfer options considered from the Route 9C, NFS and NDDS Sewer Catchments to the emerging preferred Regional WwTP Sites:

Table 4.4: - Summary of Pipeline Infrastructure Requirements – WwTP at Annsbrook

WwTP at Annsbrook - Option 1a	Infrastructure Requirements
Gravity Tunnel Sewer from Blanchardstown to Northern Regional WwTP	2,400mm Ø Gravity Tunnel
Pump Flows from NFS at Grange to Northern Regional WwTP	800mm Ø Rising Main
Pump Flows from NDDS at Sutton to Northern Regional WwTP	1,000mm Ø Rising Main
WwTP at Annsbrook - Option 1b	**Infrastructure Requirements**
Combined Pumping and Gravity Tunnel Sewer from Blanchardstown to Northern Regional WwTP	1,000mm Ø Rising Main and 2,400mm Ø Gravity Tunnel Sewer
Pump Flows from NFS at Grange to Northern Regional WwTP	800mm Ø Rising Main
Pump Flows from NDDS at Sutton to Northern Regional WwTP	1,000mm Ø Rising Main

Table 4.5: - Summary of Pipeline Infrastructure Requirements – WwTP at Clonshagh

WwTP at Clonshagh - Option 2a	Infrastructure Requirements
Gravity Tunnel Sewer from Blanchardstown to Regional WwTP at Clonshagh	2,400mm Ø Gravity Tunnel
Pump Flows from NFS at Grange to Regional WwTP at Clonshagh	600mm Ø Rising Main
Pump Flows from NDDS at Sutton to Regional WwTP at Clonshagh	1,000mm Ø Rising Main
WwTP at Clonshagh - Option 2b	**Infrastructure Requirements**
Combined Pumping and Gravity Tunnel Sewer from Blanchardstown to Regional WwTP at Clonshagh	1,000mm Ø Rising Main and 1,100mm / 1,200mm Ø Gravity Sewer
Pump Flows from NFS at Grange to Regional WwTP at Clonshagh	600mm Ø Rising Main
Pump Flows from NDDS at Sutton to Regional WwTP at Clonshagh	1,000mm Ø Rising Main

Table 4.6: - Summary of Pipeline Infrastructure Requirements – WwTP at Newtowncorduff

WwTP at Newtowncorduff - Option 3a	Infrastructure Requirements
Gravity Tunnel Sewer from Blanchardstown to Northern Regional WwTP	2,400mm Ø Gravity Tunnel
Pump Flows from NFS at Grange to Northern Regional WwTP	800mm Ø Rising Main
Pump Flows from NDDS at Sutton to Northern Regional WwTP	1,000mm Ø Rising Main
WwTP at Newtowncorduff - Option 3b	**Infrastructure Requirements**
Combined Pumping and Gravity Tunnel Sewer from Blanchardstown to Northern Regional WwTP	1,000mm Ø Rising Main and 2,400mm Ø Gravity Tunnel Sewer
Pump Flows from NFS at Grange to Northern Regional WwTP	800mm Ø Rising Main
Pump Flows from NDDS at Sutton to Northern Regional WwTP	1,000mm Ø Rising Main

Table 4.7 and Table 4.8 summarise the preliminary details of the pipelines from the load centre's to the three emerging preferred WwTP Sites together with estimated power requirements for pumped flows.

	Annsbrook	Clonshagh	Newtowncorduff
Length of Orbital Pipelines			
Total Length from 9C to WWTP Site	**20,750 m**	**12,750 m**	**22,500m**
Length as Gravity	20,750 m	12,750 m	22,500 m
Pipe Sizes	2,400mm	2,400mm	2,400mm
Total Length from North Dublin to WWTP Site	**15,500 m**	**5,850 m**	**15,500 m**
Length as Gravity	200	0 m	200
Pipe Size where Gravity	2,400mm	n/a	2,400mm
Length as Pumped	15,300 m	5,850 m	15,300 m
Pumped Main Size	Twin Main - 800mm and 1,000mm	Twin Main - 600mm and 1,000mm	Twin Main - 800mm and 1,000mm
Power Requirement			
Power Requirement from 9C to WWTP Site (*this is the lift into the inlet of the WwTP*)	1,798 kW	598 kW	1,593 kW
Power Requirement from North Dublin to WWTP Site	4,800 kW	2,678 kW	4,800 kW
Totals	6,598 kW	3,276 kW	6,393 kW

Table 4.7: - Summary of Gravity Options 1a, 2a and 3a

	Annsbrook	Clonshagh	Newtowncorduff
Length of Orbital Pipelines			
Total Length from 9C to WWTP Site	**20,750 m**	**12,750 m**	**22,500 m**
Length as Gravity	7,050 m	9,500 m	8,800 m
Pipe Sizes	2,400mm	1,200mm	2,400mm
Length as Pumped	13,700 m	3,250 m	13,700 m
Pumped Main Size	1,000mm	1,000mm	1,000mm
Total Length from North Dublin to WWTP Site	**15,500 m**	**5,850 m**	**15,500 m**
Length as Gravity	200	0 m	200
Pipe Size where Gravity at Pass Forward Flow	2,400mm	n/a	2,400mm
Length as Pumped	15,300 m	5,800 m	15,300 m
Pipe Size Range where Pumped at Pass Forward Flow	Twin Main - 800mm and 1,000mm	Twin Main - 600mm and 1,000mm	Twin Main - 800mm and 1,000mm
Power Requirement			
Power Requirement from 9C to WWTP Site (*this includes the lift into the inlet of the WwTP*)	4,254 kW	2,044 kW	4,049 kW
Power Requirement from North Dublin to WWTP Site	4,800 kW	2,678 kW	4,800 kW
Totals	9,054 kW	4,722 kW	8,849 kW

Table 4.8: - Summary of Pumped / Gravity Options 1b, 2b and 3b

4.9 Conclusions on Infrastructure for Transfer of Flows

It is technically feasible to route the orbital sewers from the load centres to the proposed WwTP sites

From Tables 4.7 and 4.8 above it is evident that irrespective of the option of flow transfer, either gravity or pumped, from the load centres to the proposed WwTP sites, a WwTP located at the Clonshagh site requires the least amount of pipeline infrastructure with a combined length of orbital sewer of 18,600m and power requirements in the range 3,276 – 4,722kW. These infrastructural requirements are significantly lower than those required for a WwTP located at either the Annsbrook or Newtowncorduff sites, with a combined length of orbital sewer of 36,250m and 38,000m respectively and power requirements in the range 6,400 – 9,054kW.

5 Preliminary Outfall Design

The design of the outfall from any of the three emerging preferred WwTP site options is influenced by:

- Final Effluent Outflow Rate;
- Length of Outfall;
- Top Water Level in WwTP Outlet;
- High Tide Levels.
- The longitudinal profile of the outfall, as it affects intertidal draindown volumes, with intermittent pumping, is also an important factor in effective outfall and diffuser operation.

Table 5.1 summarises the preliminary design of the outfall from each of three emerging preferred WwTP location options. The hydrodynamic modelling work has indicated that in the northern outfall area the outfall pipe is to extend approximately 2.0km to the -15mOD sea bed contour. Similarly it is indicated that in the southern outfall area the outfall pipe is to extend approximately 1.0km past Ireland's Eye. Tidal balancing at the WwTP would potentially reduce the size of outfall required.

WwTP Location	Approx. WwTP Outlet Top Water Level (mOD)	Distance of Site from Shore (m)	Assumed Outfall Distance into the Sea (m)	High Tide Level (mOD)	Available Head (m)	Peak Discharge Through Outfall (m^3/s)	Selected Outfall Diameter (mm)
Annsbrook	22.0	11,450	2,000	3.5	18.5	4.635	2,000
Clonshagh	36.0	6,900	6,000	3.5	32.5	4.635	1,800
Newtowncorduff	18.0	9,700	2,000	3.5	14.5	4.635	2,000

Table 5.1 -: Summary of Preliminary Outfall Design

5.1 Conclusions on Infrastructure for Outfalls

It is technically feasible to construct the outfall pipelines from the proposed WwTP sites to the respective outfall locations.

From Table 5.1 above it is evident that a WwTP located at the Newtowncorduff site would require the shortest length of outfall pipe with a combined length of 11,700m. The required outfall pipe diameter from the Newtowncorduff site is 2,000mm.

A WwTP located at the Clonshagh site would require an outfall pipe with a combined length of 12,900m and a pipe diameter of 1,800mm.

A WwTP located at the Annsbrook site would require an outfall pipe with a combined length of 13,450m and a pipe diameter of 2,000mm.

6 Preliminary Cost Estimates

Preliminary cost estimates have been prepared for the infrastructure associated with each of the three emerging preferred site options (i.e. a WwTP site, its associated orbital sewers and outfall pipeline). These budget cost estimates include construction and mitigation costs for the WwTP, construction costs for access roadway to the WwTP, costs for provision of electricity and gas supply to the WwTP, construction costs for the orbital sewers and outfall pipelines, construction costs for pumping stations, land and wayleave acquisition costs. In addition an NPV of the Pumping Costs over a 30 year period is calculated based on the estimated pump power requirements. In all cases capital costs include a 35% contingency factor. These costs are summarised in Table 5.1 and full details are provided in Appendix 1 of this report.

Table 5.1: - Summary of Preliminary Cost Estimates

Item	Annsbrook	Clonshagh	Newtowncorduff
WwTP	176,000,000	177,000,000	176,500,000
Access Roadway	1,300,000	2,000,000	650,000
Pipelines (Option 1)	509,700,000	341,500,000	508,500,000
Pumping Stations – Pipeline Option 1	incl	incl	incl
Pipelines (Option 2)	324,300,000	234,100,000	321,200,000
Pumping Stations – Pipeline Option 2	incl	incl	incl
Utilities	826,000	570,000	545,000
Land & Wayleave Acquisition	5,500,000	6,500,000	5,500,000
Total with Pipeline Option 1	693,326,000	527,570,000	691,695,000
Total with Pipeline Option 2	507,926,000	420,170,00	504,395,000

Note: Pipeline Option 1 is a gravity tunnel from Route 9C + pumped system from NFS/NDDS
Pipeline Option 2 is a pumped/gravity system from Route 9C and a pumped system from NFS/NDDS

6.1 Conclusions on Preliminary Cost Estimates

From Table 5.1 above it is evident that the Clonshagh site option, which includes for the Regional WwTP located at a site in the townland of Clonshagh, a marine outfall located in the southern marine outfall study area, approximately c.6km offshore and its associated orbital sewer network (either Pipeline Option 1 or Pipeline Option 2) represents the least cost option of the three preferred site options, by a sum in excess of €80M, that emerged from the ASA Phase 2 assessment and considered in this report.

7 Overall Conclusions

This report provides an outline assessment the Preliminary Engineering Design and Preliminary Cost Estimates associated with the three emerging preferred site options.

The report has examined projected loadings on the proposed Regional WwTP and assessed the flow transfers proposed from the three primary sewer catchments (load centres) identified for transfer/diversion to the proposed Regional WwTP.

The report has presented an indicative WwTP site layout for each of the three emerging preferred sites. These layouts were generated based on a Conventional Activated Sludge Plant (ASP), which would be expected to require the largest footprint.

Appropriate pipe diameters for the transfer of the predicted flows have been identified. Preliminary estimates of power requirements for pumped flows from the identified load centres to the proposed WwTP sites have been undertaken.

The report concludes that it is technically feasible to construct the proposed Regional WwTP on all three emerging preferred sites

Preliminary Engineering Design of the orbital sewers and outfall pipelines has indicated that there are no identified technical constraints to the construction of these sewers and outfall pipelines to / from the three emerging preferred sites.

This Preliminary Engineering Design Report concludes that a WwTP located at the Clonshagh site requires the least amount of pipeline infrastructure (orbital sewers and outfall pipeline) with a combined length 31,500m and power requirements in the range 3,276 – 4,722kW. These infrastructural requirements are significantly lower than those required for a WwTP located at either the Annsbrook or Newtowncorduff sites, with a combined length of pipeline infrastructure of 49,700m and power requirements in the range 6,400 – 9,054kW.

Preliminary cost estimates undertaken on all three emerging preferred site options indicate that the Clonshagh site option presents a substantially lower cost option (greater than €80M) than either the Annsbrook or Newtowncorduff site options.

The findings of the Preliminary Engineering Design have been brought into the ASA Phase 4 assessment to identify the final preferred site option.

Appendix 1 – Preliminary Cost Estimates

Phase 4 Alternative Sites Assessment for Emerging Preferred Sites
Cost Estimates

Pumped Option

Ref		WWTP at Annsbrook	WWTP at Clonshagh	WWTP at Newtowncorduff
	Total Length from 9C to WWTP Site	20,750 m	12,750 m	22,500 m
	Total Length in Rising Main from 9C to WWTP Site	13,700 m	3,250 m	13,700 m
	Total Length in Gravity Sewer from 9C to WWTP Site	7,050 m	9,500 m	8,800 m
	Diameter of Open Cut - Rising Main	1,000 mm	1,000 mm	1,000 mm
	Length of Open Cut - Rising Main	13,200 m	3,250 m	13,200 m
	Rate for Open Cut _ Rising Main	€ 900	€ 900	€ 900
	Cost for Open Cut - Rising Main	€ 11,880,000	€ 2,925,000	€ 11,880,000
	Diameter of Tunnel Section - Rising Main	1,000 mm	n/a	1,000 mm
	Length of Tunnel Section - Rising Main	500 m	n/a	500 m
	Rate for Tunnel Section - Rising Main	€ 2,000	n/a	€ 2,000
	Cost for Tunnel Section - Rising Main	€ 1,000,000	n/a	€ 1,000,000
	Diameter of Tunnel - Gravity Sewer	2,400 mm	1,200 mm	2,400 mm
	Length of Tunnel - Gravity Sewer	1,000 m	3,500 m	1,000 m
	Rate for Tunnel - Gravity Sewer	€ 8,000	€ 4,500	€ 8,000
	Cost for Tunnel - Gravity Sewer	€ 8,000,000	€ 15,750,000	€ 8,000,000
	Diameter of Open Cut - Gravity Sewer	2,400 mm	1,200 mm	2,400 mm
	Length of Open Cut - Gravity Sewer	6,050 m	6,000 m	7,800 m
	Rate for Open Cut - Gravity Sewer	€ 2,050.00	€ 1,200.00	€ 2,050.00
	Cost for Open Cut - Gravity Sewer	€ 12,402,500	€ 7,200,000	€ 15,990,000
	Number of Shafts	8 nr.	12 nr.	10 nr.
	Average Depth of Shaft	14 m	8m	14 m
	Average Rate per Shaft	€ 310,000	€ 175,000	€ 310,000
	Cost for Shafts	€ 2,480,000	€ 2,100,000	€ 3,100,000
	Power Requirement	4,254 kW	2,044 kW	4,049 kW
	Rate per kW	€ 1,500	€ 1,500	€ 1,500
	Cost for Pumping Station at Inlet Works	€ 6,381,000	€ 3,066,000	€ 6,073,500
	Total Cost for Gravity Pipe from 9C to WWTP Site	**€ 42,143,500**	**€ 31,041,000**	**€ 46,043,500**
	Length from North Dublin to WWTP Site	15,500 m	5,850 m	15,500 m
	Length as Gravity	Included	50 m	Included
	Length of Pumped Main	15,500 m	5,800 m	15,500 m
	Rising Main Diameter	Twin Main - 800mm and 1,000mm	Twin Main - 600mm and 1,000mm	Twin Main - 800mm and 1,000mm
	Rate for Open Cut Pipe Construction	€ 1,850.00	€ 1,650.00	€ 1,850.00
	Cost for Pumped Main	€ 28,675,000	€ 9,570,000	€ 28,675,000
	Railway Crossing / Motorway Crossing	€ 500,000	€ 250,000	€ 750,000
	Power Requirement from North Dublin to WWTP Site	4,800 kW	2,678 kW	4,800 kW
	Rate per kW	€ 1,500	€ 1,500	€ 1,500
	Cost for Pumping Station	€ 7,200,000	€ 4,017,000	€ 7,200,000
	Total Cost for Pipeline from North Dublin to WWTP Site	**€ 36,375,000**	**€ 13,837,000**	**€ 36,625,000**
	Length of Gravity Pipe from WWTP Site to Coast	11,450 m	6,900 m	9,700 m
	Total Length in Tunnel Pipe	9,050 m	2,500 m	8,900 m
	Total Length in Open Cut	2,400 m	4,400 m	800 m
	Diameter of Tunnel Section 1	2,400 mm	2,400 mm	2,400 mm
	Length of Tunnel Section	9,050 m	2,500 m	8,900 m
	Rate for Tunnel Section	€ 8,000	€ 8,000	€ 8,000
	Cost for Tunnel Section	€ 72,400,000	€ 20,000,000	€ 71,200,000
	Diameter of Open Cut Pipe	2,400 mm	2,400 mm	2,400 mm
	Length of Open Cut Pipe	2,400 m	4,400 m	800 m
	Rate for Open Cut Pipe Construction	€ 2,000.00	€ 1,800.00	€ 2,000.00
	Cost for Open Cut Pipe Construction	€ 4,800,000	€ 7,920,000	€ 1,600,000
	Number of Shafts	14 nr.	8 nr.	12 nr.
	Average Depth of Shaft	20 m	10 m	19 m
	Average Rate per Shaft	€ 440,000	€ 220,000	€ 420,000
	Cost for Shafts	€ 6,160,000	€ 1,760,000	€ 5,040,000
	Total Cost for Gravity Pipeline from WWTP to Coast	**€ 83,360,000**	**€ 29,680,000**	**€ 77,840,000**
	Length of Marine Outfall	2,000 m	6,000 m	2,000 m
	Diameter of Marine Outfall	2,000 mm	1,800 mm	2,000 mm
	Rate for Marine Outfall	€ 15,000	€ 12,000	€ 15,000
	Cost for Marine Outfall	€ 30,000,000	€ 72,000,000	€ 30,000,000
	Total Cost for Marine Outfall	**€ 30,000,000**	**€ 72,000,000**	**€ 30,000,000**
	Total Cost	**€ 191,878,500**	**€ 146,558,000**	**€ 190,508,500**
	Include a 35% contigency factor	€ 67,157,475.00	€ 51,295,300.00	€ 66,677,975.00
	Total Cost (including Contingency)	**€ 259,035,975**	**€ 197,853,300**	**€ 257,186,475**
	Pumping Station Operation Cost Estimate			
	Unit Rate for Electricity	15.0 c/kwh	15.0 c/kwh	15.0 c/kwh
	Peak pumping rate from Blanchardstown	1.85m3/s	1.85m3/s	1.85m3/s
	Assumed mean annual pumped flow (Blanchardstown)	0.69m3/s	0.69m3/s	0.69m3/s
	Factor for Mean v Maximum Pumping for 2020 to 2050	37%	37%	37%
	Peak pumping rate from North Dublin	2.79m3/s	2.41m3/s	2.79m3/s
	Assumed mean annual pumped flow (North Dublin)	1.33m3/s	1.19m3/s	1.33m3/s
	Factor for Mean v Maximum Pumping for 2020 to 2050	48%	52%	48%
	Annual Cost - Blanchardstown	€ 2,090,386	€ 1,004,408	€ 1,989,651
	Annual Cost - North Dublin	€ 3,007,848	€ 1,826,805	€ 3,007,848
	Total Annual Cost	€ 5,098,234	€ 2,831,212	€ 4,997,499
	NPV factor over 30 years at 6.7% Discount Rate	12.79	12.79	12.79
	NPV of Pumping Cost	**€ 65,218,470**	**€ 36,217,899**	**€ 63,929,824**
	Combined Capital and NPV of pumping cost	**€ 324,254,445**	**€ 234,071,199**	**€ 321,116,299**

Phase 2 Alternative Sites Assessment for Emerging Preferred Sites
Cost Estimates

Gravity Options - where feasible

Ref		WWTP at Annsbrook	WWTP at Clonshagh	WWTP at Newtowncorduff
	Total Length of Gravity Pipe from 9C to WWTP Site	20,750 m	12,750 m	22,500 m
	Total Length in Tunnel Pipe from 9C to WWTP Site	19,950 m	12,750 m	19,950 m
	Total Length in Open Cut from 9C to WWTP Site	800 m	0 m	2,550 m
	Diameter of Tunnel Section 1	2,400 mm	2,400 mm	2,400 mm
	Length of Tunnel Section 1	13,700 m	12,750 m	13,700 m
	Rate for Tunnel Section 1	€ 8,000	€ 8,000	€ 8,000
	Cost for Tunnel Section 1	€ 109,600,000	€ 102,000,000	€ 109,600,000
	Diameter of Tunnel Section 2	2,400 mm	n/a	2,400 mm
	Length of Tunnel Section 2	6,250 m	n/a	6,250 m
	Rate for Tunnel Section 2	€ 8,000	n/a	€ 8,000
	Cost for Tunnel Section 2	€ 50,000,000	n/a	€ 50,000,000
	Diameter of Open Cut Pipe	2,400 mm	n/a	2,400 mm
	Length of Open Cut Pipe	800 m	0 m	2,550 m
	Rate for Open Cut Pipe Construction	€ 2,050.00	n/a	€ 2,050.00
	Cost for Open Cut Pipe Construction	€ 1,640,000	n/a	€ 5,227,500
	Number of Shafts	27 nr.	16 nr.	29 nr.
	Average Depth of Shaft	45 m	40 m	45 m
	Average Rate per Shaft	€ 1,000,000	€ 900,000	€ 1,000,000
	Cost for Shafts	€ 27,000,000	€ 14,400,000	€ 29,000,000
	Power Requirement for Inlet Lift at WWTP Site	1,798 kW	598 kW	1,593 kW
	Rate per kW	€ 1,500	€ 1,500	€ 1,500
	Cost for Pumping Station at Inlet Works	€ 2,697,000	€ 897,000	€ 2,389,500
	Total Cost for Gravity Pipe from 9C to WWTP Site	**€ 190,937,000**	**€ 117,297,000**	**€ 196,217,000**
	Length from North Dublin to WWTP Site	15,500 m	5,850 m	15,500 m
	Length as Gravity	Included	50 m	Included
	Length of Pumped Main	15,500 m	5,800 m	15,500 m
	Rising Main Diameter	Twin Main - 800mm and 1,000mm	Twin Main - 600mm and 1,000mm	Twin Main - 800mm and 1,000mm
	Rate for Open Cut Pipe Construction	€ 1,850.00	€ 1,650.00	€ 1,850.00
	Cost for Pumped Main	€ 28,675,000	€ 9,570,000	€ 28,675,000
	Railway Crossing / Motorway Crossing	€ 500,000	€ 250,000	€ 750,000
	Power Requirement from North Dublin to WWTP Site	4,800 kW	2,678 kW	4,800 kW
	Rate per kW	€ 1,500	€ 1,500	€ 1,500
	Cost for Pumping Station	€ 7,200,000	€ 4,017,000	€ 7,200,000
	Total Cost for Pipeline from North Dublin to WWTP Site	**€ 36,375,000**	**€ 13,837,000**	**€ 36,625,000**
	Length of Gravity Pipe from WWTP Site to Coast	11,450 m	6,900 m	9,700 m
	Total Length in Tunnel Pipe	9,050 m	2,500 m	8,900 m
	Total Length in Open Cut	2,400 m	4,400 m	800 m
	Diameter of Tunnel Section 1	2,400 mm	2,400 mm	2,400 mm
	Length of Tunnel Section	9,050 m	2,500 m	8,900 m
	Rate for Tunnel Section	€ 8,000	€ 8,000	€ 8,000
	Cost for Tunnel Section	€ 72,400,000	€ 20,000,000	€ 71,200,000
	Diameter of Open Cut Pipe	2,000 mm	1,800 mm	2,000 mm
	Length of Open Cut Pipe	2,400 m	4,400 m	800 m
	Rate for Open Cut Pipe Construction	€ 2,000.00	€ 1,800.00	€ 2,000.00
	Cost for Open Cut Pipe Construction	€ 4,800,000	€ 7,920,000	€ 1,600,000
	Number of Shafts	14 nr.	8 nr.	12 nr.
	Average Depth of Shaft	20 m	10 m	19 m
	Average Rate per Shaft	€ 440,000	€ 220,000	€ 420,000
	Cost for Shafts	€ 6,160,000	€ 1,760,000	€ 5,040,000
	Total Cost for Gravity Pipeline from WWTP to Coast	**€ 83,360,000**	**€ 29,680,000**	**€ 77,840,000**
	Length of Marine Outfall	2,000 m	6,000 m	2,000 m
	Diameter of Marine Outfall	2,000 mm	1,800 mm	2,000 mm
	Rate for Marine Outfall	€ 15,000	€ 12,000	€ 15,000
	Cost for Marine Outfall	€ 30,000,000	€ 72,000,000	€ 30,000,000
	Total Cost for Marine Outfall	**€ 30,000,000**	**€ 72,000,000**	**€ 30,000,000**
	Total Cost	**€ 340,672,000**	**€ 232,814,000**	**€ 340,682,000**
	Include a 35% contigency factor	€ 119,235,200.00	€ 81,484,900.00	€ 119,238,700.00
	Total Cost (including Contingency)	**€ 459,907,200**	**€ 314,298,900**	**€ 459,920,700**
	Pumping Station Operation Cost Estimate			
	Unit Rate for Electricity	15.0 c/kwh	15.0 c/kwh	15.0 c/kwh
	Peak pumping rate for Inlet Works Lift P.S. for Blanchardstown Flows	1.85m3/s	1.85m3/s	1.85m3/s
	Assumed mean annual pumped flow (Blanchardstown)	0.69m3/s	0.69m3/s	0.69m3/s
	Factor for Mean v Maximum Pumping for 2020 to 2050	37%	37%	37%
	Peak pumping rate from North Dublin	2.79m3/s	2.41m3/s	2.79m3/s
	Assumed mean annual pumped flow (North Dublin)	1.33m3/s	1.19m3/s	1.33m3/s
	Factor for Mean v Maximum Pumping for 2020 to 2050	48%	52%	48%
	Annual Cost - Blanchardstown	€ 883,525	€ 293,853	€ 782,789
	Annual Cost - North Dublin	€ 3,007,848	€ 1,826,805	€ 3,007,848
	Total Annual Cost	€ 3,891,373	€ 2,120,658	€ 3,790,637
	NPV factor over 30 years at 6.7% Discount Rate	12.79	12.79	12.79
	NPV of Pumping Cost	**€ 49,779,858**	**€ 27,128,228**	**€ 48,491,211**
	Combined Capital and NPV of pumping cost	**€ 509,687,058**	**€ 341,427,128**	**€ 508,411,911**