Appendix 3.1

Site Selection Report

Irish Water & Wicklow County Council

Arklow Wastewater Treatment Plant

Site Assessment Report – Phase 2

Project No. PH 00857 00

May 2015

UISCE ÉIREANN : IRISH WATER

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1 Executive Summary

Irish Water (IW), working in partnership with Wicklow County Council (WCC) have engaged the services of Byrne Looby PHMcCarthy (BLP) to undertake a Phase 2 Site Assessment Report for the Arklow Wastewater Treatment Plant (WwTP).

A Phase 1 Site Assessment Report published in September 2014 included a land parcel, pipeline route and marine outfall location assessment for the Arklow WwTP. Irish Water subsequently entered a Phase 1 Consultation Period and sought the opinion of the people of Arklow and the relevant stakeholders by inviting them to express opinions on the locations and the criteria used to identify the land parcels.

The Phase 1 Consultation period was initially set to run for seven weeks from Wednesday 15th October 2014 to Friday 5th December 2014. In light of the interest shown by the people of Arklow and the volume of submissions received, it was later decided to extend this period by another week to Friday 12th December 2014.

Irish Water prepared the Phase 1 Factual Report in January 2015. This contained details of the factual submissions received during the Phase 1 consultation process.

One of the major conclusions of the Phase 1 Consultation Process was that lands at the Shelton Abbey/IFI could be made available to Irish Water as a possible site, thus no longer classifying these lands as a “sensitive receptor” which required the application of the appropriate buffer zone. On this basis and further discussions with the landowner and the input from a number of submissions, it was decided that this land parcel should be considered in greater detail.

An assumption was made at the beginning of the process that based on previous evidence, a river discharge would not be suitable hence restricting an outfall to the sea only. Due to the interest raised in the Shelton Abbey/IFI site and other potential sites close to the Avoca River, Irish Water has revisited this assumption and have investigated the preliminary suitability of available sites should a river discharge be a viable option.

An un-calibrated CFRAM flood model was initially used to rule out certain low lying lands surrounding the Shelton Abbey/IFI Site. This exclusive criteria has been re-visited in more detail in order to ascertain the risk associated with construction in this location.

The conclusion of these two studies altered the ranking system of the 10 shortlisted land parcels identified in the Phase 1 Site Assessment Report (September 2014), as the distance to an outfall location has been reduced significantly in the case of some riverside land parcels.

Based on the same criteria used in the Phase 1 Report, that a river outfall can now be considered and flooding risks can be mitigated against, the three remaining shortlisted land parcels have been redefined as:

- Ferrybank (Old Wallboard Factory)
- Kilbride
- Shelton Abbey (IFI Site)

The Phase 2 assessment is based on a qualitative process which assesses the performance of each of the alternative land parcels, transfer pipelines routes and outfall locations against a range of environmental, technical and economic criteria in order to identify three emerging preferred site options.

Environmental Criteria	Technical/Economic Criteria
Ecology	Safety
Cultural Heritage	Planning Policy
Landscape & Visual	Engineering & Design
Hydrology & Hydrogeology	Capital & Operational Costs
Soils & Geology	Land Valuation
Traffic	
Air Quality & Odour	
Agriculture & Agronomy	
Noise & Vibration	
People & Communities	

Table 1.1 Site Assessment Criteria

Each land parcel option was assessed by the relevant technical and environmental specialist under each of these criteria. These assessments were used to identify the differentiating sub-criteria to be used in the identification of the preferred 2 ha site within each of the land parcels and subsequently the identification of the emerging preferred site option. The outcomes of each of these assessments were combined into an overall assessment matrix detailing all potential constraints associated with each of the site options. Through an assessment of most and least favourable constraints in the matrix, the emerging preferred site options were identified.

Based on this qualitative assessment, the Ferrybank (Old Wallboard Factory) site has been identified as the emerging preferred site for the Arklow WwTP with the Kilbride and Shelton Abbey (IFI Site) sites having been identified as viable alternatives.

While the Ferrybank (Old Wallboard Factory) has been identified as the emerging preferred site, Irish Water will not confirm a final site location until the end of the Phase 2 consultation process.

Irish Water will be entering the second (Phase 2) non-statutory public consultation period on the 13th of May 2015. This consultation period is set to last for eight weeks and will end on 10th July 2015. This consultation process will follow on from the methodologies adopted during the Phase 1 Consultation process and a “Phase 2 Factual Report” will be published later in 2015 reporting on the findings of the process.

2 Introduction

2.1 Background

The Phase 1 Site Assessment Report published in September 2014 included a land parcel, pipeline route and marine outfall location assessment for the Arklow Wastewater Treatment Plant (WwTP). Irish Water subsequently entered a Phase 1 Consultation Period and sought the opinion of the people of Arklow and the relevant stakeholders by inviting them to express opinions on the locations and the criteria used to identify the land parcels.

The Consultation period was initially set to run for seven weeks from Wednesday 15th October 2014 to Friday 5th December 2014. In light of the interest shown by the people of Arklow and the volume of submissions received, it was later decided to extend this period by another week to Friday 12th December 2014.

Upon completion of the Phase 1 Consultation, Irish Water prepared the Phase 1 Factual Report dated January 2015. This contained details of the factual submissions received during the consultation process.

One of the major conclusions of the Phase 1 Consultation Process was that lands at the Shelton Abbey/IFI could be made available to Irish Water as a possible site, thus no longer classifying these lands as a "sensitive receptor" which requires the application of the appropriate buffer zone. Hence, the shape of the land parcel changed accordingly. On this basis and further discussions with the landowner and the input from the number of submissions, it was decided that this land parcel should be considered in greater detail.

An assumption was made at the beginning of this process that based on previous evidence, a river discharge would not be suitable hence restricting an outfall to the sea only. Due to the interest raised in the Shelton Abbey/IFI site and other potential sites close to the Avoca River, Irish Water has revisited this assumption and have investigated the preliminary suitability of available sites should a river discharge be a viable option. Irish Hydrodata Ltd. carried out an 'Investigation of the Impact of Treated Wastewater Discharges to the Avoca River & Irish Sea' report in March/April 2015. Refer to Section 2.3 for more details.

An un-calibrated CFRAM flood model was initially used to rule out certain low lying lands around the Shelton Abbey/IFI Site. This exclusive criteria has been re-visited in more detail in order to ascertain the risk associated with construction in this location. Byrne Looby PHMcCarthy carried out a 'Flood Risk Assessment & Management Report' in March 2015. Refer to Section 2.4 for more details.

The conclusion of these two studies altered the ranking system of the 10 shortlisted land parcels identified in the Phase 1 Site Assessment Report (September 2014), as the distance to an outfall location has been reduced significantly in the case of some riverside land parcels. The new ranking system can be seen in Table 2.1 below:

Ranking	Land Parcel	Distance to Load Centre (km)	Distance to Preferred Outfall Location (km)	Total Distance (km)
1	Ferrybank (Old Wallboard Factory)	0.52	0	0.52
2	Kilbride	2.41	0.46	2.87
3	Shelton Abbey (IFI Site)	2.64	0.31	2.95
4	Seabank	2.75	0.35	3.1
5	Lamberton & Ballyraine	2.45	0.7	3.15
6	Tinahask Upper	2.75	0.7	3.45
7	Killiniskyduff	2.5	1.1	3.6
8	Ballymoney	3.5	1.1	4.6
9	Money Big	3.75	1.1	4.85
10	Bogland & Kish	5.2	1.9	7.1

Table 2.1 Revised Phase 1 Report – Land Parcel Rankings

Based on the same criteria used in the Phase 1 Report, that a river outfall can now be considered and flooding risks can be mitigated against, the three remaining shortlisted land parcels have been redefined as:

- Ferrybank (Old Wallboard Factory)
- Kilbride
- Shelton Abbey (IFI Site)

A diagram of these parcels, associated pipeline corridors and outfall locations can be seen in Figure 1.1 overleaf.

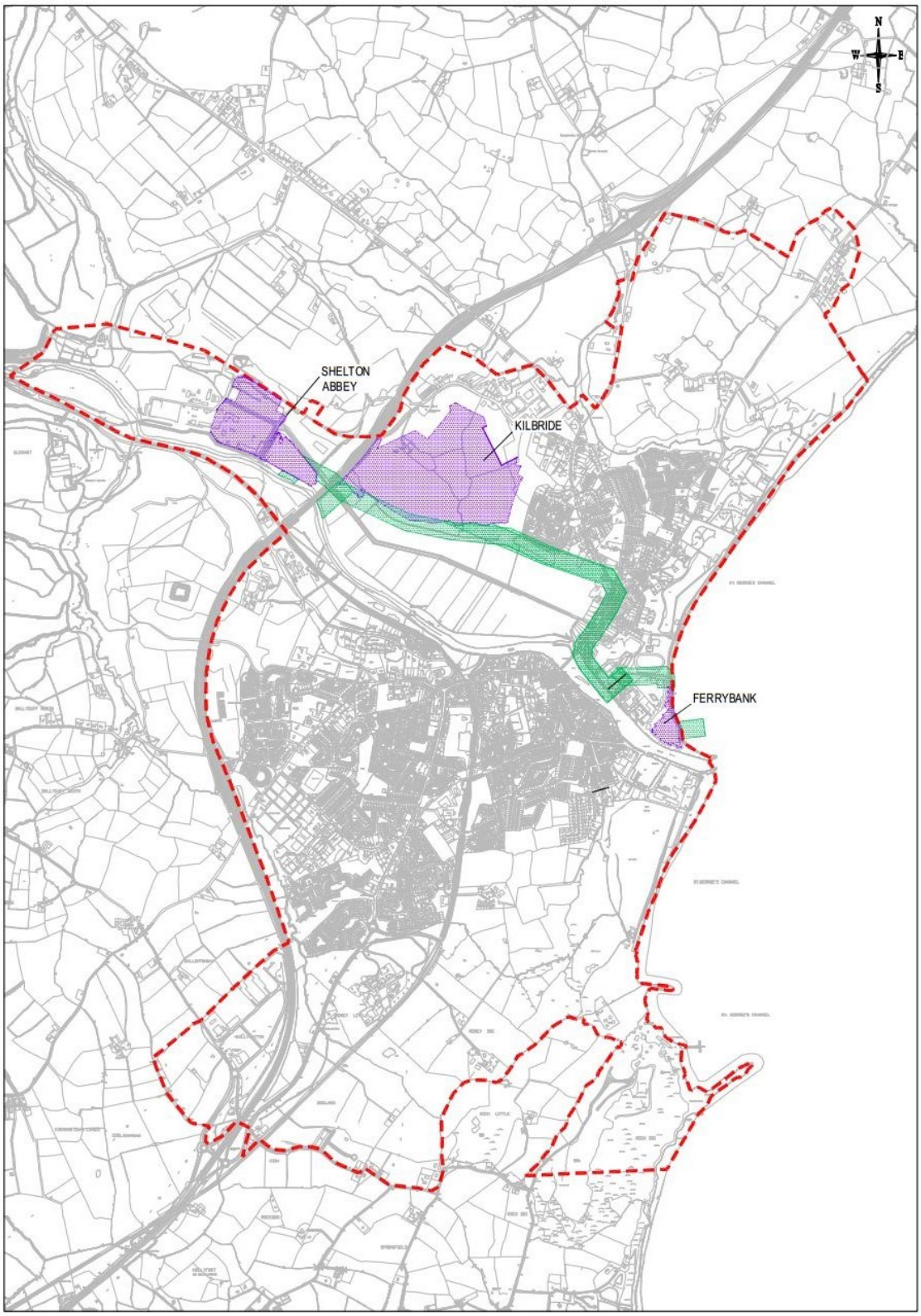

Figure 2.1 Shortlisted Land Parcels for Phase 2 Assessment

The schematic below best illustrates the course of action Irish Water have taken to date to ensure the best possible site is selected for the future Arklow WwTP.

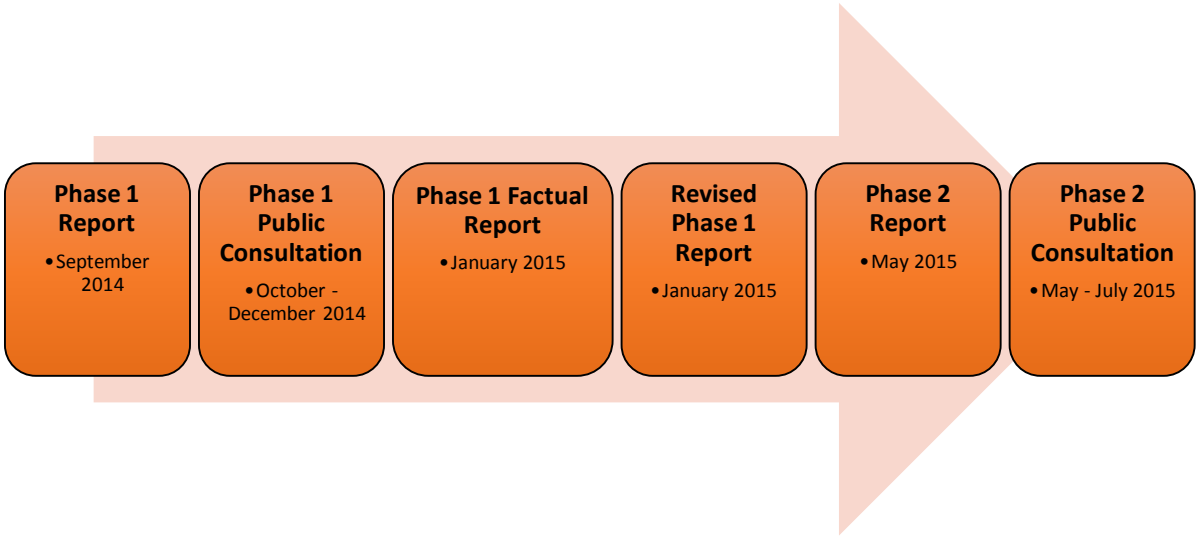

Figure 2.2 Site Selection Process to Date

2.2 Phase 2 Report Objectives

This Phase 2 Report consists of an assessment of the performance of each of the three shortlisted land parcels (mentioned above), transfer pipeline routes and outfalls against a range of environmental and technical criteria leading to the identification of emerging preferred sites for the WwTP, outfall location and transfer pipeline routes. The Sites Assessment (SA) includes

- Pipeline corridors and marine outfall study areas
- Desk-top studies
- Site visits and impact assessments by the project consultants including archaeological and ecological specialists

The Phase 2 Report also includes a more detailed examination of the criteria that were examined in Phase 1 of the SA. A higher level of information was needed in advance of the Phase 2 report to assess the criteria of the shortlisted land parcels. Irish Water engaged the services of four specialists to conduct further studies on the remaining preferred land parcels. These services included:

- Ground Investigation Works at the shortlisted brownfield land parcels
- Ecological Surveys
- Archaeological Surveys
- Asbestos Surveys

It is the conclusion of these studies that has enabled the assessment within this Phase 2 report.

2.3 Outfall Study

BLP engaged the services of Irish Hydrodata Ltd. to undergo an investigation of the impact of treated wastewater discharges to the Avoca River and the Irish Sea in January 2015. The purpose of the study was to:

- Make an assessment of effects of treated wastewater discharges to the Avoca river and the Arklow coastal area;
- Establish suitable effluent discharge standards;
- Ensure compliance with all EC and national regulations;
- Assess and compare potential outfall locations.

The brief for the studies required a focus on various scenarios to be focused on. In the marine, these include spring/neap tides and calm/windy conditions. The river discharge focused on 95%ile flows in the Avoca.

Under the Urban Wastewater Treatment Regulations 2001 secondary treatment of effluent is mandatory. This will significantly reduce overall biological impacts of discharges from the WwTP. The main concerns regarding the proposed discharges are the impacts on nutrient levels and on bacterial concentrations in nearby bathing waters.

An assessment of the impact of waste water discharges to the Avoca River and the Arklow coastal waters was conducted with the aid of numerical models.

The assessment was conducted for a PE of 36,000 with an average daily flow of 0.127 m^3/s. The analysis has allowed conclusions to be made regarding the proposed discharges and the level of treatment required in the WwTP to ensure compliance with relevant regulations.

Assessment of the river outfall was made both on the basis of Environmental Protection Agency's (EPA) background water quality data and also taking discharges from the Sigma Aldrich plant into consideration. The proposed range of Emission Level Values (ELV's) are summarised in Table 2.2 overleaf.

Analysis of the marine outfall options has shown that the coastal water depths and current speeds are sufficient to ensure rapid dilution and dispersion of the discharge. Models indicate that a 900m outfall will ensure compliance with the 'Excellent' category of Bathing Water Quality Regulations 2008. The proposed ELV's are summarised in Table 2.2 below.

These findings are provisional and the analyses and proposed ELV's need to be formally discussed with the EPA prior to making a final decision on an emerging preferred WwTP location.

Parameter	River Outfall	900m Marine Outfall
Biochemical Oxygen Demand	10 mg/l	25 mg/l
Suspended Solids	35 mg/l	35 mg/l
Total Ammonia-N	0.7 to 1 mg/l	10 mg/l
TON-N	35 mg/l	35 mg/l
PO4-P	0.7 to 1 mg/l	-
E.coli	1 x 10^6 ec/100ml	1 x 10^6 ec/100ml

Table 2.2 Proposed WwTP Discharge ELV's

The full report, as produced by Irish Hydrodata Ltd. can be found in Appendix A.

2.4 Flood Feasibility Study

Following the findings of the Phase 1 Consultation process, the IFI site, west of Arklow, was identified as a potential site for the Arklow WwTP. IW decided to further investigate the flood risk associated with this site and hence determine its suitability as a possible WwTP location.

IW Water engaged the services of Byrne Looby PH McCarthy to assess the flood risk to the IFI site in accordance with *The planning Systems and Flood Risk Management – Guidelines for Planning Authorities*, hereafter referred to as 'the Guidelines'. At this stage, a detailed design of the treatment plant has not been undertaken and the aim of this report is to assess the suitability of the IFI site (or part thereof) for use for a WwTP in relation to flood risk. The study area is set out in Figure 1.3 below:

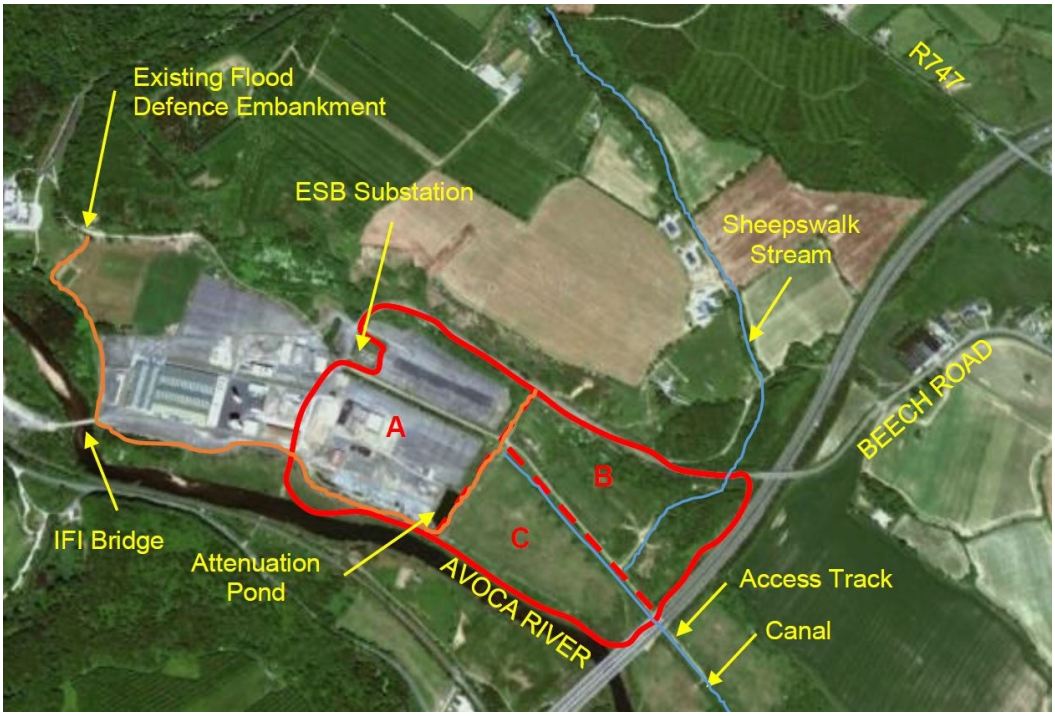

Figure 2.3 Outline of study area and sub-plots A, B & C

An assessment of the flood risk to the site has been undertaken and it has been shown that an adequate area of land is available within the assessment site for the provision of Arklow WwTP which is outside the 0.1% Annual Exceedance Probability (AEP) flood extent. Portions of the suitable land are within flood Zones A or B but are well protected by an existing flood defence embankment. The key points are:

- Adequate lands are available outside the 0.1% AEP flood extent:
- Development in Zone C is the preferred option, but development in Zone A or B where it is defended by the flood defence embankment is also acceptable;
- A justification test has been undertaken that demonstrates that an adequate area within the assessment site is suitable for development in terms of flood risk;
- Site investigations to assess the strength and condition of the existing flood defence embankment, as well as the potential for seepage should be conducted if development in plot A of the site is proposed.

- The development levels (floor and tank) are presented in Table 2.3.

Event	Q100 MFRS Flood Level (m OD)	Allowance for Freeboard (m)	Design Level (m OD)
Plot A	4.88	0.3	5.18
Plots B & C	4.18	0.3	4.48

Table 2.3 Minimum Design Development Levels for the WwTP

The full Flood Risk Assessment and Management Report can be found in Appendix B.

3 Phase 2 Process

3.1 Methodology for Phase 2 – Site Assessment

The methodology for the Phase 2 Site Assessment has been carried out in eight steps as follows;

- **Step 1 –** Production of individual matrices and mapping of impacts on the land parcel options by the environmental and technical specialists based on desktop studies and visual inspections including identification of the relative importance of sub-criteria. A complete set of these matrices has been included in Appendix J.
- **Step 2 –** Identification of the best positioned 2 ha. site within the land parcels based on relative technical and environmental constraints.
- **Step 3 –** Update individual matrices to reflect the focus from the land parcel to the individual sites
- **Step 4 –** Combination of the individual matrices into one overall primary matrix.
- **Step 5 –** Identify cells that are most favourable across the sub-criteria. Shade these cells green.
- **Step 6 –** Identify the cells which are the least favourable of the sub-criteria considered to be most important by the respective specialists. Shade these cells amber. On subsequent iterations, cells are shaded amber in the same way for the most important sub-criteria.
- **Step 7 –** Review the completed matrix to determine whether any site options with 'least favourable' classifications are
    a) Of such significance that it would be comparatively difficult to secure planning permission on this site option; or
    b) Of such environmental disadvantage that with the range of choices available this site option should not be considered further.
- **Step 8 –** Review each sub-criteria to determine whether there are any differentiating levels of impact remaining across the site options. If not, these sub-criteria can be parked from the evaluation stage.

Steps 5 to 8 area an iterative process and the steps are repeated until such time as when the matrix has been sufficiently refined so that the differentiating factors between the remaining site options are nuanced such that it is not possible to remove any further site options/sub-criteria.

3.2 Site Assessment Criteria

This Phase 2 assessment is based on a qualitative process which assesses the performance of each of the alternative land parcels, transfer pipelines routes and outfall locations against a range of environmental and technical criteria in order to identify three emerging preferred site options.

The criteria used for the assessment are provided in Table 3.1 below. Each land parcel option was assessed by the relevant technical and environmental specialist under each of these criteria. These assessments were used to identify the differentiating sub-criteria to be used in the identification of the preferred 2 ha site within each of the land parcels and subsequently the identification of the emerging preferred site option. The outcomes of each of these

assessments were combined into an overall assessment matrix detailing all potential constraints associated with each of the site options. Through an assessment of most and least favourable constraints in the matrix, the emerging preferred site options were identified.

Environmental Criteria	Technical/Economic Criteria
Ecology	Safety
Cultural Heritage	Planning Policy
Landscape & Visual	Engineering & Design
Hydrology & Hydrogeology	Capital & Operational Costs
Soils & Geology	Land Valuation
Traffic	
Air Quality & Odour	
Agriculture & Agronomy	
Noise & Vibration	
People & Communities	

Table 3.1 Site Assessment Criteria

3.3 Specialist Methodology

A generic outline of the methodology followed by each of the environmental and technical specialists for their assessments is outlined below.

3.3.1 Data Collection

Each specialist, where required, undertook a desk-based assessment of the available data collected to date on the scheme. Further data sets, relevant to each specialism were also identified, obtained and reviewed for data relevant to the proposed land parcels, pipeline corridors and outfall locations. In some cases, this involved site surveys and invasive site investigation works.

3.3.2 Site Visits

Site visits and "windshield surveys" of the three land parcels and pipeline route corridors were undertaken in the first few months of 2015. Where required by the relevant specialists, entry onto the land parcels was undertaken, generally to verify or clarify constraints identified as part of the desk based assessment.

3.3.3 Specialist Assessment

Based on the assessments undertaken, the land parcels were initially assessed to identify associated constraints which were then used to determine the best placed 2 ha site within each of the land parcels. The specialist assessments then focused on the sites, pipeline routes and marine outfall locations (site options). In general for the environmental specialists, five categories were used to categorise impacts identified for the site options, as follows:

- Profound
- Significant
- Moderate

- Slight
- Imperceptible

These categorisations are based on the EPA *"Guidelines for the information to be contained in Environmental Impact Statements"* published in 2002 and the National Roads Authority (NRA) *"Environmental Impact Assessment of National Road Schemes – A Practical Guide".* These guidelines are accepted nationally and have been used previously on similar infrastructure projects. Technical aspects of the site options were determined in a manner which would allow the most and least favourable option for each sub-criterion to be easily identified.

3.3.4 Generate Matrix

The assessments under each of the identified criteria by the relevant specialists were reported in a matrix format, which scheduled each of the identified sub-criteria against the land parcel options. The level of environmental impact or technical aspect associated with each sub-criterion for each site option was reported across the matrix. Where relevant, additional brief detail was also included which provided basis and justification for the level of impact accorded to each sub-criterion for each site option.

These matrices were then incorporated into one overall assessment matrix and the full assessment of each of the site options was undertaken.

An extensive list of the matrix criteria can be found in Appendix C.

4 Step 1 – Individual Matrices

4.1 Cultural Heritage

4.1.1 Introduction

Irish Archaeological Consultancy (IAC) were engaged to undertake a high level archaeological assessment of the three shortlisted land parcels, associated pipeline corridors & effluent outfalls in order to determine what impacts a WwTP development could have on the cultural heritage of the area. The report is summarised below. For the full report, refer to Appendix D.

4.1.2 Ferrybank (Old Wallboard Factory)

Site

The Ferrybank land parcel (Old Wallboard Factory) option is located within the townland of Ferrybank in the Parish and Barony of Arklow to the east of Arklow town. The parcel is bound to the south by the north quay and the Avoca River, the seashore to the east and the Mill Road to the west. The area is currently comprised of an abandoned factory building and associated tanks and outbuildings and the parcel is partially overgrown. The proposed parcel of land currently comprises *c*. 7 acres.

There are no RMP sites (Record of Monuments & Places) located within *c*. 500m of the proposed WwTP land parcel. The boundary of the zone of archaeological potential for the historic town of Arklow (WI040-029) is located *c.* 420m to the north-west. The nearest recorded site with an accurate location comprises of the Cistercian monastery and graveyard (WI040-029004, 8) *c.* 620m to the NNW. The receiving environment is considered to possess archaeological potential due to its proximity to the coast. Settlement from the prehistoric periods onwards found coastal regions attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

The historical mapping indicates that this area was located within the estuarine mud flats in the early 19th century. The area had been partially reclaimed by the late 19th century and was shown as undeveloped marsh land. By the first decade in the 20th century the north quay had been constructed and a chemical works had been developed within the area of proposed development. Tramlines are shown running north linking the quayside with the munitions works located along the coast.

Inspection of the aerial photographic coverage of the proposed development area held by the Ordnance Survey (1995, 2000 & 2005) and Google Earth (2010) revealed no previously unrecorded features of archaeological potential in or within the immediate vicinity of the proposed scheme.

A review of the Excavations Bulletin (1970–2010) has indicated that two programs of archaeological investigation have been undertaken within proximity to the proposed development area. Monitoring of ground works was undertaken at the site of a shopping centre on the North Quay, Ferrybank (Sullivan, 2005; licence ref.: 05E0686) and for the laying of ESB cables between Arklow Harbour and Brittas Road (Campbell, 2003; licence ref.: 03E0737). Whilst reclamation deposits were identified, no features of archaeological significance were identified. Monitoring of site investigations was undertaken along the north and south quays of Arklow Town in May 2013 as part of the current development (Bailey, 2013; licence ref.: 12E309). Nothing of archaeological significance was identified at this time.

Pipelines Route Corridor

Given the relatively short distance between the load centre and the Ferrybank land parcel (Old Wallboard Factory), only a small distance of land excavation will be required. This area of Arklow lies in the estuarine mud flats and any negative effects associated with the pipelines have been deemed imperceptible to the cultural heritage of the area. However, it is advised that if works were to go ahead at the Ferrybank land parcel (Old Wallboard Factory), a full level archaeological investigation would have to be undertaken.

Outfall

Given the coastal location of this land parcel, any negative effects associated with the marine outfall have been deemed imperceptible to the cultural heritage of the area. The nearest shipwreck site located at E = 333751.127, N = 173605.568 is c. 7.5 km from the boundary of the parcel.

Evaluation

The proposed development will not impact on any recorded terrestrial archaeological sites, which are listed within the RMP. No sites or features of previously unidentified archaeological significance were identified on the historic mapping or in the aerial photographs within the area of proposed development. The site was located within estuarine mud flats until reclamation in the later 19th century and early 20th century. The area was built up in order to construct the north quay and has been subject to redevelopment since the early 20th century.

Three previous programs of archaeological monitoring were undertaken within the vicinity of the proposed development area however only reclamation deposits were noted. No features of archaeological significance were identified in these areas.

This land parcel poses the least potential impact to the archaeological resource.

For the full high level archaeological assessment of lands report, as carried out by IAC, please refer to Appendix D.

4.1.3 Kilbride

Site

The Kilbride land parcel is located within the townland and Parish of Kilbride and Barony of Arklow. The site is situated c. 870m north of Arklow town centre to the north of the Avoca River. It is comprised of all or part of approximately five undeveloped green fields surrounding Kilbride House, to the immediate south of the M11.

The receiving environment is considered to possess archaeological potential due to its proximity to the River Avoca and the coast c. 1.2km to the east. Settlement from the prehistoric periods onwards found coastal and riverine landscapes attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

There are nine previously recorded archaeological sites located within c. 500m of the proposed WwTP option in Kilbride. The nearest of which comprise of a two sites (WI040-048 and WI040-050) excavated in advance of the Arklow Bypass Road in 1997 to the immediate north of the northwest corner of the proposed land parcel. Site WI040-048 comprised the remains of a Bronze Age settlement site - indicated by evidence for an oval structure and postholes associated with lithic artefacts and Bronze Age pottery. Near to this site the remains of an undated isolated furnace (WI040-050) were excavated. Further to the north, a burnt spread and flints (WI040-051) and a burnt mound (WI040-052) were also excavated in

advance of the scheme c. 140 - 450m north of the proposed WwTP land parcel. The find spot of a font (WI040-044) is also recorded c. 80m to the northeast however it is no longer in situ.

The only nearby recorded sites designated as Recorded Monuments, comprise the church, graveyard, enclosure and mausoleum (WI040-021001-4) recorded c. 60m north of the proposed Kilbride WwTP land parcel. These sites are located within a modern enclosure.

A review of the Excavations Bulletins (1970-2014) revealed that no archaeological investigations have been carried out within the footprint of the Kilbride land parcel. Monitoring was carried out for topsoil stripping during the construction of the Arklow Bypass to the immediate north of the site and several sites identified at this time were subject to excavation. The sites located in greatest proximity to the proposed WwTP land parcel are located to immediate north within the footprint of the existing road, including the Bronze Age settlement site (WI040-048, Breen 1997; Licence 97EO324) and furnace site (WIO40-O50, O Riordain; Licence 97E0083).

Analysis of the available aerial photographic coverage of the site (Google Earth 2010 and OSI 2000) failed to reveal any features of archaeological potential within the footprint of this land parcel option.

The following potential negative impacts have been identified:

- Slight potential to impact on cultural heritage sites (previously unrecorded sites)

Pipelines Route Corridor

Given the extent of excavation required to lay a rising main to the Kilbride land parcel, it is advised that if works were to go ahead, a full high level archaeological investigation would have to be undertaken.

For the purpose of this investigation, the following potential negative impacts have been identified:

- Moderate potential to impact on cultural heritage sites (previously unrecorded sites)

Outfall

Given the relatively short length of excavation required to lay a river outfall from the Kilbride land parcel to the Avoca River, any potential negative effects have been deemed imperceptible at this stage. Nevertheless, it is advised that if works were to go ahead at Kilbride, a full high level archaeological investigation would have to be undertaken.

Evaluation

The proposed development will not impact on any recorded archaeological sites, which are listed within the RMP. No sites or features of previously unidentified archaeological significance were identified on the historic mapping or in the aerial photographs within the area of proposed development.

Two previous archaeological excavations have been carried out to the immediate north of the proposed development area which revealed a prehistoric settlement (WI040-048) site and a furnace (WI040-050). While both of these sites have been subject to full archaeological resolution, and as such have no remaining elements in situ, it is possible that associated features associated may be located within their proximity, outside of the M11 footprint and within the current land parcel.

The proposed development is located within a rich archaeological landscape adjacent to the estuary of the River Avoca and the coast. As such the receiving environment is considered to possess high archaeological potential. Settlement from the prehistoric periods onwards found coastal regions attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

4.1.4 Shelton Abbey (IFI Site)

Site

The Shelton Abbey site option is located within the townlands of Shelton Abbey and Kilbride, Parish of Kilbride and Barony of Arklow. The site is situated c. 1.4km north - northwest of Arklow town centre on the northern banks of the Avoca River. It is comprised of all or part of three undeveloped green fields and two previously developed plots on the northern banks of the River Avoca, to the immediate west of the M11.

The receiving environment is considered to possess archaeological potential due to its immediate proximity to the River Avoca and the coast c. 2.1km further to the east. Settlement from the prehistoric periods onwards found coastal and riverine landscapes attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

There are seven previously recorded archaeological sites located within c. 500m of the proposed WwTP option in Shelton Abbey. The nearest of which comprise of a two sites (WI040-048 and WI040-050) excavated in advance of the Arklow Bypass Road in 1997 to the immediate south of |the proposed land parcel. Site WI040-048 comprised the remains of a Bronze Age settlement site - indicated by evidence for an oval structure and postholes associated with lithic artefacts and Bronze Age pottery. Near to this site the remains of an undated isolated furnace (WI040-050) were excavated. Further to the north, a burnt spread and flints (WI040 - 051) was also excavated in advance of the scheme c. 190m north of the proposed WwTP land parcel.

The only nearby recorded sites designated as Recorded Monuments, comprise the church, graveyard, enclosure and mausoleum (WI040-021001-4) recorded c. 320m east of the proposed Shelton Abbey WwTP land parcel. These sites are located within a modern enclosure.

A review of the Excavations Bulletins (1970 - 2014) revealed that no archaeological investigations have been carried out within the footprint of the Shelton Abbey land parcel. Monitoring was carried out for topsoil stripping during the construction of the Arklow Bypass to the immediate east of the site and several sites identified at this time were subject to excavation. The sites located in greatest proximity to the proposed WwTP land parcel are located to immediate south within the footprint of the existing road, including the Bronze Age settlement site (W1040-048, Breen 1997; Licence 97E0324) and furnace site (WI040-050, O Riordain; Licence 97E0083).

Cartographic analysis of the historic maps failed to identify any previously unidentified sites of archaeological potential. The proposed land parcel is shown as being located within the southern portion of the extensive demesne landscape that was associated with Shelton Abbey on the first edition OS map. As such the area would have been subject to a certain level of landscaping and ground works. The line of an old east-west running access road, which also formed the townland boundary between Kilbride, is shown on the mapping and this is preserved within the southern limit of the current land parcel. A gate lodge is shown on the later 25-inch OS maps which is no longer extant.

Analysis of the available aerial photographic coverage of the site (Google Earth 2010 and OSI 2000) failed to reveal any features of archaeological potential within the footprint of the WwTP land option. The southeast quadrant of the proposed WwTP land parcel is currently covered in rough scrub vegetation which would hamper the identification of archaeological features.

The northern half of the proposed development has been subject to a large amount of disturbance during the construction of the existing industrial facility (since at least 1995). Any archaeological features that may have existed in this area are likely to have been removed.

Pipelines Route Corridor

Given the extent of excavation required to lay a rising main to the Shelton Abbey (IFI Site) land parcel, it is advised that if works were to go ahead, a full high level archaeological investigation would have to be undertaken.

For the purpose of this investigation, the following potential negative impacts have been identified:

- Moderate potential to impact on cultural heritage sites (previously unrecorded sites)

Outfall

Given the relatively short length of excavation required to lay a river outfall from the Kilbride land parcel to the Avoca River, any potential negative effects have been deemed imperceptible at this stage. Nevertheless, it is advised that if works were to go ahead at Kilbride, a full high level archaeological investigation would have to be undertaken.

Evaluation

The proposed development will not impact on any recorded archaeological sites, which are listed within the RMP/SMR. No sites or features of previously unidentified archaeological significance were identified on the historic mapping or in the aerial photographs within the area of proposed development.

Aerial photography has indicated that the northern half of the land parcel has been subject to significant disturbance associated with the construction of the existing industrial complex, since at least 1995. Any archaeological features that may have existed in this area are likely to have been removed.

Two previous archaeological excavations have been carried out to the immediate south of the proposed development area which revealed a prehistoric settlement site (WI04O-048) and a furnace (WI04O-050). While both of these sites have been subject to full archaeological resolution, and as such have no remaining elements in situ, it is possible that associated features associated may be located within their proximity, outside of the M11 footprint and within the current land parcel.

The proposed development is located within a rich archaeological landscape adjacent to the estuary of the River Avoca. As such the receiving environment is considered to possess archaeological potential. Settlement from the prehistoric periods onwards found coastal regions attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

For the full high level archaeological assessment of lands report, as carried out by IAC, please refer to Appendix D.

1.0	Cultural Heritage	Ferrybank	Kilbride	Shelton Abbey
1.1	Cultural Heritage - Land Parcels			
1.1.1	Potential to impact (direct/indirect) on National Monuments (designated sites)	Imperceptible	Imperceptible	Imperceptible
1.1.2	Potential to impact (direct/indirect) on RMPs* (designated sites)	Imperceptible	Imperceptible	Imperceptible
1.1.3	Potential to impact (direct/indirect) on RPS/NIAH** (designated sites)	Imperceptible	Imperceptible	Imperceptible
1.1.4	Potential to impact (direct/indirect) on CH*** sites (previously unrecorded sites)	Imperceptible	Slight – greenfield land parcel	Slight – greenfield land parcel
1.1.5	Potential to impact (direct) on water courses and environs (areas of archaeological potential)	Imperceptible	Imperceptible	Imperceptible
1.1.6	Potential to impact (direct/indirect) on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
1.1.7	Potential to impact (direct) on townland boundaries (cultural heritage significance)	Imperceptible	Imperceptible	Imperceptible
1.2	Cultural Heritage - Route Corridors	Ferrybank	Kilbride	Shelton Abbey
1.2.1	Potential to impact on RMPs	Imperceptible	Imperceptible	Imperceptible
1.2.2	Potential to impact on National Monuments	Imperceptible	Imperceptible	Imperceptible
1.2.3	Potential to impact on RPS/NIAH	Imperceptible	Imperceptible	Imperceptible
1.2.4	Potential to impact on CH sites	Imperceptible	Moderate – corridor though greenfield lands	Moderate – corridor though greenfield lands
1.2.5	Potential to impact on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
1.2.6	Potential to impact on ACA****	Imperceptible	Imperceptible	Imperceptible
1.3	Cultural Heritage - Outfalls	Ferrybank	Kilbride	Shelton Abbey
1.3.1	Potential to impact on RMPs	Imperceptible	Imperceptible	Imperceptible
1.3.2	Potential to impact on National Monuments	Imperceptible	Imperceptible	Imperceptible
1.3.3	Potential to impact on RPS/NIAH	Imperceptible	Imperceptible	Imperceptible
1.3.4	Potential to impact on CH sites	Imperceptible	Imperceptible	Imperceptible
1.3.5	Potential to impact on Recorded shipwreck sites	Imperceptible	Imperceptible	Imperceptible
1.3.6	Potential to impact on inter-tidal archaeology (previously unknown)	Imperceptible	Imperceptible	Imperceptible

Table 4.1 Cultural Heritage

* Record of Monuments & Places

** Record of Protected Structures/National Inventory of Architectural Heritage

*** Cultural Heritage

**** Architectural Conservation Area

4.2 Landscape & Visual

4.2.1 Introduction

The Landscape and Visual section of the site assessment for the Arklow WwTP project compares the predicted landscape and visual impacts in relation to each of the three shortlisted land parcels. It also assesses potential impacts with respect to the pipeline routes and outfall locations. The assessment is based on desktop studies and 'windshield' site surveys and it is presented in the form of impact matrices.

The basis for the assessment is the *"Guidelines for Landscape and Visual Impact Assessment: Second Edition" Landscape Institute (LI)"* and "*Institute of Environmental Management and Assessment (IEMA), 2002'*. Also considered are the guidelines laid out by the Environmental Protection Agency (EPA) in the publications *"Guidelines on the Information to be contained in Environmental Impact Statements (2002)",* the accompanying *"Advice Notes on Current Practice in the Preparation of Environmental Impact Statements"* (September 2003) and the methodologies adopted by the *"Greater Dublin Drainage - ASA Phase Two Sites Assessment and Route Selection Report"*

These Guidelines note in the 'Landscape in the Existing Environment' Chapter that landscape impact is a combination of two separate, but closely related, aspects: 'The first aspect to be considered is visual impacts focusing on the extent to which developments can be seen, the second aspect is impacts on the character of the landscape, examining responses which are felt towards the combined effects of the new development'. The EPA Guidelines recommend the following to be included in any assessment.

- **Context:** Areas from which the existing site can be seen are generally noted with particular attention given to views from roads, residences and designated tourism routes and viewpoints. Areas from beyond the site boundary from which the site can be seen should be noted. If the site and its environs have areas of distinctive and different character, those are mapped and described.
- **Character:** A description of the landscape character differentiates between subjective assessments and objective description. A description of the character of the site as perceived both within the site and in the wider landscape is important, as is a description of the intensity and character of land use.
- **Significance:** This entails the level of visual intrusion upon designated views, designated landscape and designated landscape amenity areas.
- **Vulnerability:** The extent to which the existing landscape or views are capable of being changed in such a way as not to alter the perceived character.

Also key to this assessment, particularly given that the pipeline routes and outfall aspects will be laid underground, is the duration of any landscape and visual impacts. The EPA guidelines define the duration of impacts as follows:

- **Temporary:** One year or less
- **Short-term:** One to seven years
- **Medium-term:** Seven to twenty years
- **Long-term:** Twenty to fifty years
- **Permanent:** Over fifty years

4.2.2 Methodology

4.2.2.1 Desktop Study

The desktop study was the first aspect of the SA to be undertaken by the landscape and visual assessors. One of the key aspects of the desktop study was a review of the Wicklow County Development Plan (2010 - 2016) principally in relation to the location of designated areas of Highly Sensitive Landscape, scenic views and scenic routes.

The landscape of the County is a national asset. The Wicklow County Development Plan (2010 – 2016) incorporates the landscape characterisation for Wicklow, which identifies a range of six landscape character types. County Wicklow is richly endowed with a variety of landscape 'types' and human interaction with the natural heritage has produced a variety of characteristic landscapes and landscape features. The increasing development pressure of recent years has caused changes in the natural landscape, which are unprecedented in scale and nature, and has led to the Government setting out guidelines for landscape appraisal. This assessment of the landscape is to ensure that *"the environment and heritage generally are maintained in a sustainable manner, while at the same time enabling a proactive approach to development".*

Each landscape type is assigned a 'value' through the consideration of such elements as aesthetics, ecology, historical, cultural, religious or mythological. The corresponding vulnerability ratings range from 'low' to 'very high'.

The landscape character types and respective vulnerability ratings are listed below:

- Mountain and Lakeshore Areas of Outstanding Natural Beauty - Very High
- Coastal Areas of Outstanding Natural Beauty - Very High
- Areas of Special Amenity - High
- Access Corridor Area - Medium
- Rural Area - Medium
- Urban Area - Low

The Wicklow County Development Plan (2010 – 2016) classes Arklow and its environs as an *"urban"* area for the purpose of landscape classification. Urban areas are defined below:

"All locations designated as 'settlements' in the County settlement hierarchy are considered 'urban' areas for the purpose of landscape classification, although it is acknowledged that many of the smaller towns and villages are not 'urban' in the same sense as settlements such as Bray or Arklow. In terms of landscape classification, these settlements have already been deemed suitable for development (of the type allowed by the settlement strategy and the development standards of this plan) and the impacts on the wider landscape of such development has already been deemed acceptable. Therefore it will not be necessary for developments in urban areas to have regard to the surrounding landscape classification or to carry out landscape or visual impact assessment".

The output from the desktop study phase was a preliminary assessment of likely landscape and visual impacts. This was generated using an impact matrix format of land parcels, pipeline routes and effluent outfall locations versus a range of potential landscape and visual constraints.

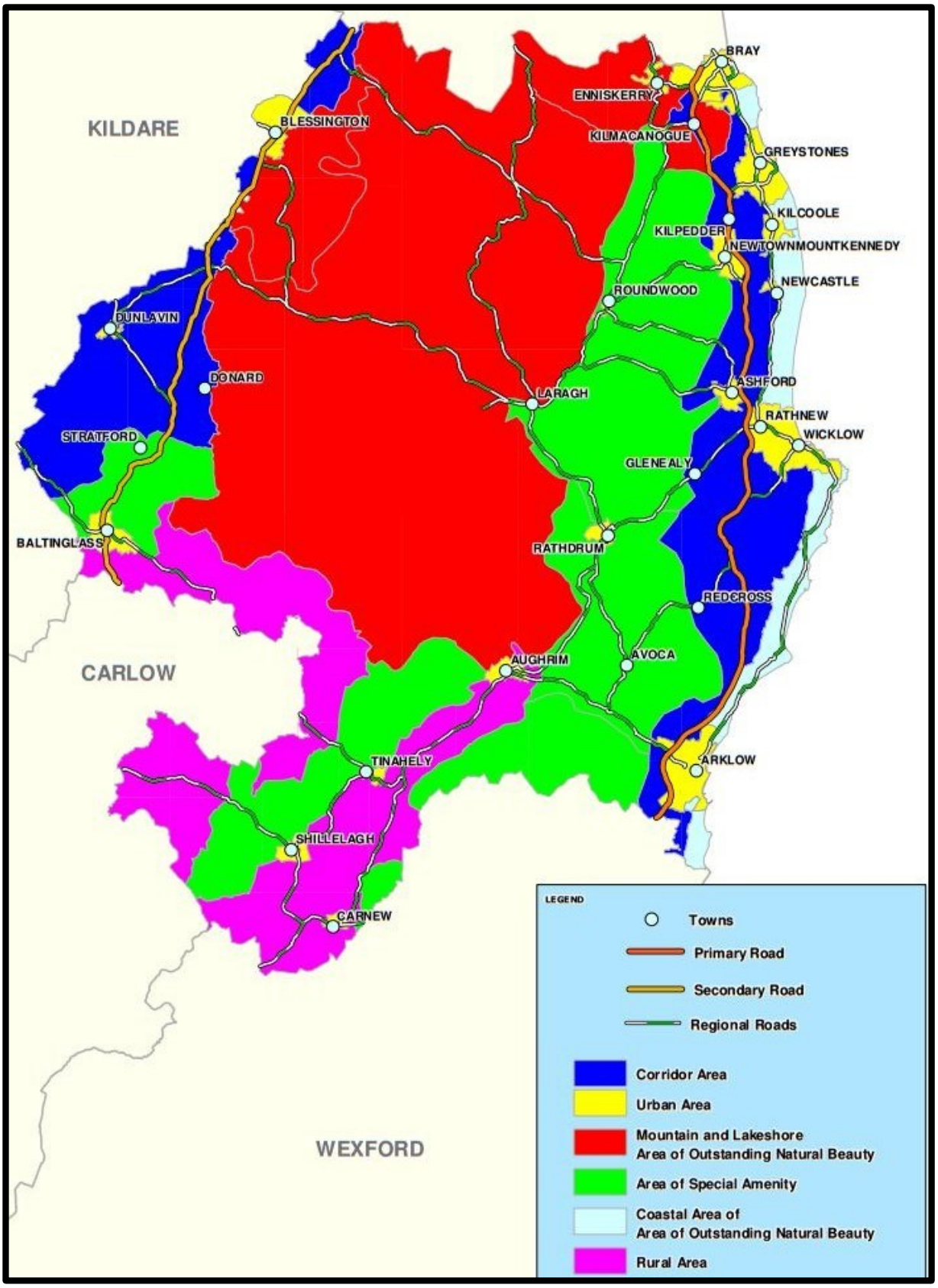

Figure 4.1 Map No. 17.09 taken from the Wicklow County Development Plan (2010-2016) – Landscape Classifications

4.2.2.2 Site Visits

Following the desktop study phase, 'windshield' site surveys were undertaken to confirm or refute the initial impact predictions. These surveys took account of such factors as the relative elevation of the land parcel and surrounding receptors as well as the level of terrain and/or vegetation screening.

The site visits afforded the landscape and visual assessors an opportunity to become familiar with the landscape character of the study area generally and more specifically, the areas subject of potential development in relation to the Arklow WwTP.

4.2.3 Predicted Impacts

This section highlights any landscape and visual impacts that are likely to occur as a result of the proposed development. These impacts might occur in relation to the construction phase or the ongoing operational phase of the development.

4.2.3.1 Construction Phase

All aspects of the proposed development will result in landscape and visual impacts during the construction phase. However, in the case of the subsurface pipeline routes and the effluent outfall aspects, the construction phase will be the likely extent of any impacts. The Wastewater Treatment Plant, by contrast, will also result in permanent operational phase impacts. The predicted nature and duration of impacts are discussed below in relation to each aspect of the project.

4.2.3.1.1 Wastewater Treatment Plant

The WwTP is likely to be the only aspect of the project that will result in both, temporary construction, and, permanent operational, landscape and visual impacts. The visible elements of the WwTP at construction phase are likely to consist of;

- Construction traffic to and from the site
- Excavation and construction machinery on site
- Temporary fencing at the perimeter of the site
- Health and safety signage and fencing within and around the site
- Stockpiles of excavated material
- Stockpiles of construction materials
- Temporary site offices

4.2.3.1.2 Pipeline Routes

For the construction phase of the pipeline routes, temporary negative visual impacts are likely to occur as a result of construction traffic, excavation machinery, health and safety signage and fencing, stockpiles of excavated material and stockpiles of construction materials (pipeline sections and backfill material). The pipeline will run along some sections of road and will also pass through farmland and other undeveloped sites. Given that the time for laying the underground pipeline is relatively short, and that the impacts are restricted to receptors at the working face, the impacts described are only likely to be in the higher order of magnitude with respect to any particular receptor for a period of weeks before the works have moved on.

In terms of landscape impacts the pipeline route will inevitably encounter tree lines and hedgerows, short sections of which will need to be removed and then replaced or replanted

depending on the nature of the vegetation affected. Where well established vegetation must be replaced the negative landscape and visual impact may extend from temporary (less than one year) to the short term (one to seven years).

Other than along road sections of the pipeline route, a line of bare earth will also remain following construction, indicating the path of the pipeline. This will only be a temporary landscape and visual impact until such time as the prevailing land cover becomes re-established.

4.2.3.1.3 Outfall

The outfall aspect of the project is likely to generate similar type of temporary landscape, seascape, and visual impacts to the pipeline routes as it is essentially an extension of the land based subterranean pipeline. A river outfall is considered to be of a similar construction to the land based subterranean pipelines, however there is potential for a permanent visual effect. It is envisaged at this stage that an outfall to the river will involve the construction of a headwall at the outfall location.

In the case of a marine outfall and given the interface of land and sea, a more complex construction scenario is envisaged. In addition to the construction elements described above for the land based pipelines, some form of marine craft will be required for laying of the pipeline below the seabed in the vicinity of the shoreline. The other key consideration is the generally higher level of sensitivity of receptors in coastal areas, which includes for example, beaches, coastal walks and bathing locations.

4.2.3.2 Operational Phase

Permanent, operational phase, landscape and visual impacts will result from a combination of the following visible elements of the WwTP.

- Site entrance and access road
- Administration buildings (modest scale to accommodate staff offices, reception, canteen etc.)
- Treatment works: Preliminary treatment, primary treatment, secondary treatment, & sludge treatment. These processes will involve the construction of screens, settlement tanks, main biological process tanks, sludge processing buildings, sludge storage buildings, odour control units, pumps and associated pipework.
- Permanent site fencing and boundary treatments
- Access and circulation roads including site traffic
- Lighting

This includes, for example, the potential for loss of field patterns, hedgerows and drainage ditches with a resultant impact on the landscape character of the surrounding area. Permanent visual impacts will also occur in relation to surrounding receptors such as dwellings and roads where views of the WwTP are afforded. The magnitude of any impacts is a factor of the composition and integrity of the existing landscape context, as well as the sensitivity of receptors in the vicinity and the potential for mitigation.

The visual impacts associated with the brownfield land parcels may not be as severe when compared to the existing landscape.

4.2.4 Evaluation

In all instances a worst case scenario is assumed in terms of potential impacts, for example, screening vegetation devoid of leaves during the winter and clear views being available beyond rear property boundaries. The predicted impact levels hereunder are also pre-mitigation. Therefore, no level of landscape screening at the site boundary or ameliorative site configuration is assumed.

4.2.5 Ferrybank (Old Wallboard Factory)

Site

The Ferrybank land parcel (Old Wallboard Factory) is located on the mouth of the Avoca River on the site of an old and derelict gypsum factory. The factory is roughly 25 m in height and has a large chimney flue extending 44 m vertically on the west side of the building. The lower walls are a blockwork construction while the majority of the factory is constructed from steel and corrugated sheet asbestos. The land parcel has 4 large disused storage tanks situated to the west and several smaller abandoned buildings. The terrain is relatively flat with an elevation of approximately 2.5 mOD.

The following negative impacts were identified:

- Moderate potential to impact on views from dwellings/roads (Mill Rd, North Quay & South Quay)

It should be noted that while the construction of a WwTP on the Ferrybank land parcel (Old Wallboard Factory) would cause the above negative impacts, it can be argued that the existing factory is much more visually obtrusive to the landscape and its demolition would improve views from the dwellings and roads listed above.

Pipelines Route Corridor

Given that all pipework will be laid underground, any potential negative impacts associated with the pipelines would be temporary, lasting only for the construction phase. Therefore, any negative effects associated with the pipelines have been deemed imperceptible to the landscape of the area.

Outfall

Similarly to above, any negative impacts associated with the marine outfall have been deemed imperceptible to the landscape of the area.

4.2.6 Kilbride

Site

The Kilbride land parcel is located roughly 1.5 km North West of the centre of Arklow town. The land has a central elevation of approximately 30.0 mOD falling to 20.0 mOD as it descends downwards towards the Avoca River. The land parcel is bounded to the north by Local secondary road L-6179 Ticknock – Kilbride (the Kilbride – old IFI plant road) to the east by existing developed areas mainly in residential and community / educational use and to the south by Arklow Marsh. This parcel is bordered by the M11 motorway to the East but existing trees and shrubbery provides screening from the road.

The following negative impacts were identified:

- Slight potential to impact the character of the landscape
- Slight potential to impact on views from dwellings/roads
- Slight potential to impact on views from M11 motorway
- Slight potential to impact on views Dublin-Rosslare railway line
- Slight potential to disrupt landscape structure (hedgerows / field pattern etc.)

Pipelines Route Corridor
Given that all pipework will be laid underground, any potential negative impacts associated with the pipelines should be temporary, lasting only for the construction phase. However, given that the pipeline corridor for this land parcel passes through various fields and hedgerows, a potential slight impact to disrupt landscape structure has been recognised. Appropriate reinstatement would have to be employed to minimise this impact.

The following potential constraints were identified along the transfer pipeline corridors:

- Slight potential to impact or disrupt landscape structure (treeline/hedgerows/field patterns etc.)

Landscape and visual impacts associated with the pipeline corridors will be temporary and route alignments will be selected within the corridors to minimise impacts.

Outfall
This assessment has assumed that the construction a headwall will be requirement for a river outfall. Nevertheless, given this land parcel's close proximity to the modelled Avoca River outfall location, any negative impacts associated with the outfall have been deemed imperceptible to the landscape of the area.

4.2.7 Shelton Abbey (IFI Site)

Site
The Shelton Abbey land parcel is located along the banks of the Avoca River on the site of the old IFI factory. Over the last few years, the landowner has commenced clearing the site and few sheds/store buildings remain standing. The terrain is relatively flat with an elevation of approximately 0 -10 m OD.

The following negative impacts were identified:

- Slight potential to impact on views from M11 motorway
- Moderate potential to impact on views Dublin-Rosslare railway line
- Slight potential to disrupt landscape structure (hedgerows / field pattern etc.)

Pipelines Route Corridor
Given that all pipework will be laid underground, any potential negative impacts associated with the pipelines should be temporary, lasting only for the construction phase. However, given that the pipeline corridor for this land parcel passes through various fields and hedgerows, a potential slight impact to disrupt landscape structure has been recognised. Appropriate reinstatement would have to be employed to minimise this impact.

The following potential constraints were identified along the transfer pipeline corridors:

- Slight potential to impact or disrupt landscape structure (treeline/hedgerows/field patterns etc.)

Landscape and visual impacts associated with the pipeline corridors will be temporary and route alignments will be selected within the corridors to minimise impacts.

Outfall

This assessment has assumed that the construction a headwall will be requirement for a river outfall. Nevertheless, given this land parcel's close proximity to the modelled Avoca River outfall location, any negative impacts associated with the outfall have been deemed imperceptible to the landscape of the area.

2.0	Landscape & Visual	Ferrybank	Kilbride	Shelton Abbey
2.1	Landscape & Visual - Land Parcels			
2.1.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.1.2	Potential to impact on areas of 'Highly Sensitive Landscape' (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.1.3	Potential to impact on views from heritage/tourist/amenity features	Imperceptible	Imperceptible	Imperceptible
2.1.4	Potential to impact on the character of the landscape	Imperceptible	Slight - existing 'rural' character	Imperceptible
2.1.5	Potential that landscape screening will be ineffective or contribute to landscape and visual impacts	Imperceptible	Imperceptible	Imperceptible
2.1.6	Potential to impact on views from settlements	Imperceptible	Imperceptible	Imperceptible
2.1.7	Potential to impact on views from dwellings / local roads	Moderate - Closest land parcel to Arklow town centre	Slight - Elevated land parcel visible from surrounds	Imperceptible
2.1.8	Potential to impact on views from M11 motorway	Imperceptible	Slight - visible from M11 bridge (northbound)	Slight - visible from M11 bridge (northbound)
2.1.9	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Slight - visible from railway line	Moderate - visible from railway line
2.1.10	Potential to impact on views from other major roads (national or regional roads)	Imperceptible	Imperceptible	Imperceptible
2.1.11	Potential to disrupt landscape structure (hedgerows / field pattern etc.)	Imperceptible	Slight - Site placing will determine extent of disruption	Slight - Site placing will determine extent of disruption
2.1.12	Potential to impact on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
2.1.13	Potential to impact on woodlands and significant tree groups	Imperceptible	Imperceptible	Imperceptible

2.2	Landscape & Visual - Route Corridors - Pipelines	Ferrybank	Kilbride	Shelton Abbey
2.2.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.2.2	Potential to impact on areas of 'Highly Sensitive Landscape' (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.2.3	Potential to impact on views from settlements	Imperceptible	Imperceptible	Imperceptible
2.2.4	Potential to impact on views from dwellings / local roads	Imperceptible	Imperceptible	Imperceptible
2.2.5	Potential to impact on views from motorways	Imperceptible	Imperceptible	Imperceptible
2.2.6	Potential to impact on views from other major roads (national or regional roads)	Imperceptible	Imperceptible	Imperceptible
2.2.7	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Imperceptible
2.2.8	Potential to impact on views from heritage/tourist features	Imperceptible	Imperceptible	Imperceptible
2.2.9	Potential to disrupt landscape structure (treelines / hedgerows / field pattern etc.)	Imperceptible	Slight - Changes during construction phase along route	Slight - Changes during construction phase along route
2.2.10	Potential to impact on woodlands and significant tree groups	Imperceptible	Imperceptible	Imperceptible
2.2.11	Potential to impact on rivers and streams	Imperceptible	Imperceptible	Imperceptible
2.2.12	Potential to impact on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
2.3	**Landscape & Visual - Outfalls (Landward side)**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.3.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.2	Potential to impact on 'Highly Sensitive Landscape' (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.3	Potential to impact on coastal walks (indicated in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.4	Potential to impact on bathing locations (indicated in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.5	Potential to impact on views from settlements	Imperceptible	Imperceptible	Imperceptible
2.3.6	Potential to impact on views from dwellings / local roads	Imperceptible	Imperceptible	Imperceptible
2.3.7	Potential to impact on views from major roads (national or regional roads)	Imperceptible	Imperceptible	Imperceptible
2.3.8	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Imperceptible
2.3.9	Potential to impact on views from heritage/tourist features	Imperceptible	Imperceptible	Imperceptible
2.3.10	Potential to Impact on Character of the Coastal Landscape	Imperceptible	Imperceptible	Imperceptible

Table 4.2 Landscape & Visual

4.3 Ecology

4.3.1 Introduction

Byrne Looby PHMcCarthy engaged the services of Senior Ecologist, Eleanor Mayes, to undertake a high level ecological assessment of the three shortlisted land parcels, associated pipeline corridors & effluent outfalls in order to determine what impacts a WwTP development could have on the ecology of the area. The report is summarised below. For the full report, refer to Appendix E.

4.3.2 Methodology

Three land parcels have been identified by Byrne Looby PHMcCarthy as options for potential alternative sites for the proposed WwTP. A desk top review of existing ecological information was carried out, and included a review of areas subject to nature conservation designations. The Natura 2000 network comprises sites that are designated as Special Areas of Conservation (SACs) under the Habitats Directive, and/or Special Protection Areas (SPAs) that are designated under the Birds Directive. Existing information on Natura 2000 sites in the vicinity of Arklow was reviewed. The DoEHLG (NPWS now within DAHG) guidance on Appropriate Assessment indicates that Natura 2000 sites within 15 km of a plan area should be considered in the assessment of plans or projects.

The location, type and extent of a plan or project will determine whether impacts on Natura 2000 sites may have a potential to arise; this will be decided on a case-by-case basis. In the case of water dependant habitats and species, plans or projects that may impact on water quality and quantity may need to be assessed over a greater radius, taking factors such as downstream effects, currents and plume dispersion into account. A 15 km radius of the three alternative WwTP land parcels under consideration at Arklow, was taken as a starting point in this assessment.

The occurrence of Habitats Directive Annex 2 listed species, and of Birds Directive Annex 1 listed species, in the vicinity of Arklow was reviewed, and information on other sites subject to nature conservation designations, was collected. Data sources included the original Arklow WwTP EIS (May 1999), and more recent project documentation including the Natura Impact Screening Statements for the waste water discharge licence (2012), the interceptor sewers and the siphon under the Avoca River Estuary (2012), and the Alps storage tank and CSO at Arklow, Co. Wicklow (2013). EPA reports, and NPWS documentation were reviewed, and an internet search for any other relevant information. Recent documentation on the Conservation Status of Habitats Directive Annex listed habitats and species was reviewed (NPWS 2013).

Walkover surveys of the Shelton Abbey and Kilbride land parcels, and of pipeline corridors, were carried out in April 2015, during which habitats, flora and fauna were noted, in order to provide an overview and summary comparison of the ecology of the sites. Habitats present were classified in accordance with Fossitt (2000). The Ferrybank land parcel (Old Wallboard Factory) and surrounding area had been reviewed in 2014, and was re-visited in April 2015 although the parcel itself was not accessed.

4.3.3 Ferrybank (Old Wallboard Factory)

Site

The Ferrybank parcel is located on the northern side of Avoca River estuary, which is retained by the quay walls of Arklow Harbour in this area. The land parcel includes a derelict gypsum factory and the following habitats are present:

- Buildings and artificial surfaces - BL3
- Spoil and bare ground - ED2
- Recolonizing bare ground - ED3
- Amenity grassland (improved) - GA2
- Scrub - WS1

Derelict buildings and tanks occupy c. 60% of the land parcel area. *Ivy Hedera Helix* is present on some walls, and gutters are overgrown with grasses. The derelict buildings are otherwise un-vegetated.

Spoil and bare ground, comprising paved and gravel surfaces, is vegetated with common colonising plant species. At the eastern end of the parcel adjoining the quay wall of Arklow Harbour, a marine influence is evident and a sparse flora includes *Buck's-Horn Plantain Plantago Coronopus, Stonecrop Sedum* and *Sea Mayweed Tripleurospermum Maritimum.*

Elsewhere within the parcel colonising plant species include mosses, *Creeping Bent-Grass Agrostis Stolonifera, Annual meadow-grass Poa Annua, Willowherb Epilobium species, Ribwort Plantago Lanceolata, Common Ragwort Senecio Jacobaea, White clover Trifolium Repens, yellow clover T. Dubium, Hairy Bittercress Cardamine Hirsuta, and Dandelion Taraxacum Officinale Agg.*

Recolonizing bare ground is more densely vegetated with more than 50% plant cover, and includes the species listed above with additional grass species *Red fescue Festuca rubra, Cock's-foot grass Dactylis Glomerata, and Yorkshire Fog Holcus Lanatus.*

A narrow strip of abandoned amenity grassland lies to the east between the main building and the rock armour along the shore at Ferrybank. This vegetation is dominated by *Red Fescue Grass*, with occasional *Creeping thistle Cirsium arvense, Dock Rumex species,* and *Bush vetch Vicia Cracca.*

Scrub is developing in parts of the parcel, and is dominated by *bramble Rubus Fruticosus Agg., Gorse Ulex Europaeus,* with occasional *Alder Alnus Glutinosa, Grey willow Salix Cinerea and Elder Sambucus Nigra.*

There is evidence that feral pigeons breed in the main building, 12 birds were present during the site visit in 2014. Birds recorded in scrub habitat and as probable breeding species within the parcel were Great tit, Blue tit, Chaffinch, Goldfinch, House sparrow, Wren, and Blackbird. A Hooded crow carrying nest materials was also recorded. A Mallard pair was recorded landing briefly on the roof of a building and in flight over the parcel.

A bat survey has not been completed at the parcel; there may be limited potential for buildings and tanks to be used as bat roosts. Fox signs were recorded, and rodents are likely to occur.

In summary, the habitats, flora, and fauna present at the Ferrybank parcel are typical of derelict urban sites.

Pipelines Route Corridor

Given the relatively short distance between the load centre and the Ferrybank land parcel (Old Wallboard Factory), only a small distance of land excavation will be required. The corridor of land is mainly urban in nature and no ecological constraints have been identified along its path.

Outfall

Marine mammals sensitive to noise are likely to occur in the vicinity of a marine outfall associated with the Ferrybank option under consideration. A Marine Mammal Observer (MMO) would be required to be employed during any geophysical survey or piling operations for the protection of individual marine mammals from noise-related injury or disturbance. With regard to the operational phase, the shallow marine waters within which marine mammals have been recorded are currently assessed, and are expected to remain at, High Status. Potential impacts are therefore assessed as neutral for the marine outfalls for each of Ferrybank land parcel (Old Wallboard Factory) under consideration.

4.3.4 Kilbride

Site

Kilbride land parcel covers an area of 0.45km^2, the principal land cover is Arable crops BC1. Field boundaries in the immediate area range from fences to treelines. Within the land parcel most field boundaries are earth banks with associated drainage ditches; these were generally overgrown with Bramble Scrub, with occasional *Gorse* and *Elder*. There are two small woodland areas within the Kilbride land parcel. To the south west of the site adjoining the M11, a Mixed broadleaved /conifer woodland WD2 includes *Cypress, Birch, Ash, Holly and Grey willow, with Bramble and Bracken Pteridium Aquilinum* extending southwards into a previously land-filled and capped area with flora similar to that of the Shelton Abbey (IFI Site) land parcel. A small area of mixed broadleaved woodland WD1 adjoins a partially derelict group of farm buildings in the central western part of the lands (Figure 6); this includes *Sycamore, Ash, Holly and Elder,* with a shrub layer of *Elder* and *Bramble* and some *Laurel*. Treelines WL2 dominated by *Sycamore* and *Ash* with *Holly, Elder, Bramble* and occasional *Gorse* extend westwards from the mixed broadleaved woodland. A small stream arises from drainage ditches adjoining these treelines, and flows south eastwards to Arklow Town Marsh in a channel that is largely overgrown with bramble. The stream substrate is initially silty but cobble and gravel further along the channel bed suggest permanent water flow. Great *Willowherb Epilobium Hirsutum* and Fool's watercress *Apium Nodiflorum* grow in unshaded sections of the stream, with *Celandine, Bracken, Nettle, Hogweed* and *Alexanders Smyrnium Olusatrum* on the banks among grasses and occasional trees of *Oak, Ash and Sycamore.* Treelines of *Oak, Ash and Holly with Hawthorn, Blackthorn, Gorse* and *Bramble* occur in the eastern part of the land parcel and extend northwards outside the site boundary; these are the most diverse treelines in the immediate area.

Rabbit burrows were found in all field boundary earth banks. Badger feeding signs and tracks were recorded frequently within the site, with one latrine; active setts were not found but could not be ruled out because of extensive bramble scrub that could not be thoroughly searched. Fox scats were found. A bat survey was not carried out. Treelines were identified as including trees with bat roost potential, and the stone built farm buildings within the site may also have bat roost potential. Treelines and scrubby field boundaries have potential as feeding and commuting corridors for bats. A Buzzard pair and a Red Kite pair were recorded hunting and soaring over the general area. Bird species recorded as probable breeders within the site hedgerows and treelines were Robin, Blackbird, Chaffinch, Wren, Wood pigeon, Pheasant, Magpie, and Great tit.

In Summary, the Kilbride land parcel has arable crops of low diversity with regard to plant species but these crops provide feeding habitat for birds and mammals. Treelines, woodland and scrub, and the small stream channel, within and adjoining the Kilbride land parcel are of high local importance for biodiversity and as ecological corridors between features of higher ecological value.

Pipelines Route Corridor

The pipeline corridor indicated for the transfer of foul flows to the WwTP at the Kilbride land parcel runs along the northern margins of Arklow Ecologically, the main pipeline design constraint is the avoidance of any diversion of existing surface and ground water flows to Arklow Town Marsh since these could have hydrological impacts on the wetland.

Outfall

A river outfall option from the Kilbride land parcel will be subject to appropriate treatment levels and licencing requirements in order to maintain or improve the conservation status of Habitats Directive Annex II listed fish species that occur in the Avoca river and its estuary; Salmon, Sea lamprey and River lamprey.

4.3.5 Shelton Abbey (IFI Site)

Site

The Shelton Abbey land parcel includes two areas of made ground with paved or stone chip surfaces which are separated by an access track and drainage ditches including a wider feature to the south of the access track which is better described as a canal. A third area, is a former land filled area that has been capped with soil and supports grassland currently in use for horse grazing.

The areas of made ground are almost entirely un-vegetated Fossitt habitat BL3 Buildings and paved surfaces. Small areas of stone chip surface within the plot are sparsely vegetated with colonising mosses, *Annual Meadow Grass Poa Annua, Willowherb Epilobium spp*., and *Common Ragwort Senecio Jacobaea*, classified as ED2 Spoil and bare ground. A Drainage ditch FW4 outside the palisade fence at the western end of the plot supports wetland vegetation of *Sweet-grass Glyceria spp. with Bulrush Typha Latifolia and Soft rush Juncus Effusus, with Reed Canary Grass Phalaris Arundinacea, False Oat Grass Arrhenatherum Elatius and Cock's-Foot Grass Dactylis Glomerata* growing along the banks, with occasional *Grey Willow Salix Cinerea* and *Bramble Rubus Fruticosus agg*. A narrow strip of mixed broadleaved woodland WD1 of planted origin is included in the land parcel; this includes *Grey Willow and Silver Birch Betula Pendula*, with a shrub layer of *Elder Sambucus Nigra* and *Bramble* with little ground flora. A narrow strip of mown Amenity grassland GA2 lies between this woodland strip and the access road to the overall former IFI site.

A portion of this land parcel is a land filled area that has been capped with soil and supports grassland currently in use for horse grazing. Colonising mosses of bare ground are frequent in a closely grazed grassy sward of improved agricultural grassland GA1. Creeping bent grass *Agrostis stolonifera* and *Yorkshire Fog Holcus Lanatus* are the dominant grasses, with *Ryegrass Lolium Perenne, False Oat Grass and Cock's-Foot Grass* also occurring occasionally. Broad-leaved herbs present include *White clover Trifolium Repens, Red clover T. Pratense, Ribwort Plantago Lanceolata, Creeping Buttercup Ranunculus Repens, Creeping Thistle Cirsium Arvense, Common Mouse-Ear Cerastium Fontanum, Common Ragwort Senecio Jacobaea, Dandelion Taraxacum Agg., Daisy Bellis* Perennis, and occasional *Soft Rush.* Occasional small shrubs of Laurel *Prunus Laurocerasus* occur in a broken line close to the western boundary of the landfill area, while closely planted groups of *Lodgepole Pine Pinus Contorta* occur with *Gorse Ulex Europaeus*, *Birch* and *Grey Willow* along the northern

boundary of the landfill area. Bramble dominated Scrub WS1 with occasional willow forms the northern boundary of the landfill area and adjoins the Canal.

Bramble Scrub with *Gorse, Birch, Ash* and Oak occurs on sloping ground near the M11. Higher mounded ground adjoining the eastern end of the landfill area has been planted with *Ash Fraxinus Excelsior, Pine and Larch Larix Decidua, Gorse* and *Willow* have colonised the area.

Rabbits, Wood Pigeon and Pheasant occur in this land parcel, fox and badger signs were also recorded. Birds were associated principally with the immediately adjoining scrub where Blackbird, Song thrush, Robin, Wren, Chiffchaff, Willow warbler, Coat tit and Chaffinch were recorded. Mallard were recorded on the Avoca River and on the canal; a Grey heron was recorded feeding at the canal. Buzzards were recorded soaring over the general area.

In summary, Shelton Abbey (IFI Site) is largely un-vegetated and of low value for flora and fauna. It is assumed that there is some connectivity between the drainage ditches at the plot margins and those present elsewhere in the Shelton Abbey land parcel. The woodland strip along the northern margin of the site has moderate local value as a wildlife corridor.

The landfill area of Shelton Abbey (IFI Site) supports common plant species; biodiversity is higher in the adjoining scrub and aquatic habitats of the Avoca River and of the canal which is hydrologically linked to Arklow Town Marsh pNHA.

Pipelines Route Corridor

The pipeline corridor indicated for the transfer of foul flows to the WwTP at the Shelton Abbey land parcel runs along the northern margins of Arklow Ecologically, the main pipeline design constraint is the avoidance of any diversion of existing surface and ground water flows to Arklow Town Marsh since these could have hydrological impacts on the wetland.

Outfall

A river outfall option from the Shelton Abbey (IFI Site) land parcel will be subject to appropriate treatment levels and licencing requirements in order to maintain or improve the conservation status of Habitats Directive Annex II listed fish species that occur in the Avoca river and its estuary; Salmon, Sea lamprey and River lamprey.

For the full ecological report, including recommendations, please refer to Appendix E.

3.0 3.1	Ecology Ecology - Land Parcels	Ferrybank	Kilbride	Shelton Abbey
3.1.1	Potential to impact on Natura 2000 Sites	Imperceptible	Imperceptible	Imperceptible
3.1.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.3	Potential to impact on Habitats Directive Annex II listed species in coastal and marine waters	Imperceptible	Imperceptible	Imperceptible
3.1.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented given the size of individual field areas within the land parcel.	Imperceptible
3.1.6	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Imperceptible	Imperceptible
3.1.7	Potential to impact on IWeBS identified areas of importance	Imperceptible	Imperceptible	Imperceptible

3.2	Ecology - Route Corridors/Pipelines	Ferrybank	Kilbride	Shelton Abbey
3.2.1	Potential to impact on Natura 2000 sites	Imperceptible	Imperceptible	Imperceptible
3.2.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.2.3	Potential to impact on Habitats Directive Annex II listed species in coastal and marine waters	Imperceptible	Imperceptible	Imperceptible
3.2.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh.	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.2.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented in the context of a revised pipeline corridor	Imperceptible
3.2.6	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Imperceptible	Imperceptible
3.2.7	Potential to impact on IWeBS identified areas of importance	Imperceptible	Imperceptible	Imperceptible

3.3	Ecology - Outfalls	Ferrybank	Kilbride	Shelton Abbey
3.3.1	Marine Outfall; Coastal Natura 2000 sites	Slight - Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests.	Slight - Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests.	Slight - Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests.
3.3.2	Marine Outfall; Marine Natura 2000 sites	Imperceptible	Imperceptible	Imperceptible
3.3.3	Marine Outfall; Habitats Directive Annex II listed species	Imperceptible - Observer (MMO) is to be employed during any geophysical survey or piling operations for the protection of individual marine mammals from noise-related injury or disturbance	Imperceptible	Imperceptible
3.3.4	Marine Outfall; Birds Directive Annex 1 listed species	Imperceptible	Imperceptible	Imperceptible
3.3.5	Potential to impact on IWeBS identified areas of importance	Imperceptible	Imperceptible	Imperceptible
3.3.6	River outfall; Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible - A river outfall option from the Kilbride land parcel will be required to be subject to appropriate treatment levels and licencing requirements in order to maintain or improve the conservation status of Habitats Directive Annex II listed fish species that occur in the Avoca river and its estuary; Salmon, Sea lamprey and River lamprey.	Imperceptible - A river outfall option from the Shelton Abbey land parcel will be required to be subject to appropriate treatment levels and licencing requirements in order to maintain or improve the conservation status of Habitats Directive Annex II listed fish species that occur in the Avoca river and its estuary; Salmon, Sea lamprey and River lamprey.
3.3.7	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage

Table 4.3 Ecology

4.4 Hydrology & Hydrogeology

4.4.1 Introduction

This section outlines the existing hydrological and hydrogeological environment at each of the three shortlisted land parcels, the corresponding transfer pipeline corridors and outfall locations. It identifies the environmental constraints, predicts and evaluates the impacts of the scheme on the existing hydrology and hydrogeology and outlines measures to mitigate these impacts.

4.4.2 Methodology

4.4.2.1 Hydrology

In considering the implications of the overall scheme on the hydrological environment, the WwTP land parcels, the transfer pipeline corridor routes, the outfall locations and their environs should be considered in terms of sensitive surface water receptors and potential to impact upon them. This element is concerned with potential effects on the surface water regime (flooding, water quality and flow).

The assessment was based on the following:

Proximity to water bodies in terms of flooding and as an indicator of sensitive water receptors - The proximity to water bodies and their water quality (based on the EPA quality results) provides an indication of the sensitive surface water receptors potentially associated with each option, assuming pathways exist.

Culverting requirement – The requirement for culverting over a stream or bridging a river is used as an indication of the potential to reduce the conveyance capacity of the watercourse and the associated increase to flood extent and frequency.

Area prone to flooding – The review of existing datasets to determine if the site is prone to flooding. The OPW records of historic floods maps available to view on www.floodmaps.ie and the extensive studies that have been carried out as part of the Arklow Flood Relief Scheme were used to assess whether the proposed sites and route options are at risk of flooding and whether extensive flooding (historic and/or predicted) occurs immediately upstream or downstream.

Potential impact on ecologically important and designated sites – The proximity to any Natura 2000 environmental designated sites such as Special Protection Areas (SPA), Natural Heritage areas (NHA), Proposed Natural Heritage Areas (pNHA) and Special Areas of Conservation (SAC).

The overall environmental impacts are a combination of the above. The risk is a combination of the assessment of the presence of a sensitive receptor (streams and sensitive water bodies) and the pathway (drainage channels) by which the receptor can be affected.

4.4.2.2 Hydrogeology

In considering the implications of the overall scheme on the hydrogeological environment, the WwTP land parcels, the transfer pipeline corridor routes, the outfall locations and their environs should be considered in terms sensitive groundwater receptors and the potential to impact. This element is concerned with potential effects on the groundwater regime (flow and quality).

The assessment was based on the following:

Aquifer classification – Aquifer Classification is based on the hydrogeological characteristics and the value/ importance of the groundwater resource in a given area. The GSI have classified all the aquifers in Ireland into three main categories namely regionally important, locally important, or poor aquifers. This information including the extent of the aquifer is provided on the GSI aquifer classification maps.

Groundwater vulnerability – Groundwater Vulnerability determines the ease with which groundwater in a given area may be contaminated. The GSI has classified GW vulnerability into low, moderate, high, extreme and rock near the surface categories. This information is provided on the GSI groundwater vulnerability maps.

Groundwater Supplies – The identification of water supply springs and bored wells in the vicinity of the proposed sites. These include supplies for public, domestic, agricultural or industrial use. This information is taken from the GSI database.

Source Protection Areas and Zones of Contribution – The objective of source protection areas (GSI mapping) and zones of contribution (EPA mapping) is to provide protection to groundwater sources by placing tighter controls on activities within all or part of the area that contributes to the groundwater source. These therefore provide information on the location and importance of groundwater sources.

Identification of Hydrogeological Features from the Karst Database – Karst features are natural hydrogeological features. These are formed in areas of limestone or other highly soluble rock, in which the landforms are of dominantly solutional origin, and in which the drainage is usually underground in solutionally enlarged fissures and conduits. Karst features include caves, swallow holes, turloughs and springs. Information on the location of all known karst features in Ireland is provided on the GSI karst data maps.

The overall environmental impact implications are a combination of the above. The risk is a combination of the assessment of the presence of a sensitive receptor (aquifer abstraction) and the pathway (proximity, vulnerability etc.) by which the receptor can be effected. In the context of groundwater quality we also need the presence of a hazard. In sewerage scheme projects the hazard is often the result of leakage or an accidental spillage.

4.4.3 Ferrybank (Old Wallboard Factory)

Hydrology

The Ferrybank land parcel (Old Wallboard Factory) is situated at the mouth of the Avoca River, on the coast of the Irish Sea. Access to the parcel would not require the construction of any culverts. Surface water from the proposed WwTP development could be discharged either into Avoca River or directly into the Irish Sea.

The National flood hazard mapping website, www.floodmaps.ie, shows no recorded instance of flooding of this land parcel, even during Hurricane Charlie in 1986. The nearest historic flooding location is on the South Quay, which is known to flood regularly. Areas to the north of the land parcel have also been known to flood, Mill road (Hurricane Charlie 1986) and Worsborough Terrace (reports as recent as 2004).

The EPA surface water quality monitoring data 2012 shows the coastal water as “Unpolluted”, the transitional water quality (Avoca River from the harbour to the stone arch bridge) as “Intermediate” and the Avoca Lower River as “Unassigned”. The nearest recreational water bodies (e.g. bathing sites) in the vicinity of the proposed land parcel is Brittas Bay (North and South) and Clogga beach, which are approximately 11 km and 4 km away respectively.

Hydrogeology

The Geological Survey of Ireland (GSI) 100k Bedrock mapping indicates that the land parcel is underlain entirely by the Kilmacrea Formation which consists of dark grey slate and minor pale sandstone. The eastern portion of the Ferrybank land parcel (Old Wallboard Factory) is also underlain by the Maulin formation which consists of Dark blue-grey slate, phyllite & schist. Refer to Figure 4.2 for further details.

According to the GSI bedrock aquifer mapping, the land parcel is underlain by a locally by a locally important bedrock aquifer (LI) which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel. Refer to Figure 4.3 for further details.

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating of low. After consulting the GSI groundwater mapping, 1 no. groundwater source well was found to be within the vicinity of the land parcel. However given the accuracy of this well mapping is to within 2 km, it is difficult to ascertain the exact location of this groundwater source well. Refer to Figure 4.5 for further details.

A review of the GSI Karst and Hydrogeological features mapping did not identify any features within 2km of the land parcel. The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel.

4.4.4 Kilbride

Hydrology

The Kilbride land parcel is offset c. 500m from the Avoca River. The surface water from the land parcel drains naturally to the Arklow Marsh and down to the Avoca River.

The National flood hazard mapping website, www.floodmaps.ie, shows no recorded instance of flooding of this land parcel .The natural elevation and profile of this land parcel has ensured helped to ensure this.

The EPA surface water quality monitoring data 2012 shows the coastal water as “Unpolluted”, the transitional water quality (Avoca River from the harbour to the stone arch bridge) as “Intermediate” and the Avoca Lower River as “Unassigned”. The nearest recreational water bodies (e.g. bathing sites) in the vicinity of the proposed land parcel is Brittas Bay (North and South) and Clogga beach, which are approximately 11 km and 5 km away respectively.

Hydrogeology

The Geological Survey of Ireland (GSI) 100k Bedrock mapping indicates that the land parcel is underlain entirely by the Kilmacrea Formation which consists of dark grey slate and minor pale sandstone. Refer to Figure 4.2 for further details.

According to the GSI bedrock aquifer mapping, the land parcel is underlain by a locally by a locally important bedrock aquifer (LI) which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel. Refer to Figure 4.3 for further details.

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating from “High” to “Extreme” to “Rock at near surface or Karst”. After consulting the GSI groundwater mapping, 1 no. groundwater source well was found to be within the vicinity of the land parcel. The location of this groundwater source well is to within 100 m and can be seen in Figure 4.5.

A review of the GSI Karst and Hydrogeological features mapping did not identify any features within 2km of the land parcel. The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel.

4.4.5 Shelton Abbey (IFI Site)

Hydrology

The Shelton Abbey land parcel lies in the natural floodplain of the Avoca River. Access to the parcel is achieved via an existing road and as such, there is no requirement for any new culverts to be constructed.

Surface run-off from the high ground to the north drains to the floodplain and into the river. The poorly draining lands at the margins of the flood plain have been drained to improve the lands locally up and downstream of the land parcel. The Shelton Abbey Canal runs through the site, parallel to the river and enters the Avoca River downstream in Arklow.

The existing flood defences have ensured that there has been no recorded instance of flooding on the land parcel (refer to www.floodmaps.ie). However, this does not mean the land parcel is free from risk of flooding if these defences were to fail. Refer to the flood study report included in Appendix B of this report for further details.

The EPA surface water quality monitoring data 2012 shows the coastal water as “Unpolluted”, the transitional water quality (Avoca River from the harbour the stone arch bridge) as “Intermediate” and the Avoca Lower River as “Unassigned”. The nearest recreational water bodies (e.g. bathing sites) in the vicinity of the proposed land parcel is Brittas Bay (North and South) and Clogga beach, which are approximately 11 km and 5 km away respectively.

The small canal which flows alongside this land parcel flows through the Arklow Marsh, a pNHA area.

Hydrogeology

The Geological Survey of Ireland (GSI) 100k Bedrock mapping indicates that the land parcel is underlain entirely by the Kilmacrea Formation which consists of dark grey slate and minor pale sandstone. Refer to Figure 4.2 for further details.

According to the GSI bedrock aquifer mapping, the land parcel is underlain by a locally by a locally important bedrock aquifer (LI) which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted and Arklow Gravels (Lg), a locally important gravel aquifer was present throughout the land parcel. These types of aquifers are generally described as poor aquifer that are only capable of supplying water to individual dwellings or farm holdings and typically are poorly yielding in drier periods of the year. Refer to Figure 4.3 for further details.

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating of moderate. After consulting the GSI groundwater mapping, no groundwater source well was found to be within the vicinity of the land parcel.

A review of the GSI Karst and Hydrogeological features mapping did not identify any features within 2km of the land parcel. The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel.

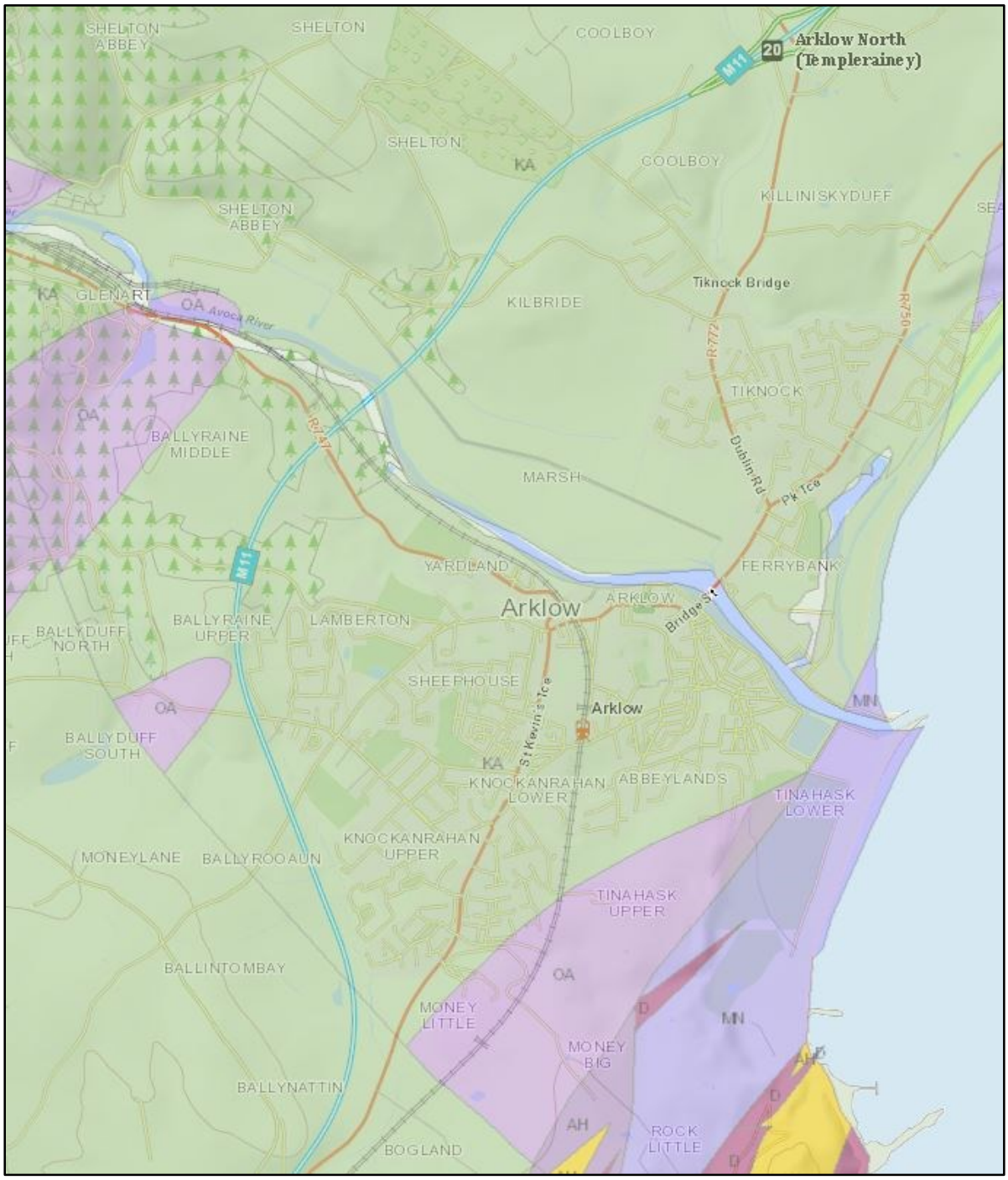

Figure 4.2 Bedrock Formations – Sourced from GSI Data Viewer

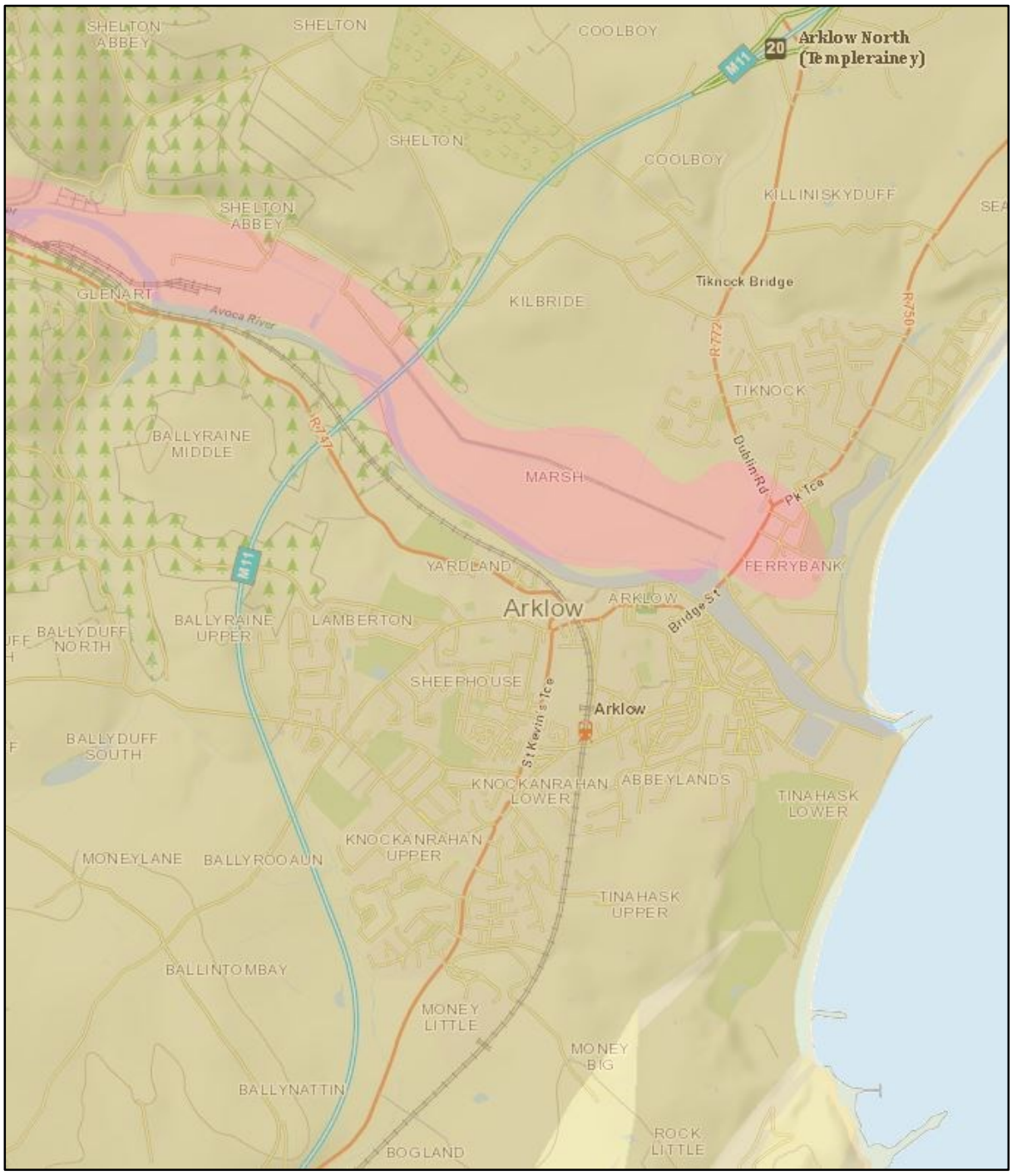

Figure 4.3 Groundwater Resources – Gravel & Bedrock Aquifers – Sourced from GSI Data Viewer

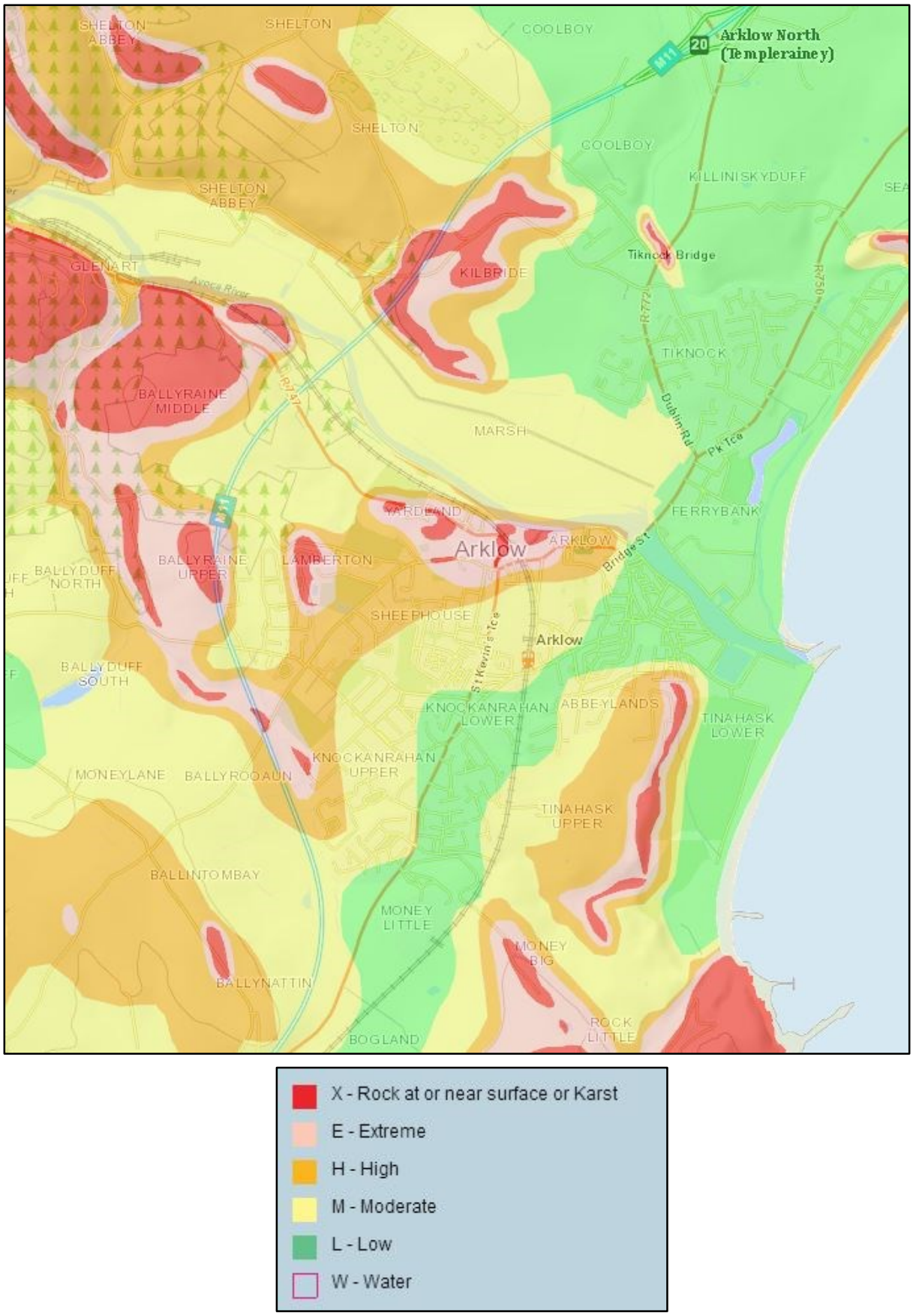

Figure 4.4 – Groundwater Vulnerability – Sourced from GSI Data Viewer

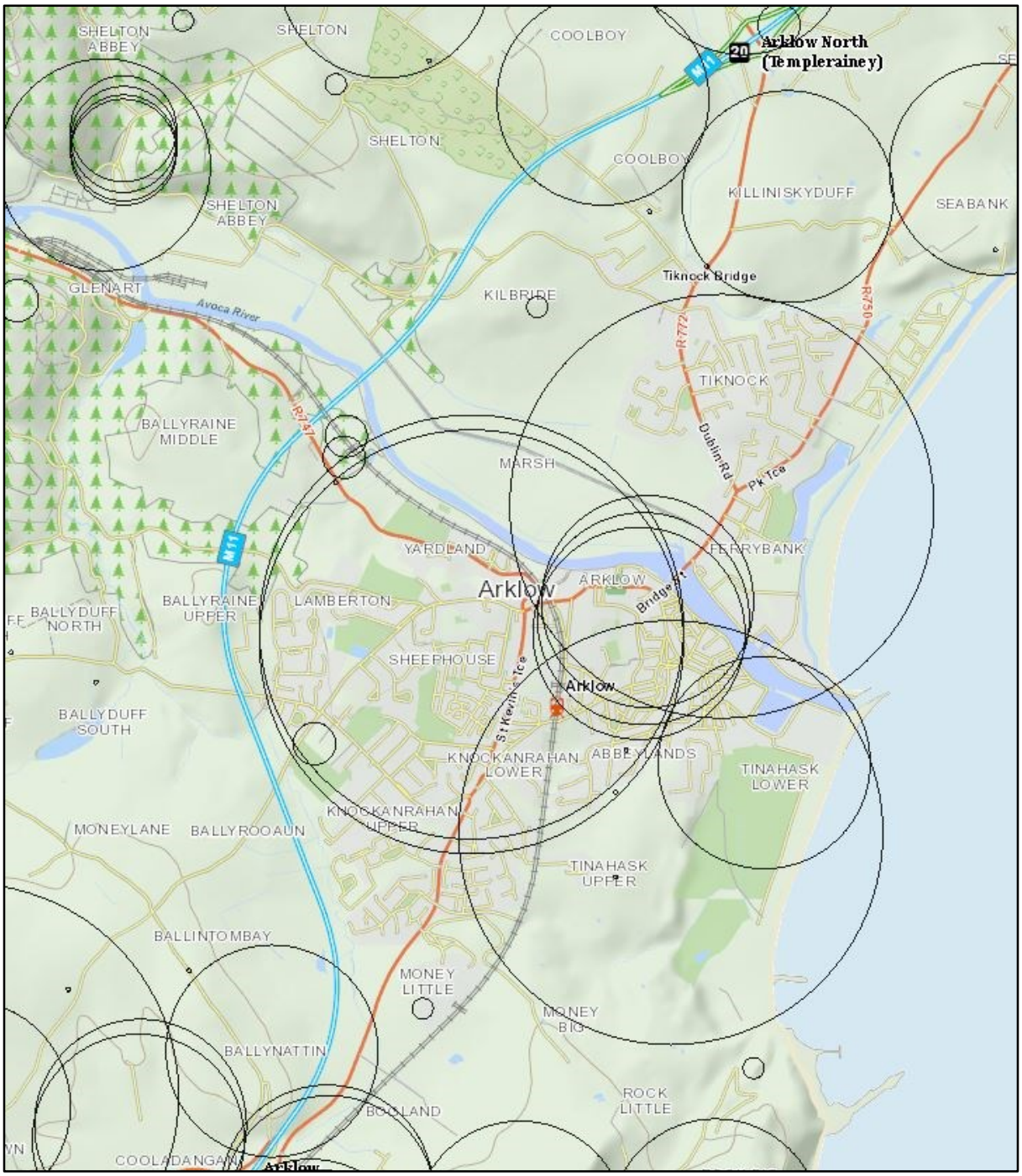

Figure 4.5 - Groundwater Wells & Springs – Sourced from GSI Data Viewer

**Note: The size of the circles above are indicative of the accuracy of the location of the groundwater wells & springs and have no bearing on the abstraction volumes.*

4.0	Hydrology	Ferrybank	Kilbride	Shelton Abbey
4.1	**Hydrology - Land Parcels**			
4.1.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.1.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged
4.1.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the land parcel as well as up and downstream locations)	Imperceptible. No recorded instance of flooding	Imperceptible. No recorded instance of flooding	Imperceptible. No recorded instance of flooding
4.1.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Imperceptible	Imperceptible
4.2	**Hydrology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.2.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.2.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged
4.2.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the land parcel as well as up and downstream locations)	Slight - historic instances of flooding along route of pipeline corridor	Slight - historic instances of flooding along route of pipeline corridor	Slight - historic instances of flooding along route of pipeline corridor
4.2.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Slight - Arklow Marsh - pNHA	Slight - Arklow Marsh - pNHA
4.3	**Hydrology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.3.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.3.2	Potential to impact Shellfish Waters	Imperceptible. Study Area is not located within the designated shellfish waters	Imperceptible. Study Area is not located within the designated shellfish waters	Imperceptible. Study Area is not located within the designated shellfish waters
4.3.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the land parcel as well as up and downstream locations)	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.3.4	Potential Impact on ecologically important and designated sites	Imperceptible	Slight - Arklow Marsh - pNHA	Slight - Arklow Marsh - pNHA

Table 4.4 Hydrology

5.0	Hydrogeology	Ferrybank	Kilbride	Shelton Abbey
5.1	**Hydrogeology - Land Parcels**			
5.1.1	Aquifer Classification - importance of the groundwater resource to a given area	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer
5.1.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Moderate - "High" to "Extreme" to "Rock at near Surface or Karst"	Slight - "Moderate"
5.1.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI records.	Imperceptible - 1 no. well - ID:3217SWW051 Accuracy: 2km	Imperceptible - 1 no. well - ID:3217SWW043 Accuracy: 100m	Imperceptible - No wells
5.1.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI data	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity
5.1.5	Identification of hydrogeological features from the GSI karst database	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km
5.2	**Hydrogeology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.2.1	Aquifer Classification - importance of the groundwater resource to a given area	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer
5.2.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Imperceptible - "Low"	Imperceptible - "Moderate" to "Low"
5.2.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI records.	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
5.2.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI data	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity
5.2.5	Identification of hydrogeological features from the GSI karst database	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km

5.3	Hydrogeology - Outfalls	Ferrybank	Kilbride	Shelton Abbey
5.3.1	Aquifer Classification - importance of the groundwater resource to a given area	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer
5.3.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low" rating	Imperceptible - "Moderate" rating	Imperceptible - "Moderate" rating
5.3.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI records.	Imperceptible - No groundwater supplies	Imperceptible - No groundwater supplies	Imperceptible - No groundwater supplies
5.3.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI data	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity
5.3.5	Identification of hydrogeological features from the GSI karst database	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km

Table 4.5 Hydrogeology

4.5 Soils & Geology

4.5.1 Introduction

This section concentrates on identifying constraints within the shortlisted WwTP land parcels, the associated pipeline corridors, and the effluent outfall locations with regard to the soils and geology of the study area. BLP engaged the services of Ground Investigation Ireland Ltd. to undertake environmental ground investigation works at the shortlisted brownfield sites (Ferrybank and Shelton Abbey). Since Kilbride is a greenfield land parcel, a review of the existing information available (GSI database, Teagasc mapping etc…) was deemed adequate.

It should be noted at this point that while every effort was made to investigate the Ferrybank land parcel (Old Wallboard Factory), permission to enter the site was not obtained by the land owner and site investigation works never took place. Nevertheless, previous site investigation reports for the Ferrybank land parcel (Old Wallboard Factory) have been made available to BLP which will be discussed in more detail later in this chapter.

4.5.2 Methodology

The assessment methodology was developed in line with best practice and included a review of desk top data, wind shield surveys, consultations and a review of guidance.

A desk top study was undertaken of all publically available relevant information and data gathered by the Arklow Sewerage Scheme and BLP project teams. The sources of information utilised in the assessment included:

- Site investigation data from previous BLP projects in or around the shortlisted land parcels
- Bedrock Mapping (Geological Survey of Ireland)
- Karst Database (Geological Survey of Ireland)
- Quarternary Maps (Geological Survey of Ireland)
- Teagasc Subsoil Mapping (2004)
- Teagasc Topsoil Mapping (2007)
- Corine Land Cover datasets, (European Environment Agency, 2012)
- Proposed / Designated NHA Sites (Geological Survey of Ireland)
- National Parks and Wildlife Service
- Office of Licensing and Guidance, Environmental Protection Agency - http://www.epa.ie/
- Historical Maps (Ordnance Survey of Ireland)
- Aerial Photographs (Geological Survey of Ireland / Ordnance Survey of Ireland/Google/Bing)
- Previous site investigation reports

4.5.3 Landfill Sites

There is a long history of landfill operations at the Shelton Abbey (IFI Site) land parcel. They can generally be separated into three main categories as follows:

- Disposal of phosphogypsum wastes from the production of phosphoric acid:
- Disposal of carbon from the ammonia plant; and
- Disposal of general plant wastes

See Figure 4.6 overleaf for more details. The Landfill Areas occupy an area of approximately 13.5 hectares (34 acres).

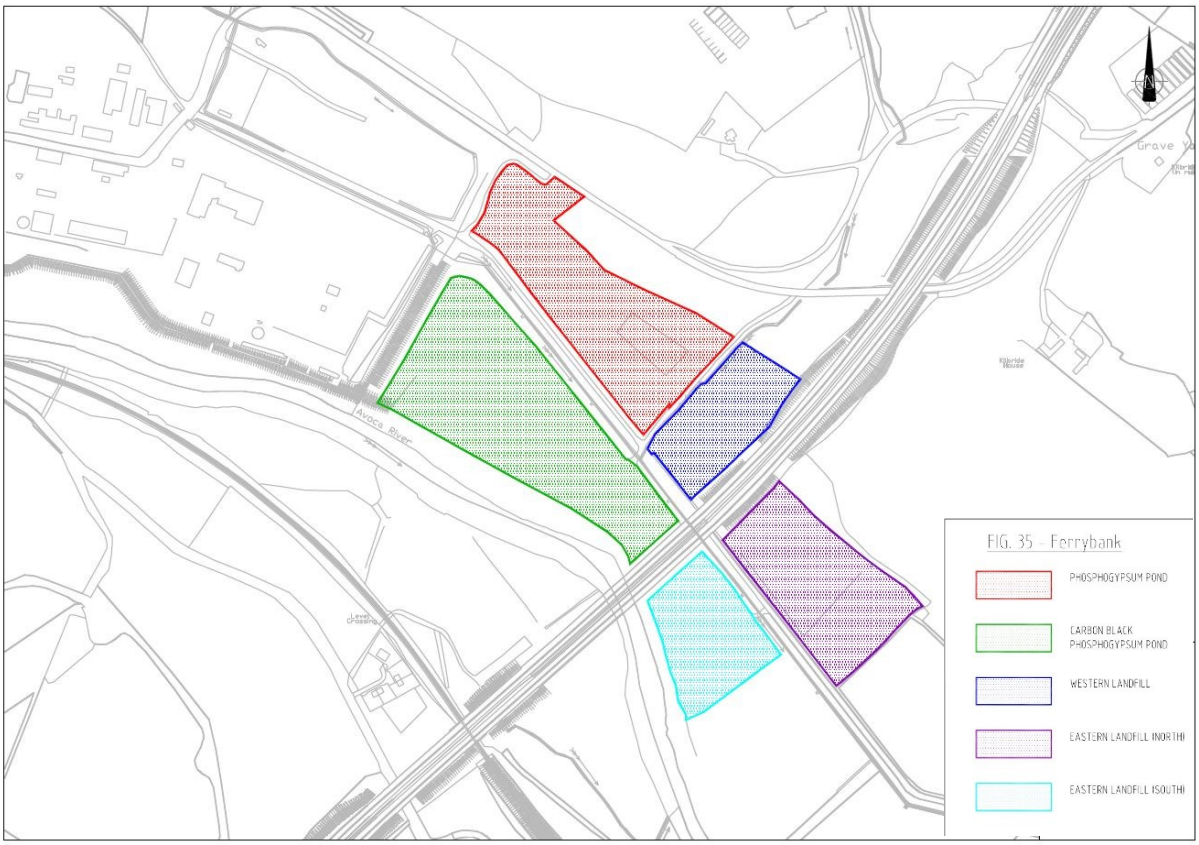

Figure 4.6 Landfill Locations

4.5.3.1 Phosphogypsum Wastes

Phosphogypsum wastes were produced during the manufacture of phosphoric acid. The phosphogypsum pond was constructed by the use of soil bunds around the perimeter of the pond and the natural alluvial clay and peat deposits formed the base of the pond. The phosphogypsum slurry was pumped to the pond where the phosphogypsum was allowed to settle with the water being drained from the pond by a series of drainage pipes through the bund and discharging into the drainage canal running through the landfill area. The gypsum pond was used for approximately 6 years (1967 - 1973) until the capacity was exhausted. At this time phosphogypsum wastes were diverted to the carbon pond which had been constructed by similar means immediately to the south of the phosphogypsum pond. The pond was covered with up to 0.6 metres of shale and topsoil and grassed.

4.5.3.2 Carbon Wastes

Carbon wastes, produced during the manufacture of ammonia, were diverted in slurry form to the carbon pond that had been constructed in the south-western corner of the landfill area. The carbon pond was constructed in a similar fashion to the phosphogypsum pond with soil embankments and the surface water was disposed of by drainage to the canal and by seepage into the ground. When exhausted the carbon pond was covered with up to 0.6 metres of shale and topsoil and grassed. Additional material made available during construction of the Arklow by-pass has been added bringing the total depth of cover material to 1 to 2 metres.

4.5.3.3 General Site Wastes

General solid wastes from the IFI Site have been disposed of in two landfill areas immediately to the east of the phosphogypsum and carbon ponds, the Eastern Landfill, North and South. Wastes disposed of in these areas have historically included excavated clay, plastic bags, insulating materials, concrete blocks, bricks, canteen wastes, dredgings from the drainage canals and effluent lagoon. The Northern Section also includes quantities of iron oxide cinder arising from the manufacture of sulphuric acid from local iron pyrite from the Avoca mines during the period 1972 to 1980. The Eastern Landfill areas were constructed with either clay or shale embankments around the perimeters and the base being provided by the natural alluvial clay and peat deposits. The Northern Section was closed and capped with shale and topsoil in 1984, after which time waste disposal activities started in the Southern Section. The western half of the Southern Section was completed in 1994/95 to allow construction of the Arklow by-pass with the Eastern Section in use until May 2001 for disposal of inert Site wastes. Capping work on the Eastern Section was completed in September 2002.

4.5.3.4 Western Landfill (Phase I)

The Eastern Landfill is located immediately alongside, and is visible from, the Bypass. IFI therefore submitted proposals to the EPA for the termination of disposal activities within the landfill and for re-location of landfill operations to a newly engineered cell within the (former) Phosphogypsum Pond, to be called the Western Landfill. The Western Landfill (Phase I) was completed according to an agreed construction plan in May 2001. Landfill activities to the east of the Arklow Bypass then ceased and the active cell was closed off. Landfilling in the Western Landfill commenced on 27 May 2001.

At end of June 2006, the following are estimates of the extent of waste in the landfill area:

- Phosphogypsum Pond - 55,847 m^3 of gypsum
- Carbon/Phosphogypsum Pond of carbon black - 137,801 m^3 of gypsum and approx. 19,080 m^3
- Eastern Landfill (North) - approx. 130,000 m^3 of waste
- Eastern Landfill (South) - approx. 59,588 m^3
- Western Landfill (Phase 1) - approx. 2,501 m^3

All of the site landfills have now ceased accepting waste. As part of the maintenance of the landfill site, remediation works were carried out in 2014. The scope of the works included:

- Provision of additional capping to existing landfill site
- Grub out existing drainage channels
- Excavate a section of new drainage channel
- Install additional ground water monitoring wells
- Install gas ventilation Wells
- Decommission some existing disused groundwater monitoring wells

If construction were to go ahead at the Shelton Abbey land parcel, extensive remediation works will be required if the landfill were to be disturbed. A portion of the pipeline corridor passes through the landfill site. The challenges affected with this option are reflected in Section 4.12 – “Engineering Design” of this report.

4.5.4 Evaluation

Refer to matrix Table 4.6.

4.5.5 Ferrybank (Old Wallboard Factory)

Site

The topography of the Ferrybank land parcel (Old Wallboard Factory) is generally flat, lying roughly 2.5 mOD. The land parcel is bounded by the Avoca River to the south and the Irish Sea to the East.

The Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers, in this case the Avoca River. Again, adjacent to the coastline an Aeolian Sand is noted in the GSI Quaternary mapping.

Copper mining in the Avoca Mines has been undertaken for centuries. It is highly probable that the material used to infill the River Avoca estuary and build up a harbour wall was sourced from mine waste/stripped overburden generated from the Avoca Mines. This hypothesis is proposed as a large volume of material would be required for infilling and there was a ready supply of mine waste/surplus overburden available from the Avoca mines. Also, there is no other land scar in the Arklow area to indicate such quarrying/mining. The creation of a harbour at Arklow would have greatly facilitated and significantly decreased costs for export of ore from Ireland to Britain.

The bedrock lithology mapped beneath the land parcel is the Kilmacrea formation and the Maulin Formation. This Kilmacrea formation is composed of dark grey slate and minor pale sandstone while the Maulin Formation is composed of dark grey slate which is rich in mica. The rock unit group has been identified as Ordovician Metasediments. This is composed of a series of layered sandstones, siltstones and shales with minor volcanic rocks.

The groundwater vulnerability of the land parcel is classified as low. The groundwater beneath the site is considered to be significantly impacted by a tidal water level fluctuations. During periods of low tide, groundwater from the site discharges to the marine environment. However, during high tide, the marine environment is considered to backflow into the site and infilled material; i.e. seawater intrudes beneath the site. The effect of this tidal water level fluctuation is that material infilled within the site has been effectively washed periodically (i.e. approximately twice daily) since it was deposited within the site.

A site investigation report was carried out in November 2005 for the Ferrybank land parcel (Old Wallboard Factory) to facilitate an assessment of the presence and significance of contaminants in the ground. This land parcel was previously in the ownership of IFI and was used as a storage depot for Heavy Fuel Oil, Sodium Hydroxide and Nitric Acid. These materials were stored in the tanks still existing within the site. However, it is understood that these tanks have not been in use for approx. 22 - 32 years.

The site investigation report carried out in 2005 consisted of a walk over survey, asbestos survey, window sampling trial pits, 2-3m borehole drilling and chemical analysis of all soil samples taken. The position of these investigations concentrated on the most likely location for contamination to exist; i.e. in close proximity to the chemical storage tanks.

Made ground comprising brown to orange sandy to gravelly material. With inclusions of red bricks, glass and coal slag was encountered from depth ranges 0.2m to 1.8m bgl. All sampling points continued to a sufficient depth to intercept natural subsoil material, which comprised a sequence to sands and gravels.

The chemical analysis of the samples taken from 0.5m to 1.5m was conducted to determine the contaminant potential presented by past IFI activities and the contaminant potential presented by the infilling of materials during the construction of the Harbour Wall. This analysis did not suggest that the soil had been impacted upon by the storage of materials within the site. The analysis did suggest that the composition of made ground presents a contamination potential due to elevated concentrations of heavy metals (Copper, Zinc, Lead and Arsenic), and Polycyclic Aromatic Hydrocarbons (PAH) compounds.

Pipelines Route Corridor & Outfall

Previous site investigations have taken place along the pipeline route corridor. Boreholes were completed in 2012 as part of the Arklow Sewerage Scheme. One such borehole (E = 325300.624 N = 173473.24) which is approximately 270 m from the boundary of the Ferrybank land parcel (Old Wallboard Factory) indicated that bedrock was deeper than 10 m, the depth of the borehole and the soil consisted mainly of a medium dense, brown fine to coarse sand and gravel. Given the relatively short distance of pipeline required for Ferrybank, this soil type can generally be expected to be encountered for the entire length of the pipeline corridor.

4.5.6 Kilbride

Site

The Kilbride land parcel slopes gently from north to south and the topography ranges between approximately 25m to 35mOD.

Topsoil mapping indicates an acidic deep poorly drained mineral (derived from mainly non-calcareous parent materials) within the land parcel. To the west of the land parcel, near the M11 motorway, surface water/groundwater gleys (shallow poorly drained mineral derived from mainly calcareous parent materials) have been mapped.

The subsoil mapping indicates a sandstone and shale till (Lower Palaeozoic) with matrix of Irish Sea Basin origin. To the west of the land parcel, near the M11 motorway, bedrock at the surface has been identified.

The bedrock lithology mapped beneath the land parcel is the Kilmacrea formation. This lithology is composed of dark grey slate, minor pale sandstone. The rock unit group has been identified as Ordovician Metasediments. This is composed of a series of layered sandstones, siltstones and shales with minor volcanic rocks. A minor fault had been mapped within the southern portion of the land parcel boundary, trending west - east.

The groundwater vulnerability of the land parcel is classified as extreme indicating that the bedrock is shallow within the land parcel. This coincides with the bedrock outcrops.

There are no other geological features shown within the Kilbride land parcel.

Pipelines Route Corridor & Outfall

Topsoil mapping along the pipeline route corridor indicates an acidic deep poorly drained mineral (derived from mainly non-calcareous parent materials). The west of the corridor, near the M11 motorway, surface water/groundwater gleys (shallow poorly drained mineral derived from mainly calcareous parent materials) and mineral alluvium have been mapped. The east of the corridor, near closer to the centre of the town, the Teagasc topsoil has been identified as “Made/Built Land”.

The subsoil mapping indicates a sandstone and shale till (Lower Palaeozoic) with matrix of Irish Sea Basin origin. The west of the pipeline route corridor, near the M11 motorway, subsoil

mapping indicates “Alluvium Undiffentiated”, typical of riverside locations. To the east of the pipeline route corridor, closer to the centre of the town, the Teagasc subsoil mapping indicates “Made Ground”.

The bedrock lithology mapped beneath the pipeline route corridor is the Kilmacrea formation. This lithology is composed of dark grey slate, minor pale sandstone. The rock unit group has been identified as Ordovician Metasediments. This is composed of a series of layered sandstones, siltstones and shales with minor volcanic rocks.

The groundwater vulnerability of the pipeline route corridor is classified as moderate to low. There are no other geological features shown within along the pipeline corridor route.

4.5.7 Shelton Abbey (IFI Site)

Site

IFI was a joint venture company formed by state company Nitrigin Eireann Teoranta (NET) and ICI plc, which operated three manufacturing facilities in Cork, Belfast and Arklow. The main products manufactured at Arklow were Calcium Ammonium Nitrate (CAN) and blends. Other nutrients, which complemented the range of fertiliser products were imported and blended as required. Nitric acid was produced mainly as an intermediate, although there was a minor acid sales business.

Facility operations required a typical range of services, including water treatment, steam generation, laboratory activities and storage of raw materials, intermediates, products and ancillary materials.

IFI was granted the IPC Licence in January 1997. A revised Licence (Register No. 495) was issued in March 2000, which approved significant process changes. In 2002, fertiliser manufacturing stopped and in 2005, following the purchase of the site, the Licence was transferred to the current owner.

The Shelton Abbey land parcel is generally flat, with elevations ranging from approx. 6.5 mOD at the top of the flood defences along the southern bank to approx. 2 mOD in the centre of the parcel.

Topsoil mapping indicates a split between mineral alluvium (in the western portion of the land parcel) and made/built ground in the developed section of the land parcel. These characteristics are to be expected with a brownfield site alongside a river. The subsoil mapping indicates alluvium (undifferentiated) subsoil in the western portion of the land parcels and again, made ground in the developed section of the land parcel.

The bedrock lithology mapped beneath the land parcel is the Kilmacrea formation. This comprises Ordovician metasediments primarily dark, grey slate, with minor pale sandstone from the Kilmacrea Formation. The bedrock outcrops in the high ground to the north of the land parcel and the bedrock surface slopes from the north to south beneath the river valley.

A minor fault had been mapped within the traversing west to east across the middle of this land parcel.

The groundwater vulnerability of the land parcel is classified as moderate. This coincides with the findings of the bedrock not being particularly deep in this area.

Previous reports carried out in the Shelton Abbey (IFI Site) land parcel are available for inspection from the EPA website. These reports indicated that the site is underlain with by drift material typical of deposition in a fluvial environment. The upper 1 to 3 metres is occupied by a layer of fill material which generally comprises a mixture of topsoil and coarse gravel and cobbles. Underlying the fill material is a clay layer which varies in thickness across the site. The clay varies from a brown grey gravely sandy silty type to a yellow grey, often organic, silty variety.

IW and BLP engaged the services of Ground Investigations Ireland Ltd. to undergo invasive site investigation works and WAC (Waste Acceptance Criteria) analysis (Murphy Suite) at the Shelton Abbey (IFI Site) land parcel in order to verify the findings of the historical reports. The GII trial pits locations, logs and laboratory analysis can be found in Appendix F. These findings concluded that the extent of the landfill site did not extend to the developed portion of the site and ground contamination in the soil would not pose an issue if construction were to go ahead at this location.

Pipelines Route Corridor & Outfall

Topsoil mapping along the pipeline route corridor indicates an acidic deep poorly drained mineral (derived from mainly non-calcareous parent materials). The west of the corridor, near the M11 motorway, surface water/groundwater gleys (shallow poorly drained mineral derived from mainly calcareous parent materials) and mineral alluvium have been mapped. The east of the corridor, near closer to the centre of the town, the Teagasc topsoil has been identified as “Made/Built Land”.

The subsoil mapping indicates a sandstone and shale till (Lower Palaeozoic) with matrix of Irish Sea Basin origin. The west of the pipeline route corridor, near the M11 motorway, subsoil mapping indicates “Alluvium Undiffentiated”, typical of riverside locations. To the east of the pipeline route corridor, closer to the centre of the town, the Teagasc subsoil mapping indicates “Made Ground”.

The bedrock lithology mapped beneath the pipeline route corridor is the Kilmacrea formation. This lithology is composed of dark grey slate, minor pale sandstone. The rock unit group has been identified as Ordovician Metasediments. This is composed of a series of layered sandstones, siltstones and shales with minor volcanic rocks.

The groundwater vulnerability of the pipeline route corridor is classified as moderate to low. There are no other geological features shown within along the pipeline corridor route.

6.0	Soils and Geology	Ferrybank	Kilbride	Shelton Abbey
6.1	Soils and Geology - Land Parcels			
6.1.1	Potential to impact on Geological Heritage Sites / County Geological Sites	Imperceptible - No such sites in close proximity	Imperceptible - No such sites in close proximity	Imperceptible - No such sites in close proximity
6.1.2	Potential to interact with contaminated land	Moderate - Chance of encountering heavy metals & PAH Compounds	Imperceptible - greenfield land parcel	Significant - Brownfield Site. EPA Landfill & history of industrial activities.
6.1.3	Potential to sterilise mineral resource	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity
6.1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc...)	Imperceptible- Bedrock estimated at 10m bgl	Significant - Outcrop in western portion of the land parcel	Slight - Moderate vulnerability indicates moderately deep bedrock
6.1.5	Potential impact on karst features	Imperceptible	Imperceptible	Imperceptible
6.1.6	Potential to encounter soft ground	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Imperceptible - No alluvial deposits mapped within land parcel	Slight - Alluvial deposits which may include soft silts mapped in eastern portion of land parcel
6.1.7	Soils Types	Made Ground	Acidic deep poorly drained mineral	Made Ground
6.1.8	Sub Soil Types	Made Ground/Alluvial Gravel Deposits	Sandstone and shale till	Made Ground
6.1.9	Depth to rock	~10m	0 - 10m	5-10m

6.2	Soils and Geology - Route Corridors	Ferrybank	Kilbride	Shelton Abbey
6.2.1	Potential to impact on Geological Heritage Sites / County Geological Sites	Imperceptible	Imperceptible	Imperceptible
6.2.2	Potential to interact with contaminated land	Slight - Chance of encountering heavy metals & PAH Compounds (associated with made ground)	Significant - Pipeline route near existing EPA landfill site	Significant - Pipeline route near existing EPA landfill site
6.2.3	Potential to sterilize mineral resource	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity
6.2.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc…)	Imperceptible	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway
6.2.5	Potential impact on karst features	Imperceptible	Imperceptible	Imperceptible
6.2.6	Potential to encounter soft ground	Slight - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh

6.3	Soils and Geology - Outfalls	Ferrybank	Kilbride	Shelton Abbey
6.3.1	Potential to impact on Geological Heritage Sites / County Geological Sites	Imperceptible	Imperceptible	Imperceptible
6.3.2	Potential to interact with contaminated land	Imperceptible - Ensure avoidance of river dredge dump site offshore	Imperceptible - Negotiate exact location away from gypsum/carbon ponds	Imperceptible - Negotiate exact location away from gypsum/carbon ponds
6.3.3	Potential to sterilize mineral resource	Imperceptible	Imperceptible	Imperceptible
6.3.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc...)	Imperceptible	Imperceptible	Imperceptible
6.3.5	Potential impact on karst features	Imperceptible	Imperceptible	Imperceptible
6.3.6	Potential to encounter soft ground	Moderate - Banks of Avoca River/ Coastal Location	Moderate - Banks of Avoca River	Moderate - Banks of Avoca River

Table 4.6 Soils & Geology

4.6 Agronomy & Landuse

4.6.1 Introduction

This report is a study of the potential agricultural impact of the construction of the WwTP, pipeline routes and effluent outfall. It involves an assessment of the three potential land parcels for construction of the wastewater treatment plant.

Only one of these parcels, Kilbride, is located in an area predominately used for agriculture. Whilst this land parcel is currently used for agricultural purposes, it should be noted that it is zoned as an "Action Area" in the *"Arklow Town and Environs Development Plan (2011 -2017)".* This is discussed in further detail in section 4.11. The other two land parcels are brownfield sites although Shelton Abbey (IFI Site) land parcel, though zoned as "Employment (E1)" in the *"Arklow Town and Environs Development Plan (2011 -2017)",* is occasionally used to hold equine stock. The area to be acquired from agricultural production is approximately 2 hectares.

4.6.2 Methodology

An assessment of the existing agricultural environment was carried out through a desktop survey of available mapping, and walk over surveys of three land parcels.

The impact on agriculture is the overall potential effect of the construction of the wastewater treatment plant and associated infrastructure on a farm holding. The degree to which the wastewater treatment plant impacts upon an individual farm depends on:

- Landtake
- Land quality
- The type of farm enterprises carried out
- Farm Size
- Impact on farm buildings and/or facilities
- Impact on shelter

4.6.2.1 Landtake

Individual Fields

In general the larger the field size the more useful the field. This is particularly because of the ease of use of machinery in larger fields. Reduction in the field size results in increased costs to the farmer.

Farm Holdings

The land take is one of the main impacts on a farm holding. The degree of the impact varies with the area of the land taken, the land quality, location and farm type. The greater the landtake and the higher the quality of the affected lands the greater will be the impact.

Landtake on the main land holding will have a greater impact on a fragmented farm holding than landtake from an outfarm i.e. land removed from the main land holding. Landtake on a dairy farm on lands used as grazing paddocks adjacent to a milking parlour may have a larger impact than taking land located on a beef farm. The size of the affected farm holding is also a factor with landtake on a smaller farm generally having a greater impact.

Intensity of Land Use

Farming systems can vary with regard to the intensity of use to which the land is put. In general, the impact will be greater on more intensively farmed lands. Only one of the land parcels is intensively farmed.

4.6.2.2 Farming Enterprise

The farm enterprise types that will be most severely affected by a proposed development are those of high stocking rates, which are intensively farmed. These would frequently be dairy farms and intensive beef farms. Dairy farming is one of the most profitable farming enterprises in the country. A reduction in the available forage area may result in a reduction in the number of dairy cows that can be maintained on the farm holding. Significant landtake, or severance of the grazing paddocks from the farm buildings, may result in the farmer being forced to change the farm enterprise type to a less profitable enterprise.

Certain farm enterprises may be impacted to a greater extent by a proposed development. Horses are of a more nervous disposition than other stock types. They are prone to stress caused by irregular noise and moving vehicles. Land take and severance of land holdings may result in fields of an irregular shape (e.g. triangular shaped fields with sharp / narrow corners), which may be unsuitable for grazing with equine stock. Horses risk injury when galloping around such fields.

Drystock enterprises such as beef and sheep are generally less affected by a proposed scheme than dairy farms. Livestock on these farm holdings are not moved from field to field as frequently as on a dairy farm. Although there is a significant impact, the farming practices on these enterprises can be adapted to mitigate the overall impact.

Horticultural enterprises are impacted to a greater extent than other enterprises because they are generally very intensive units. The farm infrastructure, such as irrigation pipes and bore holes can be affected. Interruption of a water supply can have a serious impact on a horticultural enterprise. Land may prove difficult to replace for horticulture as not all land is suited for this enterprise. Many horticultural growers spend many years getting the soil, pH balance and fertilizer levels to an optimum level to be able to grow vegetable crops.

4.6.2.3 Impact on Farmyard Buildings And/ Or Facilities

The removal of farm buildings and / or facilities on the farm will contribute towards the overall impact on the farm. This will depend on the type of farm buildings affected and extent that the facilities are affected.

4.6.2.4 Impact on Shelter

The removal of mature trees and strong hedgerows, which provide shelter to crops and livestock, especially younger stock, will have an adverse impact on a farm holding. The level of impact will depend on the extent of the shelter removed and the type of enterprise. It should be noted that this impact can be mitigated against in certain cases by the replanting of boundary hedgerows and replanting of suitable tree species.

4.6.3 Predicted Impacts - Construction & Operation Phase

4.6.3.1 Noise

The activity of earth moving machinery, transport lorries and other ancillary vehicles will generate additional noise emissions in the immediate vicinity of the construction of the wastewater treatment plant. Noise can be of significance for farm animals (i.e. when noise becomes excessively loud). In general, animals become accustomed to regular noises and sounds. Intermittent noises can cause fright and distress. Blasting activity for rock excavations can be of particular concern with certain farm enterprises such as breeding and training of horses. Intermittent noises close to farm buildings, particularly milking parlours, can also distress livestock.

4.6.3.2 Dust

Dust generated from the exposure of soil to the atmosphere during construction may cause annoyance or nuisance to the farmer and farm animals. The proliferation of dust during construction has a nuisance effect and, if produced in high volumes near milking parlours or on-farm bulk milk storage tanks, may constitute a risk as a source of contamination to the milk. Dust may accumulate on vegetable crops growing adjacent to the construction site. Livestock are at risk of eye irritations from high levels of windblown dust particles. This stress may reduce productivity and increase management difficulties, especially on dairy and equestrian farms.

4.6.3.3 Field Drainage

Field drainage systems currently in situ may be disturbed and in places severed by the construction. These systems will be restored as part of the completed works, but there may be impaired drainage in the period of time between initial disturbance and final reinstatement of such drainage works.

4.6.3.4 Malfunction of the Plant during Operation

If the WwTP malfunctioned during operation there is a danger that spillages and leakages could occur and contaminate produce grown in proximity to where a spillage or leakage occurred. In addition to this spillages and leakages could contaminate surface and groundwater sources. Growers have to adhere to strict environmental conditions in order to maintain contracts with buyers. Any leakages or spillages could have environmental consequences and could impact on the ability of the farmers to sell their produce.

4.6.4 Evaluation

Sites

The evaluation of the sites was based on percentage reduction in overall farm holding, farming enterprise, number of landowners impacted, land quality, severance, impact on shelter, impact on farm buildings, and impact on farm roadways. Intensive farming is carried out on one of the three sites. Approximately 2ha of potential farmland could be lost to agricultural production as result of the construction of the proposed wastewater treatment plant. This loss while significant to individual farmers is insignificant on a county or national level.

Pipeline Routes & Outfall Locations

A desktop survey of mapping was used to examine land use and constraints within the pipeline corridors and the land based areas of the outfall locations.

4.6.5 Ferrybank (Old Wallboard Factory)

The Ferrybank land parcel (Old Wallboard Factory) is a 2.7 ha in size. The land parcel houses an abandoned gypsum factory and is not suitable to farming enterprise. Hence, the overall impact has been deemed imperceptible to the agronomy and landuse section of this report.

4.6.6 Kilbride

Kilbride is a 44.8 ha land parcel, however, only approx. 2 ha would be required for the WwTP site. The land quality is good, suited to a wide range of farming enterprises. Some of the land in the land parcel is currently being leased. There are no farm buildings located within the land parcel area except for an old abandoned farmhouse. There are a small amount of trees and hedgerows within the land parcel.

The following potential negative impacts were identified:

- Approx. 6.5 % reduction in overall farm holding
- Overall Impact – Moderate

4.6.7 Shelton Abbey (IFI Site)

Shelton Abbey (IFI Site) is a 12.2 ha land parcel, however, only approx. 2 ha would be required for the WwTP site. There is one landowner within the land parcel and some of the land parcel is currently being leased to hold equine stock. There are no farm buildings located within the land parcel and there are a small number of trees and hedgerows present within the land parcel boundary. Given the lack of farming enterprise present on the Shelton Abbey (IFI Site) land parcel, the overall impact has been deemed imperceptible to the agronomy and landuse section of this report.

7.0	Agronomy & Landuse - Land Parcels	Ferrybank	Kilbride	Shelton Abbey
7.1	Approximate % Reduction in overall farm holding	Imperceptible	Slight - approx. 6.5% reduction	Imperceptible
7.2	Farming Enterprise	Imperceptible - no farming enterprise	Moderate - farming enterprise	Imperceptible - no farming enterprise
7.3	Number of landowners impacted within land parcel boundary	Slight - 1	Moderate - >1	Slight - 1
7.4	Land Quality	Imperceptible - Poor Land Quality	Slight - Good Land Quality	Imperceptible - Poor Land Quality
7.5	Severance based on site location within overall land holdings	TBC - Step 2/3	TBC - Step 2/3	TBC - Step 2/3
7.6	Potential Impacts on landholdings	Imperceptible	Reduction in farm size	Imperceptible
7.7	Crop rotation practiced	No	Yes	No
7.8	Overall Impact	Imperceptible	Moderate	Imperceptible

Table 4.7 Agronomy & Landuse

4.7 Noise and Vibration

4.7.1 Introduction

A preliminary assessment of the potential noise and vibration impacts on the three shortlisted land parcels was undertaken to aid in the process of the selection of an emerging preferred WwTP site location. The assessment takes cognisance of the proximity of sensitive receptors. This study has been compiled in the form of a desk top study comprising of industry guidance documents and OSI mapping.

4.7.2 Methodology

The potential for noise and vibration impact associated with the proposed WwTP at each of the three shortlisted land parcels has been assessed with reference to the National Roads Authority document entitled: “Guidance for the treatment of Noise and Vibration in National Road Schemes”.

The guidance document states that all receptors within 300m of each route option should be identified and put into one of four "bands". These bands are defined by their distance to either side of the centre line of each route option. Band 1 is from 0 to 50m of the centre line, Band 2 is from 50 to 100m, Band 3 is from 100 to 200m and Band 4 is from 200 to 300m. For this purpose, a receptor is defined as being any dwelling house, hotel, hostel, health building, educational establishment, places of worship, entertainment venue or any other facility or area of high amenity which benefits from, or requires the absence of, high noise levels.

The total number of receptors in each band is multiplied by an arbitrary rating factor. The rating factor is 4 for Band 1, 3 for Band 2, 2 for Band 3 and 1 for Band 4. The resultant values are summed to give a single number for each route option, termed the Potential Impact Rating (PIR). The PIR values may be used to assess the potential impact of each route option, the larger the PIR the greater the potential impact.

In terms of the land parcels assessment there are no receptors within 50m/100m of the boundary as this was a constraints stage criterion. As such, in order to classify each of the potential WwTP sites this methodology has been expanded out to 500m. Receptors in the 100-200m band have a rating factor of 2, while those in the 200-300m band have a rating factor of 1.

4.7.2.1 Desktop Study

The desktop study used the data as described above to calculate PIR rating for each of the three shortlisted land parcels and their associated sites. These were then ranked as having the potential for a Low, Medium or High noise and vibration impact for both the construction and operational stages of the proposed scheme.

4.7.3 Predicted Impacts

Noise and vibration impacts will occur during both the construction and operational phases of the proposed scheme.

4.7.3.1 Construction Phase

In the construction phase the noise and vibration impacts will be due to earth moving, rock breaking and general civil and structural engineering works. These activities will require to be

planned and controlled to minimise potential noise and vibration impact to the closest sensitive receptors. The nature of this sensitivity can be seen from the relative PIR ratings received by each of the three shortlisted land parcels and associated sites assessed in Table 4.8 underneath.

4.7.3.2 Operational Phase

During the operational phase the potential for noise and vibration impact should be more or less equal for all of three of the proposed WwTP sites as the operating facility will be required to meet standard noise and vibration emission criteria at the closest sensitive receptor, regardless of the proximity of that receptor. The proposed WwTP will be required to adhere to *SI No. 287/2005 - European Communities (Waste Water Treatment) (Prevention of Odours and Noise) Regulations 2005.*

4.7.4 Ferrybank (Old Wallboard Factory)

For the purposes of differentiating between parcels at the SA stage, the following can be identified for Ferrybank land parcel (Old Wallboard Factory):

- 204 dwellings (PIR Weighted) within 300 m of the parcel boundary
- The existing ambient noise climate is close to Arklow town centre.
- Overall construction phase impact rating is imperceptible
- Overall operational phase impact rating is imperceptible

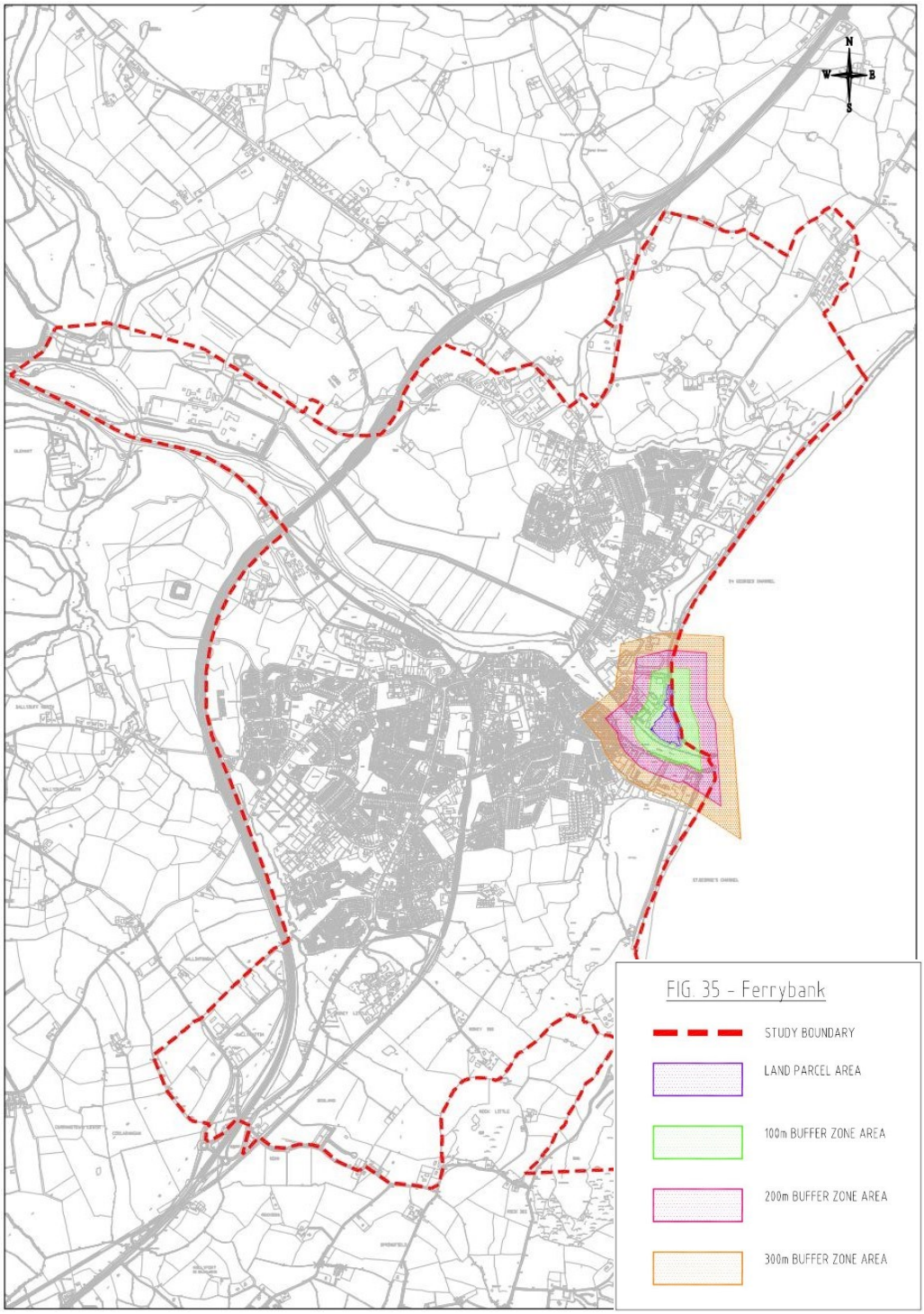

Figure 4.7 Ferrybank (Old Wallboard Factory) Noise & Vibration Buffer Zones

4.7.5 Kilbride

For the purposes of differentiating between parcels at the SA stage, the following can be identified for Kilbride:

- 365 dwellings (PIR Weighted) within 300 m of the parcel boundary
- The existing ambient noise climate is relatively rural farmland area. The parcel borders M11 motorway
- Overall construction phase impact rating is imperceptible
- Overall operational phase impact rating is imperceptible

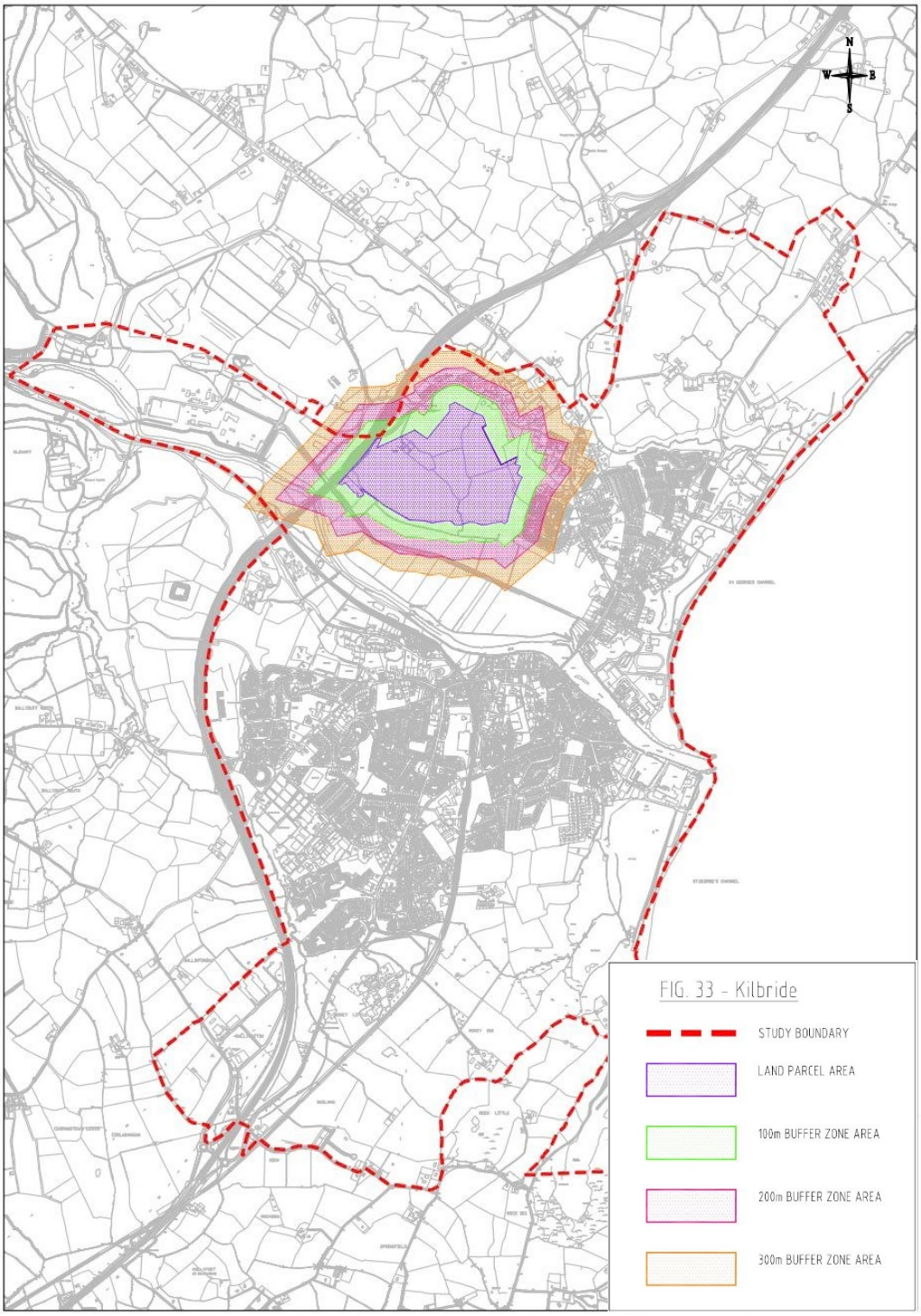

Figure 4.8 Kilbride Noise & Vibration Buffer Zones

4.7.6 Shelton Abbey (IFI Site)

For the purposes of differentiating between parcels at the SA stage, the following can be identified for Shelton Abbey (IFI Site):

- 26 dwellings (PIR Weighted) within 300 m of the parcel boundary
- The existing ambient noise climate is close to M11 motorway.
- Overall construction phase impact rating is imperceptible
- Overall operational phase impact rating is imperceptible

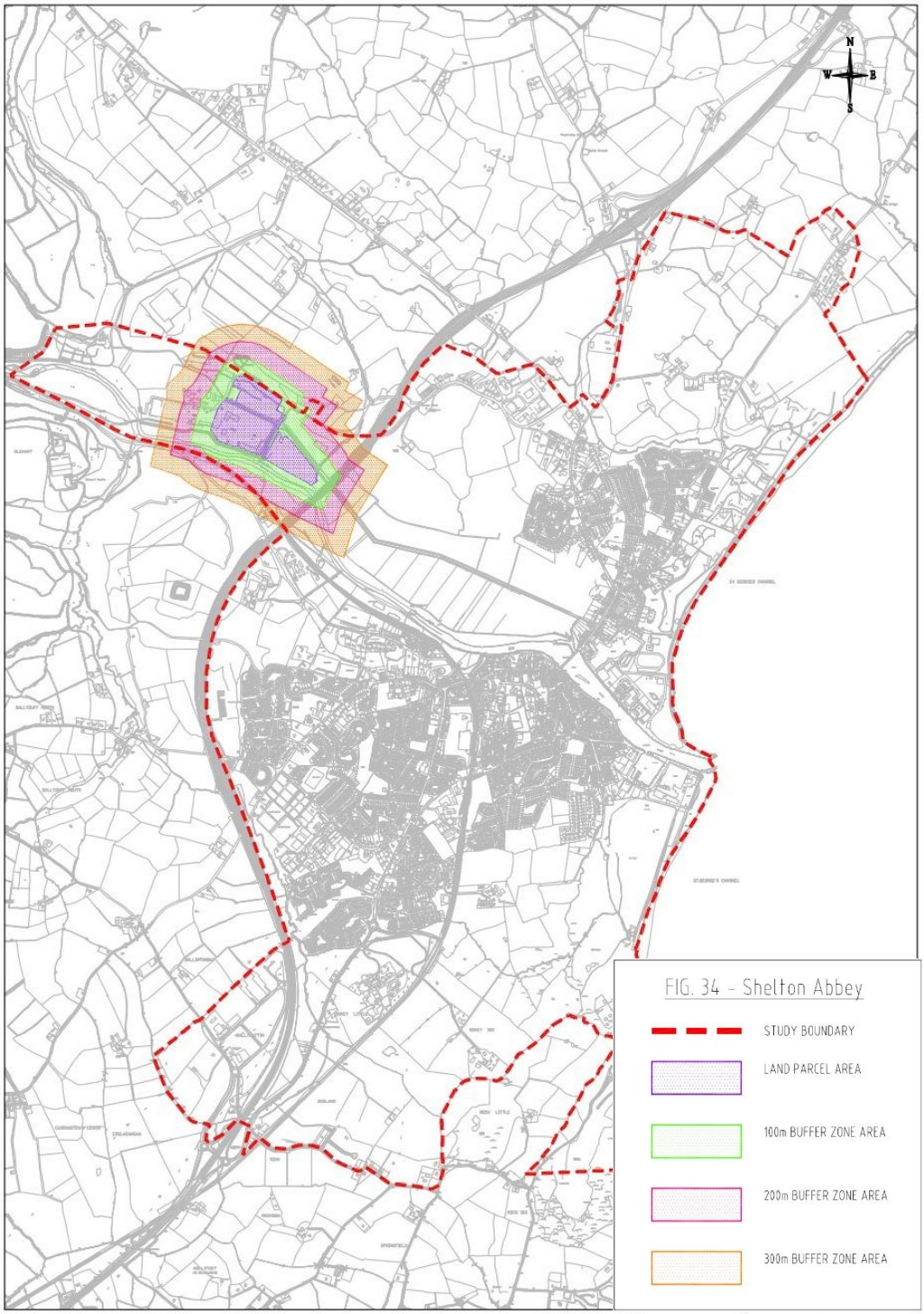

Figure 4.9 Shelton Abbey Noise & Vibration Buffer Zones

8.0	Noise & Vibration	Ferrybank	Kilbride	Shelton Abbey
8.1	Potential for Construction phase noise impact at Sensitive receptors	Significant - 204 dwellings (PIR Weighted) within 300 m	Significant - 365 dwellings (PIR Weighted) within 300 m	Slight - 26 dwellings (PIR Weighted) within 300 m
8.2	Potential for Operational phase noise impact at Sensitive receptors	Slight -Facility shall reach 55db(A) Daytime and 45 db(A) night at closest receptor	Slight - Facility shall reach 55db(A) Daytime and 45 db(A) night at closest receptor	Slight - Facility shall reach 55db(A) Daytime and 45 db(A) night at closest receptor
8.3	Existing Ambient Noise Climate in the Area (significant noise sources)	Close to Arklow Town Centre	Relatively rural farmland area. Borders M11 motorway	Relatively rural farmland area. Borders M11 motorway
8.4	Construction Phase Impact rating	Imperceptible	Imperceptible	Imperceptible
8.5	Operational Phase Impact rating	Imperceptible	Imperceptible	Imperceptible

Table 4.8 Noise & Vibration

4.8 Air and Odour

4.8.1 Introduction

A preliminary assessment of the potential air quality and odour impacts associated with locating the proposed WwTP on the three shortlisted land parcels and their associated sites was undertaken in order to aid in the design process and the emergence of a preferred site for the WwTP. The assessment takes cognisance of the proximity of sensitive receptors, existing ambient air quality and potential sources of odour.

S.I. 787 of 2005, "European Communities (Waste Water) Prevention of Odours and Noise Regulations requires that wastewater treatment plants are so designed, constructed, operated, and maintained as to avoid causing nuisance arising from odours or noise. However, the regulations do not define "nuisance" by any numerical means. A nuisance odour event is generally regarded as interfering with a person's normal activities on a reasonably frequent basis.

Therefore, to guard against creating a nuisance, an odour limit that combines a stringent boundary fence standard with very infrequent exceedances of that standard must be adopted. Meeting a stringent standard with very infrequent exceedances of that standard will undoubtedly achieve the requirements of S.I. No. 787.

The proposed scheme is not expected to cause any significant air quality or odour emissions impacts, as the facility will be designed and constructed to limit any such releases to a set boundary limit value in accordance with best practice.

With specific regard to odour, detailed design, and diligent operational phase management will be required in order to minimise the potential for any odour impact to sensitive receptors.

4.8.2 Methodology

The potential for air quality and odour impact associated with the proposed WwTP at each of the three shortlisted land parcels has been assessed by use of the National Roads Authority document entitled: "Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes" (National Roads Authority, 2011).

There are no residential receptors within 100m of the proposed boundary as this was a constraints stage criterion. As such, in order to classify the potential WwTP sites this methodology has been expanded out to 500m. Odour concentrations generally decline exponentially with distance from the odour source. This assessment employs a simple quantitative analysis of the existing dwellings within 500 m of the shortlisted land parcels with a view to carrying out a much more detailed odour assessment when a final site is chosen.

In addition, EPA documentation from www.EPA.ie has been consulted in order to establish the local ambient air quality climate in the surrounding areas of each of the three proposed land parcels as per item 9.7 in matrix Table 4.9 overleaf.

The EPA records and a desktop survey of mapping has also been carried out in order to establish the location of any pre-existing licensed waste or intensive agriculture activities in each of the areas which may have a predisposition to odour impact in the area.

4.8.3 Predicted Impacts

4.8.3.1 Operational Phase

During the operational phase there should be no sources of dust emission. There will be however, the potential for odour emissions and the magnitude of potential impact will be influenced by the relative proximity of sensitive receptors.

With regard to air quality emissions the proposed facility will be required to operate to standard EPA air quality limits and as such should not harbour any significant air quality impacts.

There is the potential for odour impact to sensitive receptors, from all the proposed WwTP sites. Distance separation from the nearest residential receptors of a minimum of 100m will serve to further reduce the impacts of odour nuisance. The setting of strict emissions from the plant and the effective design, construction and operation of the odour control would ensure that this meets the no nuisance criteria set out in SI 787 of 2005.

4.8.3.2 Construction Phase

During the Construction phase an odour impact is not envisaged other than a slight potential for odour nuisance during the plant commissioning phase. However, this can be mitigated against by testing the odour control units in advance of plant setup. The potential for Air Quality impact will be comprised of the emissions from road lorries and on site construction plant, which would be the same for all three locations, and the potential for dust generation should the site clearance and earth moving phases of the build occur during dry periods.

4.8.4 Mitigation Measures

4.8.4.1 Operational Phase

An odour limit that combines a stringent boundary standard and stack emission with very infrequent exceedances of that standard will be adopted for the proposed WwTP. Meeting this criteria would satisfy the requirements of S.I. No. 787. Therefore, the operational phase of the proposed WwTP should not to cause any significant air quality or odour emissions impacts.

To achieve this stringent standard it is proposed that potential odour generating units will be covered and vented through odour scrubbing / treatment systems prior to emission to atmosphere. The level of odour treatment required to achieve the stringent boundary fence odour standard will be determined for the preferred site of the WwTP during the EIA Phase of the project. This will include an assessment of baseline air quality data and odour and ambient air quality modelling.

4.8.4.2 Construction Phase

Mitigating potential construction phase air quality and odour impacts involves the management and prevention of particulate releases and the generation of dust. Standard mitigation measures are described in the NRA's Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes (National Roads Authority, 2011). Mitigation measures should be incorporated into the Construction Environmental Management Plan (CEMP), which will be developed during the construction stage

4.8.5 Ferrybank (Old Wallboard Factory)

For the purposes of differentiating between parcels at the SA stage, the following can be identified for Ferrybank land parcel (Old Wallboard Factory):

- Approx. 714 Dwellings within 500m of land parcel boundary at potential risk of air quality impacts during construction
- Approx. 714 Dwellings within 500m of land parcel boundary at potential risk of odour nuisance during operation should the odour control system fail
- No Odour Impacts Anticipated During Construction Phase
- No EPA Waste Licensed Facility within 1km of the Land Parcel
- No EPA Licensed Intensive Agricultural Facilities within 1km of the Land Parcel
- Zone D Rest of the Country (Rural Air Quality Classification)
- Given the small study area, the wind rose assessment for air quality & odour is considered to be the same for all 3 Shortlisted Land Parcels

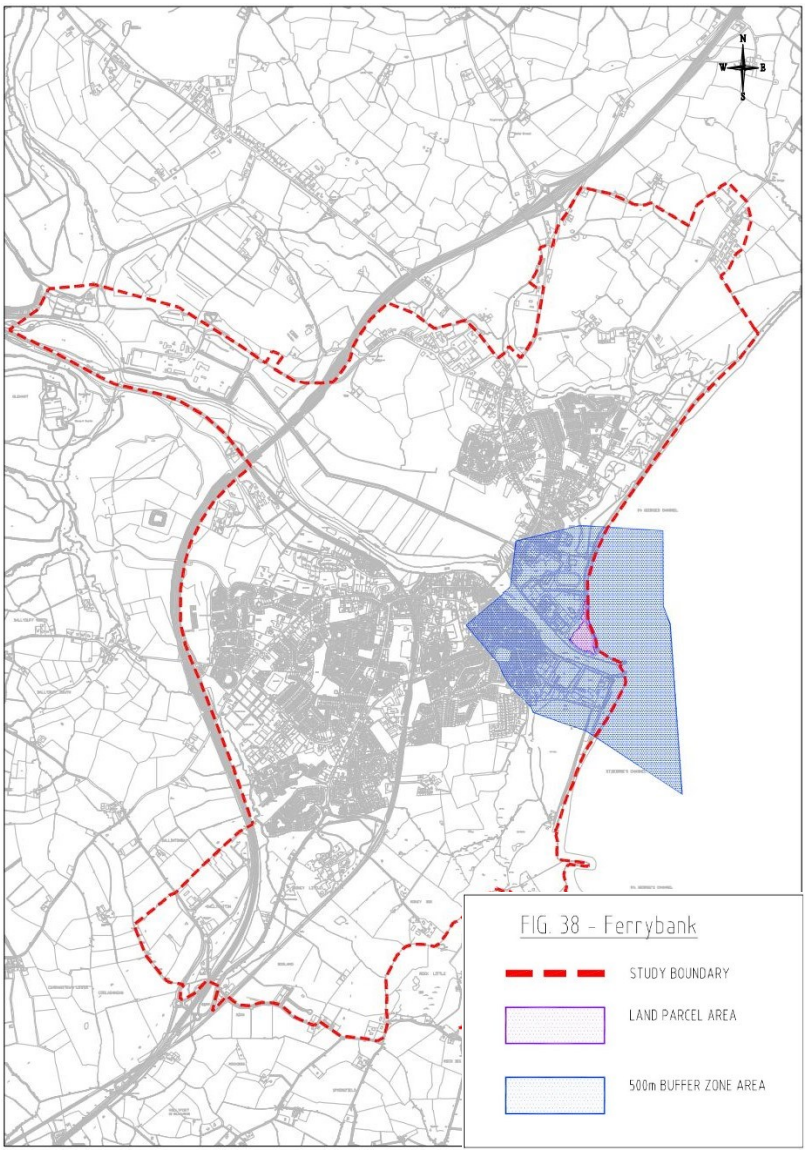

Figure 4.10 Air & Odour Buffer Zones – Ferrybank (Old Wallboard Factory)

4.8.6 Kilbride

For the purposes of differentiating between parcels at the SA stage, the following can be identified for Kilbride:

- Approx. 415 Dwellings within 500m of land parcel boundary at potential risk of air quality impacts during construction
- Approx. 415 Dwellings within 500m of land parcel boundary at potential risk of odour nuisance during operation should the odour control system fail
- No Odour Impacts Anticipated During Construction Phase
- No EPA Waste Licensed Facility within 1km of the Land Parcel
- No EPA Licensed Intensive Agricultural Facilities within 1km of the Land Parcel
- Zone D Rest of the Country (Rural Air Quality Classification)
- Given the small study area, the wind rose assessment for air quality & odour is considered to be the same for all 3 Shortlisted Land Parcels

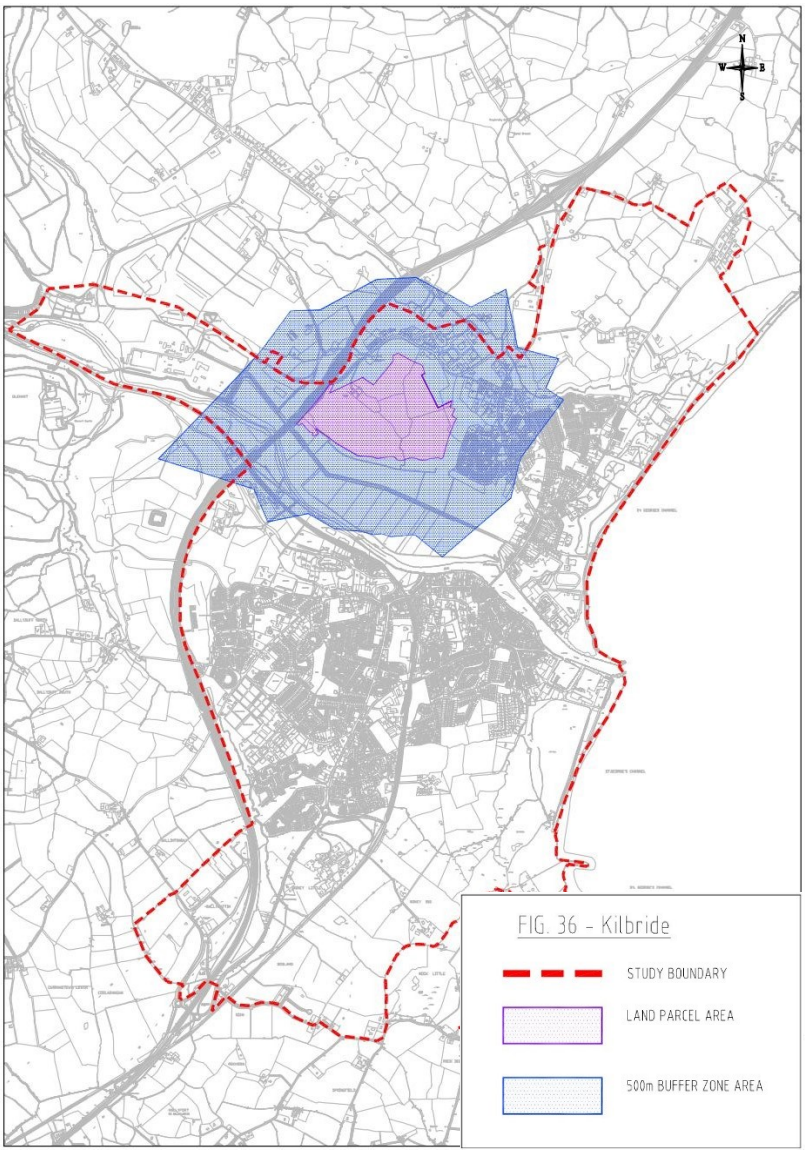

Figure 4.11 Air & Odour Buffer Zones - Kilbride

4.8.7 Shelton Abbey (IFI Site)

For the purposes of differentiating between parcels at the SA stage, the following can be identified for Shelton Abbey (IFI Site):

- Approx. 66 Dwellings within 500m of land parcel boundary at potential risk of air quality impacts during construction
- Approx. 66 Dwellings within 500m of land parcel boundary at potential risk of odour nuisance during operation should the odour control system fail
- No Odour Impacts Anticipated During Construction Phase
- No EPA Waste Licensed Facility within 1km of the Land Parcel
- No EPA Licensed Intensive Agricultural Facilities within 1km of the Land Parcel
- Zone D Rest of the Country (Rural Air Quality Classification)
- Given the small study area, the wind rose assessment for air quality & odour is considered to be the same for all 3 Shortlisted Land Parcels

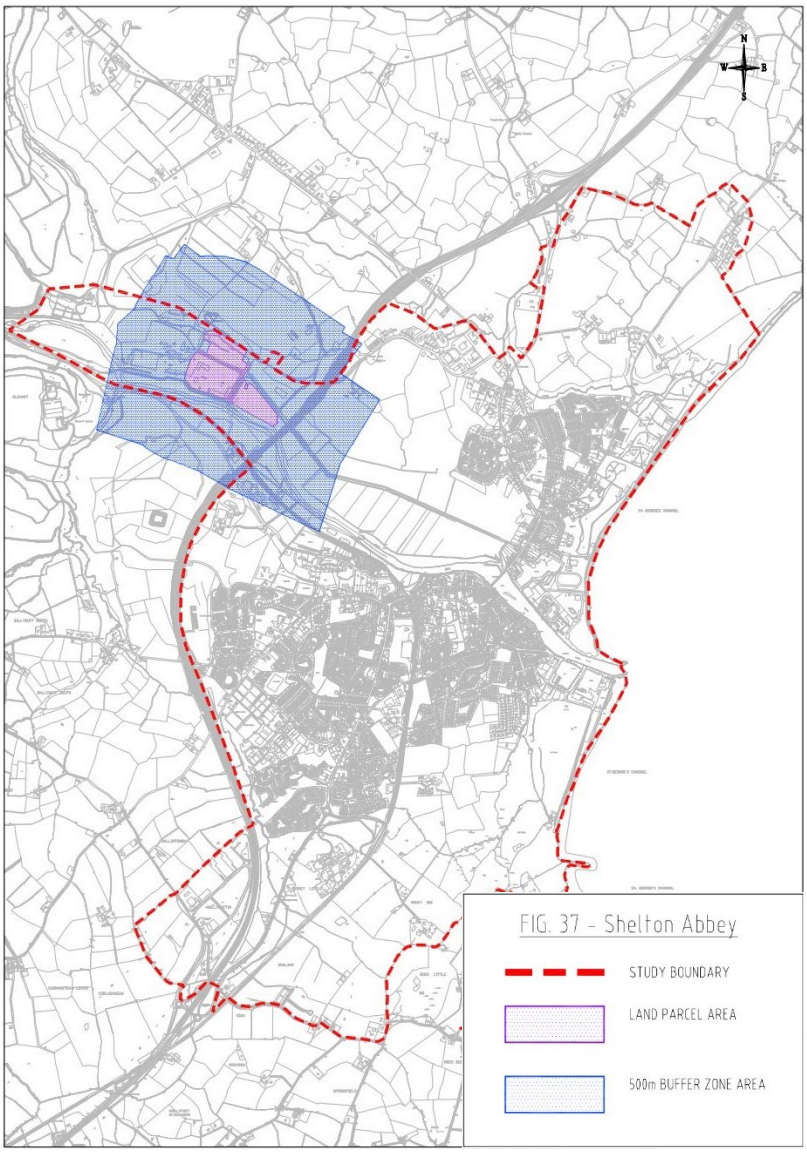

Figure 4.12 Air & Odour Buffer Zones – Shelton Abbey

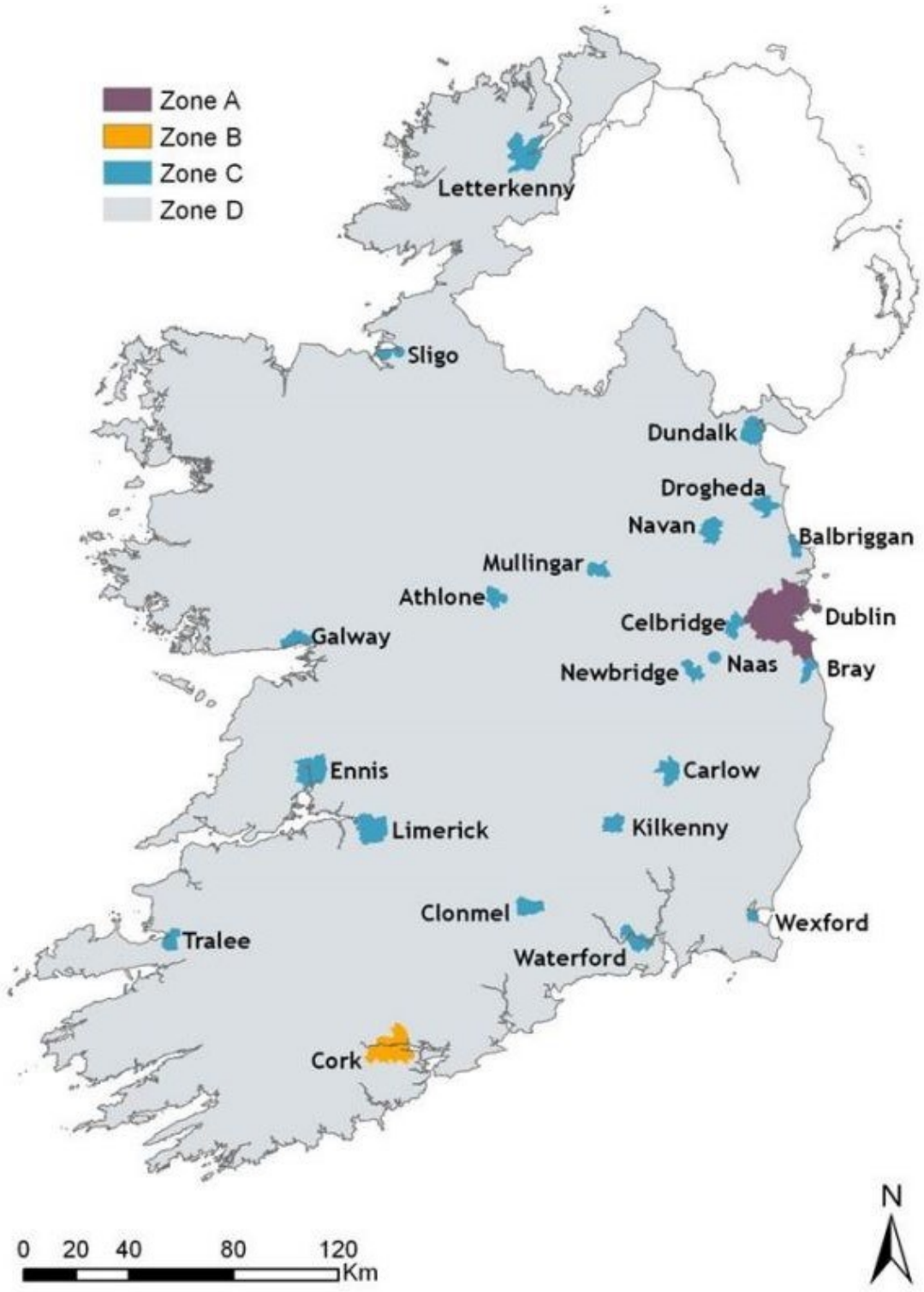

Figure 4.13 Air Quality Classification as per EPA Document - "Air Quality in Ireland 2013"

9.0	Air and Odour	Ferrybank	Kilbride	Shelton Abbey
9.1	Potential for Construction Phase Air Quality Impact at Sensitive Receptors	Significant - Approx. 714 Dwellings within 500m of Land Parcel Boundary	Significant - Approx. 415 Dwellings within 500m of Land Parcel Boundary	Slight - Approx. 66 Dwellings within 500m of Land Parcel Boundary
9.2	Potential for Operational Phase Air Quality Impact at Sensitive Receptors	Facility shall reach Appropriate Air Quality Standards at Emission Points	Facility shall reach Appropriate Air Quality Standards at Emission Points	Facility shall reach Appropriate Air Quality Standards at Emission Points
9.3	Potential for Odour Impacts at Operational phase	Significant - Approx. 714 Dwellings within 500m of Land Parcel Boundary	Significant - Approx. 415 Dwellings within 500m of Land Parcel Boundary	Slight - Approx. 66 Dwellings within 500m of Land Parcel Boundary
9.4	Potential for Odour impacts at Construction phase	Slight – Potential to cause odour during plant commissioning	Slight – Potential to cause odour during plant commissioning	Slight – Potential to cause odour during plant commissioning
9.5	Proximity to EPA Waste Licensed facility	Imperceptible - No EPA Waste Licensed Facility within 1km of the Land Parcel	Imperceptible - No EPA Waste Licensed Facility within 1km of the Land Parcel	Imperceptible - No EPA Waste Licensed Facility within 1km of the Land Parcel
9.6	Proximity to EPA IPPC Licensed Intensive Agriculture Facility	Imperceptible - No EPA Licensed Intensive Agricultural Facilities within 1km of the Land Parcel	Imperceptible - No EPA Licensed Intensive Agricultural Facilities within 1km of the Land Parcel	Imperceptible - No EPA Licensed Intensive Agricultural Facilities within 1km of the Land Parcel
9.7	EPA Air Quality Zone Classification	Zone D Rest of the Country (Rural Air Quality Classification)	Zone D Rest of the Country (Rural Air Quality Classification)	Zone D Rest of the Country (Rural Air Quality Classification)
9.8	Wind Rose Assessment	Given the Small Area, the Wind Rose Assessment is considered to be the same for all 3 Shortlisted Land Parcels	Given the Small Area, the Wind Rose Assessment is considered to be the same for all 3 Shortlisted Land Parcels	Given the Small Area, the Wind Rose Assessment is considered to be the same for all 3 Shortlisted Land Parcels

Table 4.9 Air & Odour

4.9 People and Communities

4.9.1 Introduction

The People and Communities section of this report seeks to identify the local amenities in close proximity to the shortlisted land parcels and assess how they could be potentially negatively affected.

4.9.2 Evaluation

Refer to Matrix Table 4.10 below.

4.9.3 Ferrybank (Old Wallboard Factory)

The Ferrybank land parcel (Old Wallboard Factory) is on a coastal location on the outskirts of Arklow Town. The area is predominately commercial with a tradition of boat building and trade. Specific features which can be identified for this parcel include the following:

- Approx. 29 residential dwellings located 100 – 200 m from the parcel boundary ie: outside the 100m buffer zone (3 commercial dwellings within the bufferzone).
- Approx. 714 residential and commercial buildings within 500 m of the parcel boundary
- Arklow town centre is located c. 700 m to the west.
- Amenities include the Arklow leisure centre, skate/BMX park, running track & playing pitches is c. 200 m to the north and the golf links is c. 500 m to the south

Bridgewater shopping centre is located c. 520 m from the boundary of the parcel while the Marina Village residential development lies 200 m from the parcel boundary

4.9.4 Kilbride

As indicated in the *"Arklow Town & Environs Development Plan (2011 – 2017)"*, the Kilbride land parcel lies outside of the town (See Figure 4.14 overleaf). Specific features which can be identified for this parcel include the following:

- Approx. 127 residential dwellings located 100 – 200 m from the parcel boundary ie: outside the 100m buffer zone
- Approx. 415 residential and commercial buildings within 500 m of the parcel boundary
- Arklow town centre is located c. 1.5 km south east of the land parcel
- Amenities include the Kilbride historic graveyard, which borders this land parcel and the Arklow Town Marsh c. 600 m to the south.

4.9.5 Shelton Abbey (IFI Site)

The Shelton Abbey (IFI Site) land parcel lies outside of the town as per the *"Arklow Town & Environs Plan (2011 – 2017)".* See Figure 4.14 overleaf. Specific features which can be identified for this parcel include the following:

- Approx. 6 dwellings located 100 – 200 m from the parcel boundary
- Approx. 66 residential and commercial buildings within 500 m of the parcel boundary
- Arklow town centre is located c. 1.7 km south east of the land parcel.
- Amenities include the Kilbride historic graveyard which lies c. 600 m North East of this land parcel and the Arklow Town Marsh c. 700 m to the East.

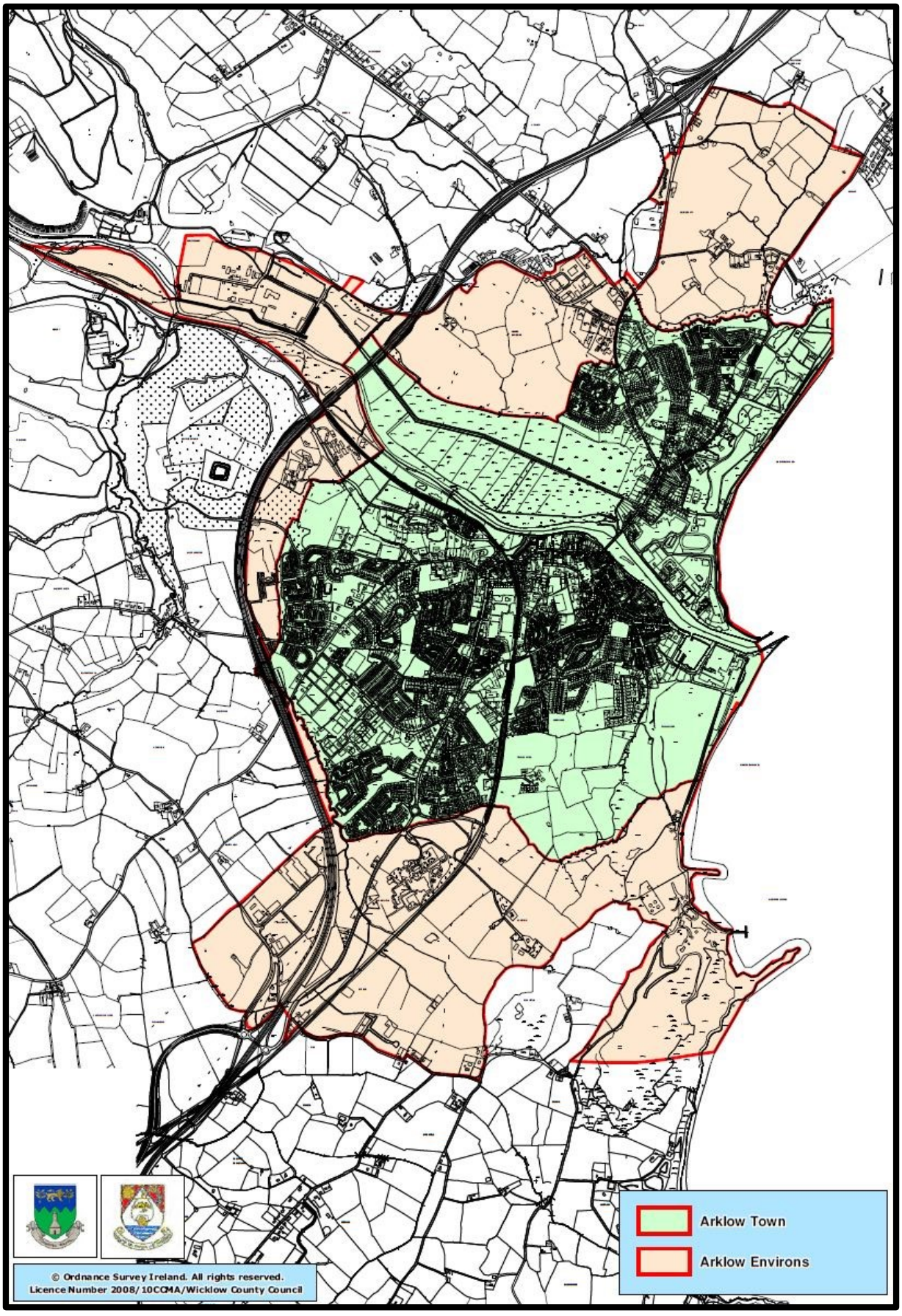

Figure 4.14 Arklow Town/Environs Border as per Map No. 1.01 - Arklow Town Development Plan (2011-2017)

10.0	People and Communities – Land Parcels	Ferrybank	Kilbride	Shelton Abbey
10.1	Number of residential & commercial buildings 100-200m from parcel boundary	Slight – Approx.29	Moderate – Approx. 127	Slight – Approx. 6
10.1	Number of residential & commercial buildings within 500m from parcel boundary	Significant – Approx. 714	Significant – Approx.415	Slight – Approx. 66
10.1	Potential to impact on known community amenities and facilities within 1km from parcel boundary.	Moderate - Arklow leisure centre, skate park/BMX, running track & playing pitches is c. 200 m to the north and the golf links c. 500 m to the south. Bridgewater shopping centre is located c. 520 m from the boundary of the parcel while the Marina Village residential development lies 200 m from the parcel boundary	Slight - The Kilbride historic graveyard borders this land parcel and the Arklow Town Marsh is c. 600 m to the south.	Slight - The Kilbride historic graveyard lies c. 600 m North East of this land parcel and the Arklow Town Marsh is c. 700 m to the East.
10.1	Potential to impact on areas of Significant Population Densities	Slight	Imperceptible	Imperceptible

Table 4.10 People & Communities

4.10 Traffic

4.10.1 Introduction

This section considers the relative merits of the three land parcels currently being considered as the site for the WwTP in terms of the ability to achieve suitable vehicular access. In comparing the potential sites, the requirements for a new access onto the public road network, the construction of a new access road leading to the facility and the suitability of the public road network to cater for traffic associated with the facility are taken into consideration.

The pipe route options for transporting effluent to and from the site also have relative merits in terms of traffic impact and this is also considered in this report. The choice of location for the outfall pipeline does not have any traffic implications and so this is not discussed.

4.10.2 Methodology

4.10.2.1 Desktop Study

In preparing this chapter, the following documents have been referred to:

- *'Wicklow County Development Plan 2010 – 2016'*
- *'NRA Traffic and Transport Assessment Guidelines September 2007'*
- *'NRA DMRB'*
- *'NRA Policy Statement on Development Management and Access to National Roads'*

The main source of data used to carry out this desktop study has been mapping and aerial photography which has been obtained from the OSI and other online satellite mapping. Other data sources included road accident data which was obtained from Wicklow County Council.

Using the available data, an access to the public road network was selected for each of the three land parcels taking into account the suitability of roads surrounding the parcel. When choosing the location of each access the physical characteristics of the receiving road such as carriageway width, horizontal and vertical alignment and visibility were considered along with the frequency of road accidents in the area. From the access point an access route to the land parcel was then generated while attempting to minimise the impact on the surrounding landscape. Similar criteria were then used to compare all the sites.

Traffic generation has not been fully considered at this stage as the volumes of traffic that the construction and operation stages will generate will not differ between sites. This will be dealt with in greater detail during the EIS planning process.

For the pipe routes, traffic generation is a factor, however in general, the longer the pipe route, the more traffic that will be generated. The only other factor from a roads or traffic viewpoint is the number and type of road crossings for the pipelines, as temporary traffic management measures or road closures would be required at these locations.

4.10.2.2 Site Visits

A site visit was carried out to each of the three land parcels in order to assess the location of the proposed accesses identified within the desktop study. The site visit further confirmed that the mapping and other data used in the desktop study accurately reflected the situation on the ground.

4.10.3 Predicted Impacts

4.10.3.1 Construction Phase

4.10.3.1.1 Land Parcels

The principal form of transport that will be used in the construction of the proposed facility will be by road. The construction of the facility will generate a temporary but sizeable increase in traffic. Although there will be some variance resulting from differing quantities of excavations etc. the volumes of movements generated by each site will be of a similar order. It is not possible to produce an accurate estimate of the volumes of traffic that the construction stage will generate and this will be carried out at the EIS planning stage. As there are similar volumes of traffic being generated at each site however, for the purposes of selecting a site, this has not been considered as a differentiating issue.

The traffic generated by a site can be categorised into two types, staff traffic and construction traffic. Staff traffic will generally be light vehicles such as cars or vans and will be generated over more condensed time periods which may coincide with existing peak traffic flows on the road network. The impact of staff traffic will therefore be primarily related to potential increases in congestion. No traffic surveys have been carried out at present so this cannot be numerically quantified, but the sites located closer to built-up areas or accessed by roads used by large volumes of commuters would be those most impacted upon – eg: Ferrybank land parcel (Old Wallboard Factory).

Construction traffic will typically be made up of heavy vehicles transporting materials to and from site. These vehicles would be making journeys throughout the site operating hours and as a result would be unlikely to have a significant impact on congestion. The impacts associated with the increase in heavy vehicles operating on the road network, are; a greater potential for accidents associated with slow moving vehicles and the greater wear on road pavements leading to potential defects.

Other traffic related impacts during the construction phase of the facility are the construction of the entrance and any associated works such as localised road widening or service diversions. It is likely these elements would require temporary traffic management perhaps resulting in temporary lane or road closures. Temporary closures would result in reduced capacity of the road, exacerbating any existing congestion issues. As such, the sites with accesses located on less trafficked roads would have a lesser impact.

4.10.3.1.2 Pipe Routes

Due to the long, linear nature of pipe routes, they are generally constructed in sections. This will result in localised impacts on the road network which will move when one section of work is complete and another commences. The impacts that are associated with the construction of the pipe is the increased vehicular traffic consisting of both construction traffic and site staff vehicles. Traffic management measures that may be required and road crossings reducing road capacity i.e. temporary road/lane closures.

As the pipe construction will take place in different sections, the criteria adopted to separate the different options is the length of pipe, the number of road crossings and the nature of the road crossings (i.e. how heavily or lightly trafficked these routes are).

The only major route specific impact would be the crossing of the M11 Motorway. This only applies to the Shelton Abbey pipe route sections. The use of tunnelling techniques or other no-dig techniques would be investigated to achieve the crossing of the M11.

4.10.3.2 Operational Phase

4.10.3.2.1 Sites

The bulk of the traffic generated by the proposed facility will occur during the construction phase with operational phase traffic being limited to staff accessing the facility and vehicles transporting by-products of the waste treatment process for disposal off site. The quantity of traffic generated during this phase is anticipated to be negligible in terms or existing traffic flows on the surrounding road network.

4.10.3.2.2 Pipe Routes

There will be no regular traffic generated by the chosen pipe route during the operational phase. Any traffic movements will be related to maintenance and will be of short duration and infrequent occurrence.

4.10.4 Evaluation

Refer to matrix Table 4.11 below.

4.10.5 Mitigation Measures

4.10.5.1 Construction Phase

Recommended construction phase mitigation measures are as follows:

- Development and implementation of a construction traffic management plan outlining haul routes using the most suitable roads for vehicles arriving at and departing site.
- Photographic survey of haul roads prior to commencement of construction
- Continuous monitoring of haul roads throughout the construction phase
- Wheel wash facilities at all site entrances
- Appropriate warning signage along haul routes alerting traffic to slow moving vehicles
- Designing of any temporary accesses to NRA DMRB standard ensuring adequate visibility and sufficient turning radii and tapers to allow vehicles turn into and out of the facility without crossing the centre of the public road
- Consider constructing the entrance to the Waste Water Treatment Facility prior to commencement of the main works
- Ensure sufficient space for parking of site staff and HGV within construction sites
- All temporary traffic management should be designed in accordance with the current version of Chapter 8 of the Traffic Signs Manual
- Consideration of deliveries outside of peak morning hours

4.10.5.2 Operational Phase

Recommended operational phase mitigation measures are as follows:

- Construction of entrance to NRA DMRB standard ensuring adequate visibility and sufficient turning radii and tapers to allow vehicles turn into and out of the facility without crossing the centre of the public road

- Ensuring sufficient parking for vehicles within the site
- Ensuring sufficient space for HGV's to park within the entrance prior to opening security gates
- Provision of signage warning of the presence of slow moving vehicles on the approaches to the facility entrance
- Development and implementation of a transportation plan outlining haul routes using the most suitable roads for vehicles arriving at and departing site.
- Locate access chambers along the pipeline route away from the middle of the road in order to reduce the traffic impacts associated with the operational phase.

4.10.6 Ferrybank (Old Wallboard Factory)

The Ferrybank land parcel (Old Wallboard Factory) is bordered by the Mill Road and North Quay, both of which are or of an appropriate standard to facilitate access. Despite being local roads, both Mill Road & North Quay are reasonably wide with a carriageway width of approximately 6m. There is no recorded accident data for either of these roads (Refer to Figure 4.15 overleaf). Mill road and North Quay link the Ferrybank land parcel (Old Wallboard Factory) to the R772 and on the M11 motorway. It must be noted that this section the R772 is urban in character and provides access to and from the Bridgewater Shopping Centre, the Arklow Marina Village and some other local businesses.

Given its coastal location and proximity to the load centre, the proposed pipeline corridor route for this parcel has only 1 road crossing and approximately 390 m of pipeline will be laid in the road.

4.10.7 Kilbride

The Kilbride land parcel is bounded to the west by the M11 Motorway. This is not suitable for direct access due to NRA policy, and would require a dedicated grade separated interchange. Thereafter, the L-6179 Ticknock – Kilbride, is the only road upon which a suitable access could be located. This local road links the Kilbride site to the R772 to the M11. Despite being a local road, it is reasonably wide with a carriageway width of approximately 7m. The 2002 – 2012 road accident data indicates infrequent minor accidents (Refer to Figure 4.15 overleaf).

Given the length of pipeline required to pump from the load centre to this land parcel, it is inevitable that this route will cause more traffic disruption than the Ferrybank land parcel (Old Wallboard Factory). The pipeline route has been routed in fields/grassland wherever possible to offset road disruptions however approximately 800 m of pipeline will still have to be laid in road. Two road crossings will be required.

4.10.8 Shelton Abbey (IFI Site)

Similar to the Kilbride land parcel, The Shelton Abbey (IFI) land parcel is bounded to the east by the M11 Motorway. This is not suitable for direct access due to NRA policy and would require a dedicated grade separated interchange. The Shelton Abbey land parcel would be best accessed along the L-6179 Ticknock – Kilbride which links the IFI site to the R772 to the M11. Despite being a local road, it is reasonably wide with a carriageway width of approximately 7m. The 2002 – 2012 road accident data indicates infrequent minor accidents (Refer to Figure 4.15 overleaf).

Given the length of pipeline required to pump from the load centre to this land parcel, it is inevitable that this route will cause more traffic disruption than the Ferrybank land parcel (Old

Wallboard Factory). The pipeline route has been routed in fields/grassland wherever possible to offset road disruptions but approximately 800 m of pipeline will still have to be laid in road. Three road crossings will be required, including the M11 motorway. There is also one short river crossing on the proposed route.

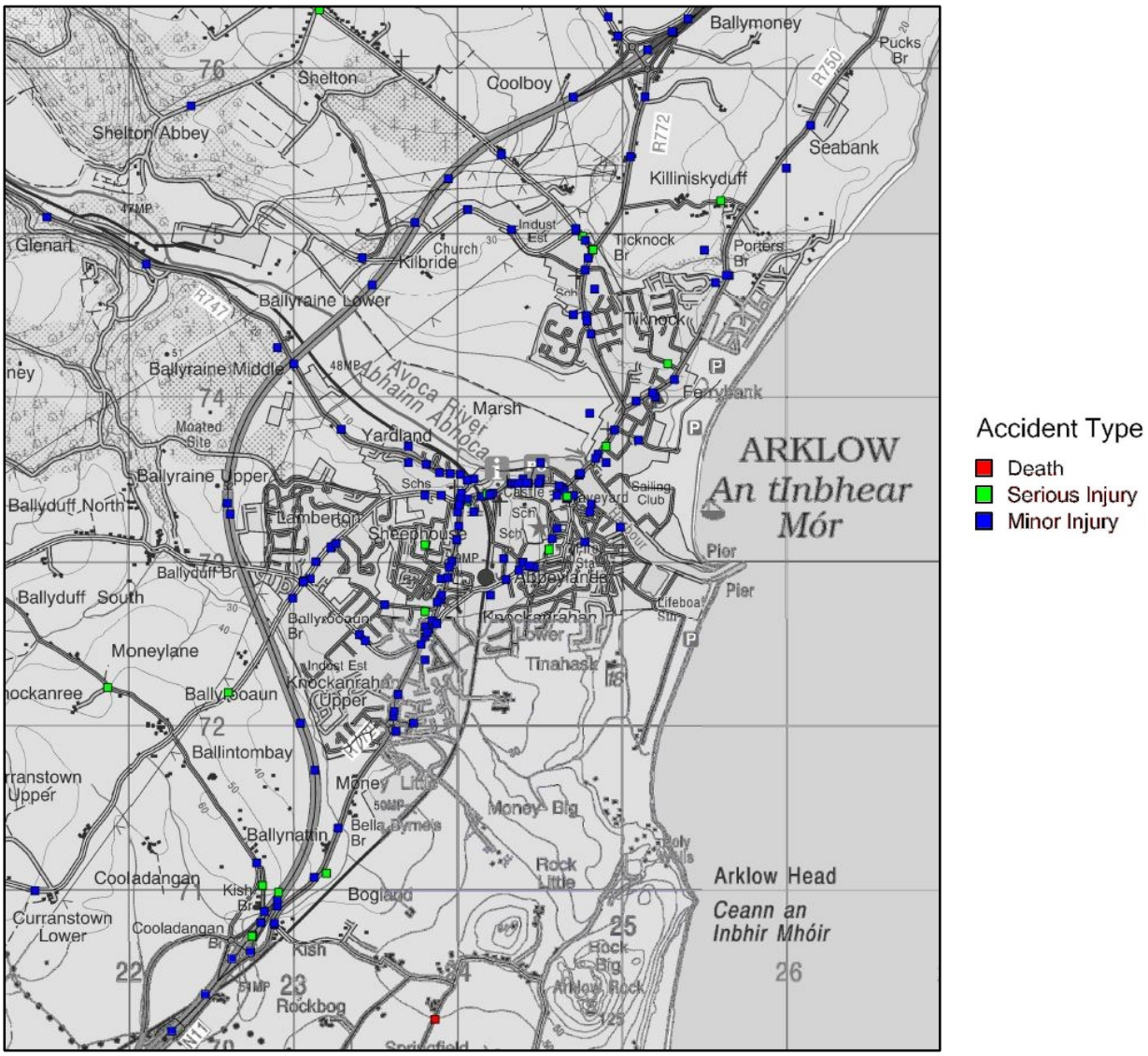

Figure 4.15 Road Collision Data – Arklow 2002 – 2012. Sourced from Wicklow County Council

11.0	Traffic – Land Parcels	Ferrybank	Kilbride	Shelton Abbey
11.1	Length of access road required	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
11.2	Number of major crossings required	0	1- R772	2 – M11 Motorway & R772
11.3	Potential Impact on landowners[1]	Moderate - Construction Phase	Slight - Construction Stage	Slight - Construction Stage
11.4	Works required to provide safe access entrance	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
11.5	Potential impact on surrounding local road network	Imperceptible	Imperceptible	Imperceptible
11.7	Frequency of accidents near entrance	Low	Low	Low
11.8	Frequency of accidents on surrounding network (indication of general road safety issues)	Low	Low	Low
11.9	Road link impacted upon by all construction traffic (excluding major routes)	Moderate	Moderate	Moderate

Table 4.11 Traffic

[1] It must be noted that there will be significant disruption on North & South Quay regardless of the WwTP location to facilitate the siphon crossing of the Avoca River. This is being carried out under a different Contract

4.11 Planning Policy

4.11.1 Introduction

This section of the report aims to investigate potential planning and land use constraints associated with each of the three parcels selected as part of the SA process for the Arklow WwTP.

4.11.2 Methodology

The methodology adopted for the preparation of this report entailed a detailed review of relevant planning and land use considerations as set out in the *Arklow Town & Environs Development Plan (2011 – 2017).*

It should be noted that while this report does provide an overview of the main planning issues associated with each site it does not address the detailed development management standards which may be relevant to a project of this type. This will be looked in more detail when a final site is chosen.

It should also be noted that the rate of further development in Arklow is currently constrained due to the lack of WwTP facility for the town and many of the objectives in the *Arklow Town and Environs Development Plan* are subject to a WwTP being constructed.

4.11.3 Evaluation

Refer to matrix Table 4.12 below.

4.11.4 Ferrybank (Old Wallboard Factory)

The "*Arklow Town and Environs Development Plan (2011 – 2017)*" has this area of plan zoned as "*Waterfront Zone*" which seeks *"to promote and provide for mix-use development".* The particulars of this zoning classification are set out below:

Waterfront Zone (WZ)
The 'waterfront zone' is that area zoned WZ along the north and south quays. This zone is made up of two distinct areas north and south of the river but sharing the common characteristics of frontage onto the river and/or the coast and former industrial use, largely abandoned.

This area has significant potential for development given the large blocks of land available, the proximity to the town centre and town amenities, the open aspect of the land with water on at least one side of most sites and the overall attractiveness of the area for a range of uses including residential, hotel, leisure and other commercial uses.
It is however important that this area is developed in such a way that maintains the river and coast as an attractive amenity area to which there is public access.

4.11.4.1 Waterfront Zone Objectives

- **WZ1** To support in-depth development of the waterfront zone, for a mix of residential, commercial, leisure and tourism uses. Applications for the development of such lands shall include a detailed survey of the existing site conditions, proposals for demolition

and remediation of previous site activities and a management plan for the disposal of such materials.

- **WZ2** To support existing and proposed water related and maritime activities in the area including sailing, fishing, other water sports and commercial shipping activities, including the development of jetties, marinas and other support infrastructure.
- **WZ3** Further retail development in the waterfront zone shall be restricted to that required to meet the everyday convenience needs of future residents or niche comparison uses such as those related to tourism and the maritime function of the area.
- **WZ4** To require any new developments to be suitably set back from the water's edge and to provide public routes and places along waterfronts; to support the development of a footbridge across the entrance to south dock.
- **WZ5** To ensure that access to the water, such as steps / slipways / river beaches etc. are maintained and improved.
- **WZ6** To allow high-density development (up to a plot ratio of (2.5:1) up to 4 storeys in height along water frontages and 3 storeys elsewhere.
- **WZ7** All new residential developments shall comply with the development standards set out in this plan, unless otherwise agreed by the Planning Authority.

4.11.5 Kilbride

The Kilbride land parcel is classified as an Action Area in *'Arklow Town & Environs Development Plan' (2011-2017)*. The development plan calls for this Action Area to be developed as a mixed residential, community and open space zone in accordance with the following criteria:

- Vehicular access to the Action Area shall be provided L-6179, with the roads configuration of the development providing / facilitating a possible future third Avoca river crossing; other, secondary access routes from the adjacent road network shall also be provided as may be possible;
- A number of pedestrian access routes into the action area shall be provided where possible from adjacent developed areas;
- A maximum of 1,500 residential units shall be provided, in a range of development formats, densities, unit sizes and designs. To achieve a sense of place and allow for visual diversity any residential application should provide for a number of identifiable and distinct housing estates (not exceeding 200 units), each containing materially different house designs within an overall unified theme.;
- A minimum of 7ha shall be reserved for the provision of primary and post primary schools, which may be located on a single campus, subject to consultation and agreement with relevant stakeholders, including the Department of Education and Skills;
- A neighbourhood centre, of scale commensurate with the needs of the future population of the Action Area shall be provided, on a site of c. 1.2ha. Such a centre may provide for one supermarket / discount retailer of up to 1,500sqm and a number of smaller local shops and services, including non-retail and professional services, in the order to 1,000sqm;
- A minimum area of 9ha shall be developed as public open space, of which a minimum area of 6.75ha shall be laid for active sports uses in a range of track, pitch and court types suitable for a variety of sports and shall include necessary car parking, lighting and changing facilities; remaining open areas shall been laid out as informal parks and walks, and shall include a number (minimum 2) of equipped children's play areas;

- Any development proposals shall have regard to the setting and curtilage of structures and sites of heritage value, and habitats of biodiversity value and appropriate buffer zones-/mitigating measures shall be provided as required.

The major Accidents Directive (Seveso II) is an EU Directive that seeks to prevent major industrial accidents involving dangerous substances and to limit the consequences of such accidents on people and the environment. The Seveso Directive applies to one site in the Action Area, the Sigma Aldrich, Vale Road which has a consultation distance or radius of 1000m from its site boundaries. A portion of the Kilbride land parcel lies within this 1000m buffer. Advice and technical support will be requested from the Health and Safety Authority (HSA) and relevant legislation where planning applications are affected by the 1000m buffer.

A portion of the pipeline route corridor for the Kilbride land parcel is zoned as a "Conservation Zone" as per the "*Arklow Town and Environs Development Plan 2011 – 2017"*. This zone aims "*To protect the proposed Natural Heritage Areas and lands which are integral to the management of this zone from inappropriate development and to retain existing public access*". It must be noted that while the zoning of the land is a conservation zone, the pipeline route corridor has been carefully selected to avoid the pNHA marsh as established by the NPWS. Nevertheless, this pipeline route may present a problem when applying for planning permission.

4.11.6 Shelton Abbey (IFI Site)

The "*Arklow Town and Environs Development Plan 2011 – 2017*" has this area of plan zoned as "Enterprise and Employment" which seeks to "*To provide for appropriate office, R+D, etc... industrial, light industrial, transport, distribution, warehouse or retail warehouse development of good architectural design, layout and landscaping. The provision of retail facilities will not be at the expense of facilities in the town centre".*

It should be noted that the Flood Feasibility Study (Refer to Section 2.3) had identified a large portion of the Shelton Abbey (IFI Site) Land Parcel to be in Zone B as per section 2.23 of the "*The Planning System and Flood Risk Management Guidelines for Planning Authorities"* – November 2009. 'Highly Vulnerable Development' such as wastewater treatment plants would generally be considered inappropriate in this zone, unless the requirements of the *'Justification Test'* can be met. The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that, are being considered in areas of moderate or high flood risk.

The major Accidents Directive (Seveso II) is an EU Directive that seeks to prevent major industrial accidents involving dangerous substances and to limit the consequences of such accidents on people and the environment. The Seveso Directive applies to one site in the plan area, the Sigma Aldrich, Vale Road which has a consultation distance or radius of 1000m from its site boundaries. The Shelton Abbey (IFI) land parcel lies within this 1000m buffer. Advice and technical support will be requested from the Health and Safety Authority (HSA) and relevant legislation where planning applications are affected by the 1000m buffer.

A portion of the pipeline route corridor for the Shelton Abbey (IFI Site) land parcel is zoned as a "Conservation Zone" as per the "*Arklow Town and Environs Development Plan 2011 – 2017"*. This zone aims "*To protect the proposed Natural Heritage Areas and lands which are integral to the management of this zone from inappropriate development and to retain existing public access*". It should be noted that while the zoning of the land is a conservation zone, the pipeline route corridor has been carefully selected to avoid the pNHA marsh as established by the NPWS. Nevertheless, due to the proximity of the marsh, this pipeline route may be challenged in the planning process.

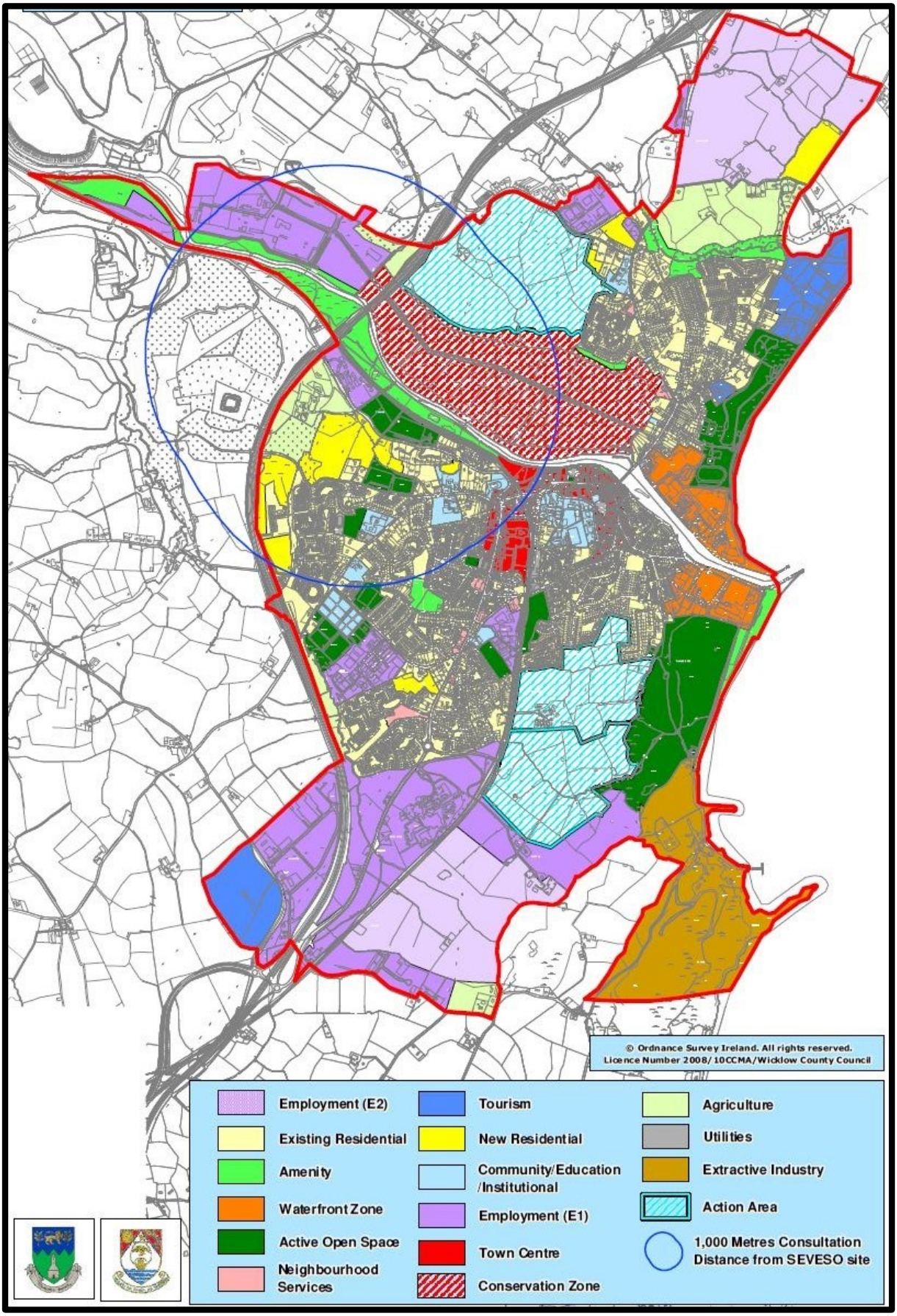

Figure 4.16 Land Use Zoning as per Map No. 11.01 - Arklow Town & Environs Plan (2011-2017)

12.0	12.0 Planning Policy – Land Parcels	Ferrybank	Kilbride	Shelton Abbey
12.1	Existing Land Use on land parcel	Derelict	Agricultural	Agricultural/Landfill
12.2	Land parcel zoning	Waterfront Zone	Action Area	Employment
12.3	Local Objectives/Constraints on land parcel	Imperceptible – No Objectives/Constraints	Imperceptible – No Objectives/Constraints	Significant -Zone B – Flood Plain. Justification Test Required
12.4	Land Uses present within 100m of land parcel boundary	Commercial Uses	Agricultural Uses	Agricultural Uses
12.5	Zoning present within 100m of land parcel boundary	Active Open Space/Existing Residential	Conservation Zone / Employment (E2) / Existing Residential	Amenity/Existing Residential/Conservation Zone
12.6	Other Local Objectives present within 1km of land parcel boundary	Imperceptible - None	Slight - SEVESO II – Inside 1000m buffer. Consultation required	Slight - SEVESO II – Inside 1000m buffer. Consultation required

Table 4.12 Planning Policy

4.12 Engineering Design - Pipelines

4.12.1 Introduction

The pipeline corridors to and from each of the three potential WwTP parcels are evaluated under the following 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
- Carbon Footprint

4.12.2 Topography

The topography for the shortlisted land parcels and associated pipeline corridors is shown in Figure 4.17 overleaf.

Ferrybank (Old Wallboard Factory)
The topography rises from the load centre (approx. 0 mOD) to approx. 2.5mOD. The topography between the load centre and Ferrybank will necessitate a pumped solution, requiring the construction of a pumping station and approximately 520 m of rising main installed utilising open cut and/or trenchless techniques.

Kilbride
The topography rises from the load centre (approximately 0 mOD) to an elevation of approximately 30 to 40mOD at the northern most point of the land parcel. The topography between the load centre and Kilbride will necessitate a pumped solution, requiring the construction of a pumping station and approximately 2870 m of rising main installed utilising open cut and/or trenchless techniques.

Shelton Abbey (IFI Site)
The topography rises from the load centre (approximately 0 mOD) to an elevation of approximately 2.5mOD. The topography between the load centre and Shelton Abbey (IFI Site) will necessitate a pumped solution to overcome the natural rise and fall of the land (approximately 30 mOD at the highest point). This will require the construction of a pumping station and approximately 2950 m of rising main, installed utilising open cut and/or trenchless techniques.

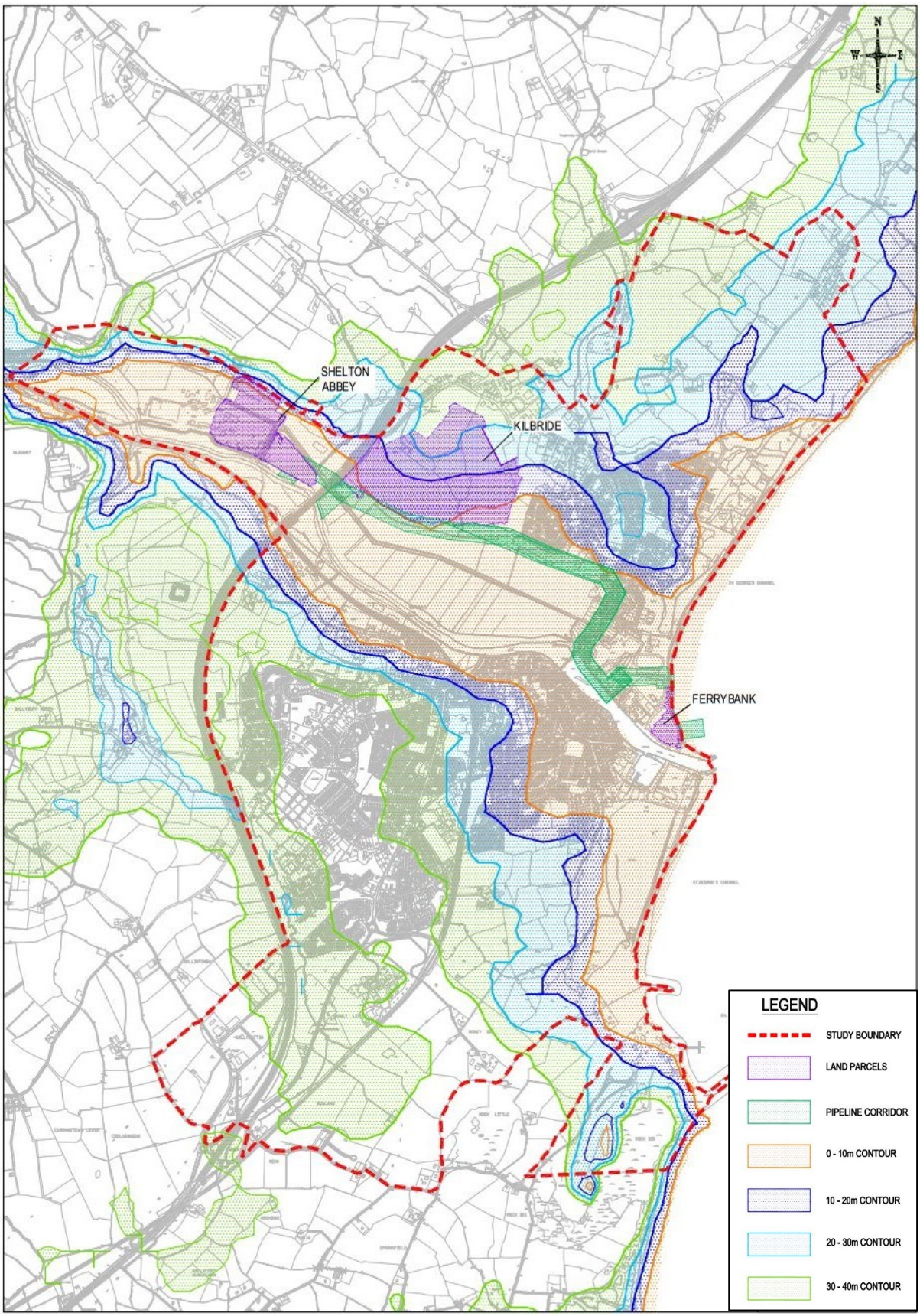

Figure 4.17 Arklow Town & Environs Topography

4.12.3 Engineering Design

A gravity sewer system from the Arklow load centre to any of the three potential WwTP sites would be the preferred design solution for the transfer pipelines. However, due to the low lying elevations of the town load centre and varied topography, a gravity solution is not a feasible option without laying extremely deep pipework.

It is feasible to provide a pumped system to transfer wastewater loads from the load centre to any of the three potential WwTP parcels. The pumped element of the system, comprising pumping station and pumped rising main, will transfer flows over any elevated topography directly to the potential WwTP sites.

Ferrybank (Old Wallboard Factory)

- Pumped Main Length = approx. 520 m
- Treated Effluent Outfall (Marine) Length = approx. 900 m

Kilbride

- Pumped Main Length = approx. 2870 m
- Treated Effluent Outfall (River) Length = approx. 25 m

Shelton Abbey (IFI Site)

- Pumped Main Length = approx. 2950 m
- Treated Effluent Outfall (River) Length = approx. 25 m

The shortest total length of pipeline to and from the potential sites is associated with the Ferrybank land parcel (Old Wallboard Factory). This is followed by Kilbride in second, and Shelton Abbey (IFI Site) in third.

4.12.4 Health and Safety

All construction projects have associated Health and Safety risks. A number of risks can be designed out while remaining risks have control measures implemented to eliminate or mitigate risks to acceptable levels. The following particular risks, as set out in the Health and Safety Regulations, can typically arise on construction projects:

- Work which puts persons at risk of falling from height, burial under earthfalls, or engulfment in swampland
- Work which puts persons at work at risk from chemical or biological substances
- Work with ionizing radiation
- Work near high voltage power lines
- Work exposing persons at work to the risk of drowning
- Work on wells, underground earthworks and tunnels
- Work carried out by divers at work having a system of air supply
- Work carried out in a caisson with a compressed air atmosphere
- Work involving the use of explosives
- Work involving the assembly or dismantling of heavy prefabricated components
- Working in marine conditions – tidal, wind, high seas

With respect to the pipeline corridors and the pipeline construction methods likely to be employed the following are the Particular Risks most likely to arise:

- Work which puts persons at risk of falling from height or burial under earthfalls
- Work near high voltage power lines

- Work exposing persons at work to the risk of drowning
- Work on wells, underground earthworks and tunnels
- Work carried out by divers at work having a system of air supply
- Work carried out in a caisson with a compressed air atmosphere
- Work involving the assembly or dismantling of heavy prefabricated components

Tunnel construction works would have the following additional particular risks:

- Work on wells, underground earthworks and tunnels
- Work carried out in a caisson with a compressed air atmosphere
- Work involving the assembly or dismantling of heavy prefabricated components

Tunnelling and underground construction works impose risks on construction workers as well as third parties. Due to the inherent uncertainties, including ground and groundwater conditions, there may be significant health and safety risks as well as environmental risks associated with tunnelling.

In general, there are more potential health and safety risks associated with tunnelling as opposed to shallower open trench excavation. On this project there are options for design and construction of pipelines using open trench excavation methods to each of the potential WwTP sites with only limited use of no-dig technologies which could include tunnelling.

The marine outfall option for the Ferrybank (Old Wallboard Factory) land parcel poses a Health and Safety risk during the construction phase of the outfall pipeline. Marine works are subject to high tides, rough seas and strong winds when compared to a river outfall option.

4.12.5 Access / Rights of Way / Wayleaves

The pipeline corridors, for all three potential WwTP Sites, are located partially off road, in private land, and access will be required for construction purposes and future maintenance.

The longer the pipeline route the likelihood of more issues will arise regarding access and right of ways.

The width of wayleave and work strip required for pipeline construction is dependent on the size of pipeline, the type of pipeline and the construction methods.

Wider wayleaves and working strips will result in more economical construction methods being employed.

In general the pipeline corridors are routed through open agricultural lands with some restrictions as follows:

Ferrybank (Old Wallboard Factory)

- Existing services & development along North Quay
- Existing services & development along Mill Road

Kilbride

- Existing services & development along R772
- Existing services & development along North Quay

Shelton Abbey (IFI Site)

- Existing services & development along R772

- Existing services & development along North Quay

The restrictions to construction described above can be overcome by refinement of the route selection at design stage and selection of appropriate construction methods.

4.12.6 Crossings – Waterways, Rail, Motorways etc.

The pipeline infrastructure, necessary to serve any of the potential WwTP Sites, is made up of a number of the pipeline corridors. The pipeline corridor required for the Ferrybank land parcel (Old Wallboard Factory) will not involve any significant crossings.

The pipeline corridor required for Kilbride will involve the following significant crossings:

- R772
- Canal Crossing

The pipeline corridor required for Shelton Abbey (IFI Site) will involve the following significant crossings:

- M11 Motorway Crossing
- Stream Crossing
- Canal Crossing
- R772

4.12.7 Physical Infrastructure

It is not anticipated that the construction of pipelines to and from any of the potential WwTP Sites would result in any significant impacts on the physical infrastructure in Arklow, following the implementation of appropriate controls and mitigation measures.

Infrastructure such as the M11 Motorway could be crossed using tunnelling techniques which when adequately designed will have no significant impacts either during the construction stage or during the operational stage.

Road / laneway crossings would be required but when properly reinstated there will be no lasting impacts.

Access points may have to be established off local roads to the pipeline for maintenance / repair, resulting in some alteration to existing road layouts. The impact of access points will be dictated by the length of the pipeline route, the density of local roads, the nature of the local roads and the condition of the local roads.

4.12.8 Strategic Utility Services

4.12.8.1 Gas

There is a 315 OD PE 4 Bar gas transmission pipeline in Arklow which runs the length of the R775. The pipeline route would have to be carefully designed in consultation with Bord Gais to avoid conflict with this transmission main in the cases of the Kilbride and Shelton Abbey land parcels. Refer to the *"Gas Networks Ireland – Gas Network Information"* drawing included in Appendix G.

4.12.8.2 Electricity

There are a number of 220Kv, 110Kv and 38Kv overhead transmission power lines, in the Arklow Town and Environs area. It would be desirable to avoid having to cross under the transmission lines but, failing this, the risks can be minimised through the appropriate coordination during design and construction stages with the relevant utility owner. There is a 38Kv station in close proximity to the Ferrybank land parcel (Old Wallboard Factory). Careful selection of the pipeline route, detailed design and liaison with the ESB during the design and construction phases should reduce all technical issues at this land parcel. The location of this substation and associated underground high voltage cable can be found in Appendix H and in Figure 4.18 below.

Figure 4.18 ESB Network Infrastructure

There is therefore no significant engineering design difference between any of the potential WwTP sites with regard to strategic utility services.

4.12.9 Land Ownership and Titles

A land registry search has not been conducted along the pipeline corridors. However, longer pipeline routes would be expected to have the greater number of landowners and titles.

4.12.10 Construction Risk

Construction risks are related to subsurface and geotechnical issues, utilities and buried structures and differing site conditions. There are also risk issues with water inflows and settlement.

Apart from the crossing of the M11 Motorway, it is not envisaged that tunnelling works will be required for any of the pipeline corridor routes. The Ferrybank land parcel (Old Wallboard Factory) has the shortest linear length of pipeline required and hence the lowest risk of encountering unforeseen ground conditions.

The Ferrybank land parcel (Old Wallboard Factory) is the only land parcel subject to a marine outfall which poses a higher construction risk when compared to a river outfall.

4.12.11 Carbon Footprint

4.12.11.1 Background

An initial carbon footprint exercise has been carried out to compare the likely emissions impacts of the various land parcel options. This has been confined to a comparison of the transfer pipelines as the WwTP itself will be essentially similar for all three options and is based on pumped flow for a set distance from the load centre with the remainder of the route (in the case of Shelton Abbey) via gravity.

This is not a precise and accurate embodied and operational CO_2 footprint, due to limited data availability at this stage. It is presented to provide a comparison using a common currency (CO_2) of the currently available options, applying necessary assumptions and approximations equally to all options. Embodied carbon, defined here, is the CO_2 released from material extraction, transport, manufacturing, and related activities. The following section outlines the approach, data requirements and key assumptions made.

These include emissions of CO_2 related to:

1. Construction
   a. Embodied carbon associated with material production
   b. Emissions from plant associated with tunnelling / open cut pipe laying etc.

2. Operation
   a. Energy associated with pumping requirements.

The relevant data inputs are the length of open-cut pipeline, length of tunnelled pipeline, length of river/marine pipeline, the power demand for pumping and estimates of the time that the systems would be in pump operation based on growth projections.

4.12.11.2 Materials

Embodied carbon emissions factors for materials have been sourced from the Inventory of Carbon & Energy (ICE) Version 1.6a database (University of Bath 2011)

- Concrete – 0.13 $kgCO_2/kg$
- GRP – 1.53 $kgCO_2/kg$
- HDPE – 1.6 $kgCO_2/kg$
- Ductile iron – 1.91 $kgCO_2/kg$

For the purpose of this assessment, it has been assumed that all categories of pipeline are manufactured with HDPE and a uniform diameter of 450mm for comparison.

4.12.11.3 Transport

The emissions associated with transport of materials have not been included at this stage due to the varied locations of manufacturers and suppliers across the globe. For example, based on other recent projects, concrete pipes are available from Ireland, GRP pipes available from Scandinavia and ductile iron pipes available from Europe/China. Other material origins and related transport solutions may be identified at design and build stage. Obviously the choice of material will have implications on the total embodied carbon emissions; however since the same pipe material has been assumed across all options, the omission of transport emissions will not significantly affect the comparison of options relative to each other.

4.12.11.4 Construction

To account for emissions from plant associated with open-cut versus tunnel pipe laying, emissions factors were sourced from the UKWIR guidance on carbon accounting in the water industry. For pipe diameters >1200mm, on-site plant and labour emissions for open cut pipe laying range from 410 to 1098 $kgCO_2/m$ depending on the depth and whether laying under fields or roads.

For the purpose of this assessment a factor of 609 $kgCO_2/m$ has been applied for open cut pipeline. This reflects the upper bound range of the factors for open-cut installation in fields.

There are currently no equivalent published emissions factors available for tunnelled pipeline construction; therefore for the purpose of this assessment it is assumed that it is as energy intensive as the open cut construction.

4.12.11.5 Operation

It should be noted that the Phase 1 population equivalent (PE) for the wastewater treatment plant of 18,000 is only for comparison purposes at this stage. The Phase 1 treatment plant size will be refined during the planning and detailed design stage to meet the immediate needs of Arklow.

Approximate annual energy consumption has been estimated by multiplying the energy requirements for transferring the wastewater volumes by the average pumping time required from first construction through to 2060. According to the 2012 WCC Scheme Review Report

- The 2011 Census report indicated a population 13,009 for Arklow town and surrounds
- The "*Arklow Town and Environs Development Plan 2011 – 2017"* predicts an increase in population of approximately 4.3% per year,
- The CSO projections for 2011 - 2026 predict a growth rate of approximately 1.8% for the south east of the country,
- The Regional Planning Guidelines (RPG's) predicts a growth rates of approx. 1.6% for 2010 – 2016 and 1.2% for 2016 – 2022

As an estimation of lifetime operational costs, the average power requirements for an 18,000 PE and 36,000 PE loadings have been used over a 40 year period. The carbon footprint of this energy use is calculated by using the latest available grid emissions factor published by Sustainable Energy Ireland. This is considered to hold across 40 years, to give an approximation of lifetime operational emissions. Whilst not precise this method is equally applied across all options to give an indicative figure for comparison purposes only.

4.12.11.6 Results

The assumptions and estimated carbon emissions can be summarised in Table 4.13 below.

Embodied & Operational Carbon Calculator - Arklow Sewage Scheme			
Assumptions			
Inland Pipe Material	-	HDPE	
Average Pipe Size	-	450 mm	
Outfall Pipe Material	-	HDPE	
Total System Annual Operating Hours	-	8760	
Total System Asset Lifetime (years)	-	40	
Open Cut/Tunnelling Total Embodied Carbon ($kgCO_2$)	-	609	
Embodied Carbon Emissions - HDPE (kgCO2/kg)	-	1.6	
Weight - PE100 SDR11 PN16 HDPE Pipe (kg/m)	-	52.8	
	Ferrybank	**Kilbride**	**Shelton Abbey**
Total Length of Rising Main	520	2870	2950
Total Length of Outfall Pipe	900	25	25
Power Requirement from Load Centre to Parcel	4.2	42.35	42.35
Hours of operation per Year	8760	8760	8760
Annual Energy Consumption - kWh	36792	370986	370986
Annual CO_2 at 2009 Emissions Factor (tonnes)	19.60	197.63	197.63
Total Lifetime Operational Carbon	783.98	7905.09	7905.09
Total Embodied Carbon - Inland Pipes	44246.28	244205.43	251012.55
Total Embodied Carbon - Outfall Pipes	76580.1	2127.225	2127.225
Total Embodied Carbon	120826.38	246332.66	253139.78
Grand Total Carbon (tonnes CO_2)	121610.36	254237.75	261044.87

Table 4.13 Embodied & Operational Carbon - Arklow Sewage Scheme

4.12.12 Ferrybank (Old Wallboard Factory) Summary

Site

It was noted that the Ferrybank land parcel (Old Wallboard Factory) includes a derelict gypsum factory incorporating disused buildings and tanks. The buildings are primarily blockwork with a corrugated asbestos cladding. These buildings and the existing tanks will need to be demolished to clear the site for development. The shape of the parcel will provide layout design challenges however these are not significant to justify a negative potential impact. As the elevation of the Ferrybank land parcel (Old Wallboard Factory) is less than 10mod, there will be reduced energy costs required to pump the flows from the load centre at North Quay when compared to the remaining two parcels. The total power requirements is estimated to be approximately 22,000 kWh/annum for the Phase 1 development (18,000PE) and 51,000 kWh/annum for the Phase 2 development (36,000PE).

Pipelines

The inlet sewer from North Quay Pump Station will enter the site on the west side. There is approximately 520 m of rising main required from North Quay to the parcel and this can be partially located within the existing road network.

The area around the Ferrybank land parcel (Old Wallboard Factory) and North Quay was identified as an uncontrolled landfill area so there is the potential risk of encountering contaminated ground along the route. Following full site investigations mitigation measures can be identified and implemented.

Outfall

It is envisaged that the proposed outfall will enter the Irish Sea to the north of the estuary. This will be constructed under the existing rock armour coastal defence system. It is not anticipated to impact on the existing coastal defence. The outfall will be constructed by a float and sink or bottom dredge and pull technique.

A submarine electrical cable, running from the Arklow Bank wind farm to the mouth of the harbour, will also have to be avoided when selecting the exact location of the marine outfall. This cable has a 300 m exclusion zone either side of it which require detailed investigation and consultation if works are to progress inside this zone. As part of maintenance works to the Avoca River, a dredge spoil dumpsite is located to the North East of Arklow Harbour.

The Arklow shipping channels are set out by a series of buoys listed below:

- North Arklow Cardinal
- South Arklow Cardinal
- Arklow Lanby
- Arklow Buoy
- No. 2 Glassgorman Buoy

While it is not envisaged that a sea outfall would potentially be an issue in relation to shipping channels further investigation should be undertaken if this option were selected and appropriate mitigation measures put in place.

4.12.13 Kilbride Summary

Site

The shape and size of the Kilbride Land parcel offers a flexible site layout. As the elevation of the Kilbride parcel is approx. 20- 40mod, there will be increased energy costs required to pump the flows from the load centre at North Quay when compared to the Ferrybank land parcel (Old Wallboard Factory). The total power requirements is estimated to be approx. 235,000 kWh/annum for the Phase 1 development (18,000PE) and 507,000 kWh/annum for the Phase 2 development (36,000PE).

Pipelines

The inlet sewer from load centre will enter the site on the east side. There is approx. 2870 m of rising main required from North Quay to the parcel. This can be partially located within the existing road network.

Outfall

Based on the river outfall modelling that was conducted as part of this report, it is envisaged that the proposed outfall will enter the Avoca River upstream of the M11 motorway bridge.

Early engagements with the EPA have indicated that this is a viable option. However, a more detailed investigation will be required once a final site is selected.

The area around Shelton Abbey (IFI Site) has been identified as a licenced EPA landfill so there is high risk of encountering contaminated ground along the outfall route. A fully detailed site investigation of the pipeline route will have to be carefully selected with mitigation and remediation measures implemented.

4.12.14 Shelton Abbey (IFI Site) Summary

Site

The shape and size of the Shelton Abbey (IFI Site) Land parcel offers a flexible site layout. Despite the elevation of the Shelton Abbey land parcel being approx. 0-10m OD, there is a need to pump influent over the rising topography of the lands in between the load centre and the site. This will result in increased energy costs when compared to the Ferrybank land parcel (Old Wallboard Factory). The total power requirements is estimated to be approx. 235,000 kWh/annum for the Phase 1 development (18,000PE) and 507,000 kWh/annum for the Phase 2 development (36,000PE).

Pipelines

The inlet sewer from load centre will enter the site on the east side. There is approx. 2950 m of sewer required from North Quay to the parcel and this can be partially located within the existing road network.

Outfall

Based on the river outfall modelling that was conducted as part of this report, it is envisaged that the proposed outfall will enter the Avoca River upstream of the M11 motorway bridge. Early engagements with the EPA have indicated that this is a viable option. However, a more detailed investigation will be required once a final site is selected.

The area around Shelton Abbey (IFI Site) has been identified as a licenced EPA landfill so there is high risk of encountering contaminated ground along the outfall route. A fully detailed site investigation of the pipeline route will have to be carefully selected with mitigation and remediation measures implemented.

13.0	Engineering Design - Pipelines	Ferrybank	Kilbride	Shelton Abbey
13.1	Pipeline Length			
	Total Length as Open Cut	520 m	2870 m	2950 m
	Total Length as Tunnel	0 m	0 m	0 m
	Total Length in Marine Outfall	1000 m	0 m	0 m
	Total Length in River Outfall	0 m	25 m	25 m
	Total Pipeline Length	1520 m	2895 m	2975 m
13.2	**Power Requirements**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Power Requirement from Load Centre to WwTP Parcel (Phase 1)	22000	235000	235000
	Power Requirement from Load Centre to WwTP Parcel (Phase 2)	51000	507000	507000
	Total Average Power Requirements	36500	371000	371000
13.3	**Carbon Emissions**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total embodied Carbon	925.68	1763.06	1811.78
	Total Lifetime Operational Carbon	783.98	7905.09	7905.09
	Total Carbon (tonnes CO_2)	1709.66	9668.15	9716.87
13.4	**Health and Safety - Pipeline Construction**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Health & Safety	Moderate - Construction of long sea outfall.	Imperceptible - no significant difference	Imperceptible - no significant difference
13.5	**Access / Right of Way / Wayleaves along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Restrictions Along Pipeline Corridors to WwTP Parcels	2	2	2
13.6	**Crossings - Waterways, Rail, etc. along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Main River Crossings	0	0	0
	Stream Crossings	0	0	1
	Canal Crossings	0	1	1
	Motorway Crossings	0	0	1
	National Road Crossings	0	0	0
	Regional Road Crossings	0	1	1
	Railway Crossings	0	0	0
	Total Crossings	0	2	4

13.7	Potential to Impact on Physical Infrastructure along Pipeline Corridors	Ferrybank	Kilbride	Shelton Abbey
		More Impact on Local Roads	More Impact on Regional Roads	More Impact on Regional Roads
13.8	**Potential to Impact on Strategic Utility Services along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
13.9	**Presence of Public Utilities within Land Parcels**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Public Utilities within the Land Parcel	38kV station & associated underground/submarine power cables in close proximity to land parcel	No major public utilities within the land parcel	220 kV overhead power cables
13.10	**Land Ownership and Titles along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Least Ownerships	Most Ownerships	Most Ownerships
13.11	**Route Traffic Management**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		No Significant Impact after Construction Stage	No Significant Impact after Construction Stage	No Significant Impact after Construction Stage
13.12	**Construction Risk along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - tunnelling works not necessary	Imperceptible - tunnelling works not necessary	Imperceptible - tunnelling works not necessary
13.13	**Operation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference

Table 4.14 Engineering Design - Pipelines

4.13 Engineering Design – WwTP Site

4.13.1 Introduction

The potential WwTP site locations, within the respective land parcels, are evaluated under the following technical criteria:

- Engineering Design/Treatment Processes Required
- Health and Safety
- Remediation Works
- Capital & Operational Costs
- Carbon Emissions

4.13.2 Engineering Design/Treatment Processes Required

Due to the more stringent effluent requirements of a river outfall, a higher level of treatment will be required at the Kilbride and Shelton Abbey (IFI Site) land parcels. To meet the estimated discharge consent (ELV's), it is envisaged that tertiary treatment will be required. This typically involves chemical dosing, filtration and UV disinfection. This will significantly add to the capital and operational cost of a WwTP on the Kilbride or Shelton Abbey (IFI Site) land parcels.

Similarly, due to the proximity of the Ferrybank land parcel (Old Wallboard Factory) to Arklow town centre, more stringent odour control systems will be required. This would typically involve chemical scrubbers and/or an activated carbon system. This will add to the capital and operational cost of a WwTP at Ferrybank land parcel (Old Wallboard Factory).

As highlighted in the flood study report included in Appendix B, a large portion of the Shelton Abbey (IFI Site) lies in the Zone B flood risk zone. If the final site is located within this zone, and a justification test for this land parcel is not acceptable, there would be a need to introduce mitigation measures including raising the ground level above anticipated flood levels. This will significantly add to the capital cost of WwTP construction at Shelton Abbey (IFI Site).

Due to the 'made ground' (reclaimed land) conditions of both the Ferrybank (Old Wallboard Factory) and Shelton Abbey (IFI Site) land parcels, specialist load bearing techniques, such as piled foundations will be required for some or all of the structures at the site. This will add to the capital cost of WwTP construction at both the Ferrybank (Old Wallboard Factory) and Shelton Abbey (IFI Site).

4.13.3 Health and Safety

All construction projects have Health and Safety Risks. Some risks can be designed out and with others control measures need to be put in place to eliminate and mitigate risks as far as reasonably practical. The following Particular Risks, as set out in the Health and Safety Regulations, can arise on construction projects:

- Work which puts persons at risk of falling from height, burial under earthfalls, or engulfment in swampland
- Work which puts persons at work at risk from chemical or biological substances
- Work with ionizing radiation
- Work near high voltage power lines
- Work exposing persons at work to the risk of drowning
- Work on wells, underground earthworks and tunnels
- Work carried out by divers at work having a system of air supply

- Work carried out in a caisson with a compressed air atmosphere
- Work involving the use of explosives
- Work involving the assembly or dismantling of heavy prefabricated components

With respect to the WwTP site construction, the following Particular Risks most likely to arise:

- Work which puts persons at risk of falling from height or burial under earthfalls
- Work near high voltage power lines
- Work exposing persons at work to the risk of drowning
- Work on wells, underground earthworks and tunnels
- Work involving the assembly or dismantling of heavy prefabricated components

It is generally considered that these particular risk can apply to all three land parcels. These particular risks will be considered when determining the preferred WwTP site location within each land parcel option.

4.13.4 Remediation Works

A large EPA registered landfill exists along the banks of the Avoca River both upstream and downstream of the M11 Bridge. Depending on the location within the land parcel, extensive remediation costs could be incurred for the Shelton Abbey (IFI Site).

Similarly, the Old Wallboard Factory on the Ferrybank land parcel is clad in corrugated asbestos which would need to be disposed of in accordance with the Health & Safety Authority's *"Practical Guidelines on ACM Management and Abatement".* The remediation costs associated with this will add to the capital cost of the WwTP at this location.

4.13.5 Capital and Operational Costs

Both capital and operational costs have been considered when reviewing the economic parameters during the preferred site selection process. The results of the river outfall modelling in Section 2.3 have indicated that a higher level of treatment will be required should a river outfall site be selected. The treated effluent standards for both river and marine outfall are set out in Table 4.15 below.

Parameter	River Outfall	900m Marine Outfall
Biochemical Oxygen Demand	10 mg/l	25 mg/l
Suspended Solids	35 mg/l	35 mg/l
Total Ammonia-N	0.7 to 1 mg/l	10 mg/l
TON-N	35 mg/l	35 mg/l
PO4-P	0.7 to 1 mg/l	-
E.coli	1 x 10^6 ec/100ml	1 x 10^6 ec/100ml

Table 4.15 Proposed WwTP Discharge ELV's as per River Outfall Study

The more stringent effluent quality and sludge treatment requirements, the higher the capital and operational cost of treatment processes to achieve these standards. This will generally cost more in either capital or operating expenditure. In practise there is an associated capital cost penalty with apparently small increases in effluent quality.

Wastewater treatment processes are varied each with its own particular merits dependent on site constraints and final treated effluent standards to achieve environmental requirements.

Processes typically used in the treatment of sewage include activated sludge, biological filters, membrane bio-reactors, oxidation ditches and sequence batch reactors.

For the purpose of comparison, a Sequence Batch Reactor (SBR) treatment process has been selected for all three land parcels.

SBR systems have been successfully implemented within the wastewater industry for treatment plants similar in size to that considered for Arklow WwTP. In conventional plant the operations are carried out sequentially in different tanks arranged in series. The SBR process involves performing a series of different operations in the same tank. There is no separate settling tank in an SBR system. Consequently all SBR systems include parallel tanks to ensure that there is always a tank available to receive the continuous inflow of wastewater. Many sub-variants of the basic system have been developed commercially.

The start of each treatment cycle is the filling stage, where wastewater is introduced into the process tank. Filling can be carried out while the contents of the tank are being aerated or it may occur in the absence of aeration (anoxic or anaerobic fill, depending on the effluent quality required of the system). After filling, the contents of the tank are aerated for a given period until the required degree of treatment has been achieved. The aeration system is then switched off and the settling phase is initiated. In the absence of aeration, the suspension of activated sludge solids will gradually settle, leaving behind a surface layer of treated effluent. The effluent is removed for discharge during the decanting stage, which usually involves the physical movement of mechanical equipment through the effluent towards the settling sludge interface. Following decanting there is usually an “idling” phase while the tank waits to receive the next batch of influent during the filling stage. The whole sequence therefore repeats itself indefinitely with parallel tanks at different stages of the treatment cycle at any instant.

4.13.5.1 Capital Costs

The capital costs associated with an SBR are broken down as follows:

Capital Costs - WwTP		
Process	**Outfall Type**	
	Marine Outfall	**River Outfall**
Screening & Grit Removal	930,000.00	930,000.00
Sequence Batch Reactor	6,100,000.00	9,386,000.00
Sand Filters	-	2,016,000.00
Total	**7,030,000.00**	**12,332,000.00**

Table 4.16 Capital Costs – WwTP

4.13.5.2 Operational Costs

The operational costs associated with an SBR are broken down as follows:

Annual Energy Costs of SBR (€'000)			
PE Band	Process	Outfall Type	
		Marine Outfall	River Outfall
10,001 - 50,000	Sequence Batch Reactor	161	-
	Sequence Batch Reactor + Sand Filter	-	313+6

Table 4.17 Annual Energy Costs of SBR

Annual Labour & Maintenance Costs of SBR (€'000)			
PE Band	Process	Outfall Type	
		Marine Outfall	River Outfall
10,001-50,000	Sequence Batch Reactor	289	289

Table 4.18 Annual Labour & Maintenance Costs of SBR

Annual Sludge Disposal Costs for SBR (€'000)			
PE Band	Process	Outfall Type	
		Marine Outfall	River Outfall
10,001-50,000	Sequence Batch Reactor	364	284

Table 4.19 Annual Sludge Disposal Costs for SBR

Taking the above annual costs into consideration, the annual costs associated with an SBR for both a marine and river outfall can be summarised as follows:

Total Annual Operating Costs of SBR (€'000)			
PE Band	Process	Outfall Type	
		Marine Outfall	River Outfall
10,001 - 50,000	Sequence Batch Reactor	814	-
	Sequence Batch Reactor + Sand Filter	-	892

Table 4.20 Total Annual Operating Costs of SBR

4.13.6 Carbon Emissions

The energy costs in Table 4.21 have been converted into carbon emission values for a carbon footprint assessment. These values can be seen in below.

Annual Carbon Emissions of SBR (kg/year)			
PE Band	Process	Outfall Type	
		Marine Outfall	River Outfall
10,001 - 50,000	Sequence Batch Reactor	824	-
	Sequence Batch Reactor + Sand Filter	-	1631

Table 4.21 Annual Carbon Emissions

4.13.7 Evaluation

Refer to matrix Table 4.22 below.

14.0 / 14.1	Engineering Design - WwTP / Treatment Processes Required - WwTP	Ferrybank	Kilbride	Shelton Abbey
		Moderate - Assumed need for further odour control	Significant - Assumed need for tertiary treatment	Profound - Assumed need for tertiary treatment & flood mitigation works
14.2	**Health & Safety - WwTP Construction**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
14.3	**Remediation Works -WwTP & Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Moderate - asbestos removal required	Moderate - EPA landfill remediation required (outfall pipeline)	Moderate - EPA landfill remediation required (rising main)
14.4	**Capital & Operational Costs**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Energy Costs - SBR Treatment Process	€161,000.00	€319,000.00	€319,000.00
	Annual Sludge Disposal Costs - SBR Treatment	€364,000.00	€284,000.00	€284,000.00
	Annual Labour & Maintenance Costs - SBR Treatment	€289,000.00	€289,000.00	€289,000.00
	Total Annual Operational Costs	€814,000.00	€892,000.00	€892,000.00
	Capital Costs of WwTP	€7,030,000.00	€12,332,000.00	€12,332,000.00
14.5	**Carbon Emissions - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Carbon Emissions Associated with SBR Treatment Process	824,000 kg/year	1,631,000 kg/year	1,631,000 kg/year

Table 4.22 Engineering Design – WwTP Site

4.14 Land Valuation

4.14.1 Introduction

GVA Donal O' Buachalla Property Advisors were engaged to undertake a land valuation assessment of the three shortlisted land parcels and associated pipeline corridors. The full assessment can be found in Appendix I and is summarised below:

4.14.2 Ferrybank (Old Wallboard Factory)

- Town centre location
- Located to the east of Arklow town centre and Bridgewater shopping centre
- High profile waterside location
- Lands zoned waterfront zone which is to provide for mixed use development. This zone permits high value use such as hotels, offices, residential, shopping.

4.14.3 Kilbride

- The lands at Kilbride are located between the public road and the Avoca River, immediately to the east of the N11 and are zoned as an Action Area 3, Kilbride.
- The Kilbride Action Area extends to approx. 70 ha and envisages mixed development including up to 1,500 residential units, neighbourhood centre, community services etc… The development specifies that piecemeal development will not be permitted and an overall plan must be agreed for the entire area before development commences unless a proposed development delivers commensurate facilities and infrastructure.
- While the zoning is generally positive the scale of development required do get planning permission is restrictive in a market which is only beginning to see new development in Dublin and the immediate environs.
- The length of wayleaves required for the Kilbride lands is approximately 1897 linear metres.

4.14.4 Shelton Abbey

- The Shelton Abbey site is located to the west of the N11 adjacent to the former chemical plant.
- The lands are zoned as employment one in the development plan which generally permits more industrial type uses such as heavy vehicle parking, industrial light, laboratories, motor sale outlets, offices, public service buildings, retail warehousing, service garages, warehouses, wholesale outlets.
- The location is somewhat removed from the town centre, however it does enjoy a profile to the existing N11.
- Given its proximity to the former chemical plant there may be issues with development, extra over development costs of a potential brownfield site.

4.14.5 Site Assessment

In considering the cost assessment an estimation of the compensation based on a current CPO and Notice to Treat (March 2015) has been assessed in each case based on the statutory heading of claim which include the following;

- Market Value of Land to be Acquired
- Injurious Affection / Severance
- Disturbance

In terms of assessing the injurious affection / severance it is difficult to properly consider as the details of land ownership is unknown and the extent of land held with the property acquired does have a material impact on the level of compensation under this particular heading.

It has been assumed that the acquiring authority will provide property accommodation works to the affected parties and that the Plant will be properly screened.

If we consider the foregoing and rank the sites only (that is ignoring the wayleave element) and ranking the most expensive as number one and least expensive as number three, Donal O' Buachalla have concluded the following:

1. Ferrybank (Old Wallboard Factory) – This land parcel is considered to be the most high cost land parcel to be acquired, having regard to its town centre waterfront location. It is anticipated that this site will be over four times more expensive to acquire than Shelton Abbey (IFI Site) and at least twice as expensive as Kilbride.

2. Kilbride – This land parcel is zoned for mixed use although given the requirements of the action area plan it is unlikely that they will be developed in the short term. The presence of the plant on mixed use zoned lands may give rise to larger claims for injurious affection and it is expected that such a site would be at least twice as expensive as Shelton Abbey (IFI Site).

3. Shelton Abbey (IFI Site) – This land parcel is zoned for industrial use. However, it is situated to the west of the N11, removed from the town centre and close to the river Avoca. This could restrict the types of development permitted. Given the previous heavy industrial nature of the surrounding lands there may be issues with contamination etc. which would have to be dealt with prior to any new development. However, with the industrial type uses the injurious affection is limited.

4.14.6 Wayleave Assessment

Given that the Shelton Abbey and Kilbride wayleaves follow the same route and that Shelton Abbey is marginally longer it stands to reason that the cost of acquiring wayleaves for the Shelton Abbey (IFI Site) land parcel will be nominally more costly than for Kilbride.

Refer to Table 4.23 overleaf for a summary of the assessment.

15.0	Land Valuation	Ferrybank	Kilbride	Shelton Abbey
15.1	Land Valuation – Land Parcels & Wayleaves			
	Price per area - Land Parcel	Most Expensive – 4 times more than Shelton Abbey	Lower than Ferrybank, Higher than Shelton Abbey – 2 times more expensive	Least Expensive
	Price - Wayleaves Required for Pipelines	Least Expensive (Smaller pipe lengths all laid in public roads)	Higher that Ferrybank, lower than Shelton Abbey (Longer pipe lengths)	Most Expensive (Longest pipe lengths)
	Summary	Most Expensive	Higher than Shelton Abbey, Lower than Ferrybank	Least Expensive

Table 4.23 Land Valuation

5 Step 2 – Position Site within Land Parcel

Due to the preliminary screening process undertaken at up to this point, the land parcels identified were, in some cases, significantly larger than the site area of approximately 2 ha required for the WwTP. It was not considered appropriate at the preliminary screening stage to identify the best positioned and best orientated site for the WwTP within each of the land parcels. It was considered more appropriate to wait until the environmental and technical assessments had been completed on the land parcels in order to ensure that the policy of avoidance of impacts was continued through to this phase.

Following completion of their assessments, each of the technical and environmental specialists produced a matrix of sub-criteria which provided differentiating factors across each of the land parcel options. That information was used to determine the most suitable location within each land parcel for the WwTP site and also the most appropriate access route to that site.

The optimum location for a site within a land parcel is as close as possible to the centre of the land parcel, as that provides the greatest possible distance from sensitive receptors. However, potential impacts identified within each land parcel resulted in a number of other considerations also being taken into account. These included topography, access road routing, and avoidance of flood plains, land ownership, farm viability, existing field boundaries, land severance and adjacent watercourses.

It should be noted that the site layouts featured in Appendix K show and oxidation treatment process as opposed to and SBR process which was discussed in section 4.13.5 above. Oxidation ditch treatment process typically feature a larger footprint than an SBR and so using it in the site layout gives a “worst case” scenario. Further refinement of the site will occur as landowner consultations are progressed and as further indicative site layouts are developed.

5.1 Ferrybank (Old Wallboard Factory)

The Ferrybank land parcel (Old Wallboard Factory) never offered much flexibility for the placing of a 2 ha site within it. Nevertheless, a suitable location has been chosen which satisfies all criteria and seeks to avoid the high voltage power cables which comes in from the off shore wind farm. The nearest sensitive receptor is situated approximately 50 m away. The total pipeline length required for this site is approximately 510 m and the access road required to this location is approximately 100 m. There is sufficient space available on the remaining portion of the land parcel to provide screening to the plant.

The proposed position of the Ferrybank site can be seen in Appendix K.

5.2 Kilbride

The placing of the 2 ha. Kilbride site has satisfied all restrictive criteria and can be found in Appendix K. While this site position requires a longer rising main than elsewhere on the land parcel, it minimises the outfall length to the river and shortens the access road distance required. The pipeline route corridor for this site also avoids the pNHA Arklow Marsh. This site location increases the distance to nearest sensitive receptor to 410 m. The total pipeline length required for this site is 2870 m and the access road required to this location is approximately 180 m. The site location utilises one field within the land parcel and therefore minimises the

effect on the agronomy & landuse of the area. Existing screening to the east of this site should minimise views from the M11 motorway and Dublin-Rosslare rail line.

5.3 Shelton Abbey (IFI Site)

The placing of the 2 ha. Shelton site has satisfied all restrictive criteria and can be found in Appendix K. While this site position requires a longer rising main than elsewhere on the land parcel, it minimises the outfall length to the river. There is no need to construct an access track as the site is already somewhat developed, however there may be a need to raise the access track to mitigate against the flooding risk. The pipeline route corridor for his site avoids the pNHA Arklow Marsh. This site location increases the distance to nearest sensitive receptor to 250 m (site security kiosk). The total pipeline length required for this site is 3375 m. The site location utilises only the developed section of the land parcel and hence minimised the effect on agronomy & landuse of the area.

It was decided not to position the final site location on the Zone C flood zone. The Zone C portion of the land parcel is the site of the old carbon black & phosopgypsum landfill and extensive remediation works would be required if construction works were to go ahead here. The flood risk report has already identified that development on the chosen site location would not impact flood risk elsewhere significantly as the site is already protected. A minor loss of existing flood plain storage would occur if the embankment was raised upstream of the site to protect against the 1 in 1000 year (0.1% AEP) event. However, the volume is a tiny fraction of the overall flow rate (peak overspill flows are less than $1m^3/s$ compared to the $894m^3/s$ peak flow rate) and as a result raising the embankment would not significantly impact flood levels downstream.

6 Step 3 – Updated Matrices

The matrices were updated to reflect the site options as opposed to the land parcel options. This narrowing of land area enabled a more specific assessment to be completed.

These matrices can be found in Appendix L.

7 Step 4 – Combined Matrix

Completion of steps 1 – 3 above has resulted in the identification of three site options from the three short listed land parcel options and the combination of the individual matrices as developed by the environmental and technical specialists into one overall primary assessment matrix. This matrix was cross referenced and refined to remove sub-criteria which were determined as non-differentiating across all three site options. The resulting matrix can be seen in Appendix M.

8 Steps 5 – 8: Iteration Process

8.1 First Iteration matrix

The first iteration on the matrix involved the application of step 5 (identification of 'most favourable' cells – assignment of green colour) of the SA Methodology to the primary assessment matrix.

The sub-criteria for the site options were reviewed to determine which cells could be identified as 'most favourable'. Environmental sub-criteria which had no impact or where relevant, an imperceptible impact were highlighted green. Similarly the 'most favourable' cells across each of the technical sub-criteria were also coloured green.

The resulting matrix can be seen in Appendix N.

8.2 Second Iteration matrix

The second iteration of the matrix involved the application of the following steps from the SA Methodology to the primary assessment matrix.

Step 6 - Each environmental and technical specialist identified their worst or 'least favourable' cell and these cells were assigned an amber colour. The resulting matrix can be seen in Appendix O.

Step 7 – The matrix was reviewed to determine whether any site option with 'least favourable' classifications could be removed. It was determined that the 'least favourable' classifications assigned to the Shelton Abbey (IFI Site) site option were of such significance that it would be comparatively difficult to secure planning permission on this site. Also, the energy requirements for the Shelton (IFI Site) site option were considerably higher than that of the other two options. The Shelton Abbey (IFI Site) site option was therefore removed from the matrix and from further consideration.

The second iteration matrix resulted in the site option at Shelton Abbey (IFI Site) being ruled out for further consideration.

8.3 Third Iteration matrix

Similar to above, the third iteration on the matrix involved the application of the following steps from the SA Methodology to the primary assessment matrix.

Step 6 - Each environmental and technical specialist identified their worst or 'least favourable' cell and these cells were assigned an amber colour. The resulting matrix can be seen in Appendix P.

Step 7 – The matrix was reviewed to determine whether any site option with 'least favourable' classifications could be removed. It was determined that the 'least favourable' classifications assigned to the Kilbride option were of such significance that it was removed from the matrix and from further consideration. Refer to the third iteration matrix in Appendix P for reference.

9 Conclusions

Based on this assessment, the Ferrybank (Old Wallboard Factory) site has been identified as the emerging preferred site for the Arklow WwTP with the Kilbride and Shelton Abbey (IFI Site) sites having been identified as viable alternatives.

It must be noted that while Ferrybank (Old Wallboard Factory) has been identified as the emerging preferred site, Irish Water will not choose a final site location until the end of the Phase 2 consultation process, which is due to commence on 13th May 2015.

9.1 Next Steps

9.1.1 Phase 2 Consultation Process

Irish Water will be entering the second non-statutory public consultation period on the 13th of May 2015. This consultation period is set to last for eight weeks and will end on 10th July 2015. This consultation process will follow on from the methodologies adopted during the Phase 1 Consultation process and a "Phase 2 Factual Report" will be published later in 2015 with the findings of the process.

9.1.2 Environmental Impact Assessment

An Environmental Impact Assessment (EIA) should be carried out by the competent authority. The EIA Directive, Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment as amended by Council Directive 97/11/EC of 3 March 1997, Directive 2003/35/EC of 26 May 2003 and Directive 2009/31/EC of 23 April 2009, now codified in Directive 2011/92/EU of 13 December 2011, is designed to ensure that projects likely to have significant effects on the environment are subject to a comprehensive assessment of environmental effects prior to development consent being given (See Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, Department of the Environment, Community and Local Government, March 2013 which also refers to the applicable EU and Irish law provisions).

9.1.3 Appropriate Assessment

An Appropriate Assessment (AA) arises from the requirement under Articles 6(3) and 6(4) of Council Directive 92/43/EEC of 21 May 1992 (the "*Habitats Directive").* See also Part X of the Planning and Development Act 2000 (as amended and substituted). The potential for the development to have a likely significant effect either individually or in combination with other plans or projects on Natura 2000 sites (i.e. Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) shall be considered as part of an Appropriate Assessment process which is required under the Habitats Directive.






Appendix A – Marine & River Outfall Modelling

A

Document Ref. No. 1207/2/15P

Preliminary Report

Arklow WWTP
Investigation of the Impact of Treated Wastewater Discharges To Avoca River and Irish Sea

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15th April 2015

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Revision History	Note	Date
1207/1/15D	Draft issued to BL-PHMcCfor comment	5/4/15
1207/2/15P	Preliminary report issued	15/4/15

Glossary

ADF	Average Daily Flow
ATT	Admiralty Tide Tables
BOD	Biochemical Oxygen Demand
DIN	Dissolved Inorganic Nitrogen (as N)
DWF	Dry Weather Flow
EC	E.Coli
ELV	Emission Limit Value
EPA	Environmental Protection Agency
IHD	Irish Hydrodata Ltd
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWN	Mean Low Water Neap
MLWS	Mean Low Water Spring
NHA	National Heritage Area
OPW	Office of Public Works
PE	Population Equivalent
SAC	Special Area of Conservation
SS	Suspended Solids
T90	Decay time
T_{90}	E.Coli Decay Time
TA	Total Ammonia (as N)
TON	Total Oxidised Nitrogen (as N)
UWTR	Urban Wastewater Treatment Regulations
WFD	Water Framework Directive
WQ	Water Quality
WWTP	Wastewater Treatment Plant

1. Introduction

1.1 Background Information

Arklow is a significant urban centre on the east coast. It is served by an outdated sewage system from which untreated municipal wastewaters discharge directly into the harbour. A treatment plant has been in planning for a number of years and various detailed designs including marine outfall studies have been completed. Improved treatment technologies and plant operation now facilitate discharges to waterbodies which would not have been possible in the past. Recent investigative studies by consulting engineers Byrne Looby PHMcCarthy have identified additional potentially suitable treatment plant sites on the seafront and to the west of the town (Figure 1.1). This study seeks to examine the possible impacts of discharges to the nearby waterbodies from a plant located in either of these environs.

There are three waterbodies in the locality identified under the Water Framework Directive (WFD). These are listed in Table 1.1 and illustrated in Figure 1.2. The results of the WFD monitoring programme indicate that there are some water quality issues with the Lower Avoca river and the Avoca estuary. These relate to historic leakages from upstream mines and untreated municipal wastewater discharges to the estuary. Arklow has numerous sandy beaches, all of which are used extensively during the summer months. The beaches at Brittas Bay and Clogga (Figure 1.3) are designated bathing waters.

There are two marine SAC's in the vicinity; these are the Wicklow Head reef and the Blackwater Bank (Figure 1.4). The Arklow town marsh, located on the northern bank of the Avoca river, is a proposed NHA (Figure 1.5).

1.2 Study Brief

The purpose of the study was to:

- make an assessment of effects of treated wastewater discharges to the Avoca river and the Arklow coastal area;
- establish suitable effluent discharge standards;
- ensure compliance with all EC and national regulations;
- assess and compare potential outfall locations.

The brief called for various scenarios to be focused on. In the marine these include spring and neap tides and calm and windy conditions. The river discharge focused on 95%ile flows in the Avoca. Under the Urban Wastewater Treatment Regulations 2001 secondary treatment of effluent is mandatory. This will significantly reduce overall biological impacts. The main concerns regarding the proposed discharges are the impacts on nutrient levels and on bacterial concentrations in nearby bathing waters.

1.3 Regulatory Framework

The main regulatory constraints that apply to the discharges are:

* Urban Wastewater Treatment Regulations 2001 (SI 254/2001);
* European Communities (Water Policy) Regulations (SI 722/2003);
* European Communities Environmental Objectives (Surface Waters) Regs 2009 (SI 272/2009);
* Bathing Water Quality Regulations 2008 (SI 79/2008);
* European Communities (Quality of Salmonid Waters) Regulations 1988 (SI 293/1988).

1.4 Summary of Study Works

The study consisted of a review of available data and previous reports. (Irish Hydrodata Ltd conducted outfall investigations for the Arklow WWTP in 1985, 1991 and 2005). Subsequently hydrodynamic & water quality models were constructed to simulate the impacts of the proposed discharges, allow comparisons to be made and suitable discharge standards to be set.

Waterbody	Risk Scores	WFD Status 2012	Quality
Avoca Lower River	At risk of not achieving Good	Unassigned	Moderate
Avoca Estuary Transitional	At risk of not achieving Good	Moderate	Intermediate
Coastal, Brittas Bay HA10	Expected to achieve Good	Good	Unpolluted

Table 1.1 - Local WFD waterbodies.

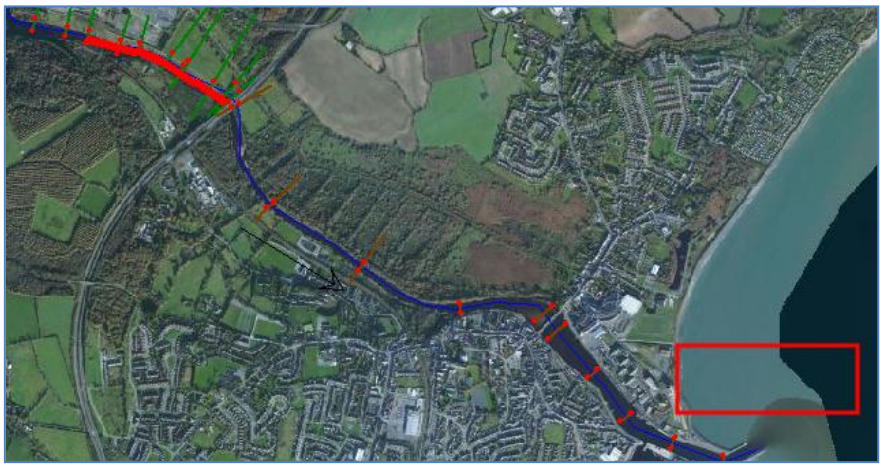


Figure 1.1 – Potential outfall points on Avoca river or to coastal waterbody

Figure 1.1 - Local WFD waterbodies:

Avoca River, Avoca Estuary, Brittas Bay (HA10)

Figure 1.2 - Designated bathing waters

Figure 1.3 - Wicklow Head (SAC 2274), & Blackwater Bank (SAC 2953)

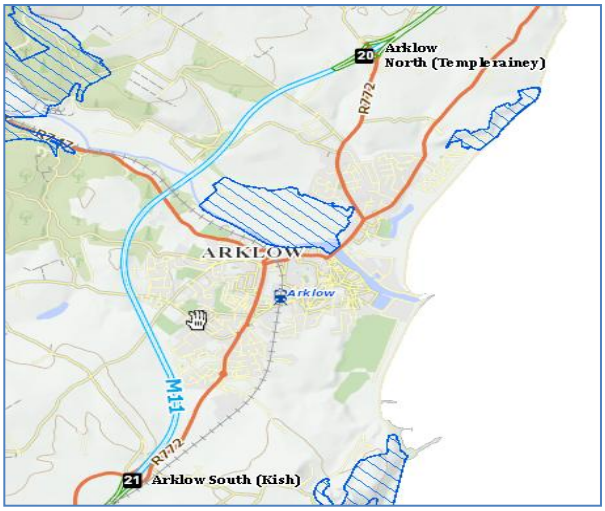


Figure 1.4 - Proposed NHA sites

2. Area Characteristics

2.1 Coastal Bathymetry

The general bathymetry for the Arklow area is available on the Admiralty chart of the area (ref:1) and is presented in Figure 2.1.

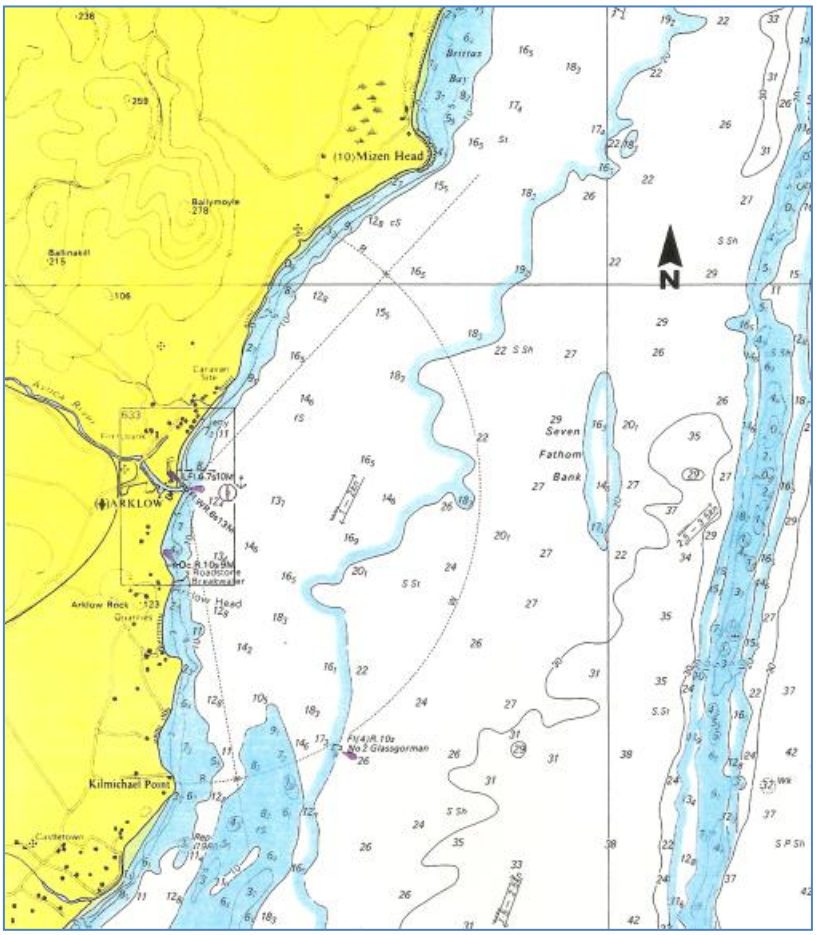


Figure 2.1 - Coastal bathymetry

2.2 Tidal Levels

Tidal patterns in the locality are semi-diurnal. Ranges are small and the tidal elevation curves are somewhat complex due to the proximity of a degenerate amphidrome near Courtown (ref:2). The Admiralty Tide Tables (ATT) publication NP-201-15 (ref: 3) provides summary tidal level information for Arklow based on historic information. This data is presented in Table 2.1. In 1985 Irish Hydrodata Ltd (IHD) conducted detailed studies in the area as part of outfall investigations (ref:4). Digital tidal data was collected for 30 days and fully analysed. Derived statistics are also included in Table 2.1. The OPW operate a water level recorder in Arklow Docks (Figure 2.2). Comparison of the OPW data with IHD data indicates that the ATT are underestimating the statistical water levels by between 0.05 and 0.15m. Therefore the IHD data is used for this study.

Figure 2.3 shows a prediction of water levels for 2015 relative to Malin Head datum. The associated percentage exceedance plot is shown in Figure 2.4.

Tide	Tide	ATT Level OD Malin	IHD Level OD Malin
MLWS	Mean high water springs	-0.53	-0.44
MLWN	Mean high water neaps	-0.23	-0.14
MHWN	Mean low water neaps	0.07	0.12
MHWS	Mean low water springs	0.27	0.42

Table 2.1 - Summary tidal statistics

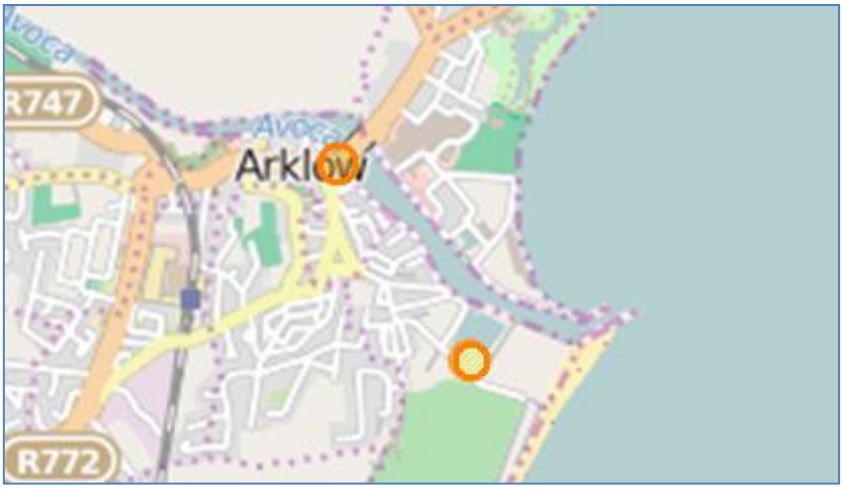


Figure 2.2 - OPW water level gauge locations. (www.waterlevel.ie)

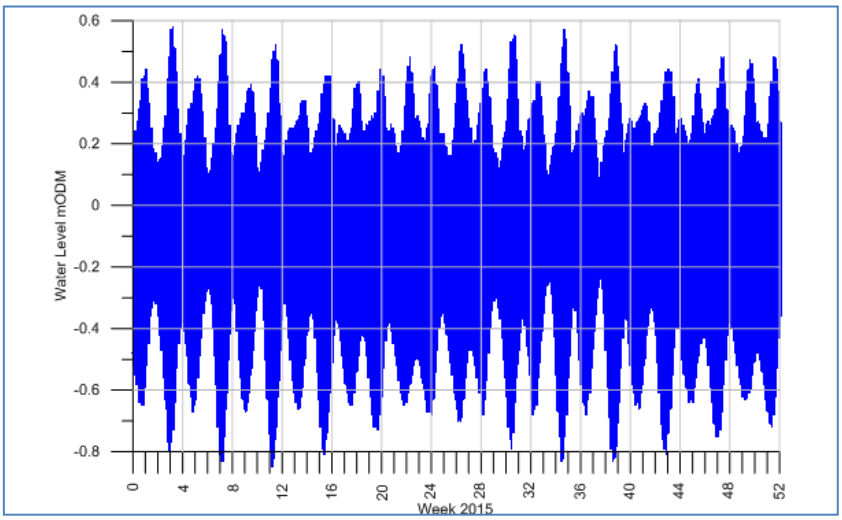


Figure 2.3 - Hourly tidal prediction for 2015 relative to Malin Head datum

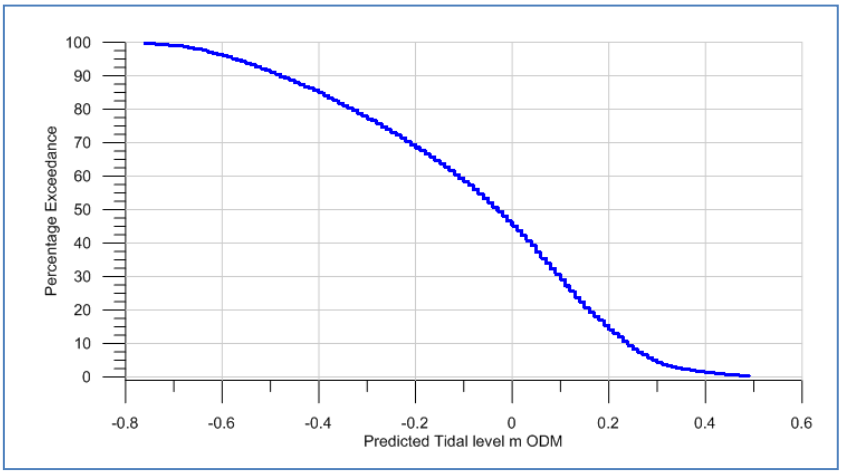


Figure 2.4 - Percentage exceedance of tidal level for 2015

2.3 Coastal Oceanography

Previously Irish Hydrodata Ltd conducted detailed studies at Arklow for various marine long sea outfalls and a possible river discharge. These studies were conducted between 1985 and 2005 (refs:4-6). The information on physical characteristics of the coastal waterbody obtained for those investigations has been used in this study. Example data are presented in Figures 2.5 to 2.11. The oceanography can be described as energetic with strong tidal currents, brief slack waters, large tidal excursions and good dispersive characteristics. Table 2.2 summarises information from the 1985 study.

A recording current meter was deployed for 30 days during the 1985 survey. This was located approximately 1000m east northeast from the harbour mouth on the then proposed outfall line (Figure 2.10). It was positioned at a height of 1.5m above the seabed. The 95%ile speed recorded at the current meter location was 0.05m/s (Figure 2.11).

	Current Speeds m/s		Drogue Excursions	
Tide	Flood	Ebb	Flood	Ebb
Spring	0.66	0.59	15km	15km
Neap	0.42	0.35	11km	6km

Table 2.2 - Summary depth averaged oceanographic information

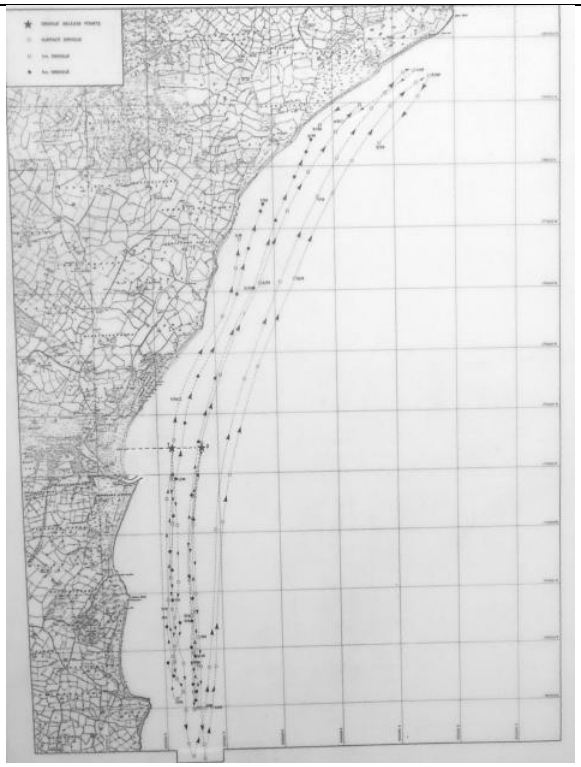


Figure 2.5 - Spring Tide Drogue Release

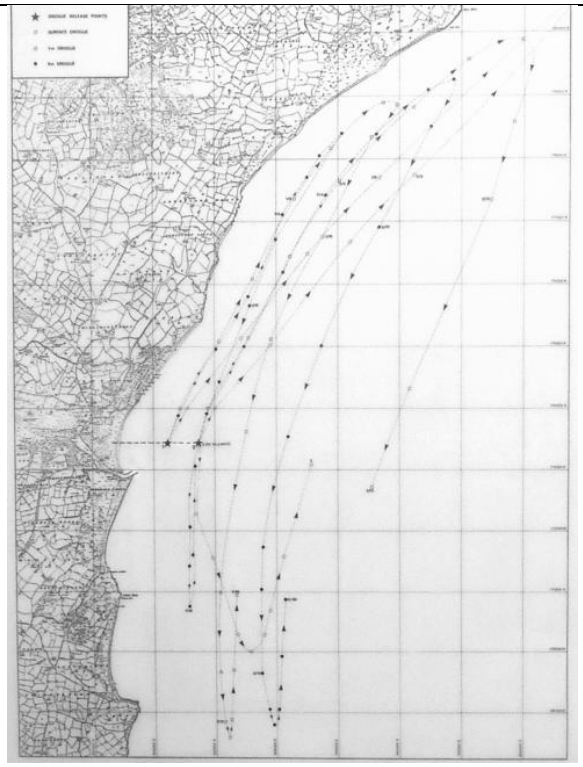


Figure 2.6 - Spring Tide Drogue Release

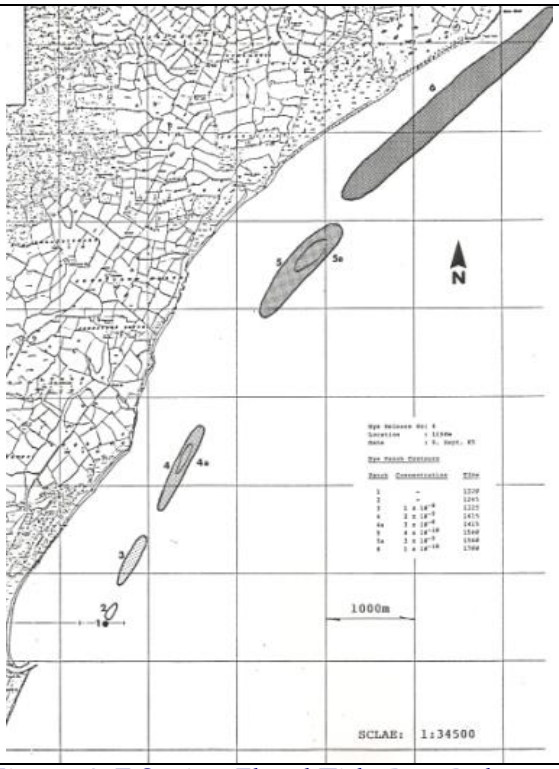


Figure 2.7 Spring Flood Tide Dye Release

Figure 2.8 - Harbour Drogue Release

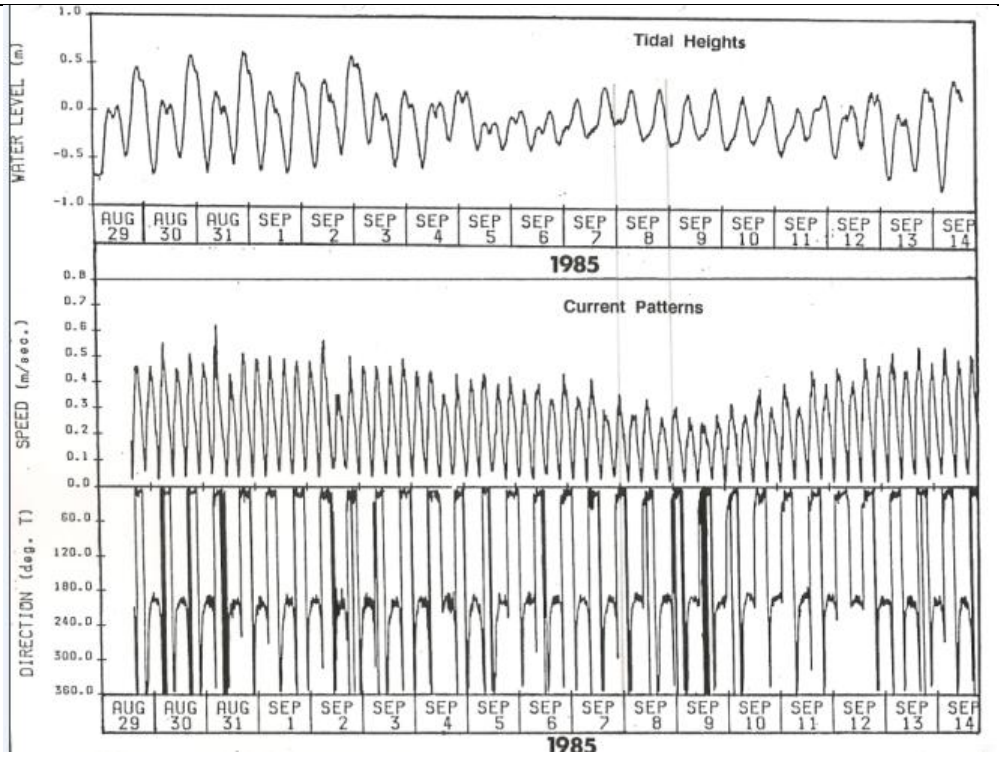


Figure 2.9 - Current meter data from previous study (ref:4)

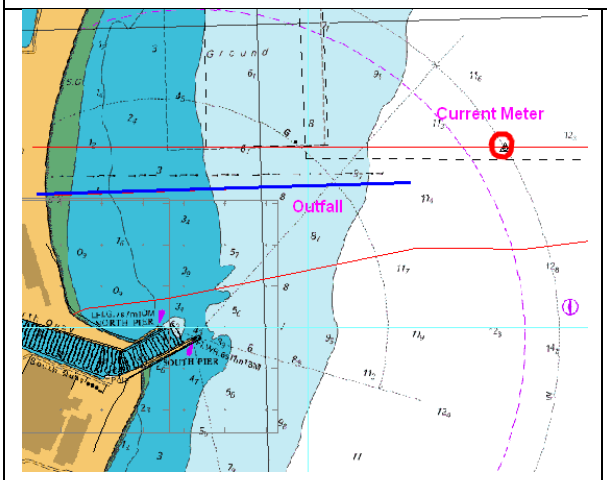


Figure 2.10 – Recording current meter location and proposed outfall line

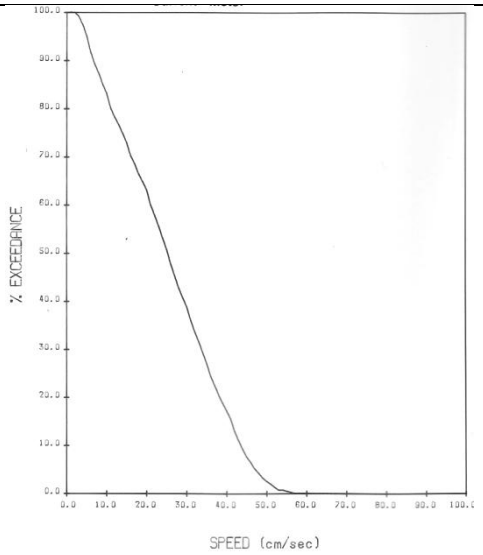


Figure 2.11 – Current speed exceedence plot

2.4 Avoca River

The Avoca river is a substantial waterbody with a primarily upland catchment of some 650m^2. From Woodenbridge to the sea the river bed profile is relatively flat with a gradient of about 1:700. Topographic data was collected as part of the overall investigations (ref:7). Figure 2.12 shows the locations of the channel profiles. The main river channel is typically rectangular and 50 to 70m wide (Figure 2.13). In the lower reaches two weir type structures control the river levels, one at the town bridge (crest level approx 0.3 m below Malin) and the other (crest level approx 0.44 below Malin)

approximately 250m upstream of the N11 bridge (Figure 2.14). The weir at the town is part of the bridge structure while the one upstream is a rubble construction. The longitudinal profile in Figure 2.14 shows that the river water surface profile is influenced by tidal levels for a distance of almost 5km upstream from the harbour mouth. The tidal statistics from Table 2.1 are shown overlain on the river profile. The modelled profile is for a river flow of 3.09m^3/s. (details of the model are described in Section 4.3). Saline intrusion has not been detected in EPA sampling at Station RS10A031100 which is located approximately 2.9km from the harbour mouth. The Avoca flow characteristics based on EPA Hydrometric data system are: DWF = 0.8 m^3/s, 95%ile = 3.09 m^3/s and 50%ile = 15 m^3/s.

Figure 2.12 - River topographic section locations

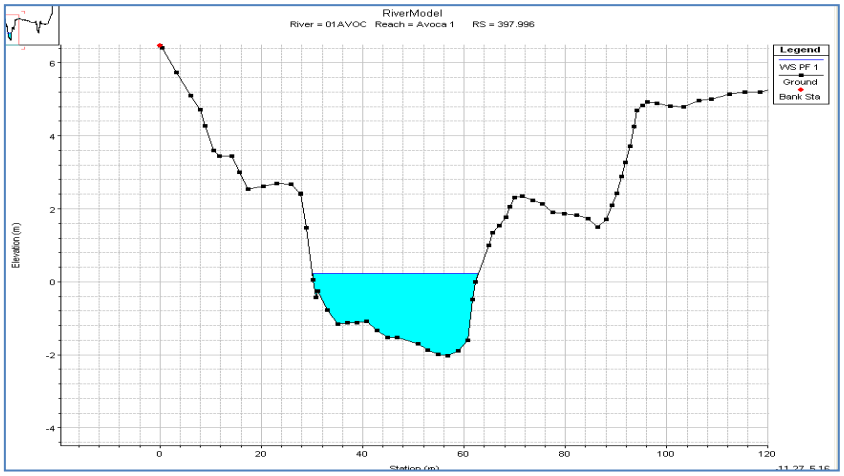


Figure 2.13 - Typical river cross-section.

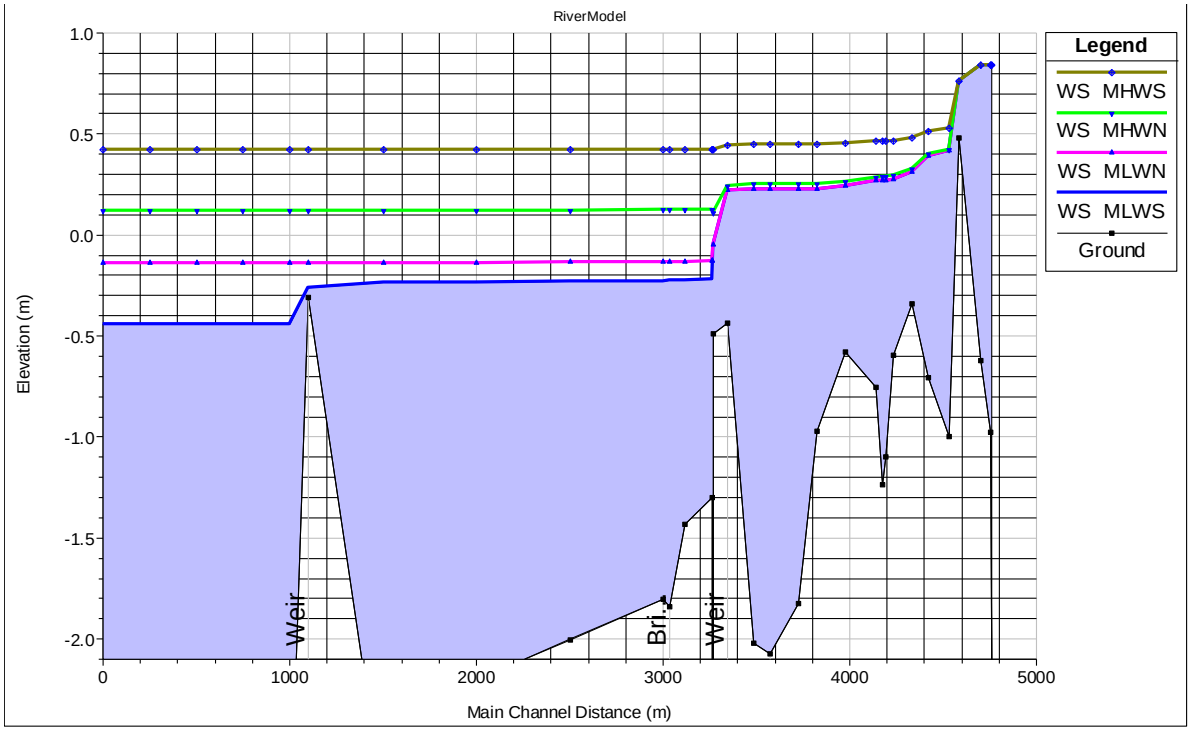


Figure 2.14 - River longitudinal section, modelled water profiles for Q=3.09m^3/s

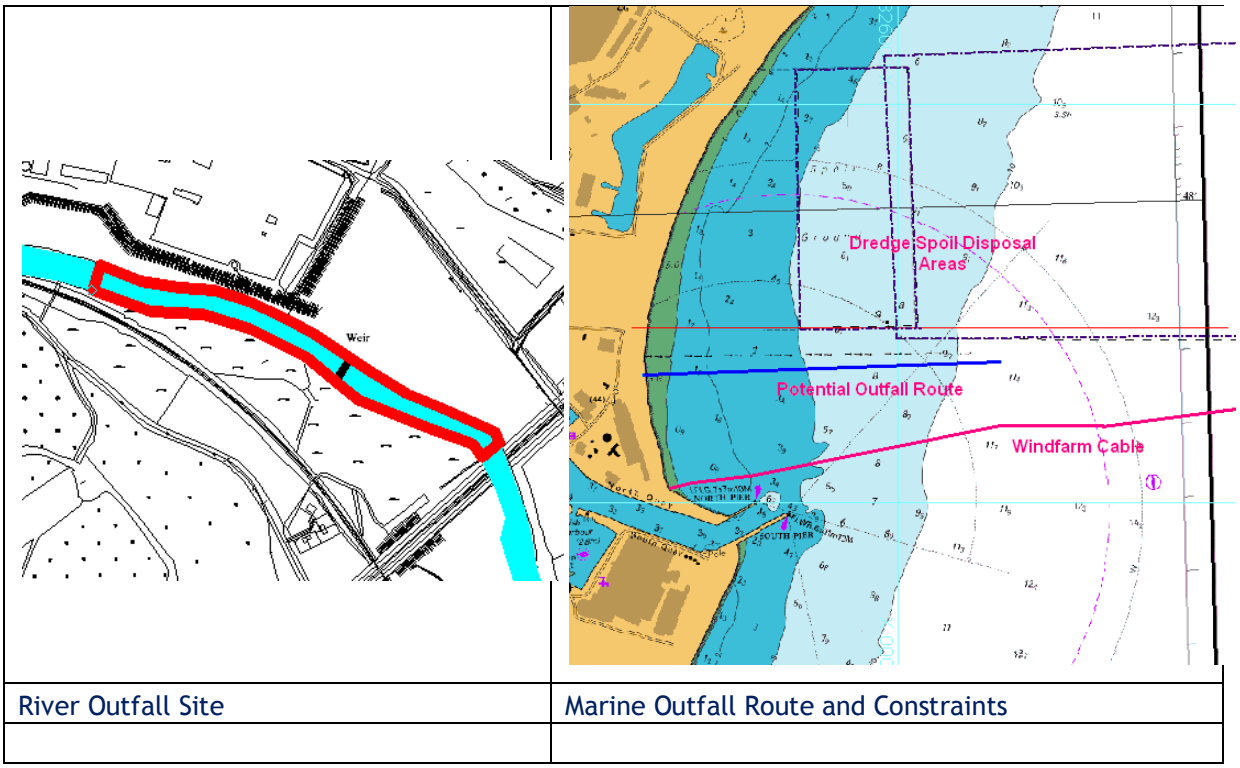
3. Design Parameters

3.1 WWTP Design Requirements

The proposed WWTP will be constructed in two phases. Phase 1 has a design population equivalent (p.e.) of 18,000p.e. while for Phase 2 it doubles to 36,000p.e. The longer term p.e. is used in this study. The associated discharge dry weather flow (DWF) is 0.101 m^3/s and the average flow is 0.127 m^3/s.

The potential WWTP outfall locations being considered in this study are indicated in Figure 3.1. The precise locations of any plant, structure or associated outfalls have yet to be decided. In the case of the upstream river outfall a potential discharge point will lie somewhere within a 500m reach. Apart from the local mixing zone the overall assimilative capacity is dependent on the river flows and not the precise location. Nutrient levels are the defining factor in determining suitability.

For the marine outfall the discharge point may be moved further offshore to provide more dilution and dispersion and therefore less treatment in the plant. There are additional constraints at this location in the form of the Arklow Bank windfarm cable and the proximity of licenced dredge spoil disposal sites. The proposed outfall route lies within the cable exclusion corridor and any works would require detailed investigation and consultation.



River Outfall Site	Marine Outfall Route and Constraints

Figure 3.1 - Potential outfall locations

3.2 WWTP Discharge Characteristics

The proposed p.e. for the plant is greater than 10,000 therefore secondary treatment is required in accordance with the UWWT regulations. None of the local waterbodies have been designated 'Sensitive' and therefore minimum design parameters for the plant are as listed in Table 3.1.

Parameters	Concentration	Minimum Percentage Reduction
BOD_5	25mg/l O_2	70-90
COD	25mg/l O_2	75
TSS	35 mg/l	90

Table 3.1 - Urban Wastewater Treatment Regulations requirements

A river discharge has the potential to impact three waterbodies while the coastal discharge will impact only one. The target water quality standards for such waterbodies are listed in Table 3.2. The primary objectives are to satisfy the 'Good Status' for river waters and the 'High Status' for coastal waters.

There are no designated bathing waters nearby (Clogga Beach is 3km south of the harbour). However for the purposes of this study the Bathing Water Quality Regulations (2008) are considered to apply to all coastal beaches immediately to the north and south of the harbour mouth. The Avoca is not a designated salmonid water.

Parameter	River Waters	Transitional	Coastal Waters
	Target	Target	Target
BOD (mg O_2/l)	High Status[1] (mean/95%ile) 1.13/2.2 Good Status[1] (mean/95%ile) 1.5/2.6	[1]4.0mg/l (95%ile)	
SS mg/l	[3]25 mg/l		
Total Ammonia (mg N/l)	High Status[1] (mean/95%ile) 0.04/ 0.09 Good Status[1] (mean/95%ile) 0.065 / 0.140		[2]0.03mg/l 95%'ile
MRP (mg P/l)	High Status[1] (mean/95%ile) 0.025 / 0.045mg/l Good Status[1] (mean/95%ile) 0.035 / 0.075	0.06mg/l (0-17psu) 0.04mg/l (34psu) median	
DIN (mg N/l)			Good Status[1] <2.6mg/l(0psu) <0.25mg/l(34.5psu) High Status[1] <0.17mg/l(34.5psu)
Bathing Waters E coli *	(Excellent Quality)[4] <500 ec/100ml (95%ile) (Good Quality)[4] <1000 ec/100ml (95%ile)	(Excellent Quality) <250 ec/100ml (95%ile) (Good Quality)[4] <500 ec/100ml (95%ile)	(Excellent Quality)[4] <250 ec/100ml (95%ile) (Good Quality)[4] <500 ec/100ml (95%ile)

Table 3.2 - Target water quality standards

[1] SI 272/2009 (Surface Waters)
[2] EPA Discussion Document (1997)
[3] *SI 273 98 (Salmonid Waters)*
[4] SI 79/2008,2006/7/EC

4. River Outfall Evaluation

4.1 Analysis Methods

The potential impacts of the proposed discharges from a river outfall were assessed using various calculations and hydraulic modelling methods. These included:

1. Mass balance calculation;
2. Travel time estimates (HEC_RAS model);
3. Coastal contaminant dispersion modelling.

Key lineal dimensional features of the river reach are outlined in Table 4.1.

Feature	Distance m
Assumed River Outfall Location	0
EPA sampling station 10A031100	650
Sigma Aldrich P0089-05	750
Transitional Waters –Avoca Estuary	1300
Coastal Waters - Irish Sea	3600
Arklow Bathing Beachs	3700
Clogga Beach (South)	6700
Brittas Beach (North)	13700

Table 4.1 - Dimensional features

Table 4.2 shows the potential dilutions available assuming complete mixing based on flow values.

River State	River Flow	Dilution
DWF	0.8 m^3/s	7.8
95%ile	3.09 m^3/s	24
50%ile	15 m^3/s	118

Table 4.2 - Dilution of WWTP discharge by river waters

4.2 Mass Balance Calculations

The objective of this calculation is to estimate discharge ELV's that will ensure that the downstream river water concentrations meet the WQ targets outlined in Table 3.2. A mass balance calculation was performed for the average effluent flow (Q_{eff} = 0.127m^3/s). The background water quality was taken from EPA site 10A031100.

Table 4.3 shows the computed downstream concentrations. The proposed ELV's have been chosen to ensure the concentrations remain well below the target levels for 'Good

Status' under Environmental Objectives (Surface Waters) Regulations 2009. The discharges will also comply with European Communities (Quality of Salmonid Waters) Regulations 1988 as both suspended solids and un-ionised ammonia levels (based on TA and ref:8) will be below the required limits.

Parameter	Background Conc. *10A031100*	Proposed ELV	Downstream Conc.	Contribution from discharge	Good SWR 2009
	mg/l	*mg/l*	*mg/l*	*mg/l*	*mg/l*
BOD	1.2	10	1.55	0.35	<2.6
SS	9.4	35	10.41	1.0	-
PO4-P	0.007	1	0.046	0.039	<0.075
Total Ammonia -N	0.071	1	0.108	0.037	<0.14

Table 4.3 - Computed concentrations after full mixing

An industrial facility, Sigma Aldrich Ireland Limited, is located approximately 750m downstream of the assumed outfall location. This facility discharges treated waste waters to the Avoca under IPC licence P0089-05. In view of the relatively short distance the mass balance calculations have been repeated taking both discharges to assess the impact on the river further downstream. The predicted concentrations and the WWTP ELV's required to meet target WQ limits for this scenario are presented in Table 4.4.

Parameter	Background Conc.	Proposed ELV	Downstream Conc.	Contribution from discharge	Good SWR 2009
	mg/l	*mg/l*	*mg/l*	*mg/l*	*mg/l*
BOD	1.67	10	2.00	0.33	<2.6
SS	10.0	35	10.98	0.98	-
PO4-P	0.011	0.7	0.038	0.027	<0.075
Total Ammonia -N	0.114	0.7	0.137	0.023	<0.14

Table 4.4 - Computed concentrations after full mixing, increased background

Note: River Background from sampling pt 10A031100 and contribution from P0089-05

Note: Calculations based on river 95%ile flow (3.09m^3/s) and WWTP AvF (0.127m^3/s)

4.3 Downstream E.coli Concentration Estimates

Discharges to the river travel downstream to the sea at a rate that is dependent on the river flow. The treated wastewater initially has a high coliform count (1 x 10^6 ec/100ml). This is diluted by the river waters and as it moves downstream bacterial die-off takes place. The die-off rate is defined in terms of a T_{90}, the time for a 90% reduction in levels. The T_{90} value varies depending on the physical conditions such as water depth, sunlight, temperature and water quality. Literature indicates that the typical values range from 4-10 hours. For the purposes for this study a more conservative value of 12 hours has been adopted.

The cumulative travel times in the river for a range of flows were computed with a HEC-RAS model (ref:9). The model used river cross-section data mentioned in Section 2.4. The downstream boundary elevation was taken to be the MLWS level to produce a worst case scenario. The computed e.coli concentrations as a function of river flow are presented in Figure 4.1. The worst case occurs when river flows are about 15m^3/s and travel times are reasonably quick. At lower flows the travel time is longer and decay reduces concentrations. At the higher flows the greater volume of river water available for mixing also helps to reduce concentrations.

The predicted bacterial concentrations at the harbour mouth for two flows are presented in Table 4.5. Once the river exits the harbour mouth further dilutions are available. The coastal model (described in the next section) indicates that peak levels on the nearby beaches (Table 4.6) will be within the 'excellent' category limit (<250 ec/100ml) as defined by the Bathing Water Quality Regulations 2008 during low flow conditions and well within to the 'Good' category limit (<500 ec/100ml) during higher winter flows.

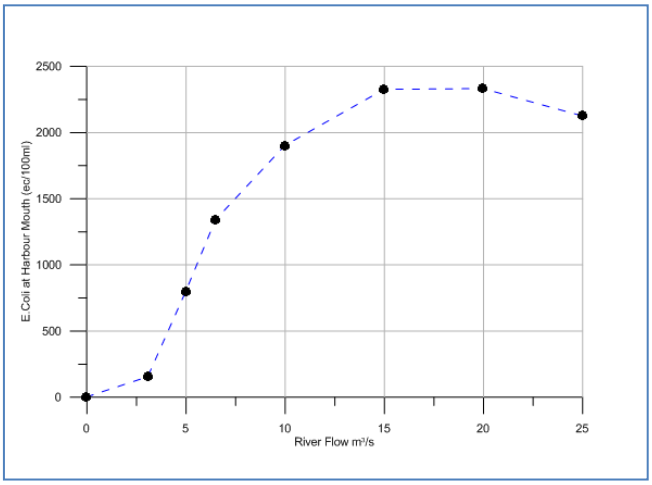


Figure 4.1 - Predicted e.coli concentration at harbour mouth vs river flow

River Flow	Travel Time from Discharge Location	E.coli Concentration in River Waters at Harbour Mouth ec/100ml
Q = 3.09 m^3/s	55 hrs	154
Q = 15.0 m^3/s	5.75hrs	2342

Table 4.5 - Predicted e.coli concentrations at harbour mouth.

	Neap Tide				Spring Tide			
	Calm		Wind		Calm		Wind	
Flow m^3/s	Beach		Beach		Beach		Beach	
	North	South	North	South	North	South	North	South
3.09	3	6	5	4	2	3	3	4
15.0	220	438	280	260	91	160	197	280

Table 4.6 - Predicted e.coli concentrations on bathing beaches ec/100ml

5. Marine Outfall Evaluation

5.1 Analysis Methods

The potential impacts of the proposed discharges on the marine waters were assessed using various calculations and hydraulic modelling methods. These included:

1. Initial Dilution Simulations;
2. Water Circulation Modelling;
3. Contaminant Dispersion Modelling.

For method 1 a jet type model was used to estimate near-field dilutions at the discharge locations. Method 2 uses bathymetry and tides to simulate hydrodynamic patterns in the wider far-field area. Method 3 uses contaminant simulations, driven by hydrodynamics of method 2, to evaluate the location-specific impacts of discharges within the mid and far-field areas.

5.2 Discharge Characteristics

The WWTP will provide secondary treatment as a minimum under Urban Wastewater Treatment Regulations 2001. Table 5.1 lists water quality standards that are achievable with a modern plant.

Parameter	Abbreviation	Design Value
Population Equivalent	PE	36000 pe
Dry Weather Flow	DWF	0.101 m^3/s
Average Daily Flow	ADF	0.127 m^3/s
Discharge Standards		
Biochemical Oxygen Demand	BOD	25mg/l
Suspended Solids	SS	35mg/l
Total Ammonia (as N)	TA	10mg/l
Total Oxidised Nitrogen (as N)	TON	35mg/l
Dissolved Inorganic Nitrogen (as N)	DIN	45mg/l
E.Coli	EC	1 x 10^6 ec/100ml
E.Coli Decay Time	T_{90}	12 hours

Table 5.1 - Discharge standards used in the outfall assessment

Target water quality values for coastal waters on the basis of various regulations were outlined in Table 3.2. Only three of these are of particular significance for the marine outfall configurations being examined. These are e.coli, total ammonia and DIN. The relatively high levels of bacterial contamination in the treated effluent mean that this is

usually the most critical parameter in outfall evaluation when bathing areas are located nearby.

5.3 Potential Outfall Locations

Three offshore discharge locations were examined, each moving further to the east from the shoreline. The locations are shown in Figure 5.1. A discharge from the harbour mouth was also considered to facilitate evaluation of the impact of a river outfall. Summary information for each discharge location is presented in Table 5.2. The outfall length is measured from the low water mark.

Outfall Location	Pipe Length	ING Easting (m)	ING Northing (m)	Bed Level (m) CD	Depth (m) OD Malin
1	400	325770	173330	5	6.1
2	650	326020	173340	9.5	10.6
3	900	326270	173350	11.0	12.1
4	Harbour Mouth	325698	173000	4.5	5.6

Table 5.2 - Potential outfall locations

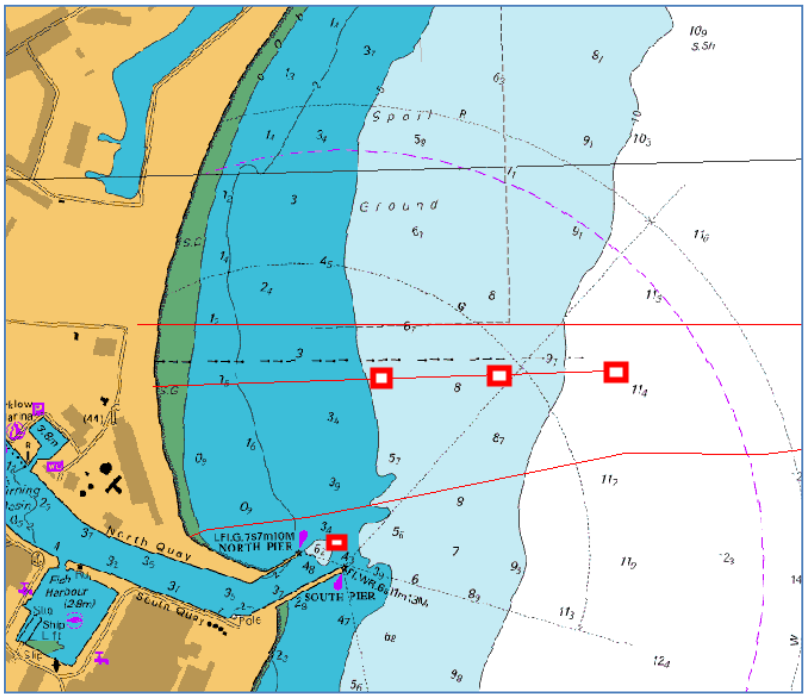


Figure 5.1 - Potential outfall locations

5.4 Initial Dilutions at Outfall Discharge Locations

Initial dilution calculations were carried out for the MLWS tide level conditions. The discharges, located near the seabed, come to the surface in a plume at a rate dependant on the buoyancy forces arising from temperature and salinity differences between the effluent and ambient waters. Estimates of initial dilutions were made with the IJP model (ref:10). Calculations were made for a 6-port diffuser configuration and a range of current speeds. The speed data is based on the current meter exceedance profile shown in Figure 2.10. Table 5.3 presents dilutions and associate displacement of the surface plume centroid from the discharge location in the direction of the current. Diffuser ports are 10m apart and plumes from each of the six remain separate in the early stages of dilution.

For the simulated configuration both the 650m and the 900m long outfalls would meet the 95%ile initial dilution target of 50 considered necessary to eliminate any slicks or odours (ref:11). Even at slack water dilution for the 900m outfall is above the target level. The initial dilution available for the 400m outfall is very much reduced due to the shallow waters at the discharge point.

	400m Outfall		650m Outfall		900m Outfall	
Tide Level = MLWS	**Dilution**	**Displ**	**Dilution**	**Displ**	**Dilution**	**Displ**
Current Speed = 0m/s	21	0	40	0	55	0
Current Speed = 0.05m/s (95%ile)	33	5	67	7	98	8
Current Speed = 0.26m/s (50%ile)	87	16	208	27	322	40
Current Speed = 0.43m/s (10%ile)	115	25	282	50	450	70

Table 5.3 - Predicted initial dilutions and displacements (ADF = 127 l/s, 6 ports, port diameter = 0.16m, , port spacing = 10m).

For comparative purposes the dilution estimates for the 95%ile tidal current have been used to calculate the near-field concentration of the parameters BOD, SS, TA, DIN and EC. Background concentrations have been taken from EPA data for Southern Irish Sea HA10 (2007-2009). The results are presented in Tables 5.4-5.7 and show that in almost all cases a relatively small amount of additional mid-field dilution (<10 fold) will bring these parameters below target WQ levels. The exception is e.coli for which results show that additional dilutions of up to 118 will be required.

Parameter	Treated Eff. Conc	Background Conc.	Conc After I.D.	Target Level	Additional Far Field Dilution Reqd
BOD (mg/l O2)	25	2	2.68	4	-
SS (mg/l)	35	2	2.48	2	1.5
DIN (mg/l N)	45	0.157	1.476	01.37	8.1
T Amm (mg/l N)	10	0.02	0.314	0.03	10.45
EC fc/100ml	1×10^6	20	29431	250	118

Table 5.4 - 400m Outfall, Eff Q = 0.127m^3/s, Initial Dilution = 33 (95%ile current)

Parameter	Treated Eff. Conc	Background Conc.	Conc After I.D.	Target Level	Additional Far Field Dilution Reqd
BOD (mg/l O2)	25	2	2.34	4	-
SS (mg/l)	35	2	2.48	2	-
DIN (mg/l N)	45	0.157	0.81	0.17	4.2
T Amm (mg/l N)	10	0.02	0.167	0.03	5.2
EC fc/100ml	1×10^6	20	14726	250	59

Table 5.5 - 650m Outfall, Eff Q = 0.127m^3/s, Initial Dilution = 67 (95%ile current)

Parameter	Treated Eff. Conc.	Background Conc.	Conc After I.D.	Target Level	Additional Far Field Dilution Reqd
BOD (mg/l O2)	25	2	2.23	4	-
SS (mg/l)	35	2	2.33	2	1.2
DIN (mg/l N)	45	0.157	0.61	0.17	3.6
T Amm (mg/l N)	10	0.02	0.121	0.03	4.0
EC fc/100ml	1×10^6	20	10121	250	40

Table 5.6 -900m Outfall, Eff Q = 0.127m^3/s, Initial Dilution = 98 (95%ile current)

Parameter	Treated Eff. Conc	Background Conc.	Conc After I.D.	Target Level	Additional Far Field Dilution Reqd
BOD (mg/l O2)	25	2	2.26	4	-
SS (mg/l)	35	2	2.38	2	1.2
DIN (mg/l N)	45	0.157	0.667	0.17	4.0
T Amm (mg/l N)	10	0.02	0.133	0.03	4.5
EC fc/100ml	1×10^6	20	11383	250	46

Table 5.7 - 400m Outfall, Eff Q = 0.127m^3/s, Initial Dilution = 87 (50%ile current)

Parameter	Treated Eff. Conc	Background Conc.	Conc After I.D.	Target Level	Additional Far Field Dilution Reqd
BOD (mg/l O2)	25	2	2.11	4	-
SS (mg/l)	35	2	2.16	2	1.1
DIN (mg/l N)	45	0.157	0.372	0.17	2.2
T Amm (mg/l N)	10	0.02	0.068	0.03	2.3
EC fc/100ml	1×10^6	20	4805	250	19

Table 5.8 - 650m Outfall, Eff Q = 0.127m^3/s, Initial Dilution = 208 (50%ile current)

Parameter	Treated Eff. Conc.	Background Conc.	Conc After I.D.	Target Level	Additional Far Field Dilution Reqd
BOD (mg/l O2)	25	2	2.07	4	-
SS (mg/l)	35	2	2.1	2	-
DIN (mg/l N)	45	0.157	0.296	0.17	2
T Amm(mg/l N)	10	0.02	0.051	0.03	2
EC fc/100ml	1×10^6	20	3116	250	12

Table 5.9 - 900m Outfall, Eff Q = 0.127m^3/s, Initial Dilution = 322 (95%ile current)

5.5 Water Circulation Modelling

Tidal circulation in the coastal waters off Arklow was investigated with a 2-dimensional numerical model M2D (ref: 12). The model is a general-purpose modelling package for simulating flow and transport in surface water systems. The configuration used for this study is suited to mid and far-field simulations, i.e. away from the immediate discharge point. The model has been used in various formats for earlier studies on the Arklow outfall (ref:5,6).

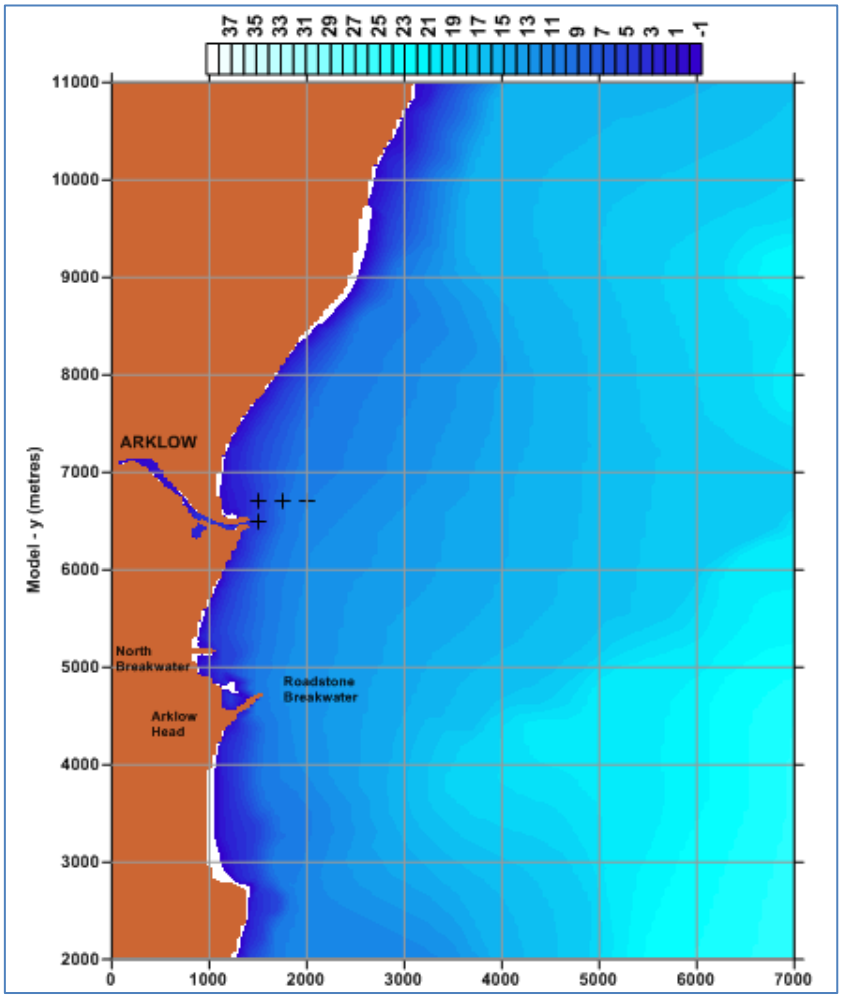


Figure 5.2 - Arklow model extents and bathymetry (chart datum)

The circulation model employed a 50 x 25m rectangular grid centred on Arklow. Bathymetry was taken from Admiralty Chart No. 1787 (Figure 2.1) mapped onto the spatial grid. The model was used to simulate typical conditions using spring and neap tidal ranges as outlined in Table 2.1. The model was calibrated with tidal elevation, current meter and drogue and dye track data (ref:4-6). Initial runs with typical coefficient settings were found to reproduce the observed tidal elevations to an acceptable level. Simulated drogue tracks closely resembled measured data (Figures 5.3, 5.4).

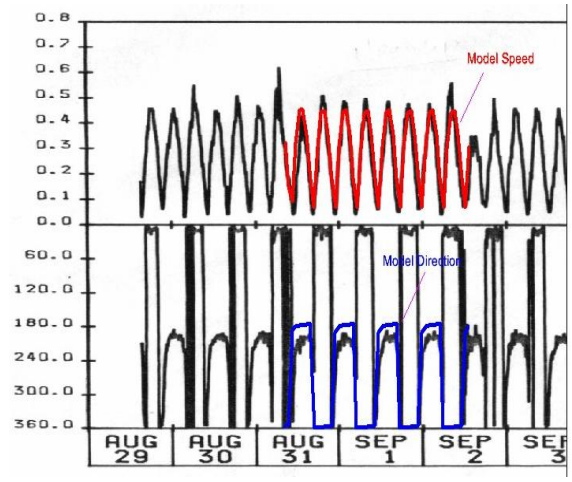


Figure 5.3 - Comparison of modelled and measured currents.

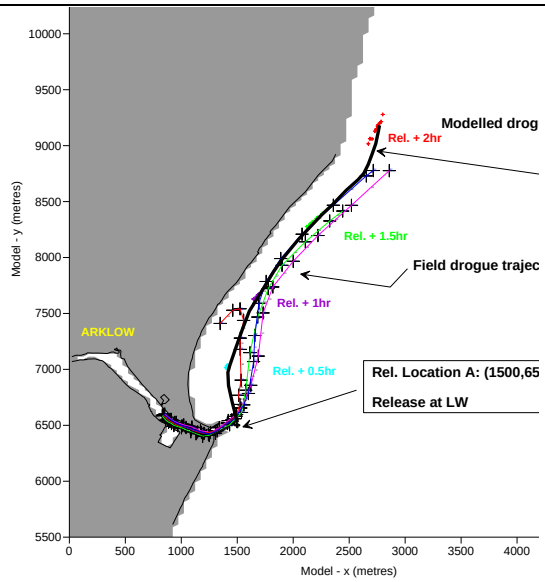


Figure 5.4 - Comparison of modelled and measured drogue trajectories

5.6 Contaminant Dispersion Simulations

The contaminant dispersion module LAG (ref:13) was used to simulate far-field dispersion. In this module the effluent stream is simulated as a continuous stream of particles. These particles are advected and dispersed through the model domain and then used to calculate contaminant concentrations at different horizontal locations and at different stages of the tide. Particle positions are tracked at 1m resolution in the model domain. Outputs are in the form of contour plots of parameter concentration as shown in Figure 5.5 or as time series at a point as shown in Figure 5.6.

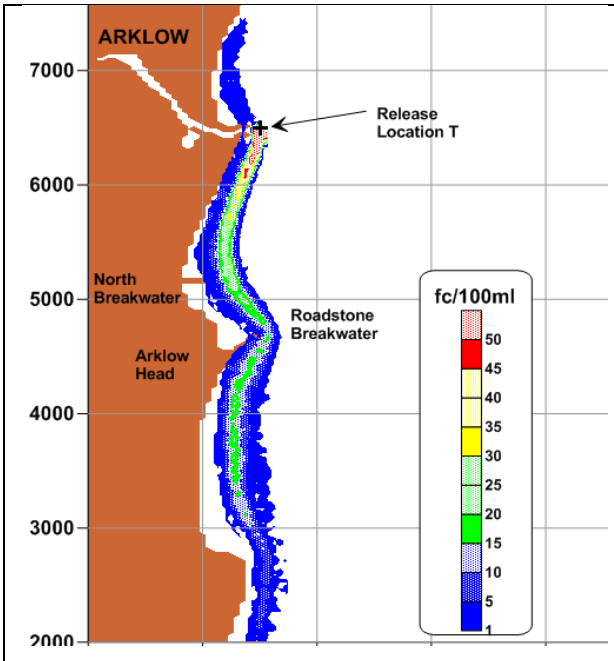


Figure 5.5 - Model Concentration Plot

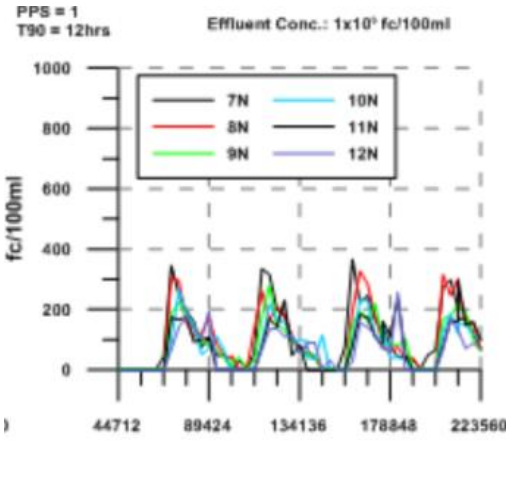


Figure 5.6 - Model Time Series Plot

While the concentration and time series plots provide a visual appreciation of plume dynamics a more quantitative method is required to allow comparison and evaluation of the outfall options and to assess the likely impact of the discharges on bathing waters. For this reason the shoreline area was divided up into a series of sampling strips as shown in Figure 5.7. Each of the strips is 100 wide and extends 200 m from the shoreline. There are 17 strips to the north of the harbour and 18 to the south. During the modelling process the highest average concentration in any model cell (50m x 25m) in each sampling strip is extracted at each time step and tabulated.

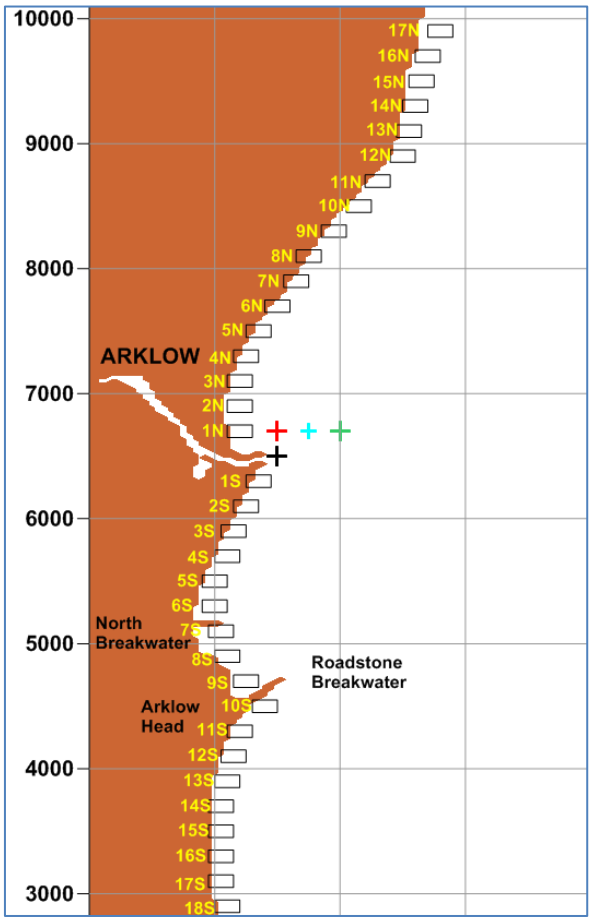


Figure 5.7 - Model sampling strips for effluent concentration estimates

Simulation of E.Coli Concentrations

Simulations of e.coli dispersion were conducted from each of the three outfalls. Model runs were conducted for both neap and spring tides for calm and windy conditions. The effect of wind was examined as a global parameter increase in contaminant diffusion rates applied to calm spring and neap flow fields. The effective wind speed was taken to be 7.5m/s.

Model results in the form of coliform concentration contours for the 900m outfall option are shown in Figures 5.8 to 5.11. The maximum concentration value at each of the

sampling location, to the north and south of the harbour mouth, was extracted from the timeseries plots and are summarised in Table 5.10. Elevated shoreline concentrations are predicted from the 400m outfall during both calm and windy conditions. The 650m outfall also produced high levels during windy conditions while the models indicate that the shoreline levels arising from the 900m outfall remain below the target 'Excellent' category limit of 250 ec/100ml.

Analysis of the local wind climate conducted for a previous outfall study (ref:5) showed that during the summer months winds with an onshore component occur for approximately 30% of the time. Thus both the 400m and 650m outfalls would require additional disinfection if the discharges are to comply with the bathing water regulations.

	Neap Tide				Spring Tide			
	Calm		Windy		Calm		Windy	
Outfall Length	North Beach	South Beach	North Beach	South Beach	North Beach	South Beach	North Beach	South Beach
400	206	324	560	402	171	277	493	429
650	15	16	233	287	3	37	274	257
900	0	12	194	179	2	38	140	239

Table 5.10 - Coliform dispersion simulations - Maximum averages in sampling cells.

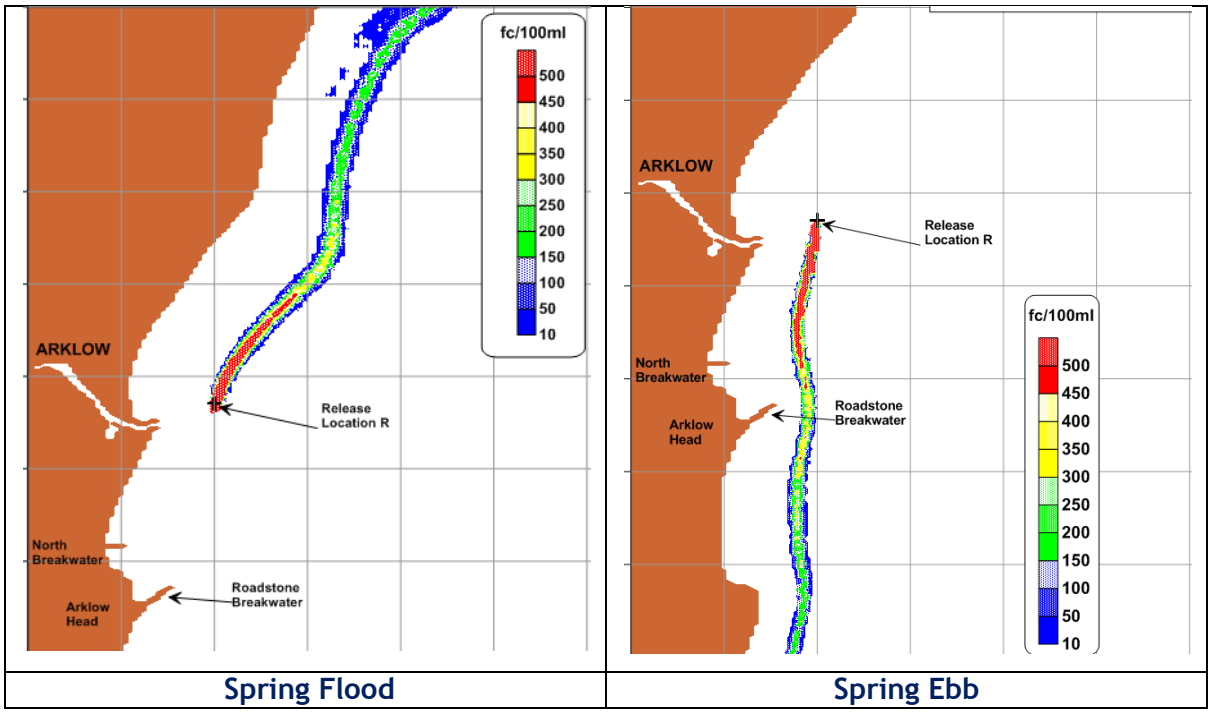
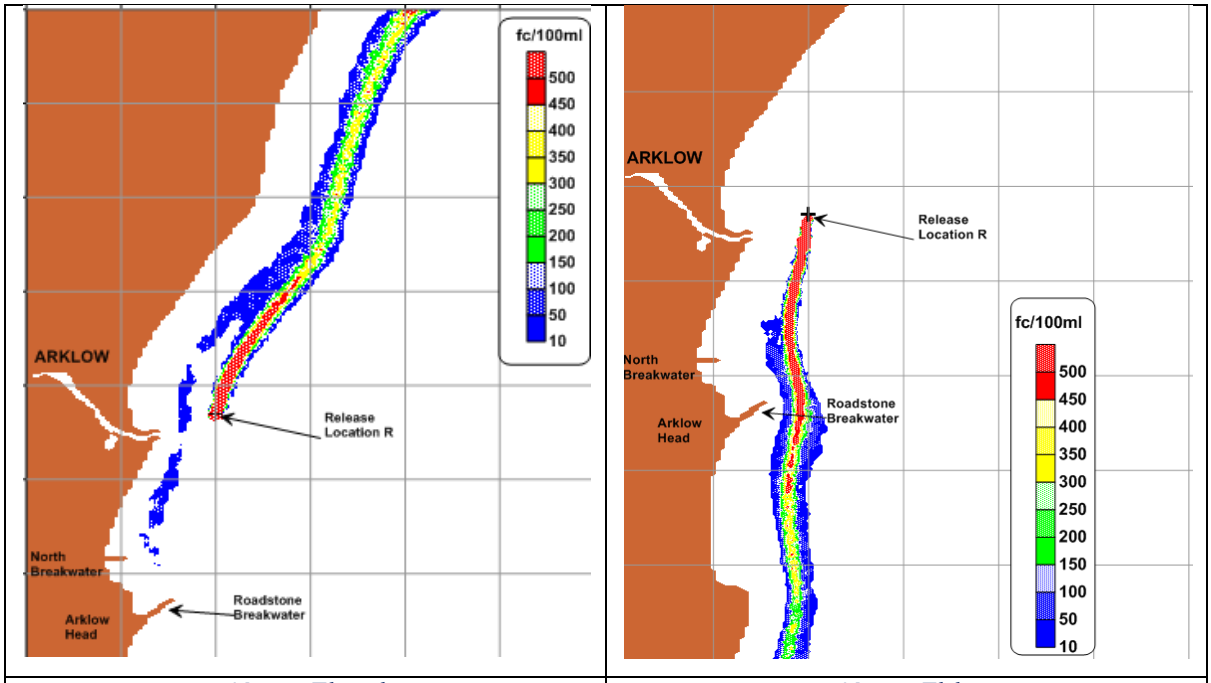
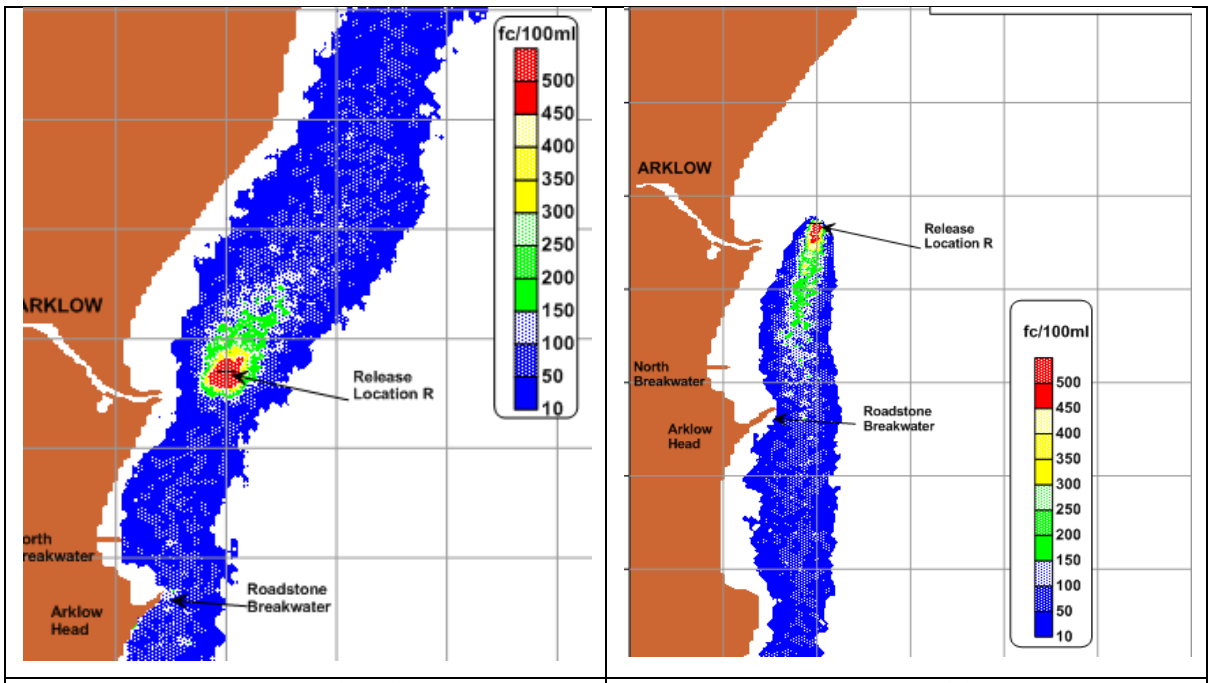


Figure 5.8a - Simulated e.coli concentrations for 900m outfall during Spring & Neap tides and calm conditions



Neap Flood	Neap Ebb

Figure 5.8b - Simulated e coli concentrations for 900m outfall during Spring & Neap tides and calm conditions



Spring Flood	Spring Ebb

Figure 5.9a - Simulated e coli concentrations for 900m outfall during Spring & Neap tides and windy conditions.

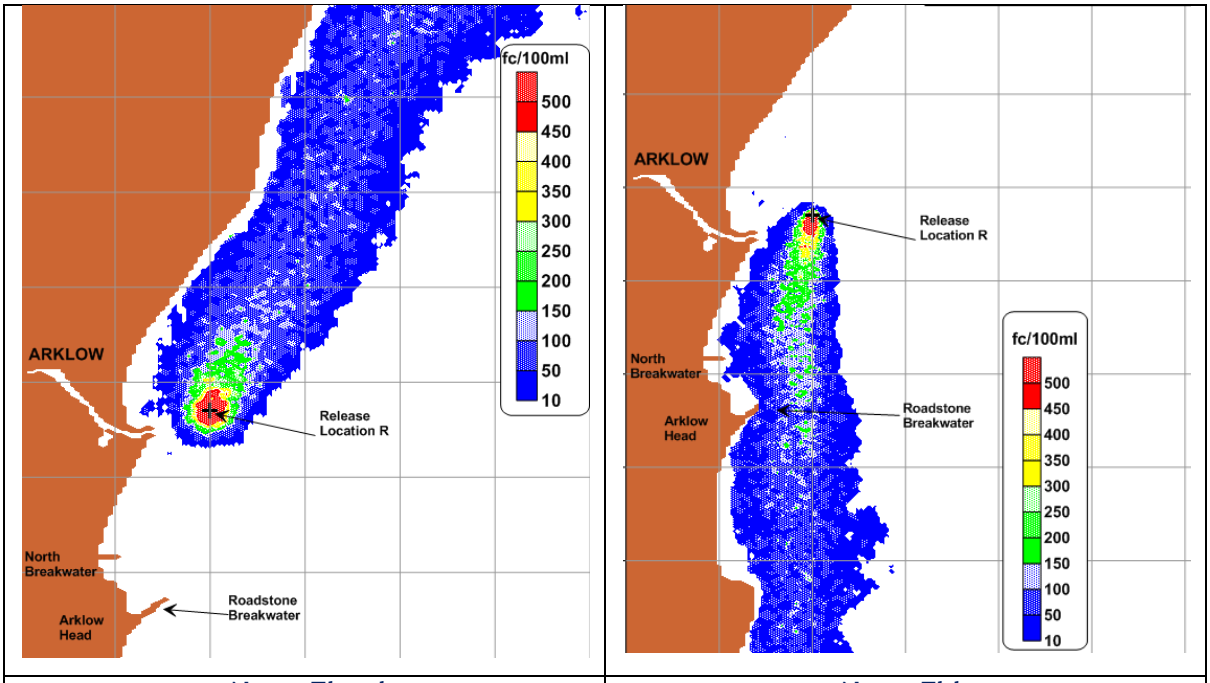


Figure 5.9b - Simulated e coli concentrations for 900m outfall during Spring & Neap tides and windy conditions.

Biochemical Oxygen Demand

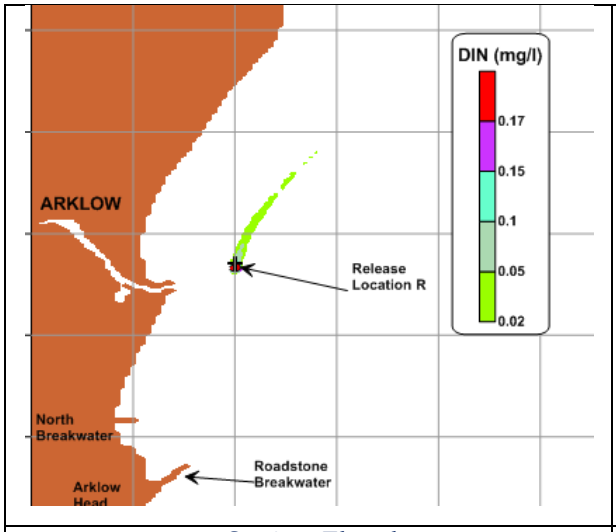
Initial dilution calculations, Tables 5.4 to 5.6, show that concentrations of this parameter will be below the target water quality level of 4mg/l as soon as the plume surfaces above the diffuser point.

Dissolved Inorganic Nitrogen

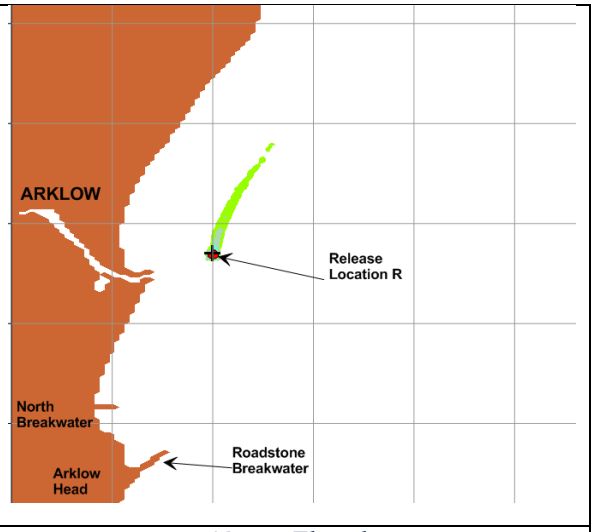
Calculations show that concentrations of this parameter will be close to but above the target water quality level of 0.17mg/l N (High Status) following initial dilution. A further mid-field/far-field dilution of between 4 and 8 will be required. Simulations with the coastal dispersion model, presented in Figure 5.10, show that the additional dilution will be achieved quickly and within about 100 m of the diffuser.

Total Ammonia

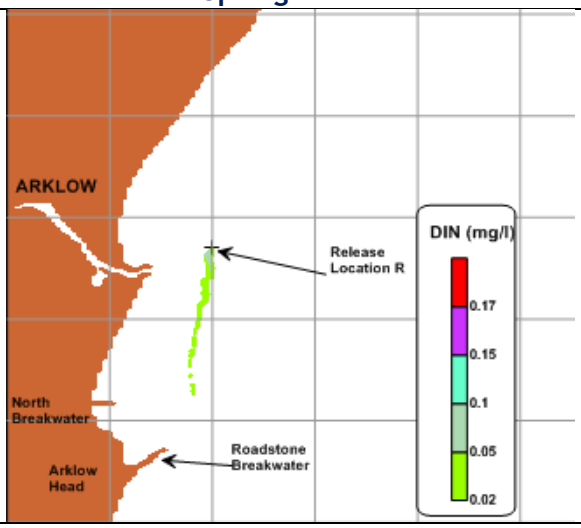
Calculations show that concentrations of TA will be close to but above the target quality level of 0.03mg/l N (EPA) following initial dilution. A further mid-field/far-field dilution of between 4 and 11 will be required. Simulations with the coastal dispersion model, presented in Figure 5.11, show that the additional dilution will be achieved quickly and within about 100 m of the diffuser.



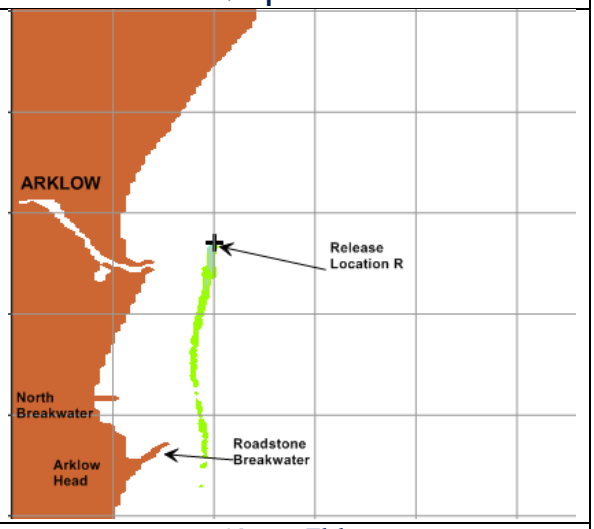
Spring Flood



Neap Flood

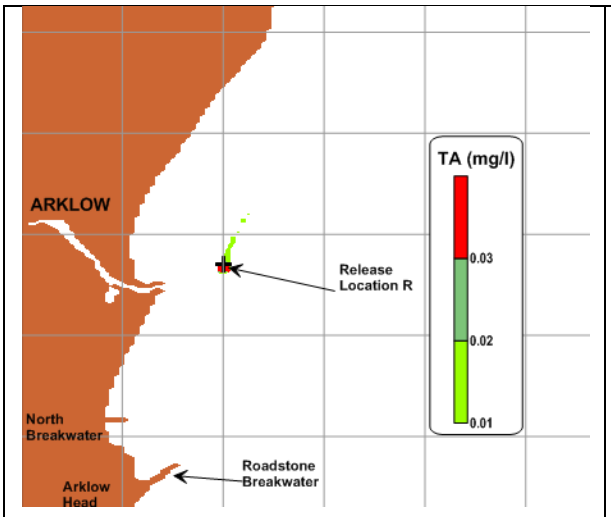


Spring Ebb

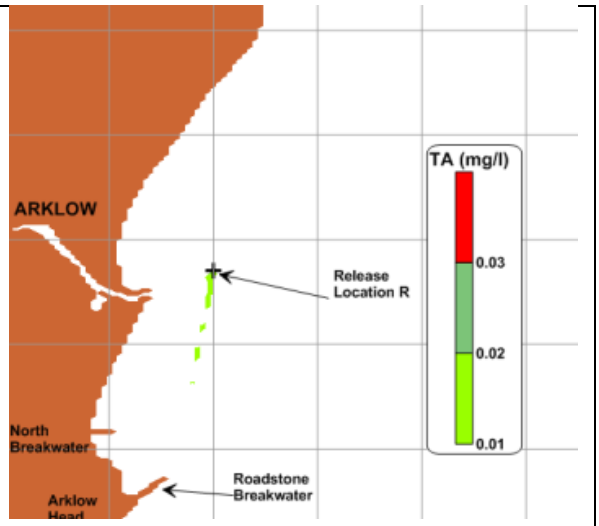


Neap Ebb

Table 5.10 - Predicted peak DIN concentrations (above background)



Spring Flood



Spring Ebb

Table 5.11 - Predicted peak TA concentrations (above background)

5.7 Summary of Marine Results

Initial dilution calculations have shown that bacterial concentrations are the critical parameter for the marine outfall evaluation as all other water quality parameters will be close to or below target levels very soon after discharge.

All three of the locations examined will provide sufficient initial dilution (from plume exiting diffuser to time it surfaces) to reduce nutrient concentrations to close to target levels. Mid-field dilution then ensures that these targets are met within 100m of the discharge point.

E.coli bacteria are present in the treated water at much higher concentrations. The models show that only the 900m outfall will ensure compliance with the bathing water 'Excellent' category during calm and windy conditions. Both of the other outfall options (400m & 650m) would require the provision of disinfection to meet this target.

6. Conclusions

An assessment of the impact of waste water discharges to the Avoca river and the Arklow coastal waters was conducted with the aid of numerical models. The assessment was conducted for a PE of 36000 with an average daily flow of 0.127m^3/s. The analysis has allowed conclusions to be made regarding the proposed discharges and the level of treatment required in the WWTP to ensure compliance with relevant regulations.

Assessment of the river outfall was made both on the basis of EPA background water quality data and also taking discharges from the Sigma Aldrich plant, 750m downstream of the assumed outfall position, into consideration. The proposed range of ELV's are summarised in Table 6.1.

Analysis of the marine outfall options has shown that the coastal water depths and current speeds are sufficient to ensure rapid dilution of all contaminants other than e.coli bacteria. Models indicate that only the 900m outfall will ensure compliance with the 'Excellent' category of Bathing Water Quality Regulations 2008. The proposed ELV's are summarised in Table 6.1.

These findings are provisional and the analyses and proposed ELV's should to be formally discussed with the EPA prior to making a final decision on a preferred WWTP location.

Parameter	River Outfall	900m Marine Outfall
Biochemical Oxygen Demand	10mg/l	25mg/l
Suspended Solids	35mg/l	35mg/l
Total Ammonia-N	0.7 to 1mg/l	10mg/l
TON-N	35mg/l	35mg/l
PO4-P	0.7 to 1mg/l	
E.coli	1 x 10^6 ec/100ml	1 x 10^6 ec/100ml

Table 6.1 - Proposed WWTP discharge ELV's

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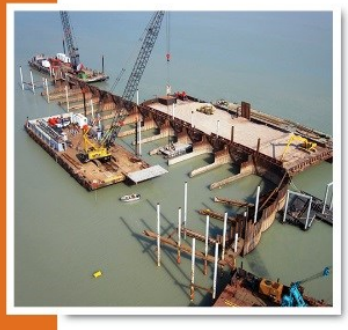

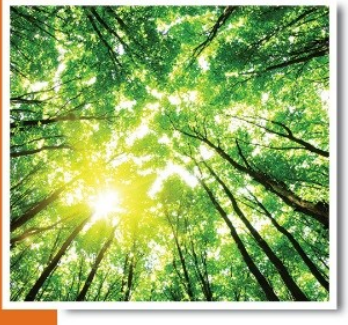

Appendix B – Flood Risk Assessment & Management Report – Shelton Abbey (IFI Site)

Irish Water & Wicklow County Council

Arklow Wastewater Treatment Works

Flood Risk Assessment and Management Report – IFI Site (Shelton Abbey)

Report No. W3111-R002

April 2015

UISCE ÉIREANN : IRISH WATER

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Disclaimer: Please note that this report is based on specific information, instructions and information from our Client and should not be relied upon by third parties.					

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1.0 Introduction

1.1 Background

Irish Water (IW) intends to develop the Arklow Wastewater Treatment Plant (WwTP) Project to eliminate untreated wastewater discharge to the Avoca River near Arklow Town, County Wicklow. The project will entail the construction of a new wastewater treatment plant to treat 36,000 PE (population equivalent) with a new sea or river outfall.

Following a non-statutory public consolation process, held by Irish Water between 15th October 2014 and 12th December 2014, the former Irish Fertiliser Industries (IFI) site at Shelton Abbey was established as a favourable site for the WwTP by the public, subject to its environmental suitability and flood resilience. Details of the consultation are presented in the *Phase 1 Consultation Report*. A high level *Site Assessment Report* has also been produced and revised in early 2015 which outlines the need to assess the flood risk to the IFI site.

1.2 Project Brief

Byrne Looby PH McCarthy have been appointed to assess the flood risk to the IFI site in accordance with *The planning Systems and Flood Risk Management – Guidelines for Planning Authorities*, hereafter referred to as 'the Guidelines'. At this stage, a detailed design of the treatment plant has not been undertaken and the aim of this report is to assess the suitability of the IFI site (or part thereof) for use for a WwTP in relation to flood risk.

1.3 Avoca Catchment & IFI Site Location

The Avoca catchment is outlined below in Figure 1.1 with the extent of the site shown in Figure 1.2. The site is located to the north west of Arklow town and is bounded to the south by the Avoca River and is crossed by the Sheepswalk steam.

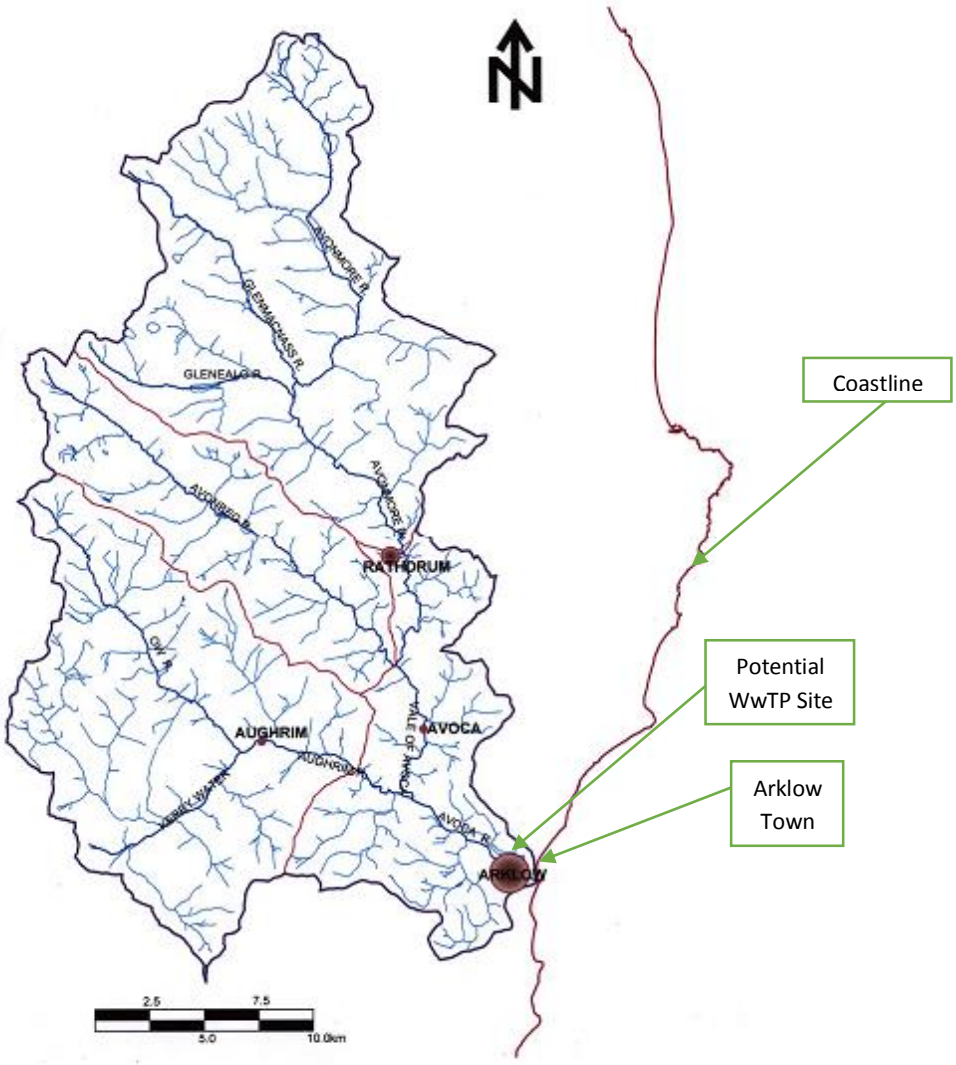


Figure 1.1 Avoca catchment

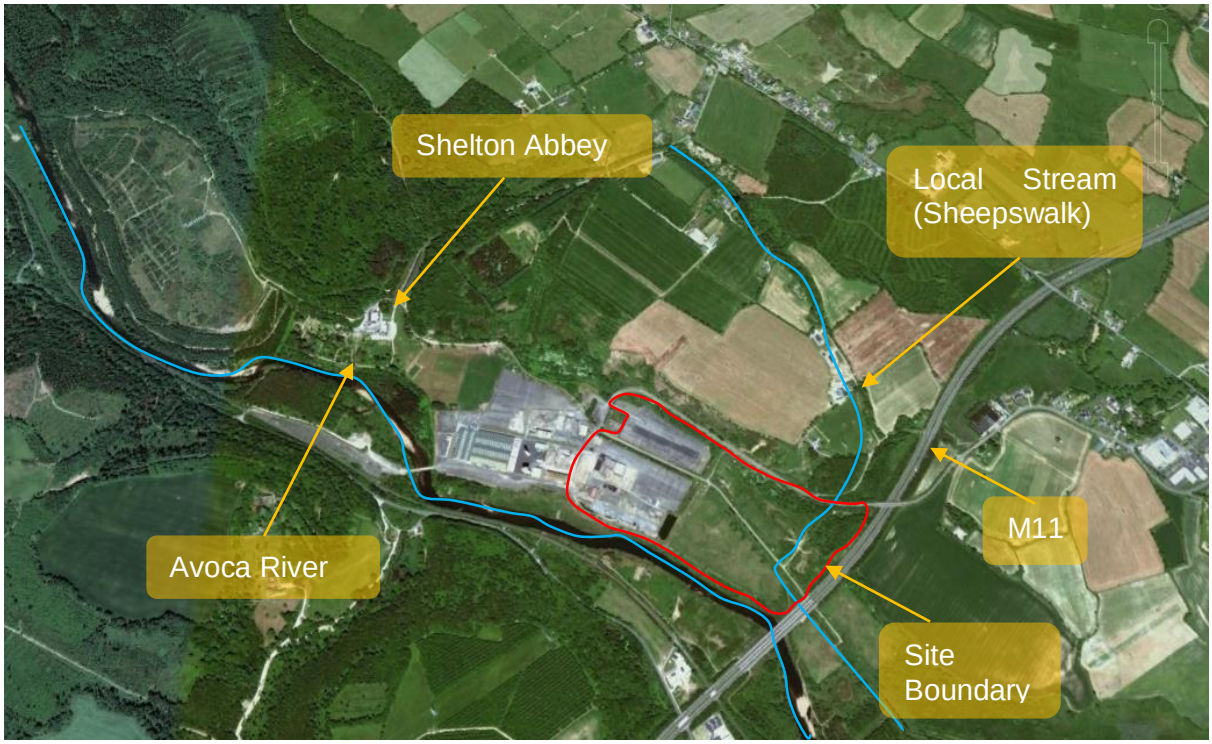


Figure 1.2 Site Location Plan

1.4 Report Objectives

The objective of the report are to:

- Establish flood zonings for the site in accordance with *The planning Systems and Flood Risk Management – Guidelines for Planning Authorities;*
- Establish the flood risk to the site;
- Determine what portions of the site (if any) are suitable for development of a WwTP in relation to flood risk.

It should be noted that only flood risk suitability is being assessed within this scope and other criteria are being assessed separately.

2.0 Data Collection

2.1 Historic Floods Data

The OPW operate and manage a database of historical flooding incidents which can be accessed at www.floodmaps.ie. An examination of this database shows that there is no record of previous flooding at the site.

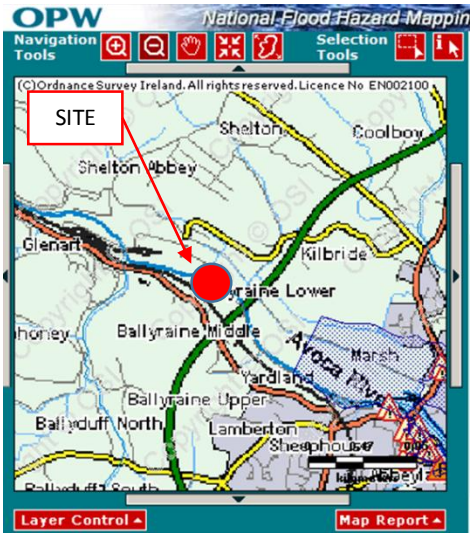


Figure 2.1 Flood history of IFI site on OPW National; Flood Hazard Mapping website

2.2 National Preliminary Flood Risk Assessment

The national Preliminary Flood Risk Assessment (PFRA) was completed in 2011 by the OPW to identify areas where there may be a significant risk associated with flooding. The objective of the PFRA is to identify areas where the risks associated with flooding might be significant, although 'significant' is not defined in the Floods Directive (2007/60/EC), the primary legislative driver behind the PRFA.

The PRFA considers flooding from natural (coastal, fluvial, pluvial and groundwater sources) but not infrastructural (drainage systems, reservoirs, water supply) sources. The OPW commissioned *Planning Systems and Flood Risk Management – Guidelines for Planning Authorities* defines each of these flood risk sources.

Draft mapping to outline the preliminary flood risk is available for all areas of Ireland. The relevant map for the Arklow environs is presented in Appendix A, and indicates that both coastal and fluvial flood risks may be present at the IFI site.

The PRFA designates Arklow as a probable AFA (Area for further Assessment) and the ESB substation at the IFI site as a possible AFA. These were further assessed under the Eastern CFRAM programme which is discussed below.

2.3 Eastern CFRAM Study

The Eastern Catchment Flood Risk Assessment and Management (CFRAM) study commenced in June 2011 and will run until the end of 2016. The district covers a land area of 6,300 km^2, including parts of counties Cavan, Dublin, Kildare, Louth, Meath, Offaly, Westmeath, Wexford and Wicklow.

Flood Risk Management Plans (FRMPs) are due to be prepared by 2016 and will include measures in relation to flood prevention, protection and preparedness. Emergency response to flooding, recovery from flooding and incorporating lessons learned will be an important element of the FRMPs along with issues such as climate change, land use practices and future development.

As of the most recent update in August 2014, the status is as follows:

- All survey work, to gather data on the elevation and shape of river channels and floodplains to feed into the computer models, is complete;
- The development of computer models to predict flood extents and flood risk is complete;
- Flood mapping is being developed;
- Flood Risk Management Measures to deal with the identified flood risk are being developed;
- Flood Risk Management Plans, including measures to deal with flood risk, are due to be published in 2016.

A Flood Risk Review (FRR) was completed under the CFRAM programme in late 2011 with Arklow being confirmed as an area for further assessment (AFA). BLP have separately been appointed by the OPW/WCC to progress the Arklow Flood Relief Scheme to address the Flood Risk to Arklow Town.

Following assessment under the FRR report, the ESB sub-station at Shelton Abbey identified as a possible AFA in the PFRA, was determined under the CFRAM programme not to be an AFA on the basis that it appeared to be within a defended site and was an individual receptor.

2.4 Arklow Flood Relief Scheme

The Hydrology and Hydraulics Report, Avoca River (Arklow) Flood Relief Study (Cawley, 2007) was prepared in 2007 on behalf of OPW. It presented flood flows for use in the optioneering of the Arklow Flood Relief Scheme. The report also notes the flood information recorded during Hurricane Charlie in 1986 where the ESB noted peak flood levels and a flood profile adjacent to the former IFI site of 4.51m OD observed at the downstream end of the IFI factory flood embankment. This event was estimated to

be a 0.66% AEP event (1:150 year) by a PH McCarthy Report (1989) with an associated flow rate of 695 m^3/s (excluding climate change).

In 2012, 2D hydraulic modelling of the Avoca River at Arklow (Cawley, 2012) was undertaken on behalf of the OPW to support the preliminary design of the Arklow Flood Relief Scheme, with particular emphasis on modelling the impact of Arklow Bridge of flood levels.

The *Avoca River Flood Relief Feasibility Study – Preliminary Report* (BLP, 2013) is the final report and collates the information from previous hydrological studies and presents the proposed design flows for the scheme which are presented in Section 4.1 below.

2.5 Arklow Town and Environs Development Plan 2011-2017

Arklow Town and Environs Development Plan 2011-2017 outlined flood zones for the town area only (not the surrounding environs) in accordance with OPW guidelines for Flood Risk Management. The proposed site is not within the town boundary and is therefore not mapped although it is within the surrounding environs.

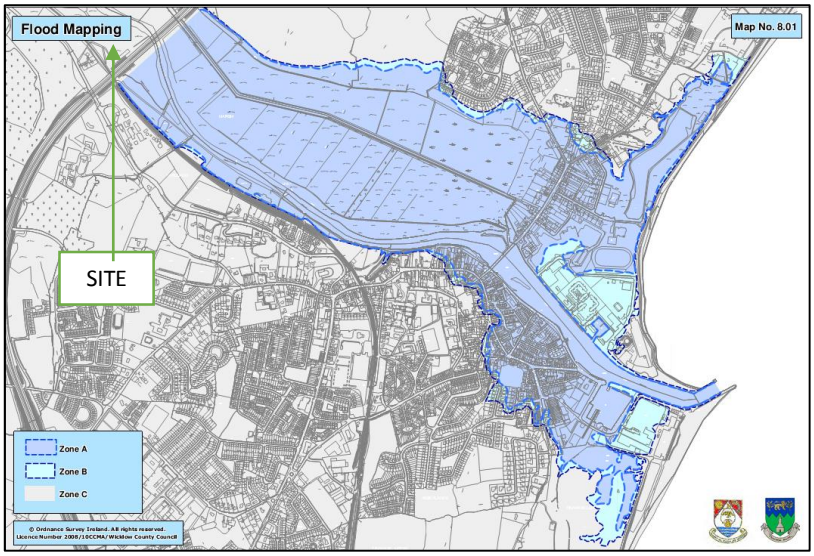


Figure 2.2 Flood Zones for Arklow

2.6 Topographical Survey

A topographical survey of the entire site was undertaken as part of this assessment. Details of the survey are included in Figure 001 included in Appendix B. The site is described below.

2.7 Site Walkover

A site walkover and recognisance survey was undertaken on the 18th February 2015. Selected photographs from the site visit are included in Appendix C along with a photograph location map.

The extent of the c. 24 hectare site under consideration is shown below in Figure 2.3 along with other relevant features. The site consists mainly of existing agricultural, wooded and industrial brownfield areas. There are live commercial activities ongoing on the IFI site to the west of the proposed site. For the purposes of describing the site, it has been sub-divided into three plots (A, B and C) as indicated in Figure 2.3 as these areas have their own individual characteristics. Access to the site is via the minor road connecting the R747 and Beech Road which runs alongside the northern boundary of the site. A canal runs through the site between plots A and B and discharges into the Avoca River immediate upstream of Arklow Bridge. It construction is believed to be associated with the former Shelton Abbey estate but little information is available on its construction or purpose.

Plot A of the site consists of relatively level made ground including a number of disused industrial buildings. It is bounded to the north by the access road and to the south by the Avoca River. Access is achieved via the local road serving the IFI site. There is an existing access track through the middle of the plot, running in an NE-SW direction, with a drainage channel on the south side of the access track. The plot is afforded flood protection by the flood defence embankment which surrounds the entire IFI site and run-off is collected in local drains and attenuated in a pond in the south east corner of plot A. There is an ESB sub-station (presumably providing power to the IFI site) located at the western extent of plot A. It is noted that the current landowner has reported that the site has not suffered from flooding in recent years.

Plot B is natural ground consisting of pasture and woodlands. The plot is at a higher elevation than plot A but lower than plot C. It is bounded to the north by the access road and to the south by the access track which runs along the north side of the canal. Current access to plot B is via the access track, but access from the local road serving the IFI site is also possible. The plot is likely to be afforded some level of flood protection by the higher ground to the south, but is at risk of flooding from backwatering via the canal during extreme flood events in the Avoca River. The plot drains naturally to the south into the canal.

Plot C is mainly set out in grass which slopes gently to the north. The plot has been artificially raised by the construction of an impoundment which was subsequently used as a waste pond for gypsum and carbon by-products from the fertiliser production process at the IFI site. The pond has subsequently been capped and set in grass. It is bounded to the north by the canal and to the south by the Avoca River. Access is available along the access track, where an existing entrance crosses the canal. At the time of the site visit, it was not possible to see any continuity (other than pumping) between the portion of canal between plots B and C and the portion in plot A. Plot C is afforded flood protection due to its increased elevation, which matches that of the flood embankment surrounding the IFI site. Notwithstanding any artificial drainage of the

underlying strata, the surface water drains naturally to the north of the site towards the canal.

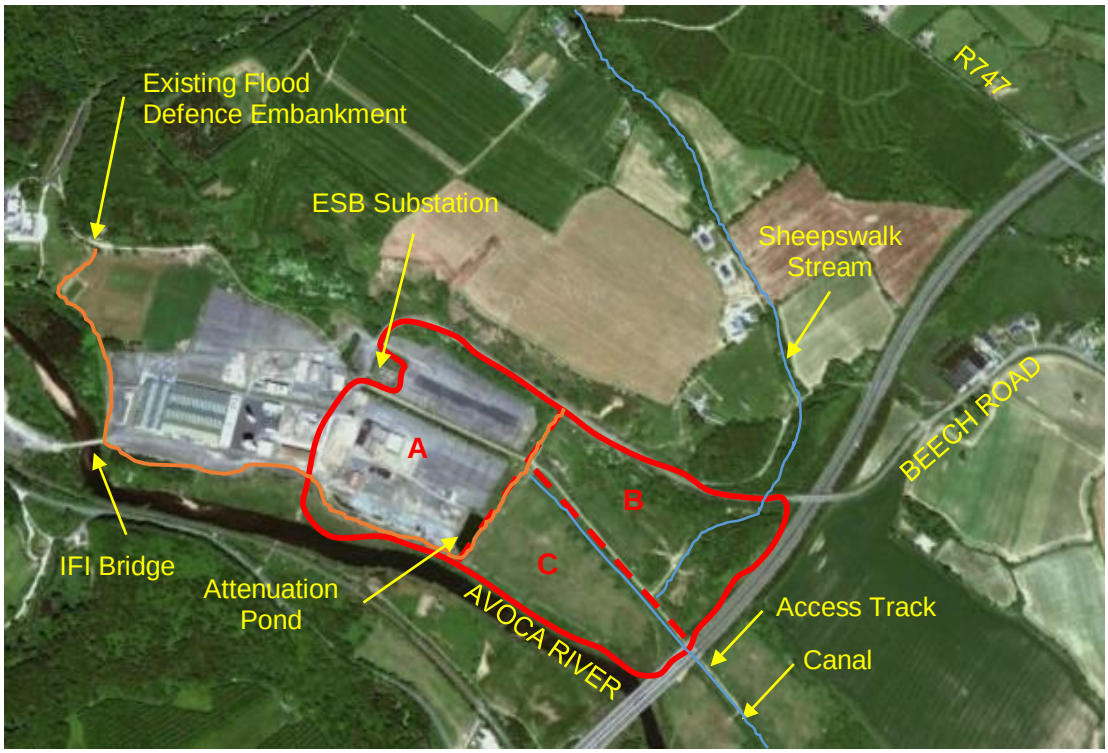


Figure 2.3 Outline of site and plots A, B and C.

3.0 Proposed Development

3.1 Description of Development

The proposed development is a wastewater treatment plant to serve a PE of 36,000. Detailed plans for the layout of the plant will not be known until the site is selected and an indicative design completed, however, it is anticipated that a site area of c. 2 hectares will suffice. Such a site area will provide flexibility in selecting the final treatment process to be used allowing for any necessary screening while also providing for future expansion.

3.2 Sources of Flood Risk

3.2.1 Pluvial

Pluvial flooding should typically not be a major issue for sites located next to or very near to river channels. It is noted that the PRFA has not indicated that the site is prone to pluvial flooding. However, surface water run-off on the site has been significantly modified by the presence of the canal and the flood defence embankment. The result is that natural run-off from the site to the Avoca River is not possible for plot A. Pumping arrangements were noted at a number of locations on the site during the site visit which are shown in Figure 3.1 below to assist in the drainage of plot A. Details of the maintenance and performance of the pumps have not been assessed. Plots B and C drain naturally to the canal.

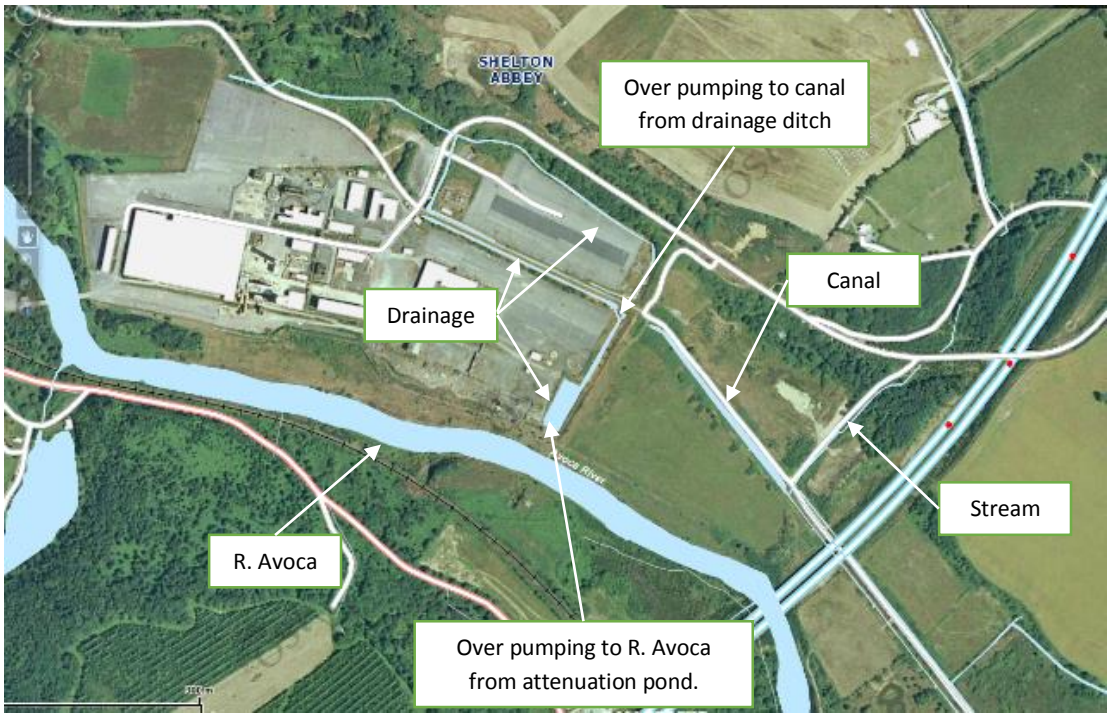


Figure 3.1 Drainage at the IFI Site

3.2.2 Fluvial

Historic 25" and 6" maps do not indicate that the site is liable to flooding, although much of the surrounding sites, and a portion of the proposed site are shown on the maps as being wet or marshy ground.

However, the fluvial flood risk to the IFI site is well established evidenced by the existing flood defence embankment that has been constructed around the site. Anecdotal evidence suggests that the embankment has been successful in defending against floods and flood events have not been recorded on the site in recent times.

The main risk to the site therefore arises from failure of the flood defence and overtopping. Of these, failure is the greater risk and the consequences would be severe if such an event was realised.

3.2.3 Coastal

The Irish Coastal Protection Strategy Study Phase 2 - South East Coast Work Packages 2, 3 & 4A - Technical Report IBE0104/June 2010 also outlines the flood risk to coastal areas. These boundaries were subsequently incorporated into the PFRA maps.

The maps show that the IFI site is generally outside the limit of coastal risk, also the canal and the River Avoca represent flood paths to the site. The maps indicate that the flood extent is restricted to the canal and river channel for coastal flooding and the plots would therefore not be at risk.

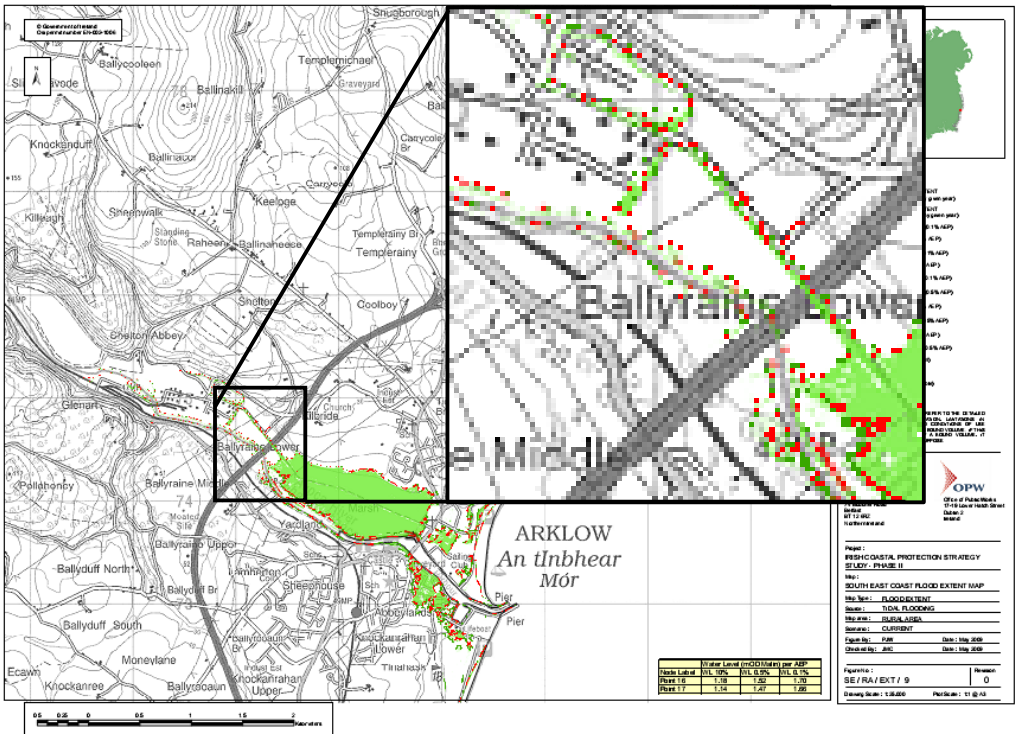


Figure 3.2 Irish Coastal Protection Strategy Mapping – Arklow

3.2.4 Groundwater

There are no mapped karst features within the site or the surrounding district which would allow the rapid passage of groundwater. The underlying bedrock geology is the Kilmacrea Formation with some Oaklands Formation in the south west portion of the site. The sub-soil consists of alluvium till with sandstone and shale tills located north and south of the alluvium band under the river.

The PFRA does not indicate significant flooding of the site from groundwater and consequently, it is anticipated that any risk of flooding at the site due to groundwater flow is minimal.

(Note: not considered here is the risk arising from seepage under the flood defence embankments which may manifest as 'groundwater' but which would be caused by high flood levels in the river).

3.2.5 Summary of Risk

Table 3.1 below summarises the flood risk to each plot on the site. In addition to the risks highlight below, there is the possibility of combined events (i.e. fluvial and coastal) where a flood risk would be exasperated by another flood risk.

The fluvial risk to the site represents the most significant risk and is discussed further in the following sections.

Table 3.1 Summary of Flood Risks

Plot / Source of Flood RIsk	Pluvial	Fluvial	Coastal	Groundwater
Plot A	✓	✓	×	×
Plot B	×	✓	×	×
Plot C	×	✓	×	×

4.0 Hydrology

4.1 Avoca catchment

The OPW have approved the use of the Flood Study Report (FSR) (NERC, 1975) catchment characteristic method for estimation of the mean annual flood (Q_{BAR}) with the design flows then estimated based on a pooled growth curve using a number of catchments and other studies. On this basis the OPW FSU portal was not used to estimate flood flows and instead, the flow rates used for the design of the OPW FRS as described above are used for input to the hydraulic model.

The flow estimation point for the Arklow FRS hydraulic model is approximately 200m upstream of the M11 Bridge, which is approximately 450m downstream of the most western part of the site. It is noted that the flow rates are considered to be conservative in the Feasibility Study and consequently the flows rate are deemed to be appropriate for use for the site. The adopted design flows are presented in Table 4.1 below. An allowance of 20% has been included for climate change in the figures below for the midrange future scenario (MFRS).

Table 4.1 Design Flow Rates

Event	Flow Rate (m^3/s)	Flood Level immediately Downstream of the M11 Bridge
Q100	560	3.49
Q1000	745	3.87
Q100 MRFS	672	3.74
Q1000 MRFS	894	4.13*
*Estimated from other design flow rates		

4.2 Local Stream catchment (Sheepswalk Stream)

The initial desk study identified a minor stream to the north of the site as a potential source of flooding. Subsequently, based on site recognisance and the results of the topographical and hydrometric surveys, it was deemed that that the stream did not represent a significant flood risk to the proposed site.

Specifically, flow rates in the stream are limited and restricted to the capacity of a culvert which has been constructed under the access road to the north of the site. The pipe is a 1.2m diameter corrugated iron pipe laid at a gradient of 3.5% with a resulting capacity of approximately $8m^3/s$. which will not result in a significant risk to the site from the Sheepswalk Stream. Assuming a 1.6m wide channel with vertical banks, a flow depth of approximately 0.6m would be required to convey the flow in the culvert, which is generally available in the channel. The flood risk to plot B from the Sheepswalk stream is therefore very low and there is no flood risk to plots A or C from the stream.

5.0 Hydraulic Modelling

5.1 Model Construction

A 1D hydraulic model was generated from survey data and analysed using HEC-RAS 5.0 beta version to estimate the water surface profile in the Avoca for a range of flood event probabilities as outlined in Table 4.1.

The model consisted of a single river reach extending from the M11 Bridge over the Avoca River upstream for approximately 1,800 meters and includes 24 river cross sections, 2 structures (bridges) and a levee (flood defence embankment).

A Manning's roughness coefficient of 0.04 was used for the main channel, which assumes a clean winding reach with some pools and shoals. For the flood plains, a Manning's roughness coefficient of 0.07 was used due to the medium brush and trees observed during the site visit. Ineffective flow areas were included in the model where the floodplain was deemed to be ineffective in conveying flood flows (for example where wooded areas or very dense scrub were identified).

The model was run using steady state flow analysis which typically results a conservative estimate of flood levels.

5.2 Model Calibration & Verification

As there are no flood records available or no record of flooding having occurred at the location of the site, a direct calibration of the model was not possible. Calibration was therefore carried out against the Avoca River Flood Relief Scheme, which overlaps with the model at the M11 Bridge for approximately 200m. The downstream boundary condition of the model was set to match the approved flood levels from the Arklow FRS.

As a check, the boundary condition was removed and the downstream boundary set to be such that critical flow conditions prevailed. This resulted in a slight lowering of flood levels at the downstream end of the reach in the order of 100-200mm. This can be expected given that the Arklow FRS flood levels are based on a more refine 2D model which includes the downstream Arklow Bridge which is a known restriction on flood flows causing a significant backwater effect upstream. In addition, the 1D model above would not take into account tidal influences. On this basis the model was deemed to be acceptable for use for the flood risk assessment purposes.

5.3 Results

The results from the various model runs are presented in Appendix D and the flood profile to the site is presented in Figure 5.1. Table 5.1 summaries the flood levels at chainage 779m in the model, which is the nearest upstream section to the proposed site, and are therefore the maximum flood levels for the site. Lower flood levels are estimated downstream of this location as presented in Appendix D.

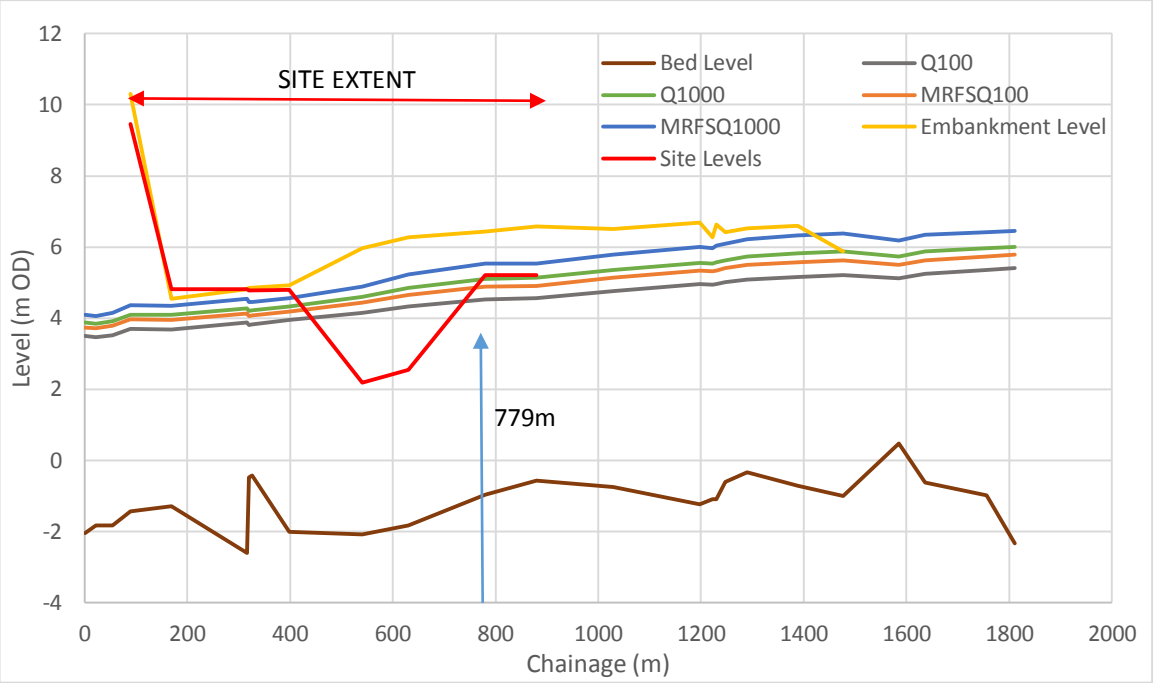


Figure 5.1 Flood Profiles for Avoca River at FIF Site

Table 5.1 Flood levels at chainage 779m (most upstream chainage of the proposed site)

Event	Event % AEP	Flow rate (m^3/s)	Flood level (m OD)
Q100	1%	560	4.52
Q1000	0.1%	745	5.1
Q100 MRFS	1%	672	4.88
Q1000 MRFS	0.1%	894	5.53
MRFS – Mid Range Future Scenario (includes for climate change)			

5.4 Flood Extents & Flood Routes

5.4.1 Flood Extents

In accordance with *The Planning Systems and Flood Risk Management – Guidelines for Planning Authorities* flood zones have been established for the site by BLP. In line with the guidelines, the development of the zones assumes that the existing flood

defence embankment does not exist. The resulting flood extent maps for the site for the current scenario are presented in Figure 002 in Appendix B.

The map confirms that plot A is within flood zone A and B, plot B is partially within flood zone A and B while plot C is largely outside of flood zones A and B.

5.4.2 Flood Routes

In the event that there was no flood defence embankment, inundation of the site would occur directly from the River Avoca via overbank flow. This would affect plots A, B and C, with flooding of plot A arising directly from the Avoca and flooding of plots B and C via the canal.

However, plots A is well protected from flooding by the flood defence embankment although overtopping of the embankment to the north represents a possible flood route to plot A. Inundation would not be expected to be rapid or significant as the low lying areas of the sports field and surrounding areas would flood initially before the water makes its way to the proposed site.

The estimated flood level for the 0.1% AEP event immediately upstream of the embankment overtopping location is 5.73m OD (Appendix D, chainage 1584m) while top of embankment where it has been surveyed is 5.80m OD. Lidar data indicates that the embankment may be lower than 5.8m OD in some areas. The likely flood route for the 0.1% AEP event immediately upstream at Shelton Abbey is shown in Figure 5.2 below.

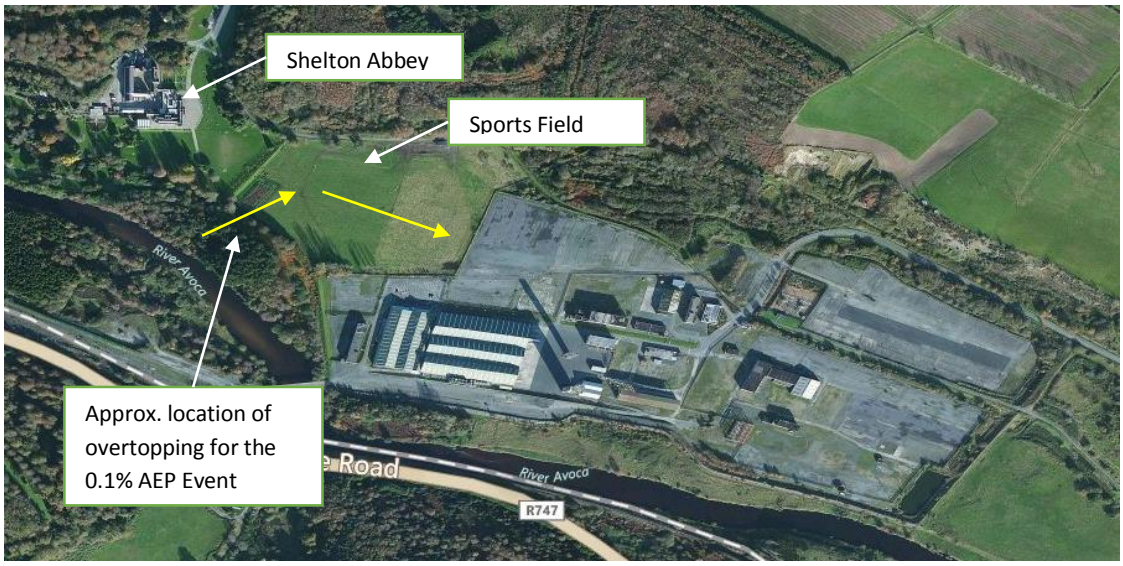


Figure 5.2 Flood Route to IFI Site

A second flood route is presented by the River Avoca backing up into the canal downstream of the site and then flowing back up the canal. This represents a significant risk to Plot B. This has been considered in the flood extent maps by conservatively

assuming that the flood level in the canal is the same as the level in the River Avoca for a given chainage.

5.4.3 Flood Route and Extents for embankment overtopping

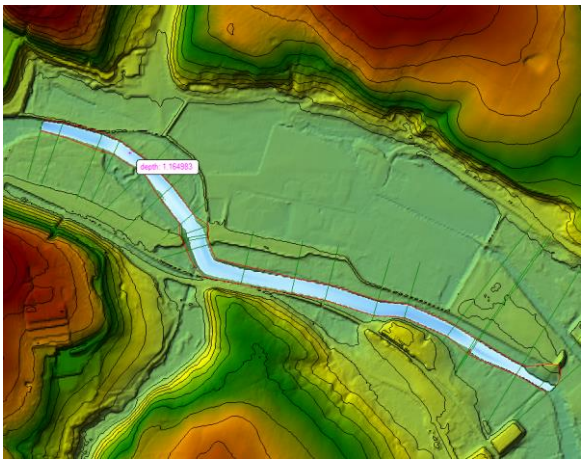
To establish the risk to plot A from the overtopping of the flood defence embankment west of the site a, linked 1D-2D model was created in HEC-RAS. Overtopping only occurs for the 0.1% AEP event, and thus this event was modelled in the hydraulic model using unsteady flow. The hydrographs for the event were adapted from the 2012 Arklow Hydrology & Hydraulics Report (Cawley, 2012)

Unsteady flow was then modelled in 1D in the river channel which was linked to a 2D flood flow area inside the protected area using a levee. This allowed a simulation of the volume, route and extent of flooding for the 0.1% AEP event. Figure 5.3 presents the sequence of flooding, the flood route and the areas at risk. The resulting flood extents map for the defended scenario is presented in Figure 003 in Appendix B.

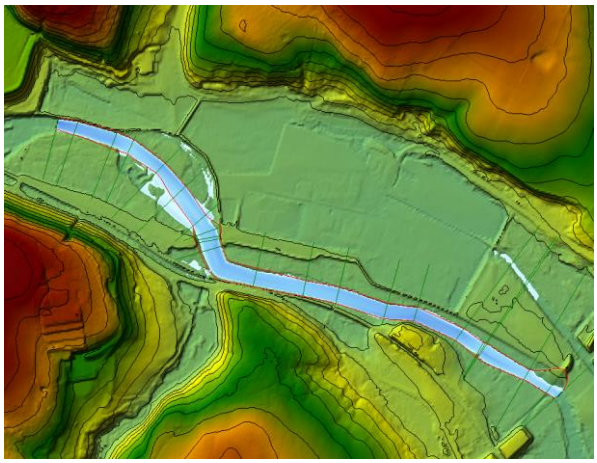
Upon overtopping the embankment, the water flows in a north eastern direction to low lying ground where an existing drainage channel is located. From here, it flows in an eastern direction along the northern extent of the IFI site before reaching plot A, where it splits in two. One flow path continues along the north side of plot A, while the other runs along the western boundary finding its way into the canal.

The northern portion of the existing ESB sub-station site is affected by ponding initially, but the operational part of the site remains above the flood level.

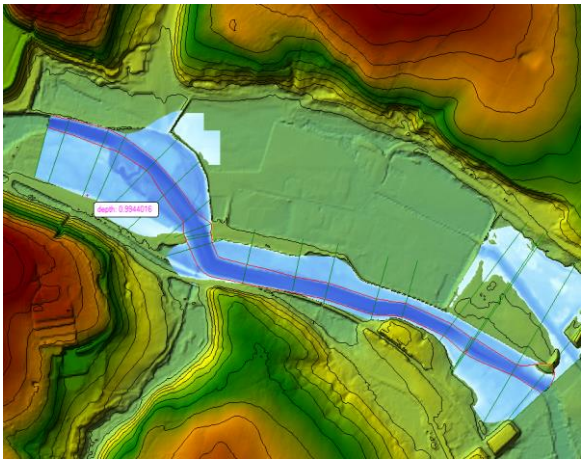
Generally, maximum flood depths on plot A are located adjacent to the drains where ground levels are lowest and flood depths are generally no more than 350mm.



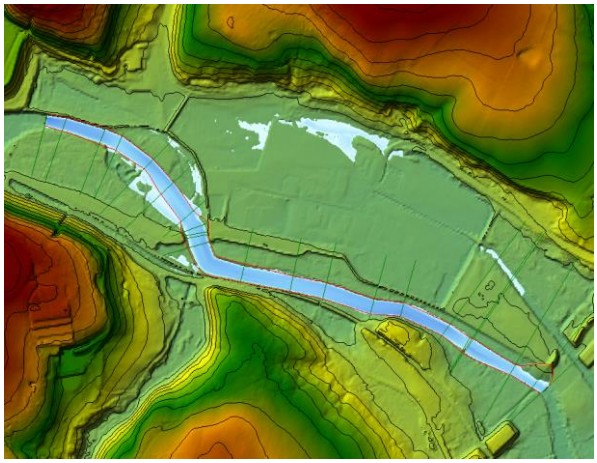
0000 hours (Q = 20 m^3/s)



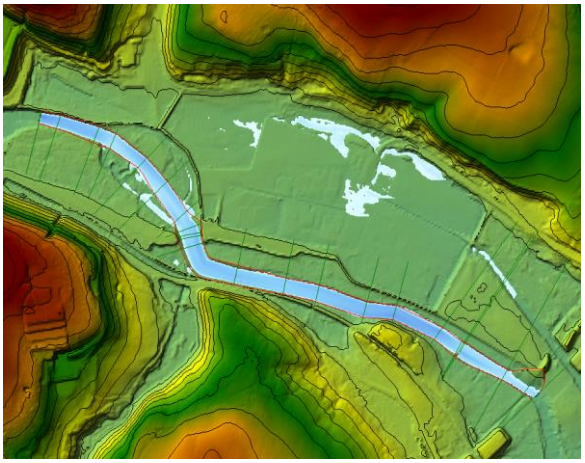
0012 hours (Q = 100 m^3/s)



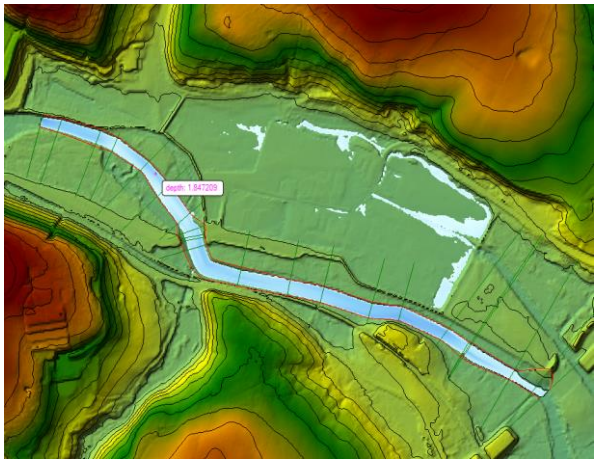
0024 hours (Q = 790m^3/s)



0036 hours (Q = 100m^3/s)



0039 hours (Q = 64m^3/s)



0048 hours (Q = 20m^3/s)

Figure 5.3 – Sequence of inundation of plot A

6.0 Proposed Mitigation Measures

6.1 Recommended Measures

The site is almost entirely defended from the 0.1% AEP event with the exception of the possible flood route upstream of the site. Given the high vulnerability of the development it would be advisable to ensure full flood protection and to consider additional mitigation measures to minimise the risk to the development, particularly given the policy outlined in Circular L8/08 where the Department of the Environment, Heritage and Local Government advocate not building treatment plants in active or former floodplains.

The proposed WwTP should be located outside the 0.1% AEP flood extent as shown in Figure 003 in Appendix B. In the event of overtopping for the embankment for the 0.1% AEP event, the WwTP would then be located outside the flood extent.

Alternatively protection up to the 0.1% AEP event could be achieved for the entire area behind the flood defence embankment by raising the embankment locally where low areas are identified (See Figure 5.2). Permission from the embankment owner would be required to undertaken the works and compensatory storage would need to be provided elsewhere should this option be undertaken.

Typically, the floor levels of building and tanks etc. are set so that they are above the level of the 1% AEP event including climate change (Q100MFRS) with further allowance for freeboard. Freeboard is typically taken as 300mm and takes account of the hydrological and hydraulic uncertainties associated with the flood level estimates.

Locating the WwTP site in Zone C will ensure that levels are above this level as the Q1000 flood levels are higher than the Q100MRFS flood levels. However, if the WwTP is developed in plot A it should be constructed so that the floor and tank levels are above the Q100MRFS to mitigate against the risk of embankment failure. The appropriate development level for plots A, B and C are presented in Table 6.1 below.

Table 6.1 Minimum Design Development Levels for the WwTP

Event	Q100 MFRS Flood Level (m OD)	Allowance for Freeboard (m)	Design level (m OD)
Plot A	4.88	0.3	5.18
Plots B & C	4.18	0.3	4.48

6.2 Impacts of Development on Flood Risk

The impacts on flood risk elsewhere, should the site be developed are discussed in this section. Detailed plans for the plant are not available, and it is therefore assumed that the proposed development will not alter the existing topography of the site. The primary impact that the development will have of flood risk elsewhere will depend on the final location chosen for the WwTP.

Plot A - Development on plot A would not impact flood risk elsewhere significantly as the site is already protected. A minor loss of existing flood plain storage would occur if the embankment was raised upstream of the site to protect against the 0.1% AEP event. However, the volume is a tiny fraction of the overall flow rate (peak overspill flows are less than $1m^3/s$ compared to the $894m^3/s$ peak flow rate and as a result raising the embankment would not significantly impact flood levels downstream.

Plot B - Development on plot B is possible in Flood Zone C without impacting flood risk elsewhere.

Plot C - Development on plot C, which is generally within Zone C, would not result in adverse impact on flood risk elsewhere. A new access arrangement may be required to ensure access is maintained during flood event, but this would not impact on flood risk elsewhere if positioned along the western boundary.

7.0 Residual Flood Risk Management Measures

7.1 Introduction

Portions of the site are within flood zones A and B and as a WwTP is considered to be highly vulnerable development, would not normally be considered. However, the site benefits from an existing flood defence embankment, which hydraulic modelling has shown offers a very high level of protection, almost to the 0.1% AEP event, for the current scenario. Additional residual flood risk management measured that should be included if the development proceeds are outlined below.

7.2 Measures for Flood Defence Failure

Failure of the flood defence embankment could occur in a number of ways with varying degrees of severity and therefore risk to the site. Seepage through or under the embankment would not be catastrophic and while flooding of the site may occur, it is possible that the onsite drainage combined with the available attenuation and pumping arrangements would prevent significant flooding of buildings. This cannot be confirmed however, and it would be prudent, should the WwTP be located in plot A, that appropriate arrangements for discharging surface water are provided.

A local breach in the embankment would be more severe and with increased flow rates and velocities could potentially lead to significant loss of protection to the site by means of embankment failure. The site would become rapidly inundated and pose a significant risk to life as well as imposing large economic losses, and may affect the operation of the WwTP. This risk is mitigated against by setting the development levels (floor levels, tank levels etc.) above the design flood level with an allowance for climate change and freeboard as discussed above.

Additionally, a routine inspection and maintenance programme to ensure that the embankment is in good order should be implemented and permission to undertake such works and repairs should form part of any sale agreement and should extend for the entire embankment length.

7.3 Measures for Flood Defence Overtopping

There is a residual risk to the site arising from the overtopping of the existing embankment. This is somewhat mitigated against by the mitigation measures presented above for flood defence failure, but cannot be eliminated. Flood resilient construction should also be incorporated into the design and in the event of a flood greater in magnitude than the 0.1% AEP event, a level of mitigation would be provided to the proposed plant.

7.4 Access/Egress

Access to development for emergency service is critical, even during flood events when people may need assistance either because they have been injured or for evacuation purposes. It is generally accepted that emergency vehicles can traverse up to 300mm depth of standing water.

Access would generally be possible to plots B and C if the WwTP was located within Zone C on these sites. Emergency access would also generally be achievable to plot A, unless one of the residual risks (i.e defence failure) was realised.

7.5 Emergency Response Planning

There are a number of flood warning systems in place in Ireland varying from national to local level. These are typically operated by Met Éireann (severe weather warnings) and local authorities (severe weather and flooding alerts).

Should the development proceed on the site, a Flood Emergency Repose Plan should need to be developed which would be triggered when necessary by the above mentioned warnings.

8.0 Justification Test

8.1 Introduction

In accordance with Table 3.1 of the FRM Guidelines, WwTPs are deemed to be "Highly Vulnerable Development". Table 3.2 of the FRM Guidelines states that developments deemed as being "highly vulnerable" that are within Flood Zones A and B require a justification test.

The following section details the justification test of the proposed development in accordance with Box 5.1 of the FRM Guidelines.

8.2 Justification Test Criteria

The following section includes each of the criteria from Box 5.1 of the FRM Guidelines, along with an explanation on how each of the criteria are satisfied:

1. *'The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines'*.

   Response:

   The current site is within the area zoned for employment in the 2011-2017 Arklow Local Area Plan which a small portion of plot B with the agricultural zone. While portions of the site are under pasture or woodlands, the entire site has a single zoning objective and forms part of a larger industrial semi brownfield site. The use of the site for the provision of wastewater treatment facilities should be reviewed with the Planning Authority.

2. *'The proposal has been subject to an appropriate flood risk assessment that demonstrates':*

   (i) 'The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk'

   Response:

   The flood risk to the site has been assessed and it has been demonstrated that in the site adequate lands are available within Flood Zone C. Further lands are available in Zone A and B, which are currently defended by a flood defence embankment and are outside the actual flood extent for the 1% AEP event. It is possible therefore to construct the development without affecting flood risk elsewhere.

(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;

Response:

Ideally, the WwTP would be located on higher ground which is not within Zones A or B. However, the lower parts of the site are well protected by the existing flood defence embankment and the risk to people, the economy and property is significantly reduced. The development proposals also include setting the building level above the design flood level plus an allowance for climate change and freeboard.

(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access:

Response:

Measures including implementing a Flood Emergency Response Plan, flood resilient construction techniques and setting the floor levels of buildings above the anticipated flood levels are proposed which mitigate against the residual risk.

(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

Response:

The existing industrial use for the site is well established and development of a WwTP is compatible and appropriate with the zoning.

9.0 Summary and Conclusions

Following IW public consultation the former IFI site west of Arklow was identified as a potential site for the Arklow WwTP. An assessment of the flood risk to the site has been undertaken and it has been shown that an adequate area of land is available within the assessment site for the provision of Arklow WwTP which is outside the 0.1% AEP flood extent. Portions of the suitable land are within flood Zones A or B but are well protected by an existing flood defence embankment.

The key points are:

- Adequate lands are available outside the 0.1% AEP flood extent:
- Development in Zone C is the preferred option, but development in Zone A or B where it is defended by the flood defence embankment is also possible;
- A justification test has been undertaken that demonstrates that an adequate area within the assessment site is suitable for development in terms of flood risk;
- No other criteria have been assessed other than flood risk;
- Site investigations to assess the strength and condition of the existing flood defence embankment, as well as the potential for seepage should be conducted if development in plot A is proposed.
- The development levels (floor and tank) shall be as presented in Table 6.1.

References

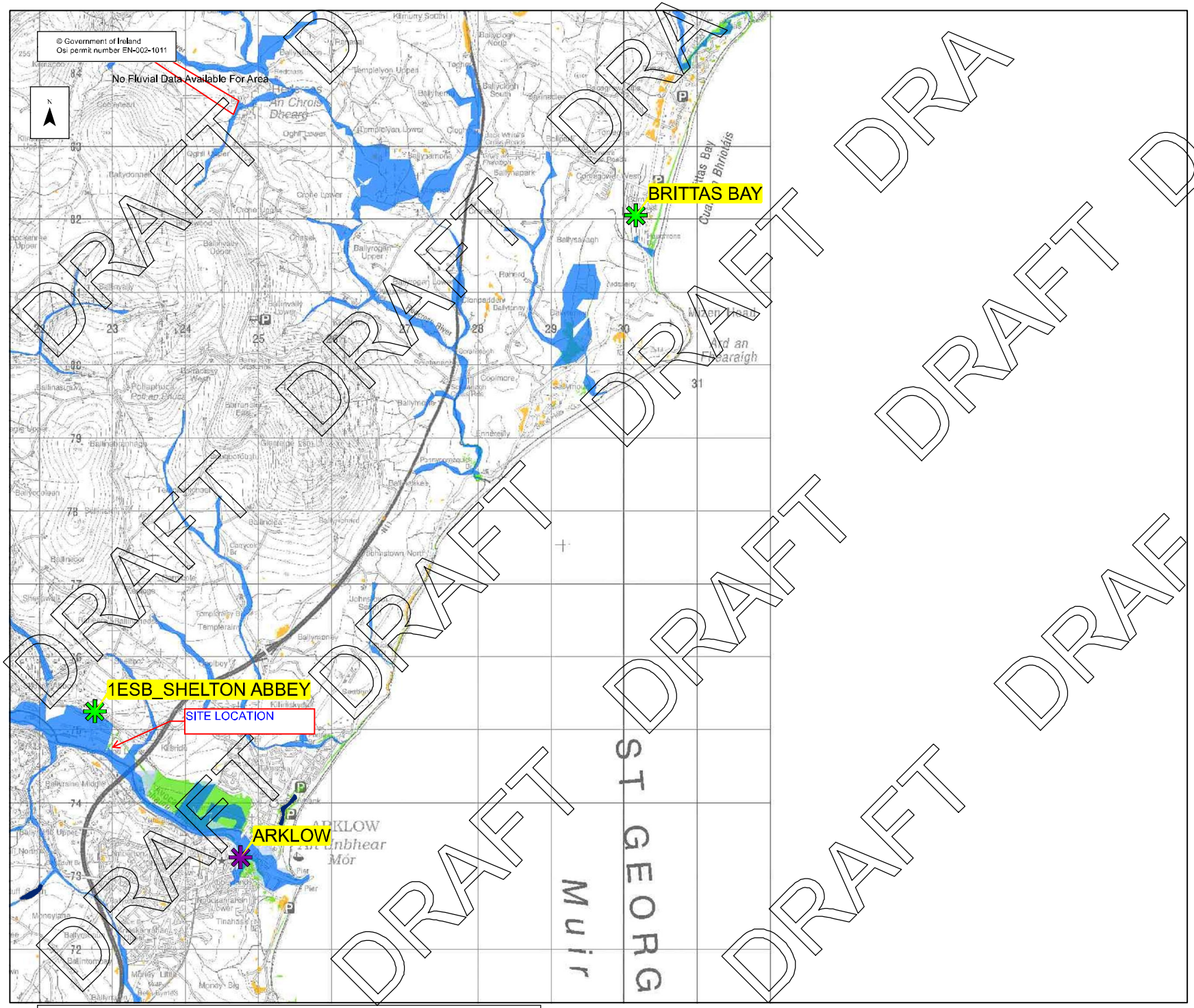
BLP, 2013, *Avoca River (Arklow) Flood Relief Feasibility Study,* Byrne Looby Partners, Dublin 12,

Cawley, A., 2012, *Avoca River (Arklow) Flood Relief Feasibility Study, Hydrology and Hydraulics Report*, Arklow Flood Relief Scheme, PHMcCarthy Consulting Engineers, Dublin 14.

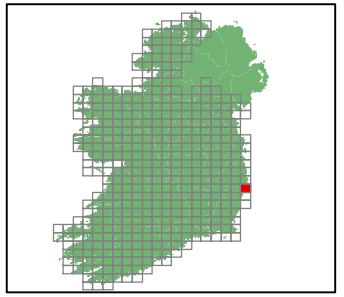
Cawley, A., 2012, *Hydraulic Report II - Two-Dimensional Hydraulic Modelling Of the Avoca River at Arklow*, Arklow Flood Relief Scheme Preliminary Engineering Design, Report No. HEL092501 v1.1, WYG, Dublin, Ireland.

Flood Studies Report (1975), Natural Environment Research Council, 5 Volumes, 1198 pages and twelve maps (available from Institute of Hydrology, Wallingford, Oxfordshire)

Appendix A – Preliminary Flood Risk Assessment Map for Arklow



Location Plan :



Legend:

Flood Extents

- Fluvial - Indicative 1% AEP (100-yr) Event
- Fluvial - Extreme Event
- Coastal - Indicative 0.5% AEP (200-yr) Event
- Coastal - Extreme Event
- Pluvial - Indicative 1% AEP (100-yr) Event
- Pluvial - Extreme Event
- Groundwater Flood Extents
- Lakes / Turloughs

PFRA Outcomes

- Probable Area for Further Assesment
- Possible Area for Further Assesment

Important User Note:

The flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location. Information on the purpose, development and limitations of these maps is available in the relevant reports (see www.cfram.ie). Users should seek professional advice if they intend to rely on the maps in any way.

If you believe that the maps are inaccurate in some way please forward full details by contacting the OPW (refer to PFRA Information leaflets or 'Have Your Say' on www.cfram.ie).

Office of Public Works
Jonathon Swift Street
Trim
Co Meath
Ireland

Project :
PRELIMINARY FLOOD RISK ASSESMENT (PFRA)

Map :
PFRA Indicative extents and outcomes
- Draft for Consultation

Figure By : PJW Date : July2011

Checked By : MA Date : July 2011

Figure No. : 2019 / MAP / 173 / A

Revision 0

Drawing Scale : 1:50,000 Plot Scale : 1:1 @ A3

Appendix B – Report Figures

001 – Topographic Survey

002 – Flood Zone Map

003 – Flood Extent Map

A3

Chainage (m)	Section ID
1810.893	01AVOC0210
1755.831	01AVOC0200
1636.97	01AVOC0190
1584.917	01AVOC0180
1476.919	01AVOC0170
1387.915	01AVOC0160
1290.073	01AVOC0150
1247.829	01AVOC0140
1230.031	01AVOC0130
1197.199	01AVOC0120
1029.347	01AVOC0110
879.89	01AVOC0100
779.8	01AVOC0090
630.124	01AVOC0080
540.847	01AVOC0070
397.996	01AVOC0060
325.88	01AVOC0055
320.23	01AVOC0050
316.041	01AVOC0045
168.647	01AVOC0040
89.131	01AVOC0030
54.533	01AVOC0020

N
W E
S

GENERAL NOTES

LEGEND:

ASSESSMENT SITE BOUNDARY

ORDNANCE SURVEY IRELAND
LICENCE No. EN 0064809

Rev	Date	Description	By	Chk	App
F1	07/04/15	FOR INFORMATION	NM	SH	KT

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CLIENT
IRISH WATER

PROJECT
ARKLOW SS FRA

DRAWING TITLE
SITE TOPOGRAPHICAL SURVEY

STATUS
FOR INFORMATION

Date: 25/03/15	Scale: AS SHOWN	Drawn: NM	Chk: SH	App: KT

Project No:	Drg. No:	Rev:
W3111	W3111-FG001	F1

A3

PLOT A

PLOT B

PLOT C

Tk

Avoca River

N

W E

S

REFER TO OPW FLOOD EXTENT MAPS FOR DETAILS OF THE FLOOD RISK DOWNSTREAM OF THE SITE

GENERAL NOTES

LEGEND:

ASSESSMENT SITE BOUNDARY

ZONE A

ZONE B

ZONE C

ORDNANCE SURVEY IRELAND
LICENCE No. EN 0064809

Rev	Date	Description	By	Chk	App
F1	07/04/15	FOR INFORMATION	NM	SH	K

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CLIENT
IRISH WATER

PROJECT
ARKLOW SS FRA

DRAWING TITLE
FLOOD ZONES FOR THE POTENTIAL WWTP AT THE IFI SITE, ARKLOW

STATUS
FOR INFORMATION

Date: 25/03/15	Scale: 1:2500	Drawn: NM	Chk: SH	App: K
Project No: W3111	Drg. No: W3111-FG002			Rev: F1

A3

PLOT A

PLOT B

PLOT C

Avoca River

Tk

N

W E

S

REFER TO OPW FLOOD EXTENT MAPS FOR DETAILS OF THE FLOOD RISK DOWNSTREAM OF THE SITE

GENERAL NOTES

LEGEND:

ASSESSMENT SITE BOUNDARY

1% AEP FLOOD EXTENT

0.1% AEP FLOOD EXTENT

ORDNANCE SURVEY IRELAND
LICENCE No. EN 0064809

Rev	Date	Description	By	Chk	App
F1	07/04/15	FOR INFORMATION	NM	SH	K

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CLIENT
IRISH WATER

PROJECT
ARKLOW SS FRA

DRAWING TITLE
EXISTING DEFENDED FLOOD EXTENTS MAP

STATUS
FOR INFORMATION

Date: 25/03/15	Scale: 1:2500	Drawn: NM	Chk: SH	App: K

Project No:	Drg. No:	Rev:
W3111	W3111-FG003	F1

Appendix C – Site Photographs

Figure C.1 Locations of photographs

1. Upstream view from IFI Bridge

2. Downstream face of IFI bridge

3. Upstream view of the Avoca River

4. Upstream view of the Avoca River

5. Weir structure on the Avoca RIver

6. Downstream view to the M11 Roadbridge

7. Site condition near IFI bridge

8. Downstream view of the IFI embankment

9. Upstream view of the IFI embankment from SW corner of Plot A

10. View from the SW corner of plot A in NE direction

11. Downstream view of the embankment adjoining plot A

12. Attenuation pond at SE corner of plot A with pumped discharge arrangement

	
13. View from the SW corner of plot C in eastern direction	14. View from the SW corner of plot C in northern direction
	
15. View of plot C in western direction	16. Upstream view of the canal from NE comers of plot C
	
17. Downstream view of canal from NW corner of plot C	18. View from east of plot A in north western direction

19. Upstream view of lower section of Sheepswalks Stream

20. Upstream view of Sheepswalks Stream

21. Upstream view of culvert on the Sheepswalks Stream

22. View of plot A on right and plot C on the left from wayleave

23. View from east of plot B in western direction

Appendix D – Hydraulic Modelling Outputs

Profile Output Table - Standard
HEC-RAS Plan: Plan 09 River: Avoca 1 Profile: Q100

Rivers 1
Hydraulic Reaches 1
River Station 28
Plans 1
Profiles 1

Date: 03/04/2015
By: SH

Reach	River Station	Profile	Q Total (m3/s)	Bed Level (mOD)	W.S. Elev (mOD)	Crit W.S. (mOD)	E.G. Elev (mOD)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Avoca 1	1810.893	Q100	560	-2.34	5.4		5.82	0.001577	2.88	196.36	183.21	0.39
Avoca 1	1755.831	Q100	560	-0.98	5.36		5.72	0.001385	2.67	210.24	194.08	0.38
Avoca 1	1636.97	Q100	560	-0.62	5.24	2.71	5.53	0.001397	2.42	243.22	208.44	0.37
Avoca 1	1584.917	Q100	560	0.48	5.11	3.44	5.45	0.001782	2.67	229.46	205.35	0.42
Avoca 1	1500		Lat Struct									
Avoca 1	1476.919	Q100	560	-1	5.2	3.02	5.28	0.000482	1.56	532.37	273.13	0.22
Avoca 1	1387.915	Q100	560	-0.71	5.16	2.75	5.24	0.000459	1.47	524.12	227.95	0.22
Avoca 1	1290.073	Q100	560	-0.34	5.08	2.41	5.19	0.000552	1.66	463.69	134.27	0.24
Avoca 1	1247.829	Q100	560	-0.6	5.01	2.3	5.16	0.000803	1.72	325.65	83.16	0.28
Avoca 1	1230.031	Q100	560	-1.1	4.96	2.28	5.14	0.000876	1.86	301.05	72.21	0.29
Avoca 1	1222.931		Bridge									
Avoca 1	1222.431	Q100	560	-1.1	4.94		5.12	0.000893	1.87	299.16	72.14	0.29
Avoca 1	1197.199	Q100	560	-1.24	4.95	1.99	5.08	0.0006	1.68	376.75	180.18	0.25
Avoca 1	1029.347	Q100	560	-0.75	4.75	2.36	4.96	0.001125	2.13	320.63	107.21	0.33
Avoca 1	879.89	Q100	560	-0.58	4.56	2.53	4.78	0.001238	2.27	313.46	104.3	0.34
Avoca 1	779.8	Q100	560	-0.97	4.52	2.14	4.66	0.000754	1.86	374.6	133.78	0.27
Avoca 1	630.124	Q100	560	-1.83	4.32	1.56	4.53	0.000905	2.13	315.1	94.35	0.3
Avoca 1	540.847	Q100	560	-2.08	4.15	1.37	4.43	0.001084	2.42	260.42	66.06	0.33
Avoca 1	397.996	Q100	560	-2.02	3.94	1.84	4.25	0.001459	2.57	258.72	83.31	0.38
Avoca 1	325.88	Q100	560	-0.43	3.83	2.75	4.12	0.002209	2.61	279.86	128.21	0.45
Avoca 1	320.23	Q100	560	-0.49	3.8	2.82	4.11	0.002902	2.87	286	138.68	0.48
Avoca 1	316.041	Q100	560	-2.6	3.88	1.56	4.06	0.000971	2.02	361.15	140.75	0.31
Avoca 1	168.647	Q100	560	-1.3	3.68	2.8	3.89	0.001418	2.43	385.19	221.5	0.36
Avoca 1	89.131	Q100	560	-1.43	3.69		3.78	0.000634	1.51	528.08	223.82	0.25
Avoca 1	54.533	Q100	560	-1.84	3.52	1.73	3.74	0.001247	2.34	373.26	262.51	0.35
Avoca 1	54.033		Bridge									
Avoca 1	21.733	Q100	560	-1.84	3.46	1.64	3.69	0.001341	2.36	359.3	268.55	0.36
Avoca 1	1	Q100	560	-2.04	3.49	1.53	3.64	0.000935	2.04	452.21	269.4	0.31

Profile Output Table - Standard
HEC-RAS Plan: Plan 09 River: Avoca 1 Profile: Q1000

Rivers 1
Hydraulic Reaches 1
River Station 28
Plans 1
Profiles 1

Date: 03/04/2015
By: SH

Reach	River Sta	Profile	Q Total (m3/s)	Bed Level (m OD)	W.S. Elev (m OD)	Crit W.S. (m OD)	E.G. Elev (m OD)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Avoca 1	1810.893	Q1000	745	-2.34	6.01		6.61	0.001986	3.44	219.13	185.38	0.45
Avoca 1	1755.831	Q1000	745	-0.98	5.97		6.48	0.001678	3.17	236.27	195.43	0.42
Avoca 1	1636.97	Q1000	745	-0.62	5.87	3.32	6.25	0.001541	2.78	285.56	209.78	0.39
Avoca 1	1584.917	Q1000	745	0.48	5.73	3.97	6.16	0.001929	3.04	268.27	208.88	0.44
Avoca 1	1500		Lat Struct									
Avoca 1	1476.919	Q1000	745	-1	5.87	3.34	5.97	0.000477	1.69	647.58	312.86	0.23
Avoca 1	1387.915	Q1000	745	-0.71	5.83	3.02	5.92	0.000479	1.64	622.42	285.53	0.23
Avoca 1	1290.073	Q1000	745	-0.34	5.73	3.02	5.86	0.000607	1.89	553.03	145.62	0.26
Avoca 1	1247.829	Q1000	745	-0.6	5.63	2.73	5.83	0.000919	1.96	379.67	87.89	0.3
Avoca 1	1230.031	Q1000	745	-1.1	5.57	2.73	5.81	0.001019	2.16	345.42	74.04	0.32
Avoca 1	1222.931		Bridge									
Avoca 1	1222.431	Q1000	745	-1.1	5.54		5.78	0.001042	2.17	342.91	73.92	0.32
Avoca 1	1197.199	Q1000	745	-1.24	5.56	2.49	5.74	0.000672	1.93	443.55	182.41	0.27
Avoca 1	1029.347	Q1000	745	-0.75	5.35	3.15	5.6	0.001215	2.38	385.07	109.17	0.35
Avoca 1	879.89	Q1000	745	-0.58	5.13	3.29	5.4	0.001362	2.56	373.57	105.56	0.36
Avoca 1	779.8	Q1000	745	-0.97	5.1	3.19	5.27	0.000772	2.04	453.54	135.3	0.28
Avoca 1	630.124	Q1000	745	-1.83	4.85	2.16	5.12	0.001082	2.49	365.11	96.13	0.33
Avoca 1	540.847	Q1000	745	-2.08	4.59	2	5	0.001441	2.94	289.49	67.6	0.39
Avoca 1	397.996	Q1000	745	-2.02	4.32	2.57	4.76	0.001911	3.1	290.19	84.68	0.44
Avoca 1	325.88	Q1000	745	-0.43	4.21	3.19	4.58	0.002544	2.99	328.93	129.76	0.49
Avoca 1	320.23	Q1000	745	-0.49	4.2	3.34	4.57	0.003195	3.22	342.21	144.88	0.51
Avoca 1	316.041	Q1000	745	-2.6	4.28	2.19	4.52	0.001199	2.38	417.86	145.89	0.34
Avoca 1	168.647	Q1000	745	-1.3	4.09	3.22	4.32	0.001484	2.63	477.74	225.17	0.38
Avoca 1	89.131	Q1000	745	-1.43	4.1		4.2	0.000734	1.71	619.89	228.63	0.27
Avoca 1	54.533	Q1000	745	-1.84	3.91	2.64	4.16	0.001388	2.6	466.01	263.7	0.37
Avoca 1	54.033		Bridge									
Avoca 1	21.733	Q1000	745	-1.84	3.84	2.84	4.09	0.001511	2.64	448.46	269.96	0.39
Avoca 1	1	Q1000	745	-2.04	3.87	2.52	4.04	0.001048	2.26	554.88	270.89	0.33

Profile Output Table - Standard
HEC-RAS Plan: Plan 09 River: Avoca 1 Profile: Q100MRFS

Rivers 1
Hydraulic Reaches 1
River Station 28
Plans 1
Profiles 1

Date: 03/04/2015
By: SH

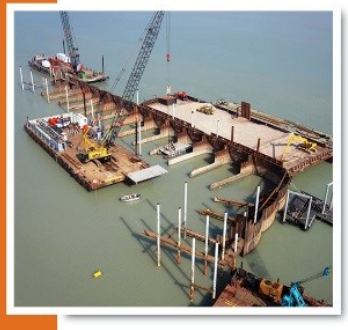
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m OD)	W.S. Elev (m OD)	Crit W.S. (m OD)	E.G. Elev (m OD)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Avoca 1	1810.893	MRFSQ100	672	-2.34	5.78		6.31	0.001838	3.23	210.41	185.38	0.43
Avoca 1	1755.831	MRFSQ100	672	-0.98	5.74		6.19	0.001567	2.98	226.33	195.43	0.41
Avoca 1	1636.97	MRFSQ100	672	-0.62	5.63	3.08	5.98	0.001488	2.64	269.55	209.78	0.38
Avoca 1	1584.917	MRFSQ100	672	0.48	5.49	3.79	5.89	0.001874	2.9	253.62	208.88	0.43
Avoca 1	1500		Lat Struct									
Avoca 1	1476.919	MRFSQ100	672	-1	5.62	3.21	5.71	0.000478	1.64	603.66	310.03	0.23
Avoca 1	1387.915	MRFSQ100	672	-0.71	5.57	2.97	5.66	0.000472	1.57	585.16	283.21	0.22
Avoca 1	1290.073	MRFSQ100	672	-0.34	5.49	2.91	5.61	0.000576	1.78	518.75	137.85	0.25
Avoca 1	1247.829	MRFSQ100	672	-0.6	5.4	2.56	5.57	0.000886	1.87	359.04	86.96	0.29
Avoca 1	1230.031	MRFSQ100	672	-1.1	5.34	2.56	5.55	0.000964	2.05	328.6	73.28	0.31
Avoca 1	1222.931		Bridge									
Avoca 1	1222.431	MRFSQ100	672	-1.1	5.31		5.53	0.000985	2.06	326.35	73.18	0.31
Avoca 1	1197.199	MRFSQ100	672	-1.24	5.33	2.3	5.49	0.000645	1.84	418.26	181.58	0.26
Avoca 1	1029.347	MRFSQ100	672	-0.75	5.13	2.8	5.36	0.001182	2.29	360.67	108.43	0.34
Avoca 1	879.89	MRFSQ100	672	-0.58	4.91	2.8	5.17	0.001316	2.45	350.85	105.09	0.35
Avoca 1	779.8	MRFSQ100	672	-0.97	4.88	2.56	5.04	0.000765	1.97	423.69	134.82	0.28
Avoca 1	630.124	MRFSQ100	672	-1.83	4.65	1.93	4.9	0.001016	2.35	346.21	95.47	0.32
Avoca 1	540.847	MRFSQ100	672	-2.08	4.43	1.77	4.79	0.0013	2.74	278.71	67.03	0.37
Avoca 1	397.996	MRFSQ100	672	-2.02	4.18	2.3	4.57	0.001729	2.89	278.72	84.17	0.42
Avoca 1	325.88	MRFSQ100	672	-0.43	4.07	3.01	4.41	0.002407	2.84	311	129.24	0.47
Avoca 1	320.23	MRFSQ100	672	-0.49	4.05	3.23	4.4	0.003074	3.09	321.51	143.04	0.5
Avoca 1	316.041	MRFSQ100	672	-2.6	4.13	1.97	4.35	0.001108	2.24	397.01	143.78	0.33
Avoca 1	168.647	MRFSQ100	672	-1.3	3.94	3.1	4.16	0.001445	2.55	444.88	224.09	0.37
Avoca 1	89.131	MRFSQ100	672	-1.43	3.96		4.05	0.00069	1.63	587.21	226.93	0.26
Avoca 1	54.533	MRFSQ100	672	-1.84	3.78	2.14	4.01	0.001322	2.5	433.74	263.29	0.36
Avoca 1	54.033		Bridge									
Avoca 1	21.733	MRFSQ100	672	-1.84	3.71	2.07	3.95	0.001429	2.52	418.02	269.48	0.38
Avoca 1	1	MRFSQ100	672	-2.04	3.74	1.91	3.9	0.000993	2.17	519.66	270.34	0.32

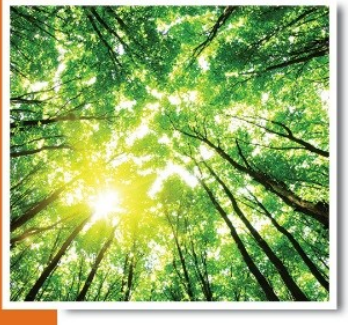
Profile Output Table - Standard
HEC-RAS Plan: Plan 09 River: Avoca 1 Profile: Q1000MRFS

Rivers 1
Hydraulic Reaches 1
River Station 28
Plans 1
Profiles 1

Date: 03/04/2015
By: SH

Reach	River Station	Profile	Q Total (m3/s)	Min Ch El (m OD)	W.S. Elev (m OD)	Crit W.S. (m OD)	E.G. Elev (m OD)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Avoca 1	1810.893	MRFSQ1000	894	-2.34	6.45		7.2	0.00226	3.85	235.98	185.38	0.48
Avoca 1	1755.831	MRFSQ1000	894	-0.98	6.42		7.05	0.001876	3.52	255.59	195.43	0.45
Avoca 1	1636.97	MRFSQ1000	894	-0.62	6.34	3.88	6.79	0.001617	3.02	317.2	209.78	0.41
Avoca 1	1584.917	MRFSQ1000	894	0.48	6.18	4.32	6.69	0.002002	3.29	297.34	208.88	0.46
Avoca 1	1500		Lat Struct									
Avoca 1	1476.919	MRFSQ1000	894	-1	6.38	3.55	6.48	0.000468	1.77	735.55	312.86	0.23
Avoca 1	1387.915	MRFSQ1000	894	-0.71	6.32	3.39	6.43	0.000487	1.75	696.73	286.5	0.23
Avoca 1	1290.073	MRFSQ1000	894	-0.34	6.22	3.32	6.37	0.000643	2.06	629.86	168.15	0.27
Avoca 1	1247.829	MRFSQ1000	894	-0.6	6.1	3.05	6.33	0.00095	2.12	421.93	91.17	0.31
Avoca 1	1230.031	MRFSQ1000	894	-1.1	6.03	3.08	6.31	0.001099	2.35	379.71	75.55	0.33
Avoca 1	1222.931		Bridge									
Avoca 1	1222.431	MRFSQ1000	894	-1.1	5.96		6.25	0.001145	2.39	374.79	75.33	0.34
Avoca 1	1197.199	MRFSQ1000	894	-1.24	6	2.96	6.21	0.00072	2.11	492.2	183.89	0.28
Avoca 1	1029.347	MRFSQ1000	894	-0.75	5.78	3.64	6.06	0.001274	2.56	432.18	110.7	0.36
Avoca 1	879.89	MRFSQ1000	894	-0.58	5.54	3.65	5.86	0.001442	2.75	417.33	106.46	0.38
Avoca 1	779.8	MRFSQ1000	894	-0.97	5.53	3.49	5.71	0.000782	2.16	510.97	135.96	0.29
Avoca 1	630.124	MRFSQ1000	894	-1.83	5.22	2.8	5.55	0.001202	2.74	401.65	97.38	0.35
Avoca 1	540.847	MRFSQ1000	894	-2.08	4.88	2.53	5.41	0.001728	3.33	309.67	68.74	0.43
Avoca 1	397.996	MRFSQ1000	894	-2.02	4.56	3.02	5.12	0.002287	3.5	311.07	85.68	0.49
Avoca 1	325.88	MRFSQ1000	894	-0.43	4.46	3.48	4.9	0.002827	3.29	361.84	131.42	0.52
Avoca 1	320.23	MRFSQ1000	894	-0.49	4.46	3.63	4.88	0.003447	3.49	380.55	147.98	0.53
Avoca 1	316.041	MRFSQ1000	894	-2.6	4.54	2.69	4.83	0.00138	2.64	456.58	148.53	0.37
Avoca 1	168.647	MRFSQ1000	894	-1.3	4.35	3.44	4.61	0.001574	2.81	537.01	226.68	0.39
Avoca 1	89.131	MRFSQ1000	894	-1.43	4.36		4.48	0.000825	1.86	679.17	231.59	0.29
Avoca 1	54.533	MRFSQ1000	894	-1.84	4.15	3.01	4.43	0.001531	2.82	523.2	264.57	0.39
Avoca 1	54.033		Bridge									
Avoca 1	21.733	MRFSQ1000	894	-1.84	4.06	3.15	4.35	0.001687	2.87	502.08	270.85	0.41
Avoca 1	1	MRFSQ1000	894	-2.04	4.1	2.82	4.3	0.001168	2.45	617.26	271.99	0.35





Appendix C – Extensive List of Matrix Criteria

1.0	**Cultural Heritage**
1.1	**Cultural Heritage - Land Parcels / Sites**
1.1.1	Potential to impact (direct/indirect) on National Monuments (designated sites)
1.1.2	Potential to impact (direct/indirect) on RMPs (designated sites)
1.1.3	Potential to impact (direct/indirect) on RPS/NIAH (designated sites)
1.1.4	Potential to impact (direct/indirect) on CH sites (previously unrecorded sites)
1.1.5	Potential to impact (direct) on water courses and environs (areas of archaeological potential)
1.1.6	Potential to impact (direct/indirect) on historic designed landscapes
1.1.7	Potential to impact (direct) on townland boundaries (cultural heritage significance)
1.2	**Cultural Heritage - Route Corridors**
1.2.1	Potential to impact on RMPs
1.2.2	Potential to impact on National Monuments
1.2.3	Potential to impact on RPS/NIAH
1.2.4	Potential to impact on CH sites
1.2.5	Potential to impact on historic designed landscapes
1.2.6	Potential to impact on ACA
1.3	**Cultural Heritage - Outfalls**
1.3.1	Potential to impact on RMPs
1.3.2	Potential to impact on National Monuments
1.3.3	Potential to impact on RPS/NIAH
1.3.4	Potential to impact on CH sites
1.3.5	Potential to impact on Recorded shipwreck sites
1.3.6	Potential to impact on inter-tidal archaeology (previously unknown)
2.0	**Landscape & Visual**
2.1	**Landscape & Visual - Land Parcels / Sites**
2.1.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)
2.1.2	Potential to impact on areas of 'Highly Sensitive Landscape' (designation in Wicklow CDP)
2.1.3	Potential to impact on views from heritage/tourist/amenity features
2.1.4	Potential to impact on the character of the landscape character
2.1.5	Potential that landscape screening will be ineffective or contribute to landscape and visual impacts
2.1.6	Potential to impact on views from settlements
2.1.7	Potential to impact on views from dwellings / local roads
2.1.8	Potential to impact on views from M11 motorway
2.1.9	Potential to impact on views from Dublin - Rosslare rail line
2.1.10	Potential to impact on views from other major roads (national or regional roads)
2.1.11	Potential to disrupt landscape structure (hedgerows / field pattern etc.)
2.1.12	Potential to impact on historic designed landscapes
2.1.13	Potential to impact on woodlands and significant tree groups
2.2	**Landscape & Visual - Route Corridors - Pipelines**
2.2.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)
2.2.2	Potential to impact on areas of 'Highly Sensitive Landscape' (designation in Wicklow CDP)
2.2.3	Potential to impact on views from settlements
2.2.4	Potential to impact on views from dwellings / local roads
2.2.5	Potential to impact on views from motorways
2.2.6	Potential to impact on views from other major roads (national or regional roads)
2.2.7	Potential to impact on views from Dublin - Rosslare rail line
2.2.8	Potential to impact on views from heritage/tourist features
2.2.9	Potential to disrupt landscape structure (treelines / hedgerows / field pattern etc.)
2.2.10	Potential to impact on woodlands and significant tree groups
2.2.11	Potential to impact on rivers and streams
2.2.12	Potential to impact on historic designed landscapes
2.3	**Landscape & Visual - Outfalls (Landward side)**
2.3.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)
2.3.2	Potential to impact on 'Highly Sensitive Landscape' (designation in Wicklow CDP)
2.3.3	Potential to impact on coastal walks (indicated in Wicklow CDP)
2.3.4	Potential to impact on bathing locations (indicated in Wicklow CDP)
2.3.5	Potential to impact on views from settlements
2.3.6	Potential to impact on views from dwellings / local roads
2.3.7	Potential to impact on views from major roads (national or regional roads)
2.3.8	Potential to impact on views from Dublin - Rosslare rail line
2.3.9	Potential to impact on views from heritage/tourist features
2.3.10	Potential to Impact on Character of the Coastal Landscape

3.0	**Ecology**
3.1	**Ecology - Land Parcels / Sites**
3.1.1	Potential to impact on Natura 2000 Sites
3.1.2	Potential to impact on Habitats Directive Annex II listed species in freshwater
3.1.3	Potential to impact on Habitats Directive Annex II listed species in coastal and marine waters
3.1.4	Potential to impact on pNHAs and Conservation Zones
3.1.5	Potential to impact upon ecological corridors, nature development area or high value habitats
3.1.6	Potential to impact on breeding habitat for Annex 1 bird species
3.1.7	Potential to impact on IWeBS identified areas of importance
3.2	**Ecology - Route Corridors/Pipelines**
3.2.1	Potential to impact on Natura 2000 sites
3.2.2	Potential to impact on Habitats Directive Annex II listed species in freshwater
3.2.3	Potential to impact on Habitats Directive Annex II listed species in coastal and marine waters
3.2.4	Potential to impact on pNHAs and Conservation Zones
3.2.5	Potential to impact upon ecological corridors, nature development area or high value habitats
3.2.6	Potential to impact on breeding habitat for Annex 1 bird species
3.2.7	Potential to impact on IWeBS identified areas of importance
3.3	**Ecology - Outfalls**
3.3.1	Marine Outfall; Coastal Natura 2000 sites
3.3.2	Marine Outfall; Marine Natura 2000 sites
3.3.3	Marine Outfall; Habitats Directive Annex II listed species
3.3.4	Marine Outfall; Birds Directive Annex 1 listed species
3.3.5	Potential to impact on IWeBS identified areas of importance
3.3.6	River outfall; Habitats Directive Annex II listed species in freshwater
3.3.7	Potential to impact on breeding habitat for Annex 1 bird species
4.0	**Hydrology**
4.1	**Hydrology - Land Parcels / Sites**
4.1.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors
4.1.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.
4.1.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the land parcel/site as well as up and downstream locations)
4.1.4	Potential Impact on ecologically important and designated sites.
4.2	**Hydrology - Route Corridors**
4.2.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors
4.2.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.
4.2.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the land parcel/site as well as up and downstream locations)
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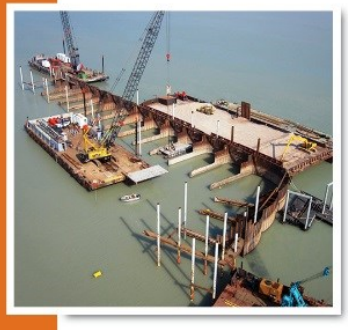

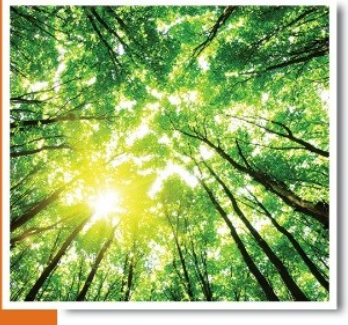

Appendix D – Cultural Heritage Report

IAC Irish Archaeological Consultancy

HIGH LEVEL ARCHAEOLOGICAL ASSESSMENT OF LANDS AT KILBRIDE, SHELTON ABBEY & FERRYBANK ARKLOW, CO. WICKLOW

PART OF THE PROPOSED ARKLOW SEWERAGE SCHEME

ON BEHALF OF BYRNE LOOBY CONSULTING ENGINEERS

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DATE: 2 APRIL 2015

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ABSTRACT

Irish Archaeological Consultancy Ltd has prepared this report on behalf of Byrne Looby Consulting Engineers. This document is a high level study of the impact, if any, on the archaeological and historical resource of three potential Waste Water Treatment Works sites at Kilbride, Shelton Abbey and Ferrybank as part of the Arklow Sewerage Scheme (OS Sheet 40). This study is not a detailed desk-top assessment of the proposed development nor has a field inspection been carried out. This assessment has been carried out by Maeve Tobin of IAC Ltd.

None of the proposed WWTW sites directly impact on any known RMPs/ SMRs. A review of the historic mapping and aerial photography for each site has failed to identify any sites of potential archaeological significance.

The proposed WWTW site at Ferrybank is located within a previously developed parcel of land within the reclaimed and built up estuarine area. Recent programs of monitoring in the vicinity of the north quay have failed to identify any deposits or features of archaeological significance.

The sites at Kilbride and Shelton Abbey are located within a rich archaeological landscape to the north of the Avoca River. The nearest RMP site, a church, graveyard and mausoleum (WI040-021) is located *c*. 60m north of the Kilbride option and *c.* 320m east of the Shelton Abbey option. Excavations in advance of the Arklow Bypass in 1997 revealed a prehistoric settlement and furnace immediately adjacent to both parcels of land. While these features have been completely removed through excavation it is possible that previously unidentified features associated with these sites may exist beyond the footprint of the existing road within the current land parcels.

Development at the Ferrybank site or within the northern half of the Shelton Abbey site poses the least potential impact to the archaeological resource; although all three areas are located within an archaeologically sensitive landscape, given the proximity to the coast and River Avoca.

Should the proposed WWTW be constructed within the northern half of the Shelton Abbey site there would be no recommendations for archaeological mitigation.

Should the proposed WWTW be constructed within the Ferrybank site it is recommended that all ground disturbances, including site investigations, be subject to archaeological monitoring. This should be carried out by a suitably qualified archaeologist with full provision made available for the resolution of any archaeological features and/or deposits that may be discovered, should that be deemed the most appropriate manner in which to proceed.

Should the proposed WWTW be located within the southern half of the Shelton Abbey site, or anywhere within the Kilbride option, it is recommended that a program

of archaeological assessment, including test trenches, be undertaken within the footprint of the WWTW once design is finalised, prior to development going ahead.

This should be undertaken by an archaeologist under licence from the Department of Arts, Heritage and Gaeltacht. Full provision should be made for the resolution of any archaeological features and/or deposits that may be discovered, should that be deemed the most appropriate manner in which to proceed.

In addition, it is recommended that any topsoil stripping, including site investigations, within these greenfield areas, are subject to archaeological monitoring. This should be carried out by a suitably qualified archaeologist with full provision made available for the resolution of any archaeological features and/or deposits that may be discovered, should that be deemed the most appropriate manner in which to proceed.

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1. INTRODUCTION

1.1 GENERAL

The following document details the results of a high level study undertaken at three potential Waste Water Treatment Plant (WWTP) sites at Kilbride, Shelton Abbey and Ferrybank as part of the Arklow Sewerage Scheme. This high level study has been carried out to ascertain the potential impact of the proposed development on the archaeological and historical resource that may exist within the area. This study is not a detailed desk-top assessment of the proposed development nor has a field inspection been carried out. The assessment was undertaken by Maeve Tobin of Irish Archaeological Consultancy Ltd, on behalf of Byrne Looby Consulting Engineers.

The high level archaeological assessment involved a detailed study of the archaeological and historical background of the proposed development site and the surrounding area. This included information from the Record of Monuments and Places of County Wicklow, the topographical files within the National Museum and all available cartographic and documentary sources for the area.

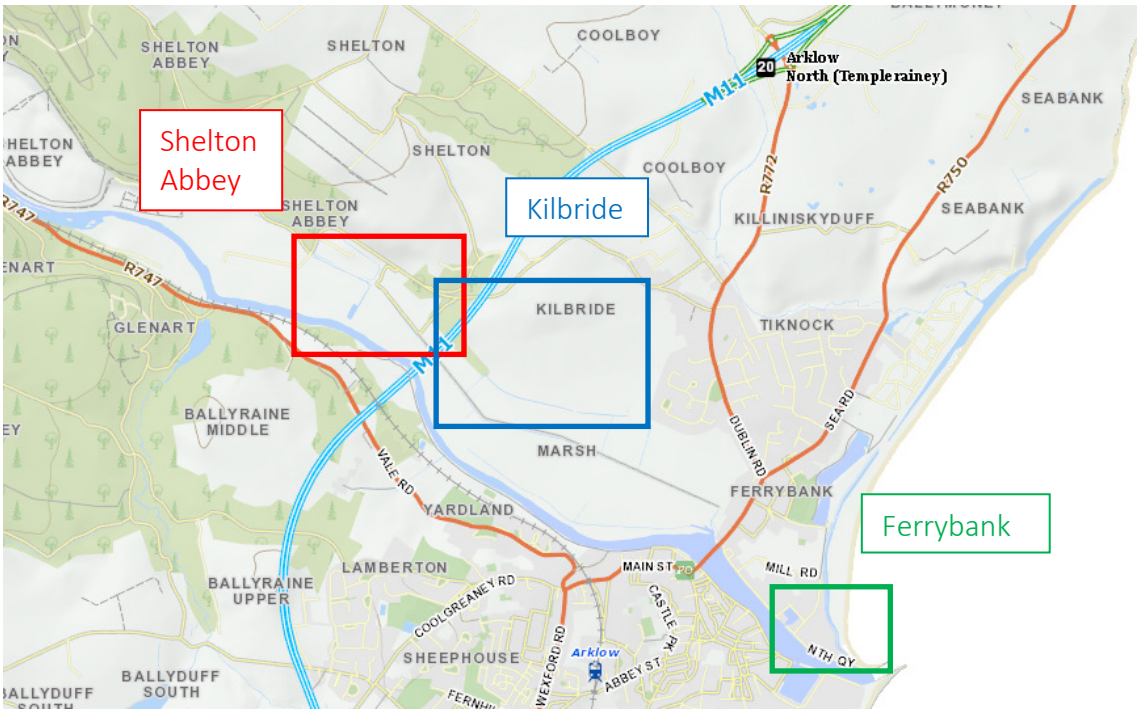

Figure 1: Proposed options for WWTW site

1.2 THE DEVELOPMENT

The proposed development will consist of the construction of a Waste Water Treatment Works at one of three locations in Kilbride, Shelton Abbey or Ferrybank townlands. Land parcels have been proposed for the WWTW measuring *c.* 43 hectares in Kilbride and *c.* 29.6 hectares in Shelton Abbey should a river outfall option be approved for the project. A third land option was proposed at Ferrybank measuring *c.* 7 acres. This assessment was undertaken in advance of any detailed design plans however the proposed WWTW will be confined within a 2 hectare

footprint. Other elements of the scheme have been previously assessed in 2012 (Bailey 2012).

2 RESULTS OF DESKTOP STUDY

2.1 KILBRIDE

The Kilbride site option is located within the townland and Parish of Kilbride and Barony of Arklow. The site is situated *c.* 870m north of Arklow town centre to the north of the Avoca River. It is comprised of all or part of approximately five undeveloped greenfields surrounding Kilbride House, to the immediate south of the M11 (Figure 2).

The receiving environment is considered to possess archaeological potential due to its proximity to the River Avoca and the coast *c*. 1.2km to the east. Settlement from the prehistoric periods onwards found coastal and riverine landscapes attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

There are nine previously recorded archaeological sites located within *c.* 500m of the proposed WWTW option in Kilbride (Figure 3). The nearest of which comprise of a two sites (WI040-048 and WI040-050) excavated in advance of the Arklow Bypass Road in 1997 to the immediate north of the northwest corner of the proposed land parcel. Site WI040-048 comprised the remains of a Bronze Age settlement site – indicated by evidence for an oval structure and postholes associated with lithic artefacts and Bronze Age pottery. Near to this site the remains of an undated isolated furnace (WI040-050) were excavated. Further to the north, a burnt spread and flints (WI040-051) and a burnt mound (WI040-052) were also excavated in advance of the scheme *c*. 140–450m north of the proposed WWTW land parcel. The find spot of a font (WI040-044) is also recorded *c*. 80m to the northeast however it is no longer *in situ*.

The only nearby recorded sites designated as Recorded Monuments, comprise the church, graveyard, enclosure and mausoleum (WI040-021001-4) recorded *c.* 60m north of the proposed Kilbride WWTW land parcel. These sites are located within a modern enclosure.

A review of the Excavations Bulletins (1970–2014) revealed that no archaeological investigations have been carried out within the footprint of the Kilbride land parcel. Monitoring was carried out for topsoil stripping during the construction of the Arklow Bypass to the immediate north of the site and several sites identified at this time were subject to excavation. The sites located in greatest proximity to the proposed WWTW land parcel are located to immediate north within the footprint of the existing road, including the Bronze Age settlement site (WI040-048, Breen 1997; Licence 97E0324) and furnace site (WI040-050, Ó Ríordáin; Licence 97E0083).

Analysis of the available aerial photographic coverage of the site (Google Earth 2010 and OSI 2000) failed to reveal any features of archaeological potential within the footprint of the WWTW land option.

Conclusions

The proposed development will not impact on any recorded archaeological sites, which are listed within the RMP/SMR. No sites or features of previously unidentified archaeological significance were identified on the historic mapping or in the aerial photographs within the area of proposed development.

Two previous archaeological excavations have been carried out to the immediate north of the proposed development area which revealed a prehistoric settlement (WI040-048) site and a furnace (WI040-050). While both of these sites have been subject to full archaeological resolution, and as such have no remaining elements *in situ,* it is possible that associated features associated may be located within their proximity, outside of the M11 footprint and within the current land parcel.

The proposed development is located within a rich archaeological landscape adjacent to the estuary of the River Avoca and the coast. As such the receiving environment is considered to possess high archaeological potential. Settlement from the prehistoric periods onwards found coastal regions attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

Figure 2: Approximate location of proposed WWTW option at Kilbride

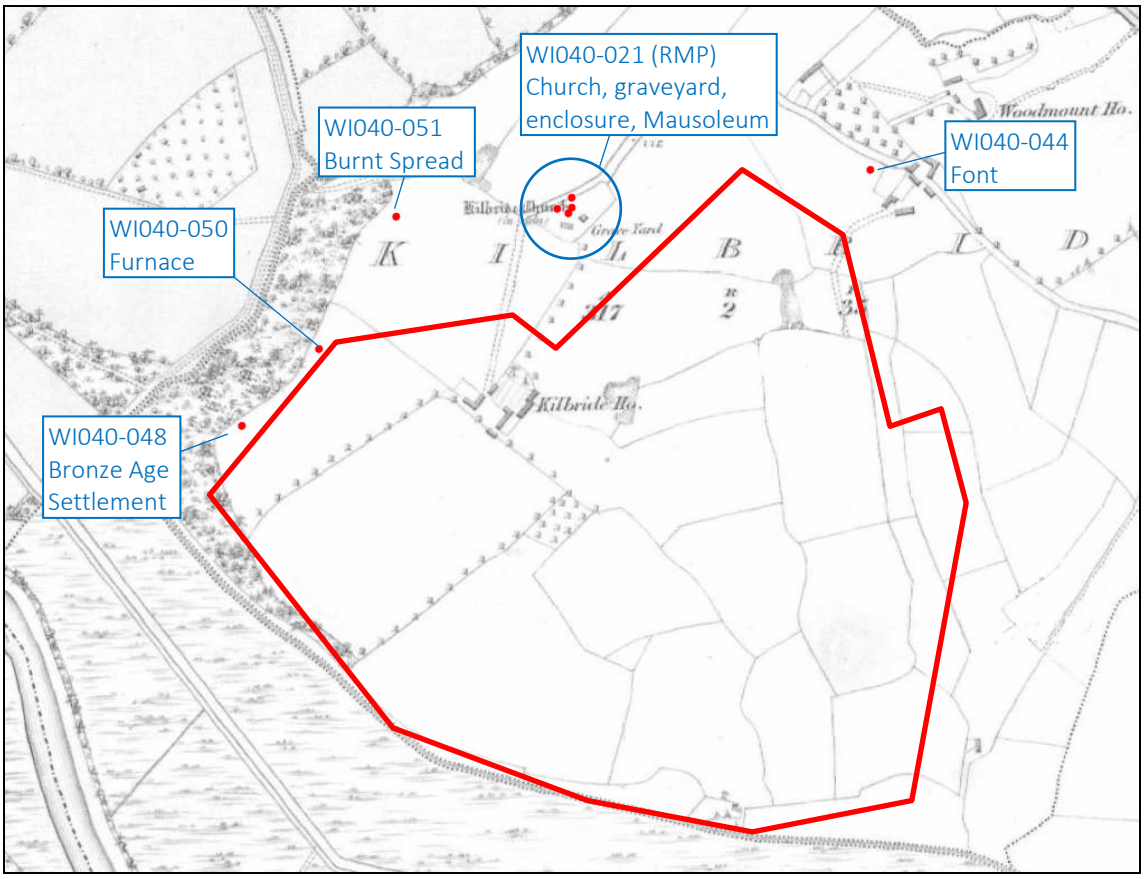

Figure 3: Extract from the First Edition 6-inch OS map showing approximate location of proposed WWTW option at Kilbride

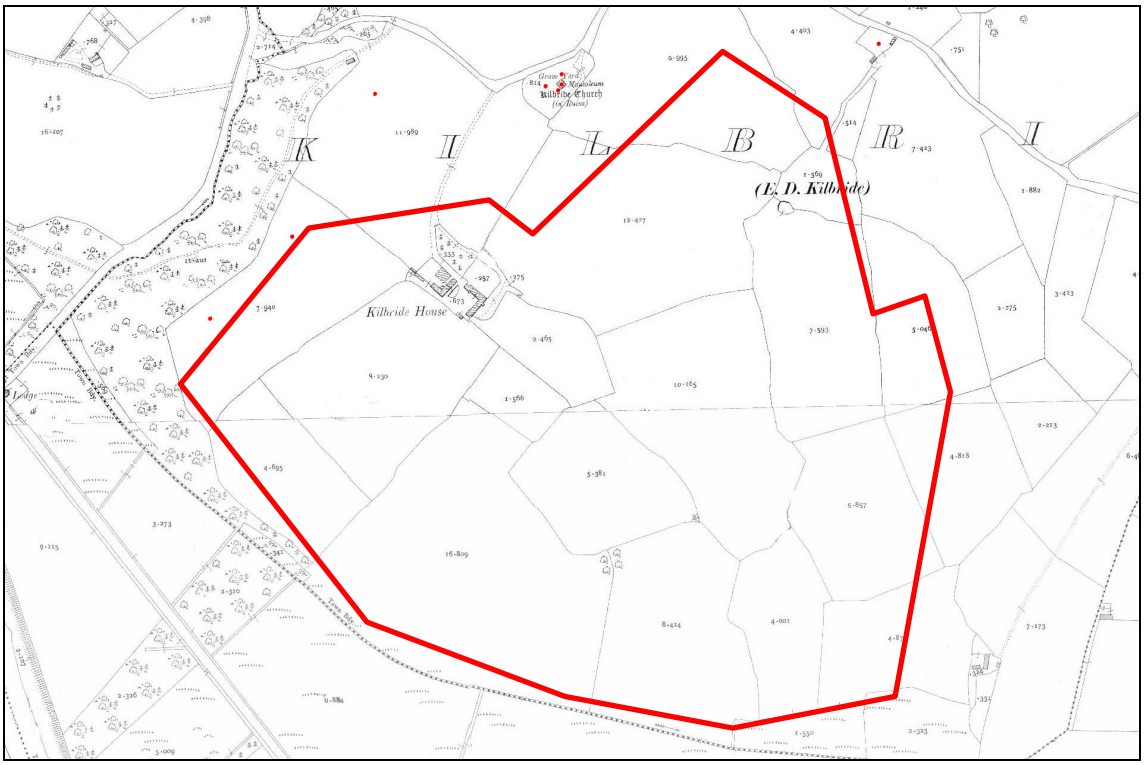

Figure 4: Extract from the 25-inch OS map showing approximate location of proposed WWTW option at Kilbride

2.2 SHELTON ABBEY

The Shelton Abbey site option is located within the townlands of Shelton Abbey and Kilbride, Parish of Kilbride and Barony of Arklow. The site is situated *c.* 1.4km north-northwest of Arklow town centre on the northern banks of the Avoca River. It is comprised of all or part of three undeveloped greenfields and two previously developed plots on the northern banks of the River Avoca, to the immediate north of the M11.

The receiving environment is considered to possess archaeological potential due to its immediate proximity to the River Avoca and the coast *c*. 2.1km further to the east. Settlement from the prehistoric periods onwards found coastal and riverine landscapes attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

There are seven previously recorded archaeological sites located within *c.* 500m of the proposed WWTW option in Shelton Abbey. The nearest of which comprise of a two sites (WI040-048 and WI040-050) excavated in advance of the Arklow Bypass Road in 1997 to the immediate south of the proposed land parcel (Figure 6). Site WI040-048 comprised the remains of a Bronze Age settlement site – indicated by evidence for an oval structure and postholes associated with lithic artefacts and Bronze Age pottery. Near to this site the remains of an undated isolated furnace (WI040-050) were excavated. Further to the north, a burnt spread and flints (WI040-051) was also excavated in advance of the scheme *c*. 190m north of the proposed WWTW land parcel.

The only nearby recorded sites designated as Recorded Monuments, comprise the church, graveyard, enclosure and mausoleum (WI040-021001-4) recorded *c.* 320m east of the proposed Shelton Abbey WWTW land parcel. These sites are located within a modern enclosure.

A review of the Excavations Bulletins (1970–2014) revealed that no archaeological investigations have been carried out within the footprint of the Shelton Abbey land parcel. Monitoring was carried out for topsoil stripping during the construction of the Arklow Bypass to the immediate south of the site and several sites identified at this time were subject to excavation. The sites located in greatest proximity to the proposed WWTW land parcel are located to immediate south within the footprint of the existing road, including the Bronze Age settlement site (WI040-048, Breen 1997; Licence 97E0324) and furnace site (WI040-050, Ó Ríordáin; Licence 97E0083).

Cartographic analysis of the historic maps failed to identify any previously unidentified sites of archaeological potential. The proposed land parcel is shown as being located within the southern portion of the extensive demesne landscape that was associated with Shelton Abbey on the first edition OS map (Figure 6). As such the area would have been subject to a certain level of landscaping and ground works. The line of an old east–west running access road, which also formed the townland boundary between Kilbride, is shown on the mapping and this is preserved within the southern

limit of the current land parcel. A gate lodge is shown on the later 25-inch OS maps (Figure 7) which is no longer extant.

Analysis of the available aerial photographic coverage of the site (Google Earth 2010 and OSI 2000) failed to reveal any features of archaeological potential within the footprint of the WWTW land option. The southeast quadrant of the proposed WWTW land parcel is currently covered in rough scrub vegetation which would hamper the identification of archaeological features.

The northern half of the proposed development has been subject to a large amount of disturbance during the construction of the existing industrial facility (since at least 1995). Any archaeological features that may have existed in this area are likely to have been removed.

Conclusions

The proposed development will not impact on any recorded archaeological sites, which are listed within the RMP/SMR. No sites or features of previously unidentified archaeological significance were identified on the historic mapping or in the aerial photographs within the area of proposed development.

Aerial photography has indicated that the northern half of the land parcel has been subject to significant disturbance associated with the construction of the existing industrial complex, since at least 1995. Any archaeological features that may have existed in this area are likely to have been removed.

Two previous archaeological excavations have been carried out to the immediate south of the proposed development area which revealed a prehistoric settlement site (WI040-048) and a furnace (WI040-050). While both of these sites have been subject to full archaeological resolution, and as such have no remaining elements *in situ,* it is possible that associated features associated may be located within their proximity, outside of the M11 footprint and within the current land parcel.

The proposed development is located within a rich archaeological landscape adjacent to the estuary of the River Avoca. As such the receiving environment is considered to possess archaeological potential. Settlement from the prehistoric periods onwards found coastal regions attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

Figure 5: Approximate location of proposed WWTW option at Shelton Abbey

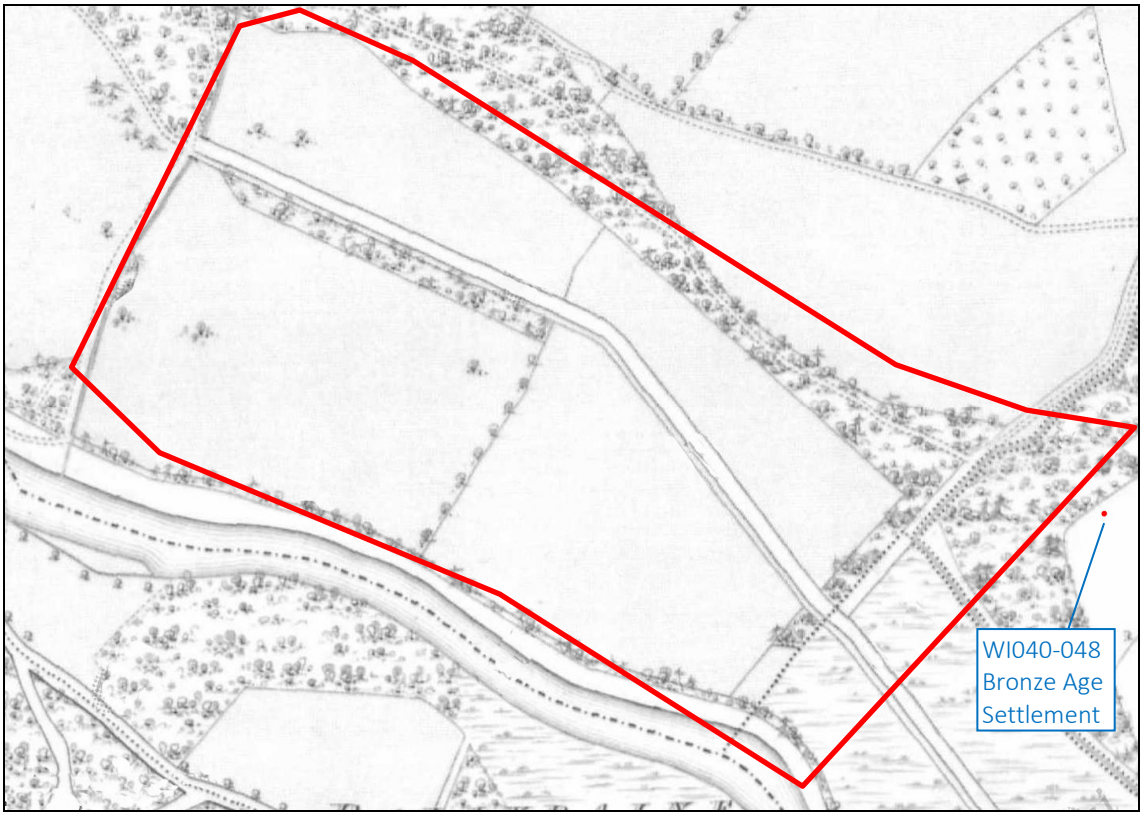

Figure 6: Extract from the First Edition 6-inch OS map showing approximate location of proposed WWTW option at Shelton Abbey

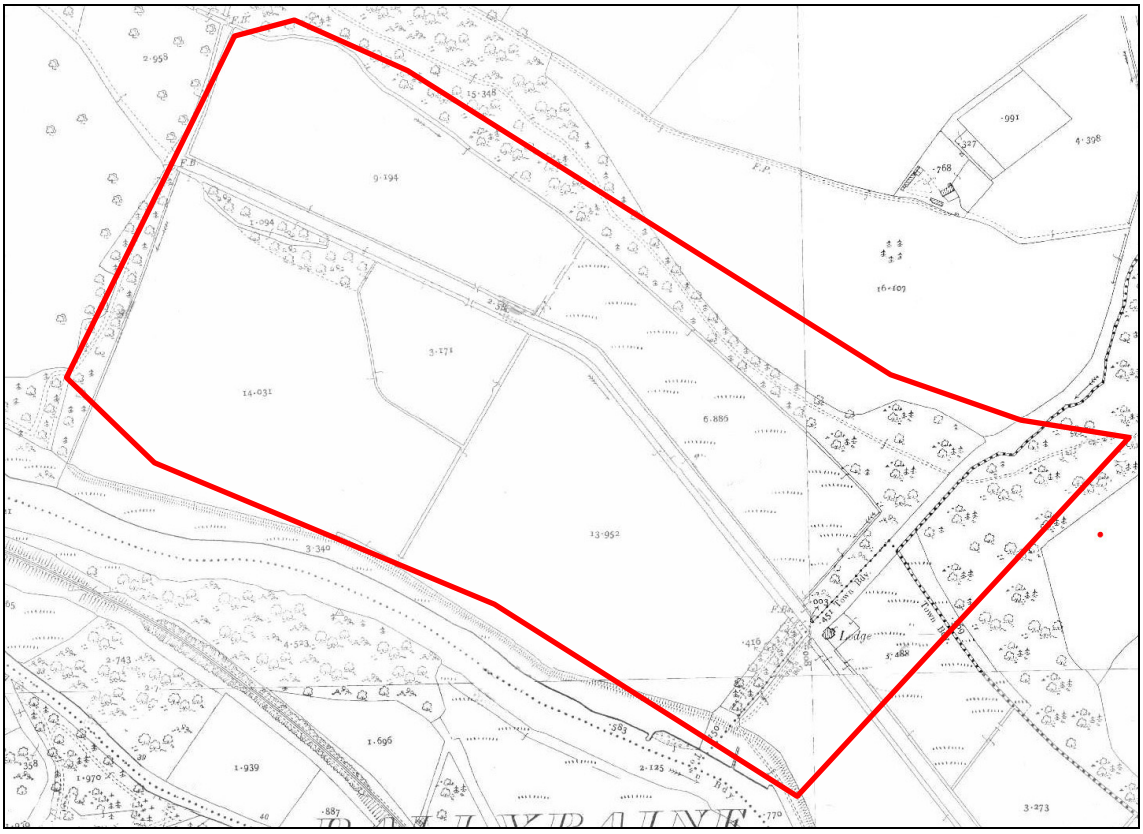

Figure 7: Extract from the 25-inch OS map showing approximate location of proposed WWTW option at Shelton Abbey

2.3 FERRYBANK

The Ferrybank site option is located within the townland of Ferrybank in the Parish and Barony of Arklow to the east of Arklow town. The site is bound to the south by the north quay and the Avoca River, the seashore to the east and the Mill Road to the west. The area is currently comprised of an abandoned factory building and associated tanks and outbuildings (Figure 8) and the site is partially overgrown. The proposed parcel of land currently comprises *c*. 7 acres.

There are no RMP sites located within *c*. 500m of the proposed WWTW site. The boundary of the zone of archaeological potential for the historic town of Arklow (WI040-029) is located *c.* 420m to the northwest. The nearest recorded site with an accurate location comprises of the Cistercian monastery and graveyard (WI040-029004, 8) *c.* 620m to the north-northwest. The receiving environment is considered to possess archaeological potential due to its proximity to the coast. Settlement from the prehistoric periods onwards found coastal regions attractive due to the relatively easy access to a food resource, as well as being able to travel and trade.

The historical mapping (Figure 9) indicates that this area was located within the estuarine mud flats in the early 19th century. The area had been partially reclaimed by the late 19th century and was shown as undeveloped marsh land. By the first decade in the 20th century the north quay had been constructed and a chemical works had been developed within the area of proposed development (Figure 10). Tramlines are shown running north linking the quayside with the munitions works located along the coast.

Inspection of the aerial photographic coverage of the proposed development area held by the Ordnance Survey (1995, 2000 and 2005) and Google Earth (2010) revealed no previously unrecorded features of archaeological potential in or within the immediate vicinity of the proposed scheme.

A review of the Excavations Bulletin (1970–2014) has indicated that two programs of archaeological investigation have been undertaken within proximity to the proposed development area. Monitoring of ground works was undertaken at the site of a shopping centre on the North Quay, Ferrybank (Sullivan, 2005; licence ref.: 05E0686) and for the laying of ESB cables between Arklow Harbour and Brittas Road (Campbell, 2003; licence ref.: 03E0737). Whilst reclamation deposits were identified, no features of archaeological significance were identified. Monitoring of site investigations was undertaken along the north and south quays of Arklow Town in May 2013 as part of the current development (Bailey, 2013; licence ref.: 12E309). Nothing of archaeological significance was identified at this time.

Conclusions

The proposed development will not impact on any recorded terrestrial archaeological sites, which are listed within the RMP/SMR. No sites or features of previously unidentified archaeological significance were identified on the historic mapping or in the aerial photographs within the area of proposed development. The site was

located within estuarine mud flats until reclamation in the later 19th century and early 20th century. The area was built up in order to construct the north quay and has been subject to redevelopment since the early 20th century.

Three previous programs of archaeological monitoring were undertaken within the vicinity of the proposed development area however only reclamation deposits were noted. No features of archaeological significance were identified in these areas.

This site poses the least potential impact to the archaeological resource.

Figure 8: Approximate location of proposed WWTW at Ferrybank (Google Earth, 2010)

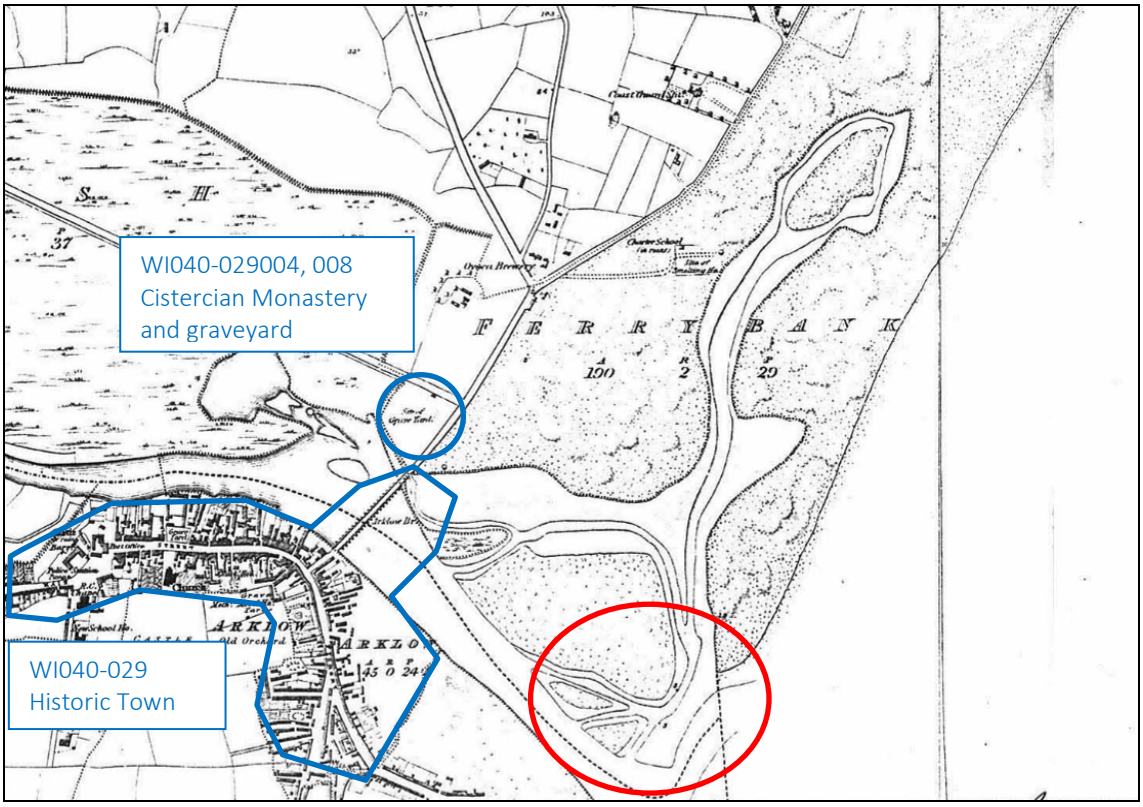

Figure 9: Extract from the First Edition 6-inch OS map showing approximate location of proposed WWTW at Ferrybank

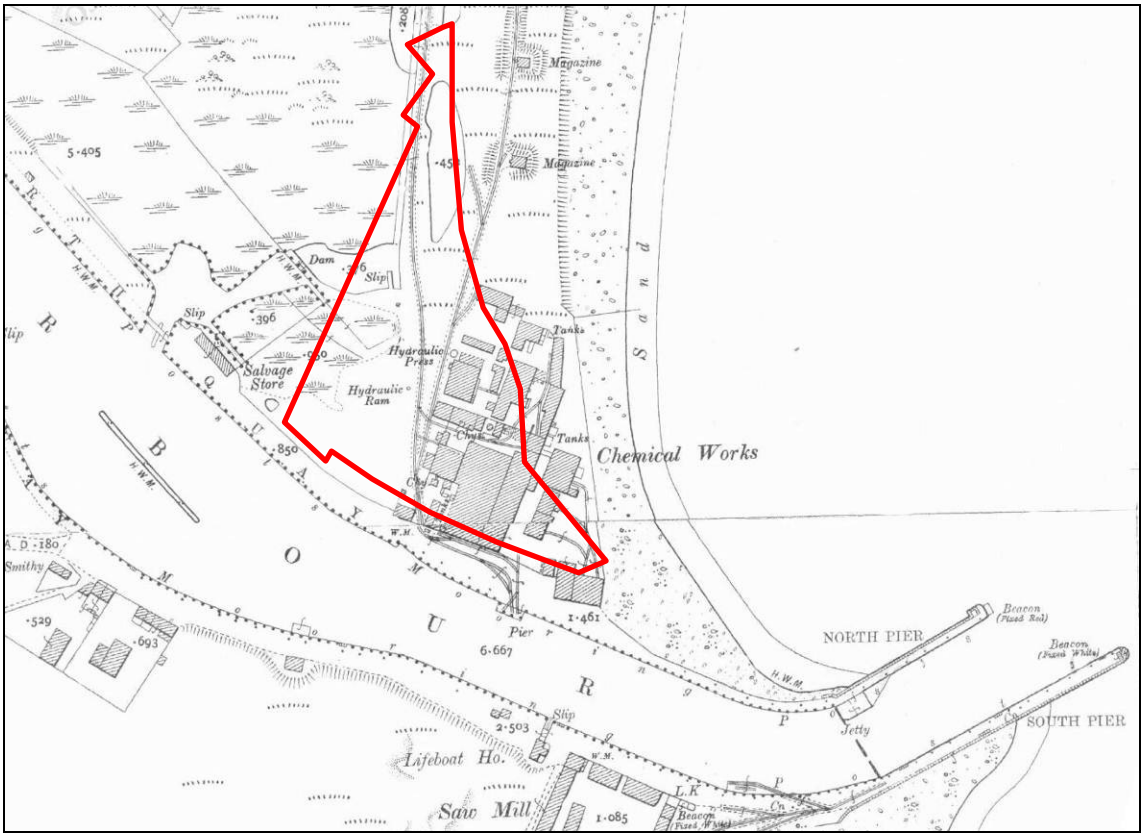

Figure 10: Extract from the 25-inch OS map showing approximate location of proposed WWTW at Ferrybank

3 APPRAISAL, IMPACT ASSESSMENT AND MITIGATION

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological resources potentially affected. Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping; disturbance by vehicles working in unsuitable conditions; and burial of sites, limiting access for future archaeological investigation.

3.1 IMPACT ASSESSMENT

Based on this assessment the Ferrybank WWTW site option or the northern half of the Shelton Abbey site option would be more preferable than the remaining Shelton Abbey and Kilbride options in terms of archaeological impact.

Proposed Shelton Abbey WWTW site option

- The northern half of the site has already been subject to large-scale disturbance and as such it is unlikely that potential archaeological features are preserved *in situ*.
- The southern half of this option is located within demsene lands associated with Shelton Abbey. There is evidence for minor disturbance and landscaping in the post-medieval period (including a gate lodge) within the southeast quadrant. The site is however an area of archaeological potential due to the proximity of the river and the excavated prehistoric settlement to the immediate south within the footprint of the M11. It is possible that the proposed WWTW would impact on previously unidentified archaeological features, associated with this settlement activity, that have the potential to survive beneath the current ground surface.

Proposed Kilbride WWTW site option

- The proposed WWTW site option at Kilbride comprises of undeveloped greenfield and is located within an area of high archaeological potential. The remains of a prehistoric settlement were excavated in 1997 to the immediate north of the site within the footprint of the M11. As such it is possible that ground disturbances associated with the proposed development will have a direct negative impact on archaeological features and/or deposits that have the potential to survive beneath the current ground level.

Proposed Ferrybank WWTW site option

- The proposed WWTW site at Ferrybank is located within an area of reclaimed mudflats which has been subject to redevelopment throughout the 20th century. There is a low potential for the ground disturbances associated with the proposed development to have a direct negative impact on previously unknown archaeological features and/or deposits that have the potential to survive within the original estuarine levels.

3.2 MITIGATION

We recommend the following actions in mitigation of the impacts above.

Proposed Shelton Abbey WWTW site option

- Should the proposed WWTW be constructed in the northern half of the proposed Shelton Abbey site there would be no recommendations for archaeological mitigation.

- Should the proposed WWTW be constructed in the southern half of the proposed Shelton Abbey site it is recommended that a full archaeological assessment including a programme of archaeological testing be carried out within the finalised footprint of the WWTW prior to development going ahead. This should be undertaken by an archaeologist under licence from the Department of Arts, Heritage and Gaeltacht. Full provision should be made for the resolution of any archaeological features and/or deposits that may be discovered, should that be deemed the most appropriate manner in which to proceed.

  In addition, it is recommended that any topsoil stripping, including site investigations are subject to archaeological monitoring. This should be carried out by a suitably qualified archaeologist with full provision made available for the resolution of any archaeological features and/or deposits that may be discovered, should that be deemed the most appropriate manner in which to proceed.

Proposed Kilbride WWTW site option

- Should the proposed WWTW be constructed within any area of the Kilbride option it is recommended that a full archaeological assessment including a programme of archaeological testing be carried out within the finalised footprint of the WWTW prior to development going ahead. This should be undertaken by an archaeologist under licence from the Department of Arts, Heritage and Gaeltacht. Full provision should be made for the resolution of any archaeological features and/or deposits that may be discovered, should that be deemed the most appropriate manner in which to proceed.

  In addition, it is recommended that any topsoil stripping, including site investigations are subject to archaeological monitoring. This should be carried out by a suitably qualified archaeologist with full provision made available for the resolution of any archaeological features and/or deposits that may be discovered, should that be deemed the most appropriate manner in which to proceed.

Proposed Ferrybank WWTW site

- Should the proposed WWTW be constructed at Ferrybank it is recommended that all ground disturbances associated with the proposed development be subject to archaeological monitoring. This should be carried out by a suitably qualified archaeologist with full provision made available for the resolution of

any archaeological features and/or deposits that may be discovered, should that be deemed the most appropriate manner in which to proceed.

Please note that all recommendations are subject to approval by the National Monument Section of the Heritage and Planning Division, Department of Arts, Heritage and The Gaeltacht.

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Ordnance Survey 6-inch & 25-inch maps of County Wicklow (1839, 1887, 1910, 1913)

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Breen, T. 1997 'Kilbride, 97E0324', *Excavations.ie database of Irish excavation reports*, 1997:616
http://www.excavations.ie/report/1997/Wicklow/0003165/

www.archaeology.ie – DoAHG website listing all SMR sites with aerial photographs

www.osiemaps.ie – Ordnance Survey aerial photographs dating to 1995, 2000 & 2005 and 6"/25" OS maps.

www.googleearth.com – Aerial photographs of the proposed development area

www.booksulster.com/library/plnm/placenamesC.php - Contains the text from *Irish Local Names Explained* by P.W Joyce (1870)

APPENDIX 1: SMR/RMP SITES WITHIN THE SURROUNDING AREA

SMR NO.	WI040-048
RMP	No
TOWNLAND	Kilbride
PARISH	Kilbride
BARONY	Arklow
I.T.M.	723440, 674772
CLASSIFICATION	Habitation site
DIST. TO DEVELOPMENT	Immediate north of Kilbride site and south of Shelton Abbey Site (in footprint of Arklow Bypass)
DESCRIPTION	This is the record for the Bronze Age settlement site excavated by Thaddeus Breen (97E0324) on the Arklow bypass road scheme. The site consisted postholes representing an oval structure (diam. 7.5m) and an assortment of other postholes forming no discernible pattern. No hearth was found but the site had been heavily truncated. Associated with these postholes were struck flakes of poor-quality flint and pottery sherds from Beaker, Cordoned Urn and Vast vessels, dating the site to the Bronze Age.
REFERENCE	www.archaeology.ie

SMR NO.	WI040-050
RMP	No
TOWNLAND	Kilbride
PARISH	Kilbride
BARONY	Arklow
I.T.M.	723531, 674863
CLASSIFICATION	Furnace
DIST. TO DEVELOPMENT	Immediate north of Kilbride site and south of Shelton Abbey Site (in footprint of Arklow Bypass)
DESCRIPTION	This is the record for the furnace excavated by Breandán Ó Ríordáin (97E0083) on the Arklow bypass road scheme. The remains occupied a space of 1.1m x 0.85m with a max. depth of 0.5m. The furnace had a lining of two stones, one on either side, and a crescent wall of solid iron slag. No finds other than fragments of slag and waste iron were recovered.
REFERENCE	www.archaeology.ie

SMR NO.	WI040-051
RMP	No
TOWNLAND	Kilbride
PARISH	Kilbride

BARONY	Arklow
I.T.M.	723623, 675021
CLASSIFICATION	Burnt spread
DIST. TO DEVELOPMENT	140m north of Kilbride site and 190m east of Shelton Abbey Site (in footprint of Arklow Bypass)
DESCRIPTION	This is the record for three adjacent spreads of burnt mound material excavated by Brendán Ó Riordáin (97E0083) on the Arklow bypass road scheme. The burnt material was present in shallow pits/depressions and the only finds recovered were some pieces of unworksd flint and fragments of burnt bone.
REFERENCE	www.archaeology.ie

SMR NO.	WI040-021001–4
RMP	Yes
TOWNLAND	Kilbride
PARISH	Kilbride
BARONY	Arklow
I.T.M.	(1, 2) 723813, 675030; (2) (4) 723831, 675032
CLASSIFICATION	Church, Graveyard, Enclosure and Mausoleum
DIST. TO DEVELOPMENT	60m north of Kilbride option and 320m east of Shelton Abbey option
DESCRIPTION	1, 2 - Situated on a level area on a very gentle SW-facing slope overlooking the Avoca River. No trace of the church remains described in the OS Letters (O'Flanagan 1928, 133) nor of any other early features other than some eighteenth-century headstones in the heavily overgrown graveyard. 3 - This record was previously classed as a possible ecclesiastical enclosure, however there is currently no evidence for its existence. 4 - At the centre of a graveyard (WI040-021002-). A rectangular structure with a colonnaded façade on its N face and built into a low hillside at S. A partially legible inscription records its dedication, 'To the memory of Frances Parnell'. A second mausoleum, erected in 1785 by Ralph, Viscount of Wicklow, (according to the inscription it bears) stands to the NE of the former and is in the form of a low, rectangular structure supporting a pyramid.
REFERENCE	www.archaeology.ie

SMR NO.	WI040-044
RMP	No
TOWNLAND	Kilbride
PARISH	Kilbride
BARONY	Arklow
I.T.M.	724183, 675076

CLASSIFICATION	Font
DIST. TO DEVELOPMENT	80m northeast of Kilbride option
DESCRIPTION	A red sandstone block (33.5cm x 15.5cm; H 15.5cm-16.5cm) which an oval basin (13cm x 25cm; D 0.08m-0.09m) in the top centre and a small heavily weathered stone head carving on one corner. Located in the E transept of St. Patrick's church when inspected by ASI in 1999 (see WI035-058---- for present location record) but had previously been located here.
REFERENCE	www.archaeology.ie

SMR NO.	WI040-052
RMP	No
TOWNLAND	Kilbride
PARISH	Kilbride
BARONY	Arklow
I.T.M.	724042, 675515
CLASSIFICATION	Burnt Mount
DIST. TO DEVELOPMENT	450m north of the Kilbride option
DESCRIPTION	This is the record for a burnt spread excavated by Brendán Ó Riordáin (97E0083) on the Arklow bypass road scheme. It consisted of an area *c*. 4m x *c*. 4m which contained burnt stone and charcoal and patches of grey and yellow marl. (Ó Riordáin 1999)
REFERENCE	www.archaeology.ie

APPENDIX 2: STRAY FINDS WITHIN THE SURROUNDING AREA

Information on artefact finds from the study area in County Wicklow has been recorded by the National Museum of Ireland since the late 18th century. Location information relating to these finds is important in establishing prehistoric and historic activity in the study area.

The following townlands were reviewed within the NMI: Abbeylands, Arklow, Ballinaheese, Ballyduff North, Ballyraine Middle, Ballyraine Upper, Ballyraine Lower, Cooladangan, Coolboy, Glenart, Kilbride, Kilcarra East, Kilcarra West, Knockanrahan Lower, Knockanrahan Upper, Lamberton, Marsh, Pollahoney, Raheen, Sheepwalk, Shelton Abbey and Yardland.

No stray finds have been recorded in or within the receiving environment of the proposed WWTW site options.

APPENDIX 3: LEGISLATION PROTECTING THE ARCHAEOLOGICAL RESOURCE

PROTECTION OF CULTURAL HERITAGE

The cultural heritage in Ireland is safeguarded through national and international policy designed to secure the protection of the cultural heritage resource to the fullest possible extent (Department of Arts, Heritage, Gaeltacht and the Islands 1999, 35). This is undertaken in accordance with the provisions of the *European Convention on the Protection of the Archaeological Heritage* (Valletta Convention), ratified by Ireland in 1997.

THE ARCHAEOLOGICAL RESOURCE

The *National Monuments Act 1930 to 2004* and relevant provisions of the *National Cultural Institutions Act 1997* are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. A National Monument is described as 'a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto' (National Monuments Act 1930 Section 2).

A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places, and the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

OWNERSHIP AND GUARDIANSHIP OF NATIONAL MONUMENTS

The Minister may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

REGISTER OF HISTORIC MONUMENTS

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the register is illegal without the permission of the Minister. Two months notice in writing is required prior to any work being undertaken on or in the vicinity of a registered monument. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

PRESERVATION ORDERS AND TEMPORARY PRESERVATION ORDERS

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site

illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

RECORD OF MONUMENTS AND PLACES

Section 12(1) of the 1994 Act requires the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for the Environment, Heritage and Local Government) to establish and maintain a record of monuments and places where the Minister believes that such monuments exist. The record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the state. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994. All recorded monuments on the proposed development site are represented on the accompanying maps.

Section 12(3) of the 1994 Act provides that 'where the owner or occupier (other than the Minister for Arts, Heritage, Gaeltacht and the Islands) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage, Gaeltacht and the Islands to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the work until two months after the giving of notice'.

Under the National Monuments (Amendment) Act 2004, anyone who demolishes or in any way interferes with a recorded site is liable to a fine not exceeding €3,000 or imprisonment for up to 6 months. On summary conviction and on conviction of indictment, a fine not exceeding €10,000 or imprisonment for up to 5 years is the penalty. In addition they are liable for costs for the repair of the damage caused.

In addition to this, under the *European Communities (Environmental Impact Assessment) Regulations 1989,* Environmental Impact Statements (EIS) are required for various classes and sizes of development project to assess the impact the proposed development will have on the existing environment, which includes the cultural, archaeological and built heritage resources. These document's recommendations are typically incorporated into the conditions under which the proposed development must proceed, and thus offer an additional layer of protection for monuments which have not been listed on the RMP.

THE PLANNING AND DEVELOPMENT ACT 2000

Under planning legislation, each local authority is obliged to draw up a Development Plan setting out their aims and policies with regard to the growth of the area over a five-year period. They cover a range of issues including archaeology and built heritage, setting out their policies and objectives with regard to the protection and enhancement of both. These policies can vary from county to county. The Planning

and Development Act 2000 recognises that proper planning and sustainable development includes the protection of the archaeological heritage. Conditions relating to archaeology may be attached to individual planning permissions.

COUNTY WICKLOW DEVELOPMENT PLAN 2010–2016

Objectives

AR1 No development in the vicinity of a feature included in the Record of Monuments & Places (RMP) will be permitted where it seriously detracts from the setting of the feature or which is seriously injurious to its cultural or educational value.

AR2 Any development that may due to its size, location or nature have implications for archaeological heritage (including both sites and areas of archaeological potential / significance as identified in Schedule 16.1 and Map 16.01 (Volume 2) of this plan shall be subject to an archaeological assessment. When dealing with proposals for development that would impact upon archaeological sites and/or features, there will be presumption in favour of the 'preservation in situ' of archaeological remains and settings, in accordance with Government policy. Where permission for such proposals is granted, the Council will require the developer to have the site works supervised by a competent archaeologist.

AR3 To ensure that provision is made through the development control process for the protection of previously unknown archaeological sites and features where they are discovered during development works.

AR4 To facilitate public access to National Monuments in State or Local Authority care, as identified in Schedule 16.2 (Volume 2) of this plan.

AR5 That Wicklow recognise the important of Hillforts in south west Wicklow and that the Council request central Government to conduct a detailed study of their importance.

AR6 To promote and campaign for the designation of the Glendalough Monastic Settlement as a UNESCO World Heritage Site.

Wicklow has a wealth of structures, items and places of historical and cultural heritage that do not fall neatly into the categories of 'architectural' or 'archaeological' heritage. A number of examples would be:

- Structures and items associated with Wicklow's industrial heritage;
- Historical mining works;
- Wicklow's Military Road;
- Places and items associated with local history and folklore such as mass rocks and holy wells.

Industrial heritage refers to such structures as mills, watermills, windmills, roads, bridges, railways, canals, harbours, dams and features associated with utility industries such as water, gas and electricity. It is important part of Wicklow's socio economic history and contributes greatly to the interest of the Wicklow landscape.

Objectives

HC1 To protect and facilitate the conservation of structures, sites and objects which are part of the County's industrial heritage, in particular features which relate to

former mining, transport or utilities activities, whether or not such structures, sites and objects are included on the RPS.

HC2 To facilitate access to and appreciation of areas of mining heritage, through the development of appropriate trails and heritage interpretation, in association with local stakeholders.

HC3 To facilitate future community initiatives to increase access to and appreciation of railway heritage, through preserving the routes of former lines free from development.

HC4 Any road or bridge improvement works along the Military Road shall be designed and constructed with due regard to the history and notable features of the road (in particular its original support structures, route and alignment), insofar as is possible and reasonable given the existing transport function of the road.

HC5 Through the development management process, to endeavour to identify and suitably protect items and places of local historical or cultural significance.

ARKLOW TOWN AND ENVIRONS DEVELOPMENT PLAN 2011–2017

Architectural Objectives

AH1 To consolidate and safeguard the historical and architectural character of Arklow Town Centre through the protection of individual buildings, structures, shopfronts and elements of the public realm that contribute greatly to this character.

AH 2 To conserve buildings and features of historical and vernacular interest through ensuring that adequate consideration is given to their protection as part of development proposals and that mitigation measures are put in place as required.

Protected Structures Objectives

RPS 1 To safeguard the character of Protected Structures and encourage appropriate alterations to these buildings to render them viable for modern use, subject to best conservation practice (in accordance with Architectural Heritage Protection guidelines produced by the DoEHLG). (Arklow RPS are set out in Appendix 1 of the Plan)

Archaeological Heritage Objectives

AR1 To safeguard archaeological heritage by ensuring that development in the vicinity of a recorded monument which are listed in table 7.1 below shall be permitted only where it can be demonstrated that there will be no damage to the monument itself, its setting or its cultural and educational value.

AR2 Any development that may due to its size, location or nature have implications for archaeological heritage shall be subject to an archaeological assessment.

AR3 To ensure that provision is made through the development control process for the protection of previously unknown archaeological sites and features where they are discovered during development works.

Maritime Heritage Objectives

MH1 To support facilities such as the Arklow Maritime Museum which increase public awareness and appreciation of the town's maritime heritage.

MH2 To support initiatives to highlight Arklow's Maritime heritage in the public realm.

MH3 To ensure that any development projects in and around the Arklow quays respect any valuable structures or items of Arklow's maritime heritage.

APPENDIX 4: IMPACT ASSESSMENT AND THE CULTURAL HERITAGE RESOURCE

POTENTIAL IMPACTS ON ARCHAEOLOGICAL AND HISTORICAL REMAINS

Impacts are defined as 'the degree of change in an environment resulting from a development' (Environmental Protection Agency 2003: 31). They are described as profound, significant or slight impacts on archaeological remains. They may be negative, positive or neutral, direct, indirect or cumulative, temporary or permanent.

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological and historical resources potentially affected. Development can affect the archaeological and historical resource of a given landscape in a number of ways.

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape.

- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery; disturbance by vehicles working in unsuitable conditions; or burial of sites, limiting accessibility for future archaeological investigation.

- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or longer-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits.

- Visual impacts on the historic landscape sometimes arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic monuments and historic landscape elements as well as their visual amenity value.

- Landscape measures such as tree planting can damage sub-surface archaeological features, due to topsoil stripping and through the root action of trees and shrubs as they grow.

- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluviums or peat deposits.

- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, and service trenches.

Although not widely appreciated, positive impacts can accrue from developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments, and the increased level of knowledge of a site or historic landscape as a result of archaeological assessment and fieldwork.

PREDICTED IMPACTS

The severity of a given level of land-take or visual intrusion varies with the type of monument, site or landscape features and its existing environment. Severity of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;
- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected;
- Assessment of the levels of noise, visual and hydrological impacts, either in general or site specific terms, as may be provided by other specialists.

APPENDIX 5: MITIGATION MEASURES AND THE CULTURAL HERITAGE RESOURCE

POTENTIAL MITIGATION STRATEGIES FOR CULTURAL HERITAGE REMAINS

Mitigation is defined as features of the design or other measures of the proposed development that can be adopted to avoid, prevent, reduce or offset negative effects.

The best opportunities for avoiding damage to archaeological remains or intrusion on their setting and amenity arise when the site options for the development are being considered. Damage to the archaeological resource immediately adjacent to developments may be prevented by the selection of appropriate construction methods. Reducing adverse effects can be achieved by good design, for example by screening historic buildings or upstanding archaeological monuments or by burying archaeological sites undisturbed rather than destroying them. Offsetting adverse effects is probably best illustrated by the full investigation and recording of archaeological sites that cannot be preserved *in situ*.

DEFINITION OF MITIGATION STRATEGIES

ARCHAEOLOGICAL RESOURCE

The ideal mitigation for all archaeological sites is preservation *in situ*. This is not always a practical solution, however. Therefore a series of recommendations are offered to provide ameliorative measures where avoidance and preservation *in situ* are not possible.

Full Archaeological Excavation involves the scientific removal and recording of all archaeological features, deposits and objects to the level of geological strata or the base level of any given development. Full archaeological excavation is recommended where initial investigation has uncovered evidence of archaeologically significant material or structures and where avoidance of the site is not possible.

Archaeological Test Trenching can be defined as 'a limited programme... of intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site on land or underwater. If such archaeological remains are present test trenching defines their character and extent and relative quality.' (IFA 2001c, 1)

Archaeological Monitoring can be defined as a 'formal programme of observation and investigation conducted during any operation carried out for non-archaeological reasons within a specified area or site on land or underwater, where there is possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive.' (IFA 2001b, 1)

Underwater Archaeological Assessment consists of a programme of works carried out by a specialist underwater archaeologist, which can involve wade surveys, metal

detection surveys and the excavation of test pits within the sea or riverbed. These assessments are able to access and assess the potential of an underwater environment to a much higher degree than terrestrial based assessments.

ARCHITECTURAL RESOURCE

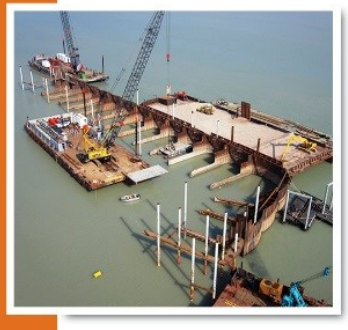
The architectural resource is generally subject to a greater degree of change than archaeological sites, as structures may survive for many years but their usage may change continually. This can be reflected in the fabric of the building, with the addition and removal of doors, windows and extensions. Due to their often more visible presence within the landscape than archaeological sites, the removal of such structures can sometimes leave a discernable 'gap' with the cultural identity of a population. However, a number of mitigation measures are available to ensure a record is made of any structure that is deemed to be of special interest, which may be removed or altered as part of a proposed development.

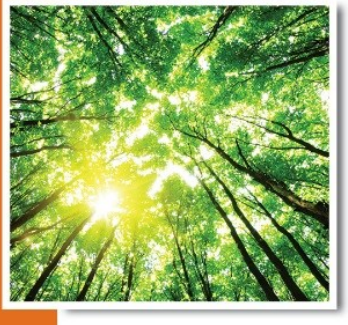
Conservation Assessment consists of a detailed study of the history of a building and can include the surveying of elevations to define the exact condition of the structure. These assessments are carried out by Conservation Architects and would commonly be carried out in association with proposed alterations or renovations on a Recorded Structure.

Building Survey may involve making an accurate record of elevations (internal and external), internal floor plans and external sections. This is carried out using a EDM (Electronic Distance Measurer) and GPS technology to create scaled drawings that provide a full record of the appearance of a building at the time of the survey.

Historic Building Assessment is generally specific to one building, which may have historic significance, but is not a Protected Structure or listed within the NIAH. A full historical background for the structure is researched and the site is visited to assess the standing remains and make a record of any architectural features of special interest. These assessments can also be carried out in conjunction with a building survey.

Written and Photographic record provides a basic record of features such as stone walls, which may have a small amount of cultural heritage importance and are recorded for prosperity. Dimensions of the feature are recorded with a written description and photographs as well as some cartographic reference, which may help to date a feature.





Appendix E – Ecological Report

Arklow Wastewater Treatment Works
Phase 2 Site Selection Report

Ecology Assessment

Prepared for Byrne Looby PH McCarthy

Eleanor Mayes
Ecological Consultant

Old Post Office
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Ecology Assessment

1. Methodology

Three land parcels have been identified by Byrne Looby PH McCarthy as options for potential alternative sites for the proposed Arklow Waste Water Treatment Works (WWTW). A desk top review of existing ecological information was carried out, and included a review of areas subject to nature conservation designations. The Natura 2000 network comprises sites that are designated as Special Areas of Conservation (SACs) under the Habitats Directive, and/or Special Protection Areas (SPAs) that are designated under the Birds Directive. Existing information on Natura 2000 sites in the vicinity of Arklow was reviewed. The DoEHLG (NPWS now within DAHG) guidance on Appropriate Assessment indicates that Natura 2000 sites within 15 km of a plan area should be considered in the assessment of plans or projects. The location, type and extent of a plan or project will determine whether impacts on Natura 2000 sites may have a potential to arise; this will be decided on a case-by-case basis. In the case of water dependant habitats and species, plans or projects that may impact on water quality and quantity may need to be assessed over a greater radius, taking factors such as downstream effects, currents and plume dispersion into account. A 15km radius of the three alternative Waste Water Treatment Works sites under consideration at Arklow, was taken as a starting point in this assessment.

The occurrence of Habitats Directive Annex 2 listed species, and of Birds Directive Annex 1 listed species, in the vicinity of Arklow was reviewed, and information on other sites subject to nature conservation designations, was collected. Data sources included the original Arklow WWTW EIS, and more recent project documentation including the Natura Impact Screening Statements for the waste water discharge licence (2012), the interceptor sewers and the siphon under the Avoca River Estuary (2012), and the Alps storage tank and CSO at Arklow, Co. Wicklow (2013). EPA reports, and NPWS documentation were reviewed, and an internet search for any other relevant information. Recent documentation on the Conservation Status of Habitats Directive Annex listed habitats and species was reviewed (NPWS 2013). Fisheries information for the Avoca River previously provided by Inland Fisheries Ireland in 2012 is reproduced.

Walkover surveys of the Shelton Abbey and Kilbride sites, and of pipeline corridors, were carried out in April 2015, during which habitats, flora and fauna were noted, in order to provide an overview and summary comparison of the ecology of the sites. It was not possible to access the pipeline corridor between The Marshlands Youth and Sports Centre and the immediately adjoining lands to the east, and Dublin Road Arklow. Habitats present were classified in accordance with Fossitt (2000). The Ferrybank site and surrounding area had been reviewed in 2014, and was re-visited in April 2015 although the site itself was not accessed. Site evaluation was carried out having regard to NRA (2004) Guidelines. It should be noted that aquatic ecology baseline studies are not included in the scope of this report.

2. Potential interactions with Natura 2000 sites and protected species

All three land parcels under consideration lie on the northern side of the Avoca River. Natura 2000 sites in the general area are shown in Figure 1.

2.1. Natura 2000 sites within 15km

Ferrybank Parcel
Buckroney – Brittas Dunes and Fen SAC (Site Code 000729) lies to the north, and Kilpatrick Sandhills SAC (Site Code 001742) to the south, within 15km of the Ferrybank parcel. Part of Maharabeg Dunes SAC (Site Code 001766) lies within 15km of the Ferrybank parcel. Part of the Slaney River Valley SAC

(Site Code 000781) lies within 15km to the south west, but there is no hydrological connection between the Slaney River catchment and the Ferrybank parcel, so this SAC is not considered further.

Kilbride parcel

Natura 2000 sites within 15km of the Kilbride parcel are the same as the Ferrybank parcel: Buckroney – Brittas Dunes and Fen SAC (Site Code 000729) to the north, and Kilpatrick Sandhills SAC (Site Code 001742) to the south, within 15km, and part of Maharabeg Dunes SAC (Site Code 001766) to the north. Part of the Slaney River Valley SAC (Site Code 000781) lies within 15km to the south west, but there is no hydrological connection between the Slaney River catchment and the Ferrybank parcel, so this SAC is not considered further.

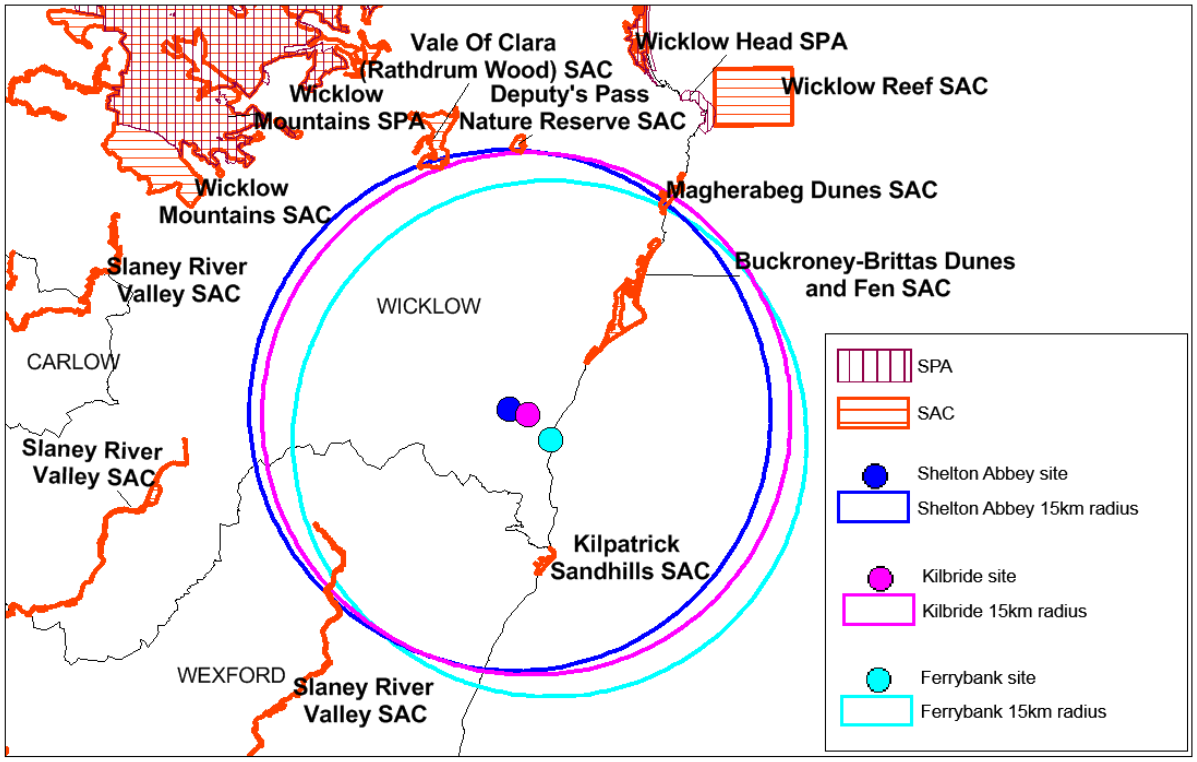

Figure 1. Natura 2000 sites in the vicinity of Arklow, and a 15km radius around each of the three sites under consideration.

Shelton Abbey parcel

Natura 2000 sites within 15km of the Shelton Abbey parcel are the same as those within 15 km of the Kilbride and Ferrybank parcels, but additionally include portions of the Vale of Clara (Rathdrum Wood) SAC (Site Code 000733), and the Deputy's Pass Nature Reserve SAC (Site Code 000717). Deputy's Pass Nature Reserve SAC lies outside the Avoca River catchment and is not hydrologically linked to the Shelton Abbey site, and is not considered further.

Other Natura 2000 sites within 15km of the Shelton Abbey, Kilbride and Ferrybank parcels are the same: Buckroney – Brittas Dunes and Fen SAC (Site Code 000729) to the north, Kilpatrick Sandhills SAC (Site Code 001742) to the south, and part of Maharabeg Dunes SAC (Site Code 001766) to the north. Part of the Slaney River Valley SAC (Site Code 000781) lies within 15km to the south west, but there is no hydrological connection between the Slaney River catchment and the Shelton Abbey parcel, so this SAC is not considered further.

Coastal SACs

All of the Habitats Directive Annex 1 habitats that are listed as Qualifying Interests for the three SACs listed in Table 1 are considered to be water dependent (O'Riain *et al*, 2005). Drift line, stony bank, and sand dune habitats have been grouped as coastal onshore habitats in Mayes (2008). These coastal onshore habitats depend on coastal geomorphological and sediment transport processes for their formation and continued existence, and derive their 'water dependent' status, with regard to the Water Framework Directive, from these processes. For this reason, they are considered to be dependent on coastal and transitional water sources (Table 1). However, all of these habitats lie above high water spring tide level and are not capable of being impacted by changes in water chemistry should such changes arise.

Table 1. Qualifying Interests for the three coastal SACs located within 15km of Arklow.

Annex 1 Habitat	Magharabeg Dunes SAC	Buckroney/ Brittas Dunes and Fen SAC	Kilpatrick Sandhills SAC	Main water source
Annual vegetation of drift lines [1210]	✓	✓	✓	c, (t)
Embryonic shifting dunes [2110]	✓	✓	✓	c, (t)
Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]	✓	✓	✓	c, (t)
Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*	✓	✓	✓	c, (t)
Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150]*	✓	✓	✓	c, (t)
Perennial vegetation of stony banks [1220]		✓		c, (t)
Mediterranean salt meadows (Juncetalia maritimi) [1410]		✓		c, t, s, g
Dunes with Salix repens ssp.argentea (Salix arenariae) [2170]		✓		g, c, (t)
Humid dune slacks [2190]		✓		g, c, (t)
Alkaline fens [7230]		✓		g, s
Petrifying springs with tufa formation (Cratoneurion) [7220]*	✓			g

Note: *** Priority Annex 1 habitats.** Main water source based on O'Riain *et al* (2005); c coastal; t transitional; s surface; g ground water.

The immediate hinterland of sand dune systems often includes low-lying areas of other water dependent habitats. At Buckroney – Brittas Dunes and Fen SAC, these include the fen habitat Alkaline fen located to the west of the R750, inland and above tidal influence, and a small area of the saltmarsh habitat Mediterranean salt meadow. Annex 1 listed saltmarsh habitats (1330, 1410 and 1420) develop in sheltered areas in estuaries and to the lee of islands and other coastal barriers and spits, where muddy sediments can accumulate. They occur on the upper shore, and tend to form zones or habitat mosaics

of halophytic and salt tolerant plant species in relation to the extent of tidal submergence and salinity. Mediterranean salt meadow generally occupies the upper zone of the saltmarsh, adjacent to the boundary with terrestrial habitats, with minimal inundation on spring tide high water. At Buckroney-Brittas, a small area of Mediterranean salt meadow is described, associated with the Buckroney River (McCorry and Ryle, 2009).

Sand dune systems may include the wetland habitats Humid dune slacks 2190, and Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) 2170, which occur in topographic depressions within dune systems and are mainly ground water dependent, generally with a lens of fresh water overlying more saline water. Both of these habitats occur at Buckroney-Brittas Dunes and Fen SAC.

Petrifying springs with tufa formation are listed as a Qualifying Interest at Magherabeg Dunes SAC. These are ground water dependent habitats, developed in this SAC where groundwater seeps through exposed rock above the littoral zone (NPWS Conservation Plan).

There will be no construction phase impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC, since all construction activity will occur well outside the boundaries of these sites, irrespective of which of the three WWTW land parcels under consideration is selected.

Marine water quality is not considered relevant to the following habitats occurring at the coastal SACs, since their water dependency derives from coastal geomorphological and sediment transport processes for their formation and continued existence, and they lie above tidal high water:

- Annual vegetation of drift lines [1210]
- Embryonic shifting dunes [2110]
- Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]
- **Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]***
- **Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150]***
- Perennial vegetation of stony banks [1220]

Mediterranean salt meadows (Juncetalia maritimi) [1410] are regarded as being of medium sensitivity to Nitrogen enrichment of marine waters and ground waters. Dissolved Inorganic Nitrogen (DIN) levels in coastal waters adjacent to Arklow were found to be consistent with High Status; the provision of secondary treatment at any one of the three WWTW sites under consideration will not result in any adverse impact.

Marine water quality is not considered relevant to the following habitats, because their nutrient sensitivity relates to ground water, and their marine water dependency water derives from coastal geomorphological and sediment transport processes:

- Dunes with Salix repens ssp.argentea (Salix arenariae) [2170]
- Humid dune slacks [2190]

Marine water quality is not relevant to the following habitats, since they are not dependent on marine waters:

- Alkaline fens [7230]
- **Petrifying springs with tufa formation (Cratoneurion) [7220]***

2.2. Natura 2000 sites within the Avoca River catchment

The Avonmore River (a tributary of the Avoca River) flows through the Vale of Clara (Rathdrum Wood) SAC (Site Code 000733), located 15km or more upstream of all three land parcels under consideration. This SAC is designated for the Annex 1 listed woodland habitat Old sessile oak woods with Ilex and Blechnum in the British Isles (EU Habitat Code 91AO), currently listed as the sole Qualifying interest

for this SAC. This habitat is not regarded as water dependent (O'Riain et al, 2005), and is not considered further.

Some of the headwaters of the Avonbeg and Ow Rivers (tributaries of the Avoca River) rise within the Wicklow Mountains SAC (Site Code 002122), located some 25 to 30km upstream of all three land parcels under consideration. The Qualifying Interests for this SAC, are shown in Table 2.

Table 2. Qualifying Interests for Wicklow Mountains SAC

Annex listed habitat or species	**Main water source**
Otter (Lutra lutra) [1355]	
Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea [3130]	s, g
Natural dystrophic lakes and ponds [3160]	s, (g)
Northern Atlantic wet heaths with Erica tetralix [4010]	s, p, (g)
European dry heaths [4030]	-
Alpine and Boreal heaths [4060]	-
Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230]	-
Blanket bog (*active only) [7130]	p, s, (g)
Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani) [8110]	-
Calcareous rocky slopes with chasmophytic vegetation [8210]	-
Siliceous rocky slopes with chasmophytic vegetation [8220]	-
Old sessile oak woods with Ilex and Blechnum in British Isles [91A0]	-

Note: *** Priority Annex 1 habitats.**
The main water source is indicated for water dependent habitats, based on O'Riain et al (2005): s surface; g ground water; p precipitation.

Four of the eleven habitats that are listed as Qualifying Interests for Wicklow Mountains SAC are considered to be water dependent (O'Riain et al, 2005). The water dependent habitats include two Annex 1 listed lake habitats, Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea [3130], and Natural dystrophic lakes and ponds [3160]. This SAC is located far upstream, and its qualifying interests do not have a potential to be impacted by the development of a waste water treatment works at any of the land parcels under consideration at Arklow.

2.3. The Avoca River and Habitats Directive Annex 2 listed fish species.

The Avoca River Catchment covers an area of 650 km^2 and the river itself is formed by the joining of the Avonbeg and Avonmore rivers and further south, by the Aughrim River as well as a few minor tributaries. The water quality of the Avoca River Catchment is generally good to high, however the lower 11.5 km of the Avoca River itself is badly polluted (McGarrigle *et al*., 2010). This is mainly due to the input of mining leachate from the abandoned copper mines along the river (acid mine drainage), which has resulted in elevated levels of heavy metals including copper, cadmium and zinc (McGarrigle *et al*., 2010).

Inland Fisheries Ireland provided the following information on the Avoca River in 2012:
"The Avoca is an important salmonid water with excellent populations of salmon, sea trout and brown trout throughout. It is a large mainly upland catchment, with many varying habitats for fish, excellent species diversity and a good fishery potential. According to the Central Fisheries Boards report "The Quantification of the Freshwater Salmon Habitat Asset in Ireland" (2003) a total of 261 discrete migratory salmonid "fishery systems" were identified nationally, of which 173 are recorded as "salmon

& sea trout" and 88 as sea trout only. Of these Rivers the Avoca system ranked 17th overall with regard to the fluvial habitat accessible to salmon.

Dr. Willie Roche in the "Preliminary Assessment of the Avoca River Electrofishing Survey 2002" states that salmon & sea trout continue to ascend into the Avoca despite the ongoing pollution of the lower reaches which has continued unabated for over 200 years. Trout dominate the catchment, good densities of 1 year plus, and older trout were a feature of the results at the majority of sites. Physically the catchment has excellent production potential, the presence of good trout stocks shows that the system can support salmonids. The presence of salmon fry indicated that adult salmon penetrated up into the upper reaches of the Avonmore, the middle reaches of the Avonbeg and the upper reaches of the Aughrim complex in Winter 2001. The wider distribution of salmon parr compared to fry indicates that there are no barriers to migration and salmon could ascend further into the headwaters than is the case at present. There is an abundance of clean well oxygenated gravels ideal for spawning in many parts of the catchment allied to the availability of good quality nursery water. In addition to a Summer run of salmon, grilse & sea trout the Avoca system is known for a spring salmon run. Subsequent surveys undertaken by the ERFB/IFI have highlighted excellent salmon/sea trout spawning and recruitment throughout the Avoca catchment upstream.

Inland Fisheries Ireland acknowledges that the Avoca River has been persistently polluted by Acid Mine Drainage discharges from the abandoned Avoca Mine site upstream of Avoca village for approximately 200 years. A biological survey carried out by the EPA as part of the EPA's Interim Report on the Biological Survey of River Quality 2006 indicated a significant improvement in the biological quality of the Avoca River at Avoca village since 2003. This improvement which was noted by the EPA corresponds with the presence of significant populations of juvenile salmon in the lower freshwater reaches of the Avoca in 2006, indicating that salmon spawning has occurred in this area in recent years.

The Avoca is also known to contain populations of all three species of lamprey found in Ireland. All three Irish Lamprey species are Annex II species under the EU Habitats Directive. Fisheries staff have encountered large seaward runs of juvenile lamprey and large runs of adult River lamprey returning from the sea to spawn in the Avoca system. Dr. Roche's electro-fishing survey recorded juvenile lamprey and adult River lamprey in the Avonmore, Aughrim and most notably in both the polluted and unpolluted sections of the Avoca. Otters (Habitats Directive Annex II listed species) and Kingfishers (Birds Directive Annex 1 listed species) are widely distributed throughout the entire catchment also.

Migratory salmon, sea trout, and lamprey (juvenile fish on their seaward run and adult fish returning from the sea to spawn) will have to pass through Avoca estuary / Arklow harbour to reach the sea or return to their spawning grounds. Large numbers of eels also migrate through this stretch. Estuaries / transitional waters include a variety of different habitats. Their importance to fisheries relate to the fact that migratory fish must pass through these zones on their passage to / from the sea, while such transitional waters also act as important spawning / nursery areas for a wide variety of different marine fish species."

2.4. Coastal and marine Annex listed species

Habitats Directive Annex II listed marine mammals occur in coastal and marine waters off Arklow. The Harbour Porpoise (*Phocoena phocoena*) is the most commonly occurring Annex II listed cetacean in the waters off Arklow (Appendix 3). The only other cetacean listed in Annex II of the Habitats Directive that was recorded in the Arklow area is the Common Bottlenose Dolphin (*Tursiops truncatus*). Grey Seals (*Halichoerus grypus*) (Appendix 3) and Harbour Seals (*Phoca vitulina*) are likely to occur in the area occasionally, though there are no breeding colonies in the Arklow area due to the lack of any suitable, sheltered, undisturbed breeding habitat.

The Birds Directive Annex 1 listed bird species, Red-throated Diver *Gavia stellata* has been recorded in nationally important numbers in coastal waters between Brittas Bay and Mizen Head. A peak count of 49 Red-throated Divers was recorded in 1996, with a single Black-throated Diver *Gavia arctica* and two Great Northern Divers *Gavia immer* (Crowe, 2005). Boland and Crowe (2012) do not note Red-throated Diver numbers in coastal waters between Brittas Bay and Mizen Head more recently, though the species is likely to continue to occur. Divers are primarily wintering migrants to Irish waters. Red-

throated Divers are recorded mainly in shallow sandy inshore waters along the south and east coasts of Ireland (Pollock *et al*, 1997).

3. Arklow Town and Environs Development Plan 2011-2017

There are a good variety of natural habitats present in the Arklow Town and environs area, including three proposed Natural Heritage Areas (pNHA); Arklow Town Marsh, Arklow Sand Dunes and Arklow Rock. The marsh is the principal wetland habitat in the area, providing an important flood control role and supporting a variety of plant and animal life, in particular reed species and bird life.

The Natural Heritage and Biodiversity Objectives, and the Water Systems Objectives of the Arklow Town and Environs Development Plan 2011-2017, are reproduced below. The pNHAs are shown in Figure 2. Arklow Town Marsh is listed as nationally important in the Arklow Urban Habitat Mapping, reproduced in Figure 3.

"7.4.1. Natural Heritage and Biodiversity Objectives

BD1 To ensure that consideration is given to the impact of proposals for new developments on bio-diversity, and that appropriate mitigation schemes are proposed as relevant.
BD2 To maintain the favourable conservation status of all proposed and future Natural Heritage Areas (NHAs) in the plan area in particular the Arklow Marsh which has been designated a 'Conservation Zone'.
BD3 To protect features such as native hedgerows, trees and watercourses, and the locally important biodiversity areas from inappropriate development, and to strengthen through development management the role of these sites as "green corridors" to enhance overall biodiversity.
BD4 To ensure that appropriate consideration is given to the protection of trees of amenity and environmental value in the design of new developments, and discourage the felling of mature trees to facilitate development.
BD5 To require the planting of native and locally characteristic species of trees and shrubs in all new developments.
BD6 To encourage the retention and enhancement of hedgerows and traditional stone walls in the plan area.
BD7 Any programme, plan or project carried out on foot of this development plan, including any variation thereof, with the potential to impact upon a Natura 2000 site(s) shall be subject to Appropriate Assessment in accordance with Article 6 (3) and (4) of the EU Habitats Directive 1992 and 'Appropriate Assessment of plans and projects in Ireland – Guidance for Planning Authorities' DoEHLG 2009.

7.4.1 Water Systems Objectives:
WS1 To co-operate with statutory bodies and all stakeholders to reduce the pollution of the Avoca River and facilitate the Eastern Regional Fisheries Board in implementing the recommendations of the "Restoring the Avoca River" Report.
WS2 To implement the EU Water Framework Directive and associated River Basin and Sub-Basin Management Plans and the EU Groundwater Directive to ensure the protection, improvement and sustainable use of all waters in the plan area, including rivers, lakes, ground water coastal and estuarine waters, and to restrict development likely to lead to deterioration in water quality.
WS3 To resist development that would interfere with the natural water cycle to a degree that would interfere with the survival and stability of natural habitats.
WS4 To prevent development that would pollute water bodies and in particular, to regulate the installation of effluent disposal systems in the vicinity of water bodies that provide drinking water or development that would exacerbate existing underlying water contamination.
WS5 To minimise alterations or interference with river/stream beds, banks and channels, except for reasons of overriding public health and safety (e.g. to reduce risk of flooding); a buffer of 10m along watercourses shall be provided free of built development with riparian vegetation generally being retained in as natural a state as possible. In all cases where works are being carried out, to have regard

to Regional Fisheries Board “Requirements for the protection of fisheries habitat during the construction and development works at river sites.”

WS6 To promote the development of riparian walks and parks, subject to the sensitivity and /or designation of the riverside habitat, particularly within 10m of the watercourse.”

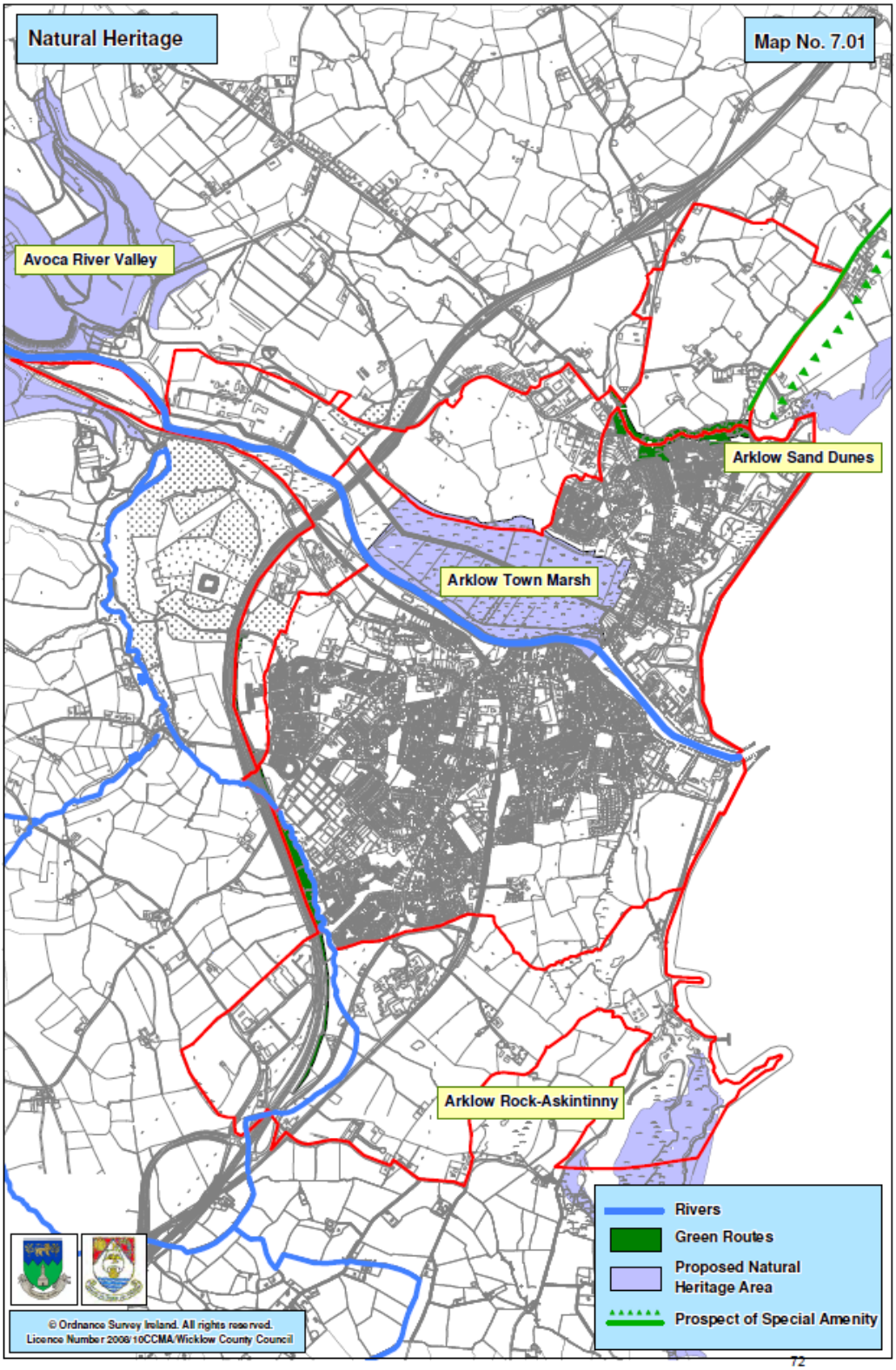

Figure 2. Natural Heritage Map. Reproduced from Arklow Town and Environs Development Plan 2011-2017

Figure 3.5 Urban Habitat Mapping (MERC: 2008)

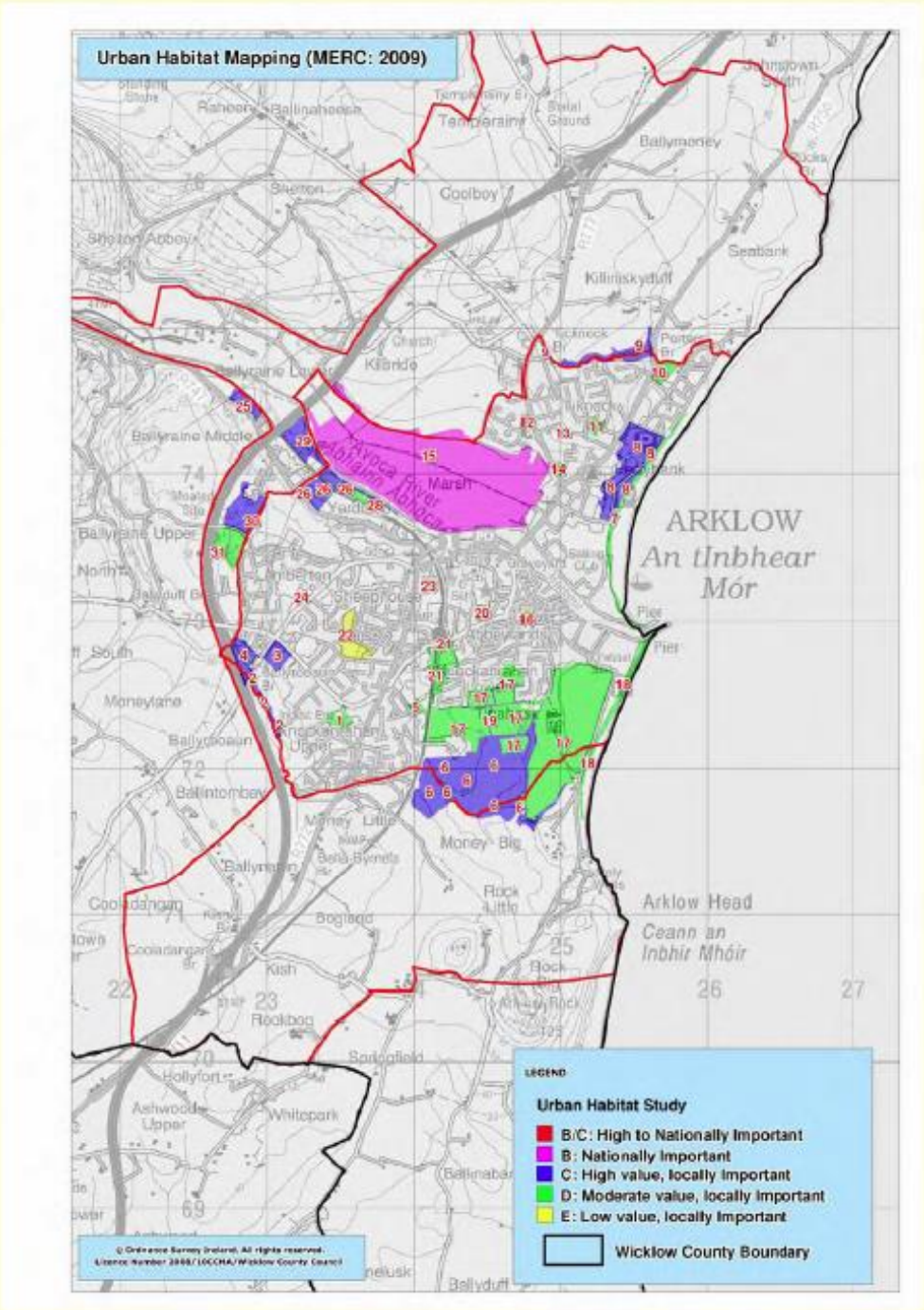

Figure 3. Arklow Urban Habitat Mapping.

Reproduced from Environmental Report of the Arklow Town and Environs Development Plan 2011-2017 Strategic Environmental Assessment (SEA)

4. Arklow Town Marsh

Arklow Town Marsh pNHA (Site Code 001931) is located on the northern side of the Avoca River in Arklow, and covers an area of approximately 0.84 km^2, including the adjoining river channel (Figure 2 and 3). The NPWS site synopsis is reproduced in Appendix 1. Arklow Town Marsh was included in the Wicklow Wetlands Survey in 2012 (Wilson *et al*, 2012), the report is reproduced in Appendix 2. Habitats recorded within the site by Wilson *et al* are as follows:

FS1 Reed and large sedge swamps
FW2 Depositing/lowland rivers
FW4 Drainage Ditches
GM1 Marsh
WN6 Wet willow-alder-ash woodland
WS1 Scrub.

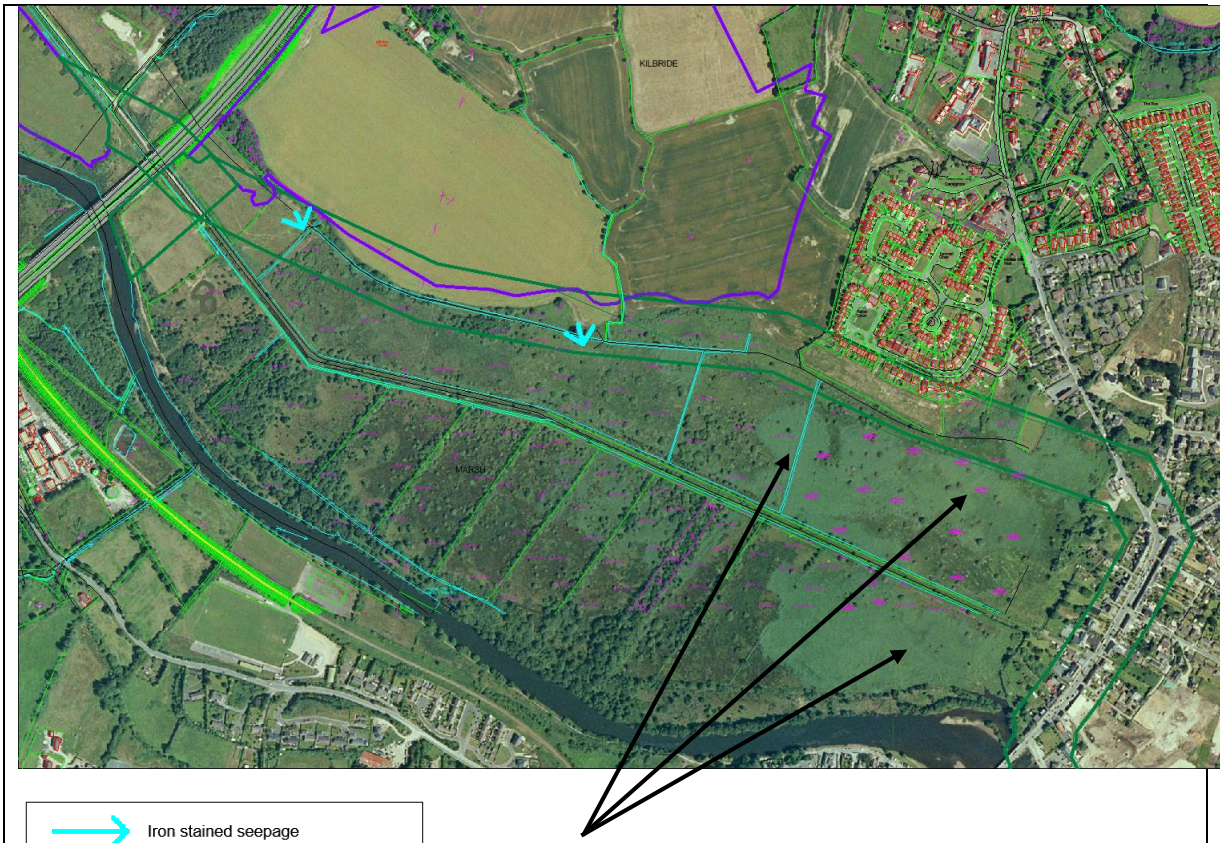

Figure 4. Arklow Town Marsh pNHA, showing hydrological features

The hydrology of Arklow Town Marsh does not appear to have been studied in detail. Water sources supporting the wetland habitats of the marsh are likely to include hydrological inputs from the canal and Sheepwalk stream flowing eastwards from the Shelton Abbey lands, water inputs from higher ground to the north of the marsh including a small stream at Kilbride together with overland and groundwater

flow, tidal flooding from the east immediately upstream of Arklow bridge, and riverine flooding. Two iron stained seepages into the marsh were identified during field survey in April 2015, and are shown in Figure 4 and Plate 1. Common reed Phragmites australis dominated swamp occurs mainly in the eastern part of Arklow Town Marsh (Figure 4), and may reflect a brackish water influence in this area in addition to hydrological factors. Water level was at or above ground level within the marsh in April 2015. In general, the western end of the marsh is more grassy in character, particularly under wet willow dominated woodland.

Plate 1. Top left, iron stained seepage with Bulrush *Typha latifolium* flowing into western end of marsh; Top right, drainage channel within pNHA at western end with Branched bur-reed *Sparganium erectum* and Sweet-grass *Glyceria* spp.; Centre left, arable land sloping down to northern marsh edge at Kilbride; Centre right, tall sedge swamp dominated by Greater pond sedge *Carex riparia* at northern marsh edge in Kilbride; Bottom left, standing water with Yellow iris *Iris pseudaorus* at northern marsh edge; Bottom right, tall sedge swamp with Common reed *Phragmites australis* swamp and Wet willow woodland in the background.

Existing hydrological impacts on the marsh include infilling at the western end, and past drainage. The effects of aerial pollution noted in the Site Synopsis (Appendix 1) are no longer apparent, with recovery and re-growth of willow within the marsh area and of trees on adjoining lands. It is likely that the marsh receives nutrient inputs from adjoining arable land to the north.

5. Shelton Abbey land parcel.

The Shelton Abbey land parcel is shown in Figure 5. This land parcel includes two areas of made ground with paved or stone chip surfaces (Figure 5, plot A and lands to the south), which are separated by an access track and drainage ditches including a wider feature to the south of the access track which is better described as a canal, although its original function is unclear (Byrne Looby PH McCarthy, 2015). A third area, Plot C, is a former land filled area that has been capped with soil and supports grassland currently in use for horse grazing.

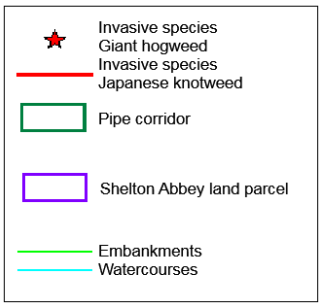

Figure 5. Shelton Abbey land parcel, showing watercourses and invasive plant species records

Plot A

Plot A is almost entirely un-vegetated Fossitt habitat **BL3 Buildings and paved surfaces**. Small areas of stone chip surface within the plot are sparsely vegetated with colonising mosses, Annual meadow grass *Poa annua*, Willowherb *Epilobium* spp., and Common ragwort *Senecio jacobaea*, classified as **ED2 Spoil and bare ground**. A **Drainage ditch FW4** outside the palisade fence at the western end of the plot supports wetland vegetation of Sweet-grass *Glyceria* spp. with Bulrush *Typha latifolia* and Soft rush *Juncus effusus*, with Reed canary grass *Phalaris arundinacea*, False oat grass *Arrhenatherum elatius* and Cock's-foot grass *Dactylis glomerata* growing along the banks, with occasional Grey willow *Salix cinerea* and Bramble *Rubus fruticosus* agg. A narrow strip of **Mixed broadleaved woodland WD1** of planted origin is included in Plot A (Figure 5, Plate 2); this includes Grey willow and Silver Birch *Betula pendula*, with a shrub layer of Elder *Sambucus nigra* and Bramble and with little ground flora. A narrow strip of mown **Amenity grassland GA2** lies between this woodland strip and the access road to the overall former IFI site.

Fauna

Habitat for fauna on Plot A is limited to the woodland and drainage ditches at the site margins. Blackbird, Robin, Chaffinch and Wren were recorded in the woodland.

Summary: Plot A is largely un-vegetated and of low value for flora and fauna. It is assumed that there is some connectivity between the drainage ditches at the plot margins and those present elsewhere in the Shelton Abbey land parcel. The woodland strip along the northern margin of the site has moderate local value as a wildlife corridor.

Plate 2. Plot A at Shelton Abbey, viewed from the access track adjoining the south eastern corner of the site

Lands south of Plot A

Lands south of Plot A, on the southern side of the access track, are almost entirely un-vegetated Fossitt habitat **BL3 Buildings and paved surfaces** (Figure 5). Small areas of stone chip surface within the plot are sparsely vegetated with colonising mosses, Annual meadow grass *Poa annua*, Willowherb *Epilobium* spp., and Common ragwort *Senecio jacobaea*, classified as **ED2 Spoil and bare ground**.

A wide drainage channel classified as a **Canal FW3** adjoins the track and supports a vegetation of Sweet-grass and Duckweed *Lemna minor*, with a line of Grey willow along its southern side. False oat grass and Cock's-foot grass grow on the banks, with occasional Soft rush and Common reed; Reed canary grass *Phalaris arundinacea* is occasional on the higher banks together with bramble. Sluices are in place that control water flow southwards into a series of two constructed **Reservoirs FL7 (Plate**

3). The smaller reservoir is vegetated with Common reed with shrubs of grey willow on the banks, while the larger reservoir is fringed with Common reed along part of the margins.

Fauna.

This plot provides limited habitat for fauna at the canal and reservoir and associated vegetation.

Summary: Lands south of Plot A are largely un-vegetated and of low value for flora and fauna. It is assumed that there is some connectivity between the canal and reservoirs at the plot margins and those present elsewhere in the Shelton Abbey land parcel; these water bodies and the adjoining Willow scrub have moderate local value as a wildlife corridor.

Plate 3. Shelton Abbey, lands south of Plot A. Top left, Canal at north east corner of site showing sluices and aquatic vegetation; Top right, embankment at south east corner of site showing Avoca River and floodplain to left; Bottom left, Reservoir with fringing reedbed; Bottom right, smaller reservoir with reedbed; un-vegetated areas of site can be seen in the background.

Plot C

Plot C is a former land filled area that has been capped with soil and supports grassland currently in use for horse grazing. Colonising mosses of bare ground are frequent in a closely grazed grassy sward of **Improved agricultural grassland GA1**. Creeping bent grass *Agrostis stolonifera* and Yorkshire fog *Holcus lanatus* are the dominant grasses, with Ryegrass *Lolium perenne*, False oat grass and Cock's-foot grass also occurring occasionally. Broad-leaved herbs present include White clover *Trifolium repens*, Red clover *T. pratense*, Ribwort *Plantago lanceolata*, Creeping buttercup *Ranunculus repens*, Creeping thistle *Cirsium arvense*, Common mouse-ear *Cerastium fontanum*, Common ragwort *Senecio jacobaea*, Dandelion *Taraxacum* agg., Daisy *Bellis perennis*, and occasional Soft rush. Occasional

small shrubs of Laurel *Prunus laurocerasus* occur in a broken line close to the western boundary of Plot C, while closely planted groups of Lodgepole pine *Pinus contorta* occur with Gorse *Ulex europaeus*, Birch and Grey willow along the northern boundary of Plot C. Bramble dominated **Scrub WS1** with occasional willow forms the northern boundary of Plot C, and adjoins the Canal.

The southern boundary of Plot C coincides with the edge of the land filled area; ground slopes steeply down from the boundary to the Avoca River floodplain (Figure 5, Plates 3 and 4). Floodplain Wet grassland GS4 on sandy alluvial soil is dominated by Creeping bent with Yorkshire fog and Sweet-grass, with Marsh ragwort *Senecio aquaticus*, Common sorrel *Rumex acetosa*, *Celandine Ranunculus ficaria*, and occasional soft rush. An area of standing water is dominated by Sweet-grass with Soft rush (Plate 4). There is some slumping along the Avoca river bank. Scattered willow and birch, tussocks of Tufted hair-grass *Deschampsia cespitosa*, Common reed and Yellow iris growing along the bank. Flood debris caught in bramble scrub towards the eastern end indicates that flooding can extend across the floodplain to the sloped edge of the land-filled area.

Bramble scrub with gorse, birch, ash and oak occurs on sloping ground near the M11. Higher mounded ground adjoining the eastern end of Plot C has been planted with Ash *Fraxinus excelsior*, Pine and Larch *Larix decidua*, Gorse and willow have colonised the area.

Plate 4. Shelton Abbey, Plot C. Top left, standing water within Wet grassland GS4 on the Avoca river floodplain adjoining Plot C; Top right, river floodplain looking east towards M11 bridge, with bramble and gorse scrub near the bridge; Bottom left and right, Plot C viewed from higher ground to the east.

Fauna

Rabbits, Wood pigeon and Pheasant occur in this plot, fox and badger signs were also recorded. Birds were associated principally with the immediately adjoining scrub where Blackbird, Song thrush, Robin,

Wren, Chiffchaff, Willow warbler, Coat tit and Chaffinch were recorded. Mallard were recorded on the Avoca river and on the canal; a Grey heron was recorded feeding at the canal. Buzzards were recorded soaring over the general area.

Summary: Plot C at Shelton Abbey supports common plant species; biodiversity is higher in the adjoining scrub and aquatic habitats of the Avoca river and of the canal which is hydrologically linked to Arklow Town Marsh pNHA.

Relevant considerations:

1. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
2. The distribution of invasive plant species Giant hogweed *Heracleum mantegazzanium* and Japanese Knotweed *Fallopia japonica* recorded in April 2015 is shown in Figure 5. It is recommended that the Giant hogweed is treated with appropriate herbicide as a matter of priority by the relevant agency. Any works in the vicinity of the Japanese knotweed should be subject to a management plan.

6. Kilbride land parcel

Kilbride land parcel covers an area of 0.45km^2, the principal land cover is **Arable crops BC1**. Field boundaries in the immediate area range from fences to treelines. Within the land parcel most field boundaries are earth banks with associated drainage ditches; these were generally overgrown with Bramble scrub, with occasional Gorse and Elder.

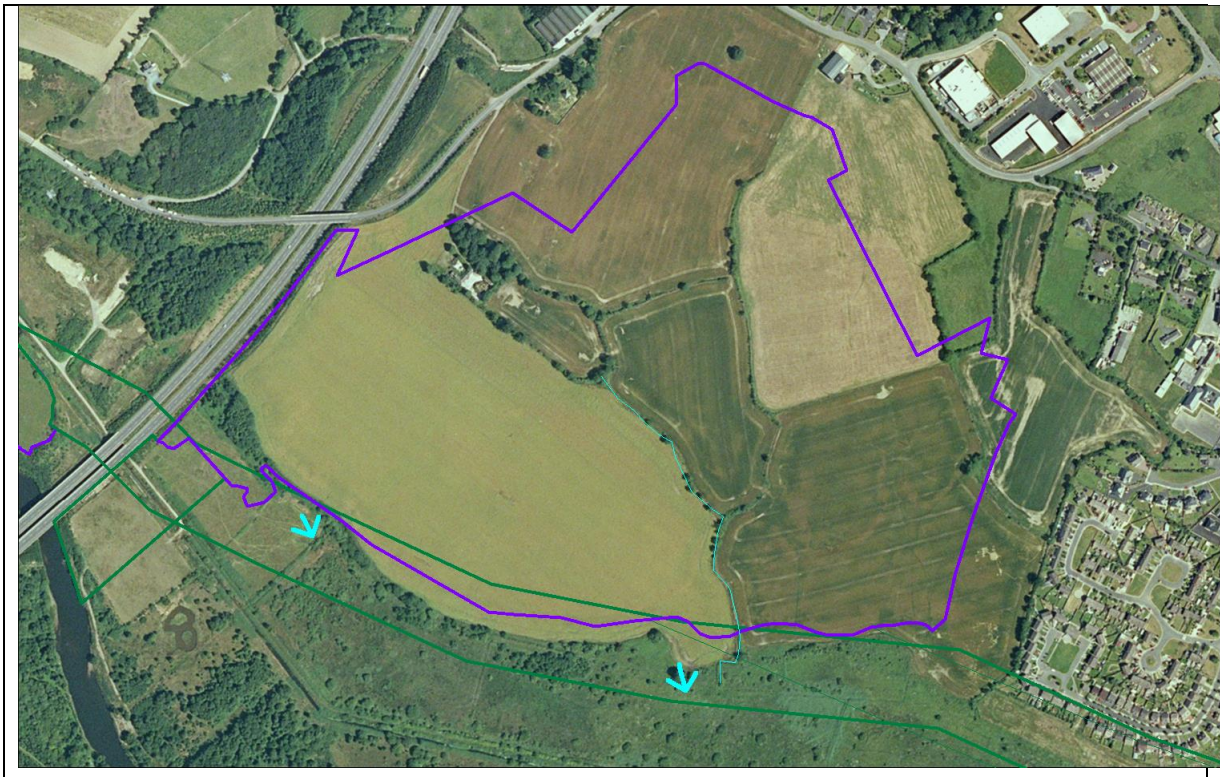

Figure 6. Kilbride land parcel, showing a stream and seepages into Arklow Town Marsh pNHA to the south of the land parcel.

There are two small woodland areas within the Kilbride land parcel. To the south west of the site adjoining the M11, a **Mixed broadleaved /conifer woodland WD2** includes Cypress, Birch, Ash, Holly and Grey willow, with Bramble and Bracken *Pteridium aquilinum* extending southwards into a previously land-filled and capped area with flora as described for Plot C at Shelton Abbey. A small area of **Mixed broadleaved woodland WD1** adjoins a partially derelict group of farm buildings in the central western part of the lands (Figure 6); this includes Sycamore, Ash, Holly and Elder, with a shrub layer of Elder and Bramble and some Laurel. Treelines WL2 dominated by Sycamore and Ash with Holly, Elder, Bramble and occasional Gorse extend westwards from the Mixed broadleaved woodland. A small stream arises from drainage ditches adjoining these treelines, and flows south eastwards to Arklow Town Marsh in a channel that is largely overgrown with bramble. The stream substrate is initially silty but cobble and gravel further along the channel bed suggest permanent water flow. Great willowherb *Epilobium hirsutum* and Fool's watercress *Apium nodiflorum* grow in unshaded sections of the stream, with Celandine, Bracken, Nettle, Hogweed and Alexanders *Smyrnium olusatrum* on the banks among grasses and occasional trees of Oak, Ash and Sycamore. Treelines of Oak, Ash and Holly with

Hawthorn, Blackthorn, Gorse and Bramble occur in the eastern part of the land parcel and extend northwards outside the site boundary; these are the most diverse treelines in the immediate area (Plate 5).

Plate 5. Kilbride land parcel. Top left, Mixed broadleaved /conifer woodland WD2 in the south west of the site; Top right, Treeline and Mixed broadleaved woodland in the centre west; Bottom left, treeline near the eastern site boundary; Bottom right, treeline extending from the north eastern site boundary.

Fauna.

Rabbit burrows were found in all field boundary earth banks. Badger feeding signs and tracks were recorded frequently within the site, with one latrine; active setts were not found but could not be ruled out because of extensive bramble scrub that could not be thoroughly searched. Fox scats were found. A bat survey was not carried out. Treelines were identified as including trees with bat roost potential, and the stone built farm buildings within the site may also have bat roost potential. Treelines and scrubby field boundaries have potential as feeding and commuting corridors for bats. A Buzzard pair and a Red Kite pair were recorded hunting and soaring over the general area. Bird species recorded as probable breeders within the site hedgerows and treelines were Robin, Blackbird, Chaffinch, Wren, Wood pigeon, Pheasant, Magpie, and Great tit.

Summary: in the Kilbride land parcel, the arable crops are low diversity with regard to plant species but provide feeding habitat for birds and mammals. Treelines, woodland and scrub, and the small stream channel, within and adjoining the Kilbride land parcel are of high local importance for biodiversity and as ecological corridors between features of higher ecological value.

Relevant considerations: Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented given the size of individual field areas within the land parcel.

7. Ferrybank land parcel

Vegetation and habitats
The Ferrybank parcel is located on the northern side of Avoca River estuary, which is retained by the quay walls of Arklow Harbour in this area. The parcel includes a derelict gypsum factory and the following habitats are present:

Buildings and artificial surfaces BL3
Spoil and bare ground ED2
Recolonising bare ground ED3
Amenity grassland (improved) GA2
Scrub WS1

Derelict buildings and tanks occupy c. 60% of the parcel area. Ivy *Hedera helix* is present on some walls, and gutters are overgrown with grasses. The derelict buildings are otherwise unvegetated.

Spoil and bare ground, comprising paved and gravel surfaces, is vegetated with common colonising plant species. At the eastern end of the parcel adjoining the quay wall of Arklow Harbour, a marine influence is evident and a sparse flora includes Buck's-horn plantain *Plantago coronopus*, stonecrop *Sedum* and Sea Mayweed *Tripleurospermum maritimum*.
Elsewhere within the parcel colonising plant species include mosses, Creeping bent-grass *Agrostis stolonifera*, Annual meadow-grass *Poa annua*, Willowherb *Epilobium* species, Ribwort *Plantago lanceolata*, Common Ragwort *Senecio jacobaea*, White clover *Trifolium repens*, yellow clover *T. dubium*, Hairy bittercress *Cardamine hirsuta*, and Dandelion *Taraxacum officinale* agg.

Recolonising bare ground is more densely vegetated with more than 50% plant cover, and includes the species listed above with additional grass species Red fescue *Festuca rubra*, Cock's-foot grass *Dactylis glomerata*, and Yorkshire fog *Holcus lanatus*.

A narrow strip of abandoned amenity grassland lies to the east between the main building and the rock armour along the shore at Ferrybank. This vegetation is dominated by Red fescue grass, with occasional Creeping thistle *Cirsium arvense*, Dock *Rumex* species, and Bush vetch *Vicia cracca*.

Scrub is developing in parts of the parcel, and is dominated by bramble *Rubus fruticosus* agg., Gorse *Ulex europaeus*, with occasional Alder *Alnus glutinosa*, Grey willow *Salix cinerea* and Elder *Sambucus nigra*.

Fauna
There is evidence that feral pigeons breed in the main building, 12 birds were present during the site visit in 2014. Birds recorded in scrub habitat and as probable breeding species within the parcel were Great tit, Blue tit, Chaffinch, Goldfinch, House sparrow, Wren, and Blackbird. A Hooded crow carrying nest materials was also recorded. A Mallard pair was recorded landing briefly on the roof of a building and in flight over the parcel.

A bat survey has not been completed at the parcel; there may be limited potential for buildings and tanks to be used as bat roosts. Fox signs were recorded, and rodents are likely to occur.

Summary
The habitats, flora, and fauna present at the Ferrybank parcel are typical of derelict urban sites.

Relevant considerations: none

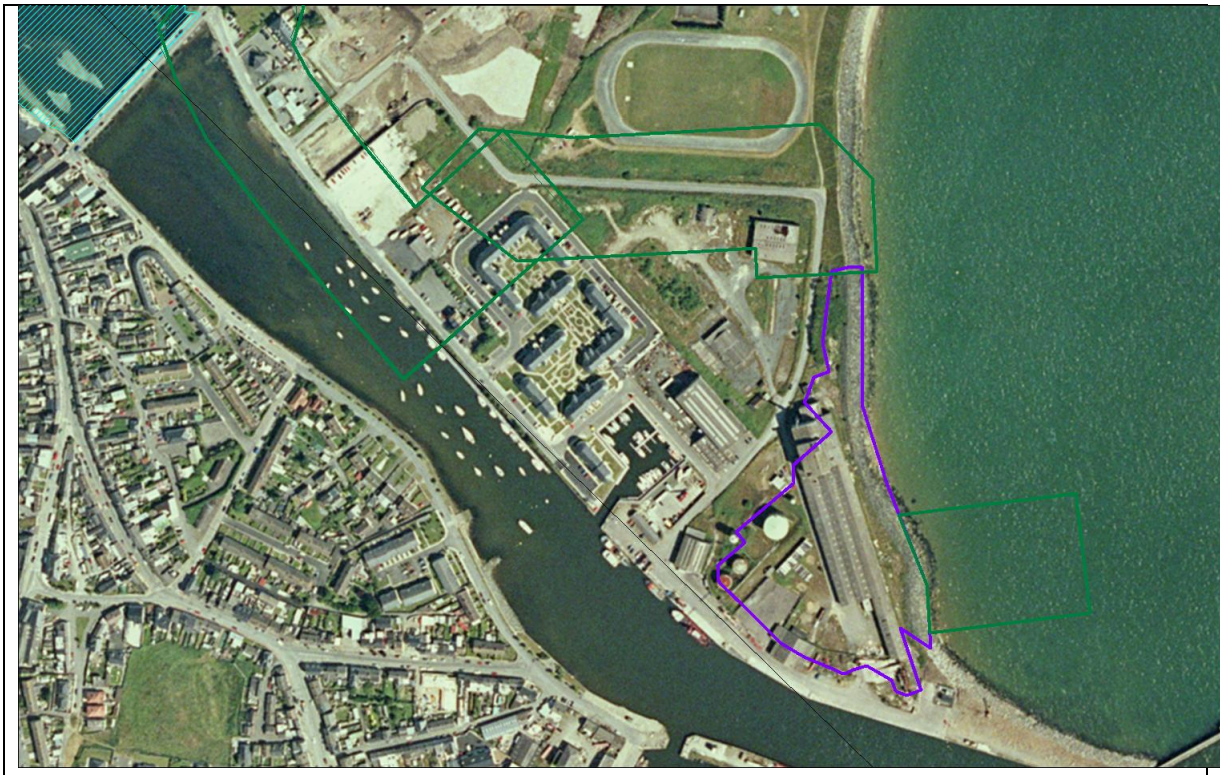

Figure 7. Ferrybank land parcel and pipe corridor. Arklow Town Marsh pNHA is shown, upstream of Arklow bridge.

8. Pipe corridors

8.1. Potential river outfall

The pipe corridor is indicated as a 100m wide strip in Figure 8, within which a construction corridor in the order of 6 to 8m wide will be required. The Shelton Abbey and Kilbride options both involve a proposal to discharge treated waste water to the Avoca river at a point to the east of the M11 bridge, subject to appropriate treatment level and licencing requirements. This route crosses into a previously land-filled and capped area with flora as described for Plot C at Shelton Abbey, and traverses a narrow strip of Scrub WS1 on the Avoca river bank.

Relevant considerations:

1. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
2. Arklow Town and Environs Development Plan 2011-2017 Objectives: WS1, WS2

8.2. Foul main connection to Shelton Abbey and Kilbride options: Arklow Town Marsh

The pipeline corridor indicated for the transfer of foul flows to waste water treatment works at the Shelton Abbey and Kilbride options runs along the northern margins of Arklow Town Marsh pNHA. The indicative 100m wide corridor includes portions of the pNHA area; construction of a pipeline within the pNHA area would be contrary to Objective BD2 of Arklow Town and Environs Development Plan 2011-2017 since it would be likely to give rise to short term (one to seven years) to medium term (seven to fifteen years) impacts on wetland habitats, and a potential to give rise to long term (fifteen to sixty years) impacts, depending on detailed routing and construction methodology in wetland habitats in which water level is at or above the ground surface.

The indicative pipeline corridor available outside Arklow Town Marsh pNHA is narrow at The Marshlands Youth and Sports Centre and to the rear of properties in Avondale Crescent, and from this area to Dublin Road Arklow, with variations in ground level. More detailed investigations are recommended to establish the feasibility of this route; ecologically the main pipeline design constraint is the avoidance of any diversion of existing surface and ground water flows to Arklow Town Marsh since these could have hydrological impacts on the wetland. An alternative pipeline route to the north may be preferable and it is recommended that this possibility is investigated further.

Relevant considerations:

Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2

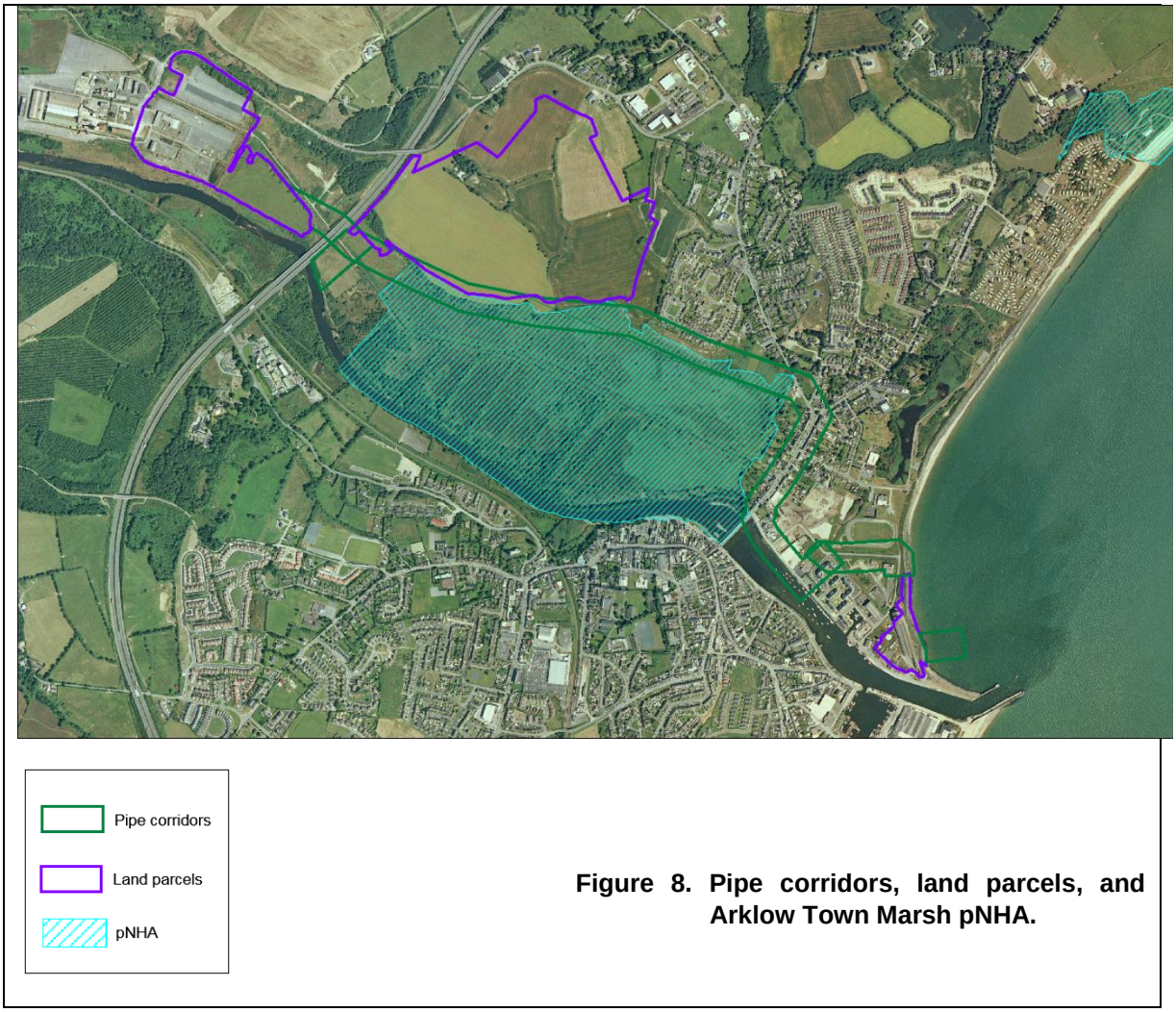

Figure 8. Pipe corridors, land parcels, and Arklow Town Marsh pNHA.

8.3. Foul main connection to Shelton Abbey land parcel

A pipeline for the transfer of foul flows to waste water treatment works at the Shelton Abbey land parcel would seem likely to be constructed within the existing access track that adjoins the northern boundary of Plot C at Shelton Abbey (Figure 5). The Canal lies between Plot C and the track. In its western section, there is little evidence of flow and the canal is vegetated with Sweet-grass and Duckweed. In shallower silty sections towards the east, Water-cress *Nasturtium officinale*, Fool's water-cress, Bulrush, Branched bur-reed, Reed canary-grass and Common reed, and Great willowherb occur (Plate 6). A smaller wet drainage ditch adjoins the northern side of the access track from the Sheepswalk stream eastwards; both the ditch and the canal extend eastwards into Arklow Town Marsh and provide a surface water flow into the marsh.

A short section of the pipeline corridor to the east of the M11 bridge crosses into a previously land-filled and capped area with flora as described for Plot C at Shelton Abbey. An iron stained seepage towards the eastern end of the land-filled area flows into the marsh (Figure 4).

Relevant considerations:

The maintenance of existing water sources supporting the wetland habitat of Arklow Town Marsh, and maintaining or improving water quality, are the main considerations that arise.

1. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
2. Arklow Town and Environs Development Plan 2011-2017 Objectives: BD2

Plate 6. Canal and adjoining access track at Shelton Abbey. Left, looking east, the Sheepswalk stream is culverted under the track and into the canal; Right, looking west.

8.4. Foul main connection to Ferrybank land parcel

The pipeline corridor associated with Ferrybank runs on the existing road network. Adjoining potentially available lands comprise amenity grassland GA2.

Relevant considerations: none

9. Outfalls

Natura 2000 sites
Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests are assessed as neutral for each one of the three land parcels under consideration as a location for Arklow WWTW.

Protected species
With regard to Birds Directive Annex 1 listed bird species, Red-throated Diver *Gavia stellata* has been recorded in nationally important numbers in coastal waters between Brittas Bay and Mizen Head. A peak count of 49 Red-throated Divers was recorded in 1996, with a single Black-throated Diver *Gavia arctica* and two Great Northern Divers *Gavia immer* (Crowe, 2005). Boland and Crowe (2012) do not note Red-throated Diver numbers in coastal waters between Brittas Bay and Mizen Head more recently, though the species is likely to continue to occur. Divers are primarily wintering migrants to Irish waters. Red-throated Divers are recorded mainly in shallow sandy inshore waters along the south and east coasts of Ireland (Pollock *et al*, 1997). Potential impacts on Red-throated Divers are assessed as neutral for both the construction phase and operational phase of a marine outfall from Ferrybank, and as neutral for a river outfall from Kilbride or from Shelton Abbey. The shallow marine waters within which Red-throated divers have been recorded are currently assessed, and are expected to remain at, High Status. Potential impacts are therefore assessed as neutral for the outfalls for each of the three parcels under consideration.

Kingfishers *Alcedo atthis* occur in the Avoca River catchment, and have been observed at Three Mile Water in Magherabeg Dunes SAC (NPWS Conservation Plan), and are likely to occur at the inflowing rivers at Buckroney – Brittas Dunes and Fen SAC. Potential impacts on Kingfisher are assessed as neutral for both the construction phase and operational phase of a marine outfall from Ferrybank parcel. With regard to a river outfall potentially required in association with the Kilbride and Shelton Abbey land parcels, riverine flooding in this area may exclude Kingfishers from nesting in the banks immediately south of the M11 bridge, however this section would need to be re-surveyed as part of any detailed design phase. Otter signs were not found along the Avoca river bank in April 2015, but are likely to occur and would also require re-survey as part of any detailed design phase.

Marine mammals sensitive to noise are likely to occur in the vicinity of a marine outfall associated with the Ferrybank option under consideration (Appendix 3). A Marine Mammal Observer (MMO) would be required to be employed during any geophysical survey or piling operations for the protection of individual marine mammals from noise-related injury or disturbance. With regard to the operational phase, the shallow marine waters within which marine mammals have been recorded are currently assessed, and are expected to remain at, High Status. Potential impacts are therefore assessed as neutral for the marine outfalls for each of the three parcels under consideration.

A river outfall option from the Kilbride and Shelton Abbey land parcels will be required to be subject to appropriate treatment levels and licencing requirements in order to maintain or improve the conservation status of Habitats Directive Annex II listed fish species that occur in the Avoca river and its estuary; Salmon, Sea lamprey and River lamprey.

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Appendix 1. Arklow Town Marsh Site Synopsis

SITE NAME: ARKLOW TOWN MARSH

SITE CODE: 001931

This site is now the principal wetland area in Arklow. It is a large marsh located north of the Avoca estuary on the perimeter of Arklow town. A disused roadway bisects the site from east to west.

Much of the site is dominated by Reeds (Phragmites australis), with Creeping Bent Grass (Agrostis stolonifera) and Valerian (Valeriana officianalis) common in places. On the southern side, numerous scattered bushes of Willow (Salix spp.) are growing among the Reeds, forming a scrub in places. Drier areas are characterised by large tussocks of Tufted Hair Grass (Deschampsia caespitosa). Other plants present include Soft Rush (Juncus effusus), Iris (Iris pseudacorus), Skullcap (Scutellaria galericulata), Lesser Pond Sedge (Carex acutiformis) and several other Sedges (Carex spp.).

Wet grassy areas with extensive stands of Water Horsetail (Equisetum fluviatile) occur on the northeast margin, with Creeping Bent Grass (Agrostis stolonifera), Spike Rush (Eleocharis palustris), Meadowsweet (Filipendula ulmaria) and Rushes (Juncus articulatus & J. conglomeratus) present.

The scarce Broad-leaved Cottongrass (Eriophorum latifolium) has been recorded growing on this site.

Much of the Willow (Salix spp.) has been defoliated, possibly due to atmospheric pollution from the nearby fertilizer factory.

The importance of this site is that it is a good example of a relatively large wetland, despite the impacts of atmospheric pollution and its proximity to Arklow town. The presence of at least one scarce plant species increases the interest of the site.

16th February 1995.

Appendix 2. Wicklow Wetland Survey report on Arklow Town Marsh

Site Name: ARKLOW TOWN MARSH pNHA

Site Code: WW193 **Area (ha):** 81.36 **Easting:** 324079 **Northing:** 174095 **County:** WI

Photograph 1. Arklow Town Marsh County Wicklow showing reed beds with willow scrub on site. Photograph: F. Wilson

Site Designation(s):
cNHA
pNHA

Surveyed by:
Faith Wilson

Date of Wetland Survey:
12/10/2012

Survey Code:
WWS2012

Site Source Information:
Detailed Wetland Survey undertaken

Wetland Present on the Site
YES

Conservation Ranking after Survey:
B Rating: Nationally Important

Townland:
MARSH

Solid Geology:
Ordovician Metasediments

Subsoil Type:
AlluvMIN

Substrate Type:
Made Ground
Mineral Soil
Peat

Substrate Stability:
Firm

River Catchment:
Not applicable

Site Location

This extensive reedbed and marsh is located within the boundaries of Arklow town.

Site Description and Wetland Habitats Recorded

This is a large reedbed with scattered Salix scrub adjoining the Avoca River. There has been recent infilling and development along the northern edge of the site with historic infilling at the western end.

Target Notes - *(see Habitat Map for location of Target Notes)*

No.	Category	Easting	Northing	Comment

Management Recommendations following Survey

Ensure no further infilling occurs on the site.

Future Survey Recommendations

None.

Landowner Information Comments

Arklow Town Council.

Description of potential EU Habitats Directive Annex 1 Habitats

None.

Main Fossitt Habitats on Site	EU Habitats Directive Habitats on Site
FS1 Reed and large sedge swamps	None noted
FW2 Depositing/lowland rivers	
FW4 Drainage ditches	
GM1 Marsh	
WN6 Wet willow-alder-ash woodland	
WS1 Scrub	

Fossitt Habitats Surrounding Site

BC1 Arable crops

BL3 Buildings and artificial surfaces

ED2 Spoil and bare ground

GA1 Improved agricultural grassland

WL1 Hedgerows

Landuse / Management Activity	Frequency of Use
None	4 Dominant (>50%)

Impacting Activity (EU code and title)	Intensity	Impact
J02.05 Modification of hydrographic functioning,	C = low	- 1 = reparable negative influence
J02.01.03 Infilling of ditches, dykes, ponds, pools,	B = medium	- 2 = irreparable negative influence
E03.02 disposal of industrial waste	C = low	- 1 = reparable negative influence
E03.03 disposal of inert materials	C = low	- 1 = reparable negative influence
J01.01 burning down	C = low	0 = neutral

Threats

J02.01.02 reclamation of land from sea, estuary or marsh

J02.01.03 infilling of ditches, dykes, ponds, pools, marshes or pits

Flora on Site - Latin & English Species Name

Agrostis stolonifera	Creeping Bent
Anthoxanthum odoratum	Sweet Vernal-grass
Calystegia sepium	Hedge Bindweed
Cardamine pratensis	Cuckooflower
Carex acutiformis	Lesser Pond-sedge
Carex paniculata	Greater Tussock-sedge

Carex rostrata	Bottle Sedge
Carex sp.	Sedge
Cirsium palustre	Marsh Thistle
Comarum palustre	Marsh Cinquefoil
Deschampsia cespitosa	Tufted Hair-grass
Eleocharis palustris	Common Spike-rush
Epilobium hirsutum	Great Willowherb
Equisetum fluviatile	Water Horsetail
Equisetum palustre	Marsh Horsetail
Filipendula ulmaria	Meadowsweet
Galium palustre	Marsh-bedstraw
Holcus lanatus	Yorkshire-fog
Iris pseudacorus	Yellow Iris
Juncus effusus	Soft-rush
Lotus pedunculatus	Greater Bird's-foot-trefoil
Lythrum salicaria	Purple-loosestrife
Mentha aquatica	Water Mint
Phalaris arundinacea	Reed Canary-grass
Phragmites australis	Common Reed
Rubus fruticosus agg.	Blackberry
Salix cinerea subsp. oleifolia	Rusty Willow
Schedonorus arundinaceus	Tall Fescue
Scutellaria minor	Lesser Skullcap
Typha latifolia	Bulrush
Ulex europaeus	Gorse
Urtica dioica	Common Nettle
Valeriana officinalis	Common Valerian
Vicia cracca	Tufted Vetch

Fauna on Site - English and Latin Species Name

Common Frog	*Rana temporaria*
Common Kingfisher	*Alcedo atthis*
Grey Heron	*Ardea cinerea*
Otter	*Lutra lutra*

GIS Habitat Map of the Site

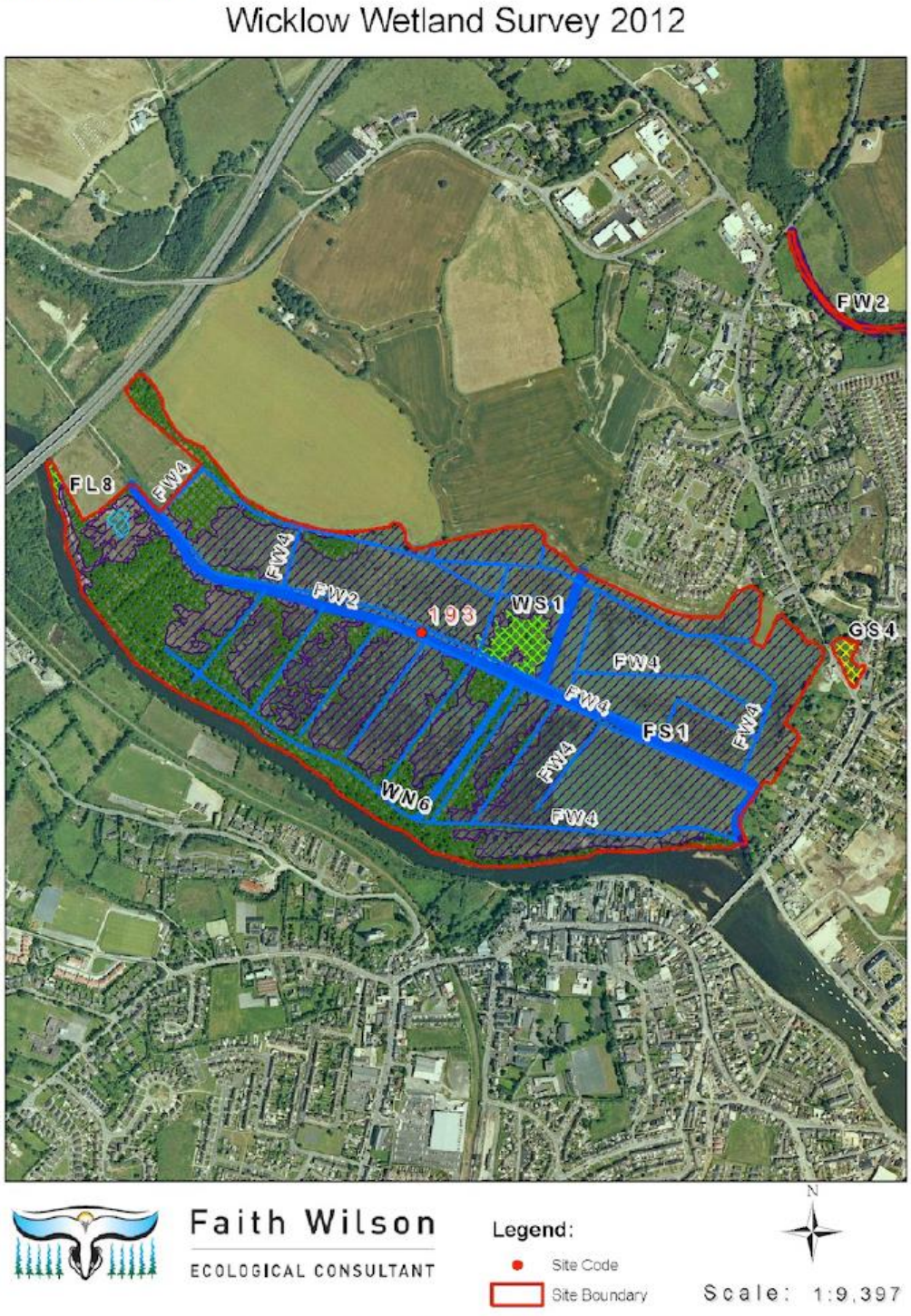
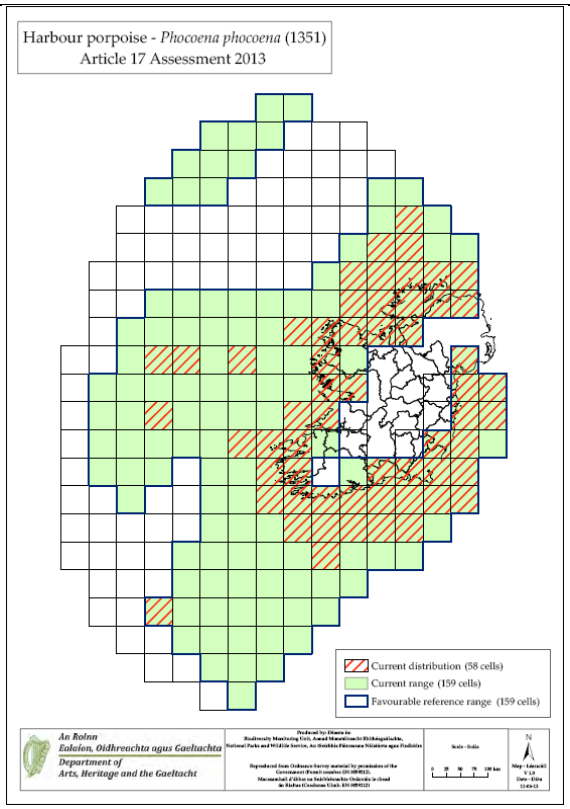
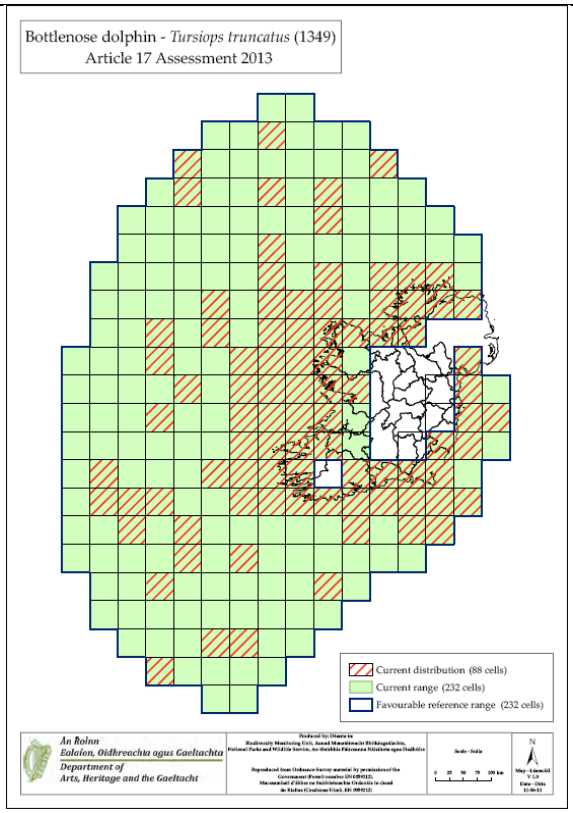
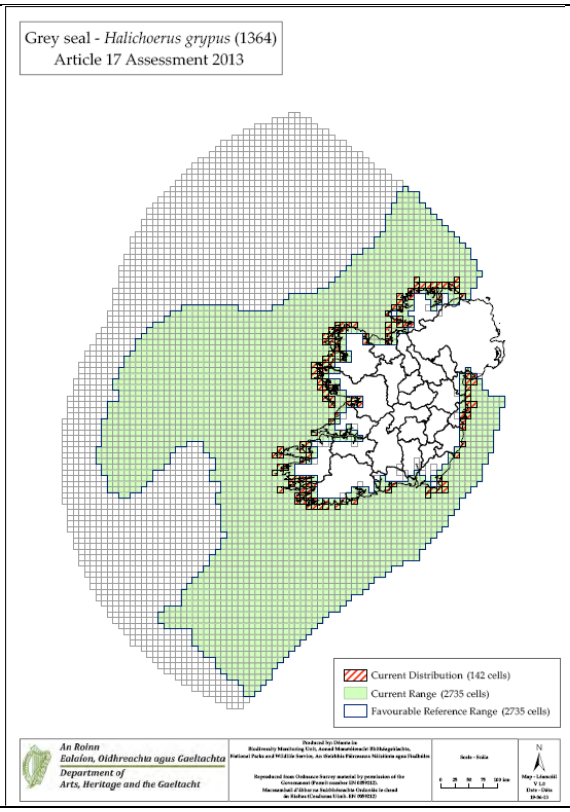


Figure 2. Habitat map of Arklow Town Marsh (site number WW193). Base map copyright Ordnance Survey of Ireland. Key to habitat symbols is presented at the start of this report.

Appendix 3. Habitats Directive Annex 2 listed marine mammal species occurring in the study area and/or adjoining coastal waters.



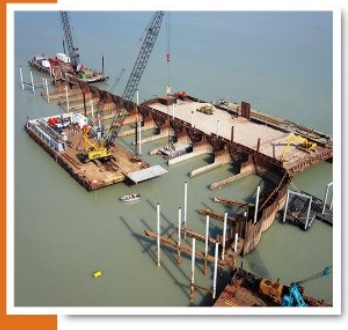


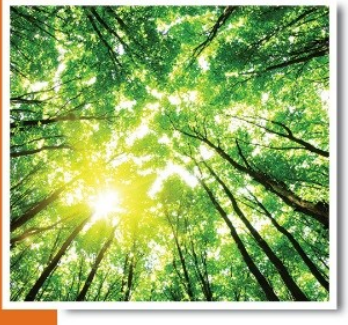


Mapping reproduced from NPWS (2013) *The Status of EU Protected Habitats and Species in Ireland.* Species Assessments Volume 3, Version 1.0.

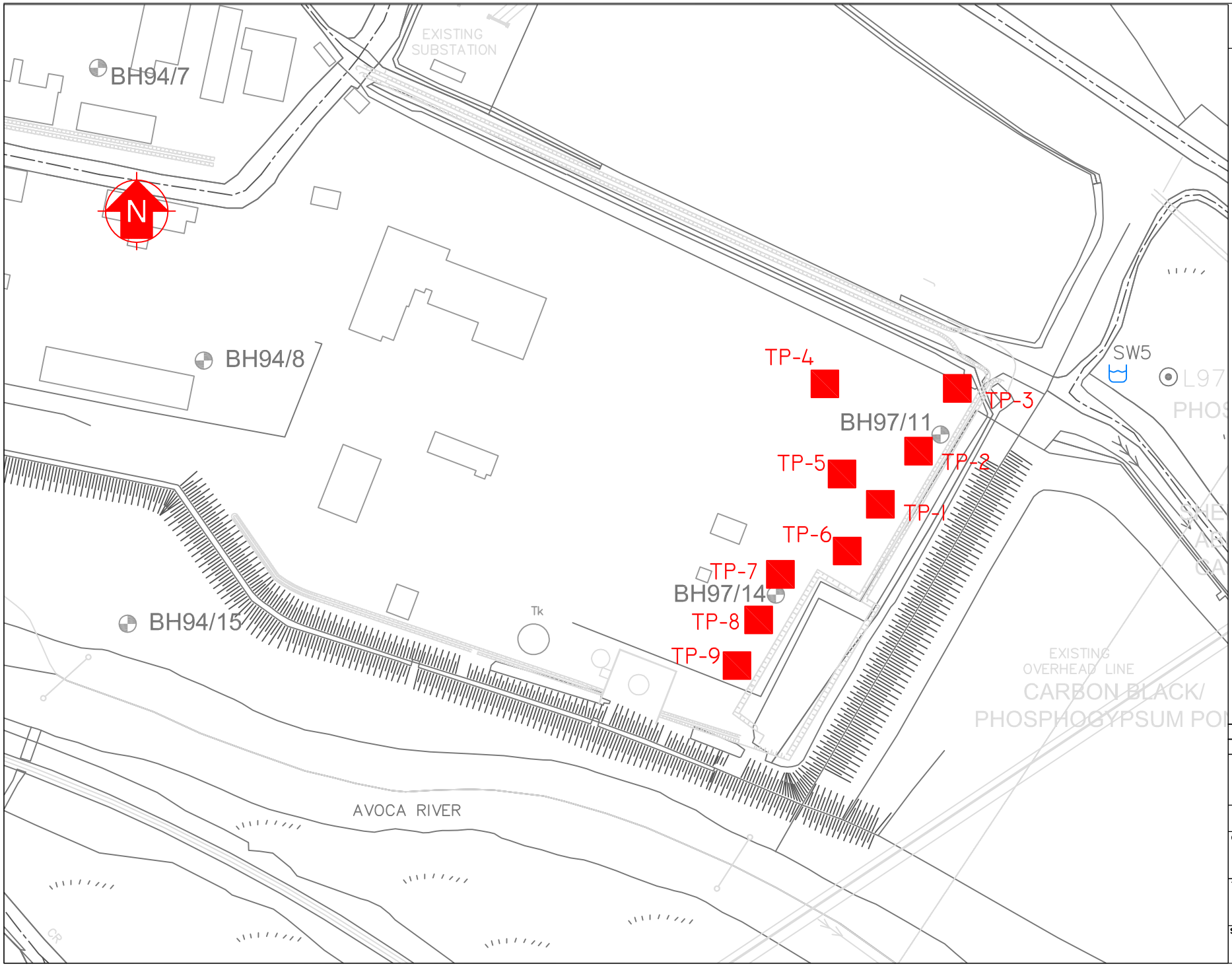
Cetaceans			Pinnipeds	Pinnipeds
Low frequency	***Mid-frequency***	***High frequency***	***in water***	***in air***
7 Hz-22 kHz	150 Hz-160 kHz	200 Hz-180 kHz	75 Hz-75 kHz	75 Hz-30 kHz
Baleen whales	Most toothed whales, dolphins	Certain toothed whales, porpoises	All species	All species
Species- Ireland	***Species- Ireland***	***Species- Ireland***	***Species- Ireland***	***Species- Ireland***
Humpback Whale	Sperm Whale	Pygmy Sperm Whale	Grey seal	Grey seal
Blue Whale	Killer Whale	Harbour Porpoise	Harbour seal	Harbour seal
Fin Whale	Long-finned Pilot Whale			
Sei Whale	Beaked whale species			
Minke Whale	Dolphin species			

Table 1. Cetacean and seal sensitivity to sound frequency.
Reproduced from Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (Dept. of Artes, Heritage and the Gaeltacht, Draft, March 2012.





Appendix F – Site Investigation Reports



NOTES

REV	DATE	DESCRIPTION	DRN	CHKD	APP
REV	DATE	DESCRIPTION	DRN	CHKD	APP

O' Callaghan Moran & Associates
Granary House, Rutland Street,
Cork, Ireland.
Tel. (021) 4321521 Fax. (021) 4321522
email : ocm@indigo.ie

CLIENT

GROUND INVESTIGATIONS IRELAND

TITLE

TRIAL PIT LOCATIONS

SCALE	DRAWING No.	REV.

TRIAL PIT RECORD

Project Name: WWTP — **Hole ID: TP1**

Client:
Consultant: Byrne Looby Partners
Location: Arklow
Date: 19/03/2015
Excavator used: Tracked Excavator

Co-ordinates: -
-
Elevation: -
Project no. 4867-02-15
Logged by: B Sexton

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TARMAC		0.05						
Gravel, sand and cobbles FILL								
Grey firm CLAY		1.00						
Brown soft sandy SILT		1.80						
End of Trial pit at 2.50 m		2						
		3						
		4						

Remarks:

Stability:
Water:
Remarks: Perched water on top of clay layer at 1.0m
Trial pit backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: -
Depth: -
2.50

GROUND INVESTIGATIONS IRELAND
www.gii.ie

TRIAL PIT RECORD

Project Name: WWTP — **Hole ID: TP2**

Client:
Consultant: Byrne Looby Partners
Location: Arklow
Date: 19/03/2015
Excavator used: Tracked Excavator

Co-ordinates: -
-
Elevation: -
Project no. 4867-02-15
Logged by: B Sexton

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TARMAC		0.05						
Gravel, sand and cobbles FILL							▽ 0.50	19/03/2015
End of Trial pit at 0.80 m		0.80						
		1						
		2						
		3						
		4						

Remarks:

Stability:
Water: Groundwater encountered at 0.5m
Remarks: Digging stopped due to presence of water as risk of breaking services under water
Trial pit backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: -
Depth: -
0.80

GROUND INVESTIGATIONS IRELAND
www.gii.ie

TRIAL PIT RECORD

Project Name: WWTP **Hole ID: TP3**

Client:
Consultant: Byrne Looby Partners
Location: Arklow
Date: 19/03/2015
Excavator used: Tracked Excavator

Co-ordinates: -
-
Elevation: -
Project no. 4867-02-15
Logged by: B Sexton

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TARMAC		0.05						
Gravel, sand and cobbles FILL							▽ 0.90	19/03/2015
		1						
Stiff grey CLAY		1.20						
End of Trial pit at 1.50 m		1.50						
		2						
		3						
		4						

Remarks:

Stability:
Water: Groundwater encountered at 0.9m
Remarks: Digging stopped due to presence of water as risk of breaking services under water
Trial pit backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: -
Depth: -
1.50

GROUND INVESTIGATIONS IRELAND
www.gii.ie

TRIAL PIT RECORD

Project Name: WWTP — **Hole ID: TP4**

Client:
Consultant: Byrne Looby Partners
Location: Arklow
Date: 19/03/2015
Excavator used: Tracked Excavator

Co-ordinates: -
-
Elevation: -
Project no. 4867-02-15
Logged by: B Sexton

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TARMAC		0.05						
Gravel, sand and cobbles FILL								
Soft grey SILT		1.00						
End of Trial pit at 1.50 m		1.50						
		2						
		3						
		4						

Remarks:

Stability:
Water: No groundwater encountered
Remarks: Trial pit backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: -
Depth: -
1.50

GROUND INVESTIGATIONS IRELAND
www.gii.ie

TRIAL PIT RECORD

Project Name: WWTP — **Hole ID: TP5**

Client:
Consultant: Byrne Looby Partners
Location: Arklow
Date: 19/03/2015
Excavator used: Tracked Excavator

Co-ordinates: -
-
Elevation: -
Project no. 4867-02-15
Logged by: B Sexton

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
GRAVEL								
		0.30						
Concrete and steel - refusal		0.40						
End of Trial pit at 0.40 m								
		1						
		2						
		3						
		4						

Remarks:

Stability:
Water: No groundwater encountered
Remarks: Trial pit backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: -
Depth: -
0.40

GROUND INVESTIGATIONS IRELAND
www.gii.ie

TRIAL PIT RECORD

Project Name: WWTP

Hole ID: TP6

Client:
Consultant: Byrne Looby Partners
Location: Arklow
Date: 19/03/2015
Excavator used: Tracked Excavator

Co-ordinates: -
-
Elevation: -
Project no. 4867-02-15
Logged by: B Sexton

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
gravel FILL								
		0.60						
sandy gravelly clay FILL								
		0.80						
grey soft firm SILT		1						
		2					▽ 2.40	19/03/2015
		2.70						
End of Trial pit at 2.70 m		3						
		4						

Remarks:

Stability:
Water: Groundwater encountered at 2.4m
Remarks: Trial pit backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: -
Depth: 0.00
2.70

GROUND INVESTIGATIONS IRELAND
www.gii.ie

TRIAL PIT RECORD

Project Name: WWTP — **Hole ID: TP7**

Client:
Consultant: Byrne Looby Partners
Location: Arklow
Date: 19/03/2015
Excavator used: Tracked Excavator

Co-ordinates: -
-
Elevation: -
Project no. 4867-02-15
Logged by: B Sexton

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
gravel								
		0.40						
Concrete and steel - refusal		0.50						
End of Trial pit at 0.50 m								
		1						
		2						
		3						
		4						

Remarks:

Stability:
Water: No goundwater encountered
Remarks: Trial pit backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: -
Depth: -
0.50

GROUND INVESTIGATIONS IRELAND
www.gii.ie

TRIAL PIT RECORD

Project Name: WWTP — **Hole ID: TP8**

Client:
Consultant: Byrne Looby Partners
Location: Arklow
Date: 19/03/2015
Excavator used: Tracked Excavator

Co-ordinates: -
-
Elevation: -
Project no. 4867-02-15
Logged by: B Sexton

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TARMAC		0.05						
sandy gravelly clay FILL								
grey soft to firm SILT		0.60						
		1						
		2						
End of Trial pit at 2.60 m		2.60						
		3						
		4						

Remarks:

Stability:
Water: No goundwater encountered
Remarks: Trial pit backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: -
Depth: -
2.60

GROUND INVESTIGATIONS IRELAND
www.gii.ie

TRIAL PIT RECORD

Project Name: WWTP — **Hole ID: TP9**

Client:
Consultant: Byrne Looby Partners
Location: Arklow
Date: 19/03/2015
Excavator used: Tracked Excavator

Co-ordinates: -
-
Elevation: -
Project no. 4867-02-15
Logged by: B Sexton

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
GRAVEL								
CONCRETE and steel - refusal		0.40						
End of Trial pit at 0.50 m		0.50						
		1						
		2						
		3						
		4						

Remarks:

Stability:
Water: No goundwater encountered
Remarks: Trial pit backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: -
Depth: -
0.50

GROUND INVESTIGATIONS IRELAND
www.gii.ie

Parameter	Unit	TP-1	TP-3	TP-6	TP-8	Inert Landfill	Non-Hazardous Landfill	Hazardous Landfill
	Depth (m)	**1.50**	**0.50**	**0.50**	**1.50**			
Antimony	**mg/kg**	0.06	<0.02	<0.02	<0.02	0.06	0.7	5
Arsenic	**mg/kg**	0.304	<0.025	<0.025	0.235	0.5	2	25
Cadmium	**mg/kg**	0.006	<0.005	<0.005	<0.005	0.04	1	5
Copper	**mg/kg**	0.24	<0.07	<0.07	<0.07	2	50	100
Chromium	**mg/kg**	0.030	<0.015	<0.015	0.029	0.5	10	70
Lead	**mg/kg**	0.05	<0.05	<0.05	0.11	0.5	10	50
Nickel	**mg/kg**	0.03	<0.02	<0.02	0.03	0.4	10	40
Molybdenum	**mg/kg**	<0.02	<0.02	0.03	<0.02	0.5	10	30
Selenium	**mg/kg**	<0.03	<0.03	<0.03	<0.03	0.1	0.5	7
Zinc	**mg/kg**	0.07	<0.03	<0.03	0.09	4	50	200
Mercury	**mg/kg**	0.0017	<0.0001	0.0003	0.0011	0.01	0.2	2
Barium	**mg/kg**	0.08	0.04	0.05	0.15	20	100	300
Chloride	**mg/kg**	26	<3	<3	7	800	15,000	25,000
Fluoride	**mg/kg**	<3	<3	<3	<3	10	150	500
Sulphate*	**mg/kg**	98.0	56.0	14.9	422.9	1000*	20,000	50,000
Dissolved Organic Carbon	**mg/kg**	320	<20	30	130	500	800	1,000
Total Dissolved Solids	**mg/kg**	670	210	210	560	4,000	60,000	100,000
Phenols	**mg/kg**	<0.1	<0.1	<0.1	<0.1	1	NE	NE
Total Organic Carbon	**%**	2.24	0.09	0.17	0.85	3**	NE	NE
Benzene	**mg/kg**	<0.005	<0.005	<0.005	<0.005	6	NE	NE
Toluene	**mg/kg**	<0.005	<0.005	<0.005	<0.005	6	NE	NE
Ethylbenzene	**mg/kg**	<0.005	<0.005	<0.005	<0.005	6	NE	NE
o-Xylene	**mg/kg**	<0.005	<0.005	<0.005	<0.005	6	NE	NE
x-Xylene	**mg/kg**	<0.005	<0.005	<0.005	<0.005	6	NE	NE
Total BTEX	**mg/kg**	<0.025	<0.025	<0.025	<0.025	6	NE	
PCB Total of 7	**mg/kg**	<0.035	<0.035	<0.035	<0.035	1	NE	NE
Naphthalene	**mg/kg**	<0.04	<0.04	<0.04	<0.04	NE	NE	NE
Acenaphthylene	**mg/kg**	<0.03	<0.03	<0.03	<0.03	NE	NE	NE
Acenaphthene	**mg/kg**	<0.05	<0.05	<0.05	<0.05	NE	NE	NE
Fluorene	**mg/kg**	<0.04	<0.04	<0.04	<0.04	NE	NE	NE
Phenanthrene	**mg/kg**	<0.03	<0.03	<0.03	<0.03	NE	NE	NE
Anthracene	**mg/kg**	<0.04	<0.04	<0.04	<0.04	NE	NE	NE
Fluoranthene	**mg/kg**	<0.03	<0.03	<0.03	<0.03	NE	NE	NE
Pyrene	**mg/kg**	<0.03	<0.03	<0.03	<0.03	NE	NE	NE
Benzo(a)anthracene	**mg/kg**	<0.06	<0.06	<0.06	<0.06	NE	NE	NE
Chrysene	**mg/kg**	<0.02	0.02	0.02	<0.02	NE	NE	NE
Benzo(b)+Benzo(k)fluoranthene	**mg/kg**	<0.07	<0.07	<0.07	<0.07	NE	NE	NE
Benzo(a)pyrene	**mg/kg**	<0.04	<0.04	<0.04	<0.04	NE	NE	NE
Indeno(123cd)pyrene	**mg/kg**	<0.04	<0.04	<0.04	<0.04	NE	NE	NE
Dibenzo(ah)anthracene	**mg/kg**	<0.04	<0.04	<0.04	<0.04	NE	NE	NE
Benzo(ghi)perylene	**mg/kg**	<0.04	<0.04	<0.04	<0.04	NE	NE	NE
Coronene	**mg/kg**	<0.04	<0.04	<0.04	<0.04	NE	NE	NE
Total 17 PAH's	**mg/kg**	<0.64	<0.64	<0.64	<0.64	NE	NE	NE
Mineral Oil	**mg/kg**	<45	<45	<45	<45	500	NE	NE

NE - Not Established

* - sulphate level exceeding inert waste limit may be considered as complying if the TDS value does not exceed 6,000mg/kg at L/S = 10l/kg.

**-a higher limit may be accepted provided the DOC values of 500mg/kg is achieved

APPROX 270m from FERRYBANK

Project No: 1337-12

Project: Arklow Sewerage Scheme, Contract 6

Client: Wicklow County Council

Engineer: Byrne Looby Partners

Log of Borehole: BH 203-01

Position: E=325300.624 N=173473.24

Elevation (mOAD): 1.931m

whiteford
explore the possibilities

Depth	Description	Elevation (mOAD)	Sample Type	SPT ("N" Blows)	Remarks	Observations
	Ground Surface	1.93				
0	TOPSOIL	1.73	B			
	Probably loose, brown, fine to coarse SAND and GRAVEL with medium cobble content. [MADE GROUND]	1.13	B			
1	Loose, grey, clayey, sandy, fine to coarse GRAVEL containing domestic waste. [MADE GROUND]		B	N6	SPT at 1.20m - 1,1,1,1,2,2	
				N6	SPT at 1.70m - 1,1,2,1,2,1	
2			B S	N4	SPT at 2.20m - 1,1,-,1,2,1	Groundwater seepage encountered at 1.90m b.g.l
				N6	SPT at 2.70m - 1,1,1,2,1,2	
3		-1.27	B			
	Medium dense, brown, fine to coarse SAND and GRAVEL. [GLACIAL]		S	N3	SPT at 3.70m - 1,1,1,2,2,3	
4			B	N12	SPT at 4.20m - 1,-,2,3,3,4	
				N13	SPT at 4.70m - 1,2,2,4,3,4	
5			B	50	SPT at 5.20m - 1,2,4,8,17,21 for 65mm	
6			B			
		-4.67				
	Medium dense, brown, fine to coarse SAND. [GLACIAL]		D	N22	SPT at 6.80m - 2,3,4,4,7,8	
7			B			
8			B	N25	SPT at 8.30m - 2,4,4,6,8,7	
9			B			
				N22	SPT at 9.80m - 2,3,4,5,6,7	
		-8.07	B			
10	End of Borehole					Groundwater seepage encountered at 10.00m b.g.l

Bore Method: Shell and Auger

Bore Date: 05-09-12

Hole Size: 150mm

Scale: Not to Scale

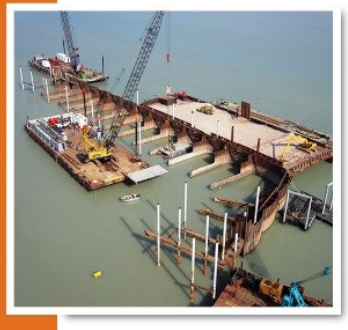
Whiteford Geoservices Ltd
Straid House
2 Main Street, Straid
Ballyclare, BT39 9NE

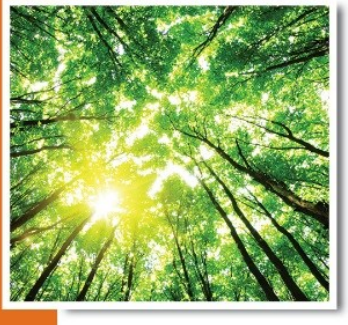
Equipment: Dando 2000

Logged by: DA

Checked by: GF

Sheet: 1 of 1





Appendix G – Bord Gais Strategic Networks Map- Arklow

Distribution Network: Gas network information is provided as a general guide. Ervia trading as Gas Networks Ireland [GNI] (formerly Bord Gáis Networks) cannot guarantee its accuracy and it should not be relied upon for accurate distance or depth of cover measurements. The exact location and depth of gas pipes must be verified on site by hand digging trial holes along the route of the pipe. Service pipes are not generally shown but their presence should always be anticipated. GNI does not accept any responsibility or liability to you in respect of any discrepancy, omission or deviation of the actual location of pipelines from the drawings provided.

NORTH.

COOLBOY

KILLINISKYDUFF

SEABANK

KILBRIDE
ED KILBRIDE

BALLYRAINE LOWER

MARSH

TIKNOCK

FERRYBANK

YARDLAND

ARKLOW

ST GEORGES CHANNEL

Aurora Telecom Fibre Optic Cable
Aurora Telecom Duct
Aurora Telecom Sub-duct
Aurora Telecom Inserted Gas Pipe

Contact Aurora Telecom on 1850-427-399 or (01)203-0120.

Transmission Pipe (High Pressure)
Transmission Pipe (Construction Issue)
Distribution Pipe (Medium Pressure)
Distribution Pipe (Low Pressure)
Service Pipe (Medium Pressure)
Service Pipe (Low Pressure)
Strategic Pipe (Medium Pressure)
Strategic Pipe (Low Pressure)
Inserted Pipe (Medium Pressure)
Inserted Pipe (Low Pressure)
Distribution Pipe (Abandoned)

.C=? Cover (depth in meters)
CP Test Point
End Cap
Hot Tap
Installation
Valve
Mains Verification **
Pressure Monitor
Protection (Sleeve)
Protection (Slabbing)
Reducer
Service Terminator
Tee
Transition

** Please contact GNI on 1850-427747 for specific information.

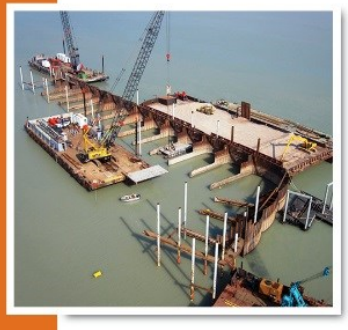
Design Department - DUBLIN

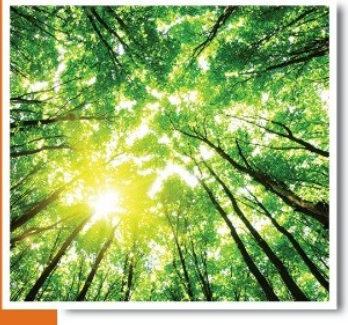
Gas Networks Ireland

GAS NETWORK INFORMATION

Issue: BYRNE LOOBY	
Location: ARKLOW	
Plot Date: 20/03/15	Contact: S.CROWLEY
Plotted by: DK	Scale: 1:5000

Damaging a gas pipe can result in serious injury or death. Failure to carry out appropriate investigations to establish the exact locations of gas pipelines is an offence. Failure to comply with the HSA 'Code of Practice for Avoiding Danger from Underground Services' may be used in evidence in the prosecution of an offence.





Appendix H – Arklow Bank Wind Farm; On-Shore Electric Cable & Sub-Station

H

ESB NETWORKS

TITLE: 2014/03/21-01#8

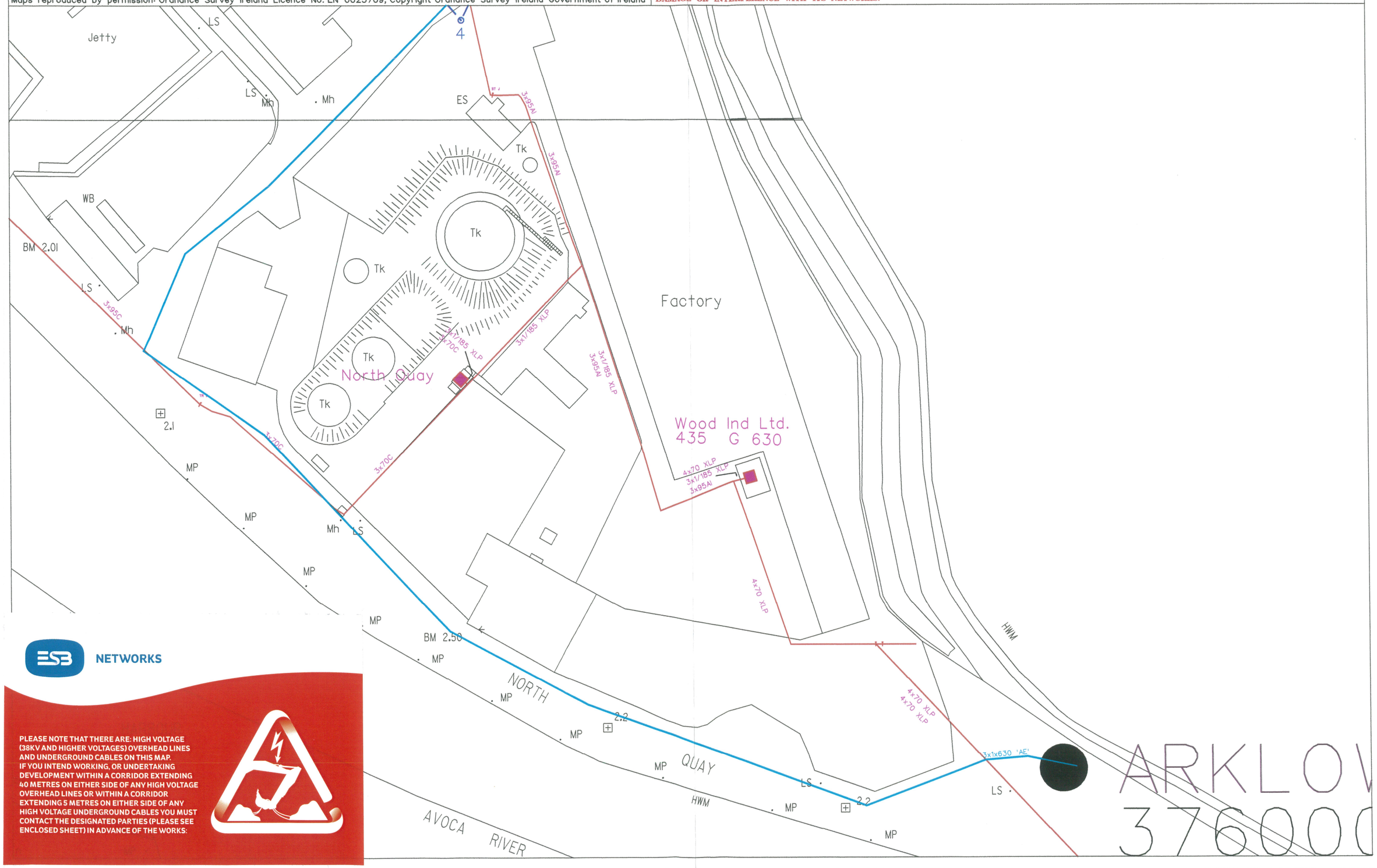
COLOUR CODE:
- BLACK - 38KV & HIGHER VOLTAGE OVERHEAD LINES
- GREEN - MV (10KV/20kV) OVERHEAD LINES
- BLUE - LV (400V/230V) OVERHEAD LINES
- CYAN - 38KV & HIGHER VOLTAGE UNDERGROUND CABLE ROUTES
- RED - MV/LV (10KV/20KV & 400V/230V) UNDERGROUND CABLE ROUTES

SCALE: 1: 1000

DATE: 21-MAR-2014

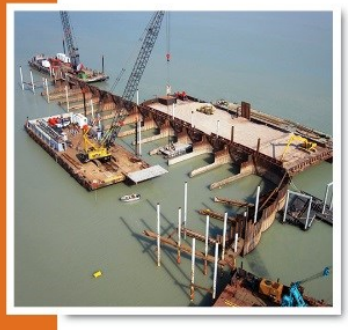
WARNING

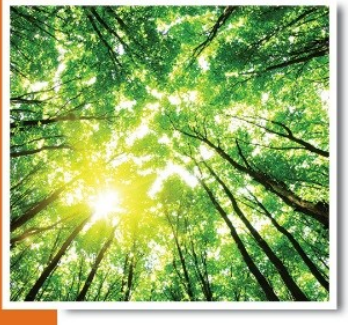
THIS MAP INDICATES THE APPROXIMATE LOCATION OF ESB NETWORKS TRANSMISSION (400KV, 220KV, 110KV, 38KV) AND DISTRIBUTION (20KV, 10KV, 230V/400V) UNDERGROUND CABLES AND OVERHEAD LINES IN THE GENERAL AREA OF THE PROPOSED WORKS. ESB NETWORKS TAKES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THIS MAP. LOW VOLTAGE (230V/400V) SERVICE CABLES (E.G. HOUSE SERVICES, FACTORY/SHOP SERVICES, PUBLIC LIGHTING LAMP SERVICES, ETC) ARE NOT INCLUDED BUT THEIR PRESENCE SHOULD BE ANTICIPATED. THE DEPTHS OF UNDERGROUND CABLES MUST NEVER BE ASSUMED. ADDITIONAL MORE DETAILED INFORMATION IS AVAILABLE FOR HIGH VOLTAGE TRANSMISSION UNDERGROUND CABLES (38KV, 110KV, 220KV, 400KV) FROM THE LOCAL ESB NETWORKS TRANSMISSION REPRESENTATIVE – SEE ATTACHED LIST FOR CONTACT DETAILS OR CALL 1850 372 757. NO WORK SHOULD BE CARRIED OUT IN THE VICINITY OF 38KV OR HIGHER VOLTAGE UNDERGROUND CABLES WITHOUT PRIOR CONSULTATION WITH ESB NETWORKS. BEFORE ANY MECHANICAL EXCAVATION IS UNDERTAKEN, THE ACTUAL LOCATION OF ALL UNDERGROUND ELECTRICITY CABLES MUST BE ESTABLISHED AND VERIFIED ON SITE USING:
(A) UP-TO-DATE MAP RECORDS; (B) CABLE LOCATOR EQUIPMENT OPERATED IN BOTH POWER AND RADIO MODES; (C) CAREFUL HAND DIGGING OF TRIAL HOLES USING 'SAFE DIGGING PRACTICE'. REFER ALSO TO "HSA CODE OF PRACTICE FOR AVOIDING DANGER FROM UNDERGROUND SERVICES". ESB TAKES NO RESPONSIBILITY AND SHALL BEAR NO LIABILITY IN RELATION TO ANY DAMAGE, INJURY /DEATH OR LOSS OF SUPPLY AS A RESULT OF DAMAGE OR INTERFERENCE WITH ITS NETWORKS.



ESB NETWORKS

PLEASE NOTE THAT THERE ARE: HIGH VOLTAGE (38KV AND HIGHER VOLTAGES) OVERHEAD LINES AND UNDERGROUND CABLES ON THIS MAP.
IF YOU INTEND WORKING, OR UNDERTAKING DEVELOPMENT WITHIN A CORRIDOR EXTENDING 40 METRES ON EITHER SIDE OF ANY HIGH VOLTAGE OVERHEAD LINES OR WITHIN A CORRIDOR EXTENDING 5 METRES ON EITHER SIDE OF ANY HIGH VOLTAGE UNDERGROUND CABLES YOU MUST CONTACT THE DESIGNATED PARTIES (PLEASE SEE ENCLOSED SHEET) IN ADVANCE OF THE WORKS:





Appendix I – Property Valuation Report

DRAFT 2

GVA Donal O Buachalla

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Ireland

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60 Founded 1954 years in business

Mr. Seán Crowley
Byrne Looby PH McCarthy
H5 Centrepoint Business Park
Oak Road
Dublin

Our Ref:TK/RD/28379

13th April 2015

By Email

Re: Proposed Wastewater Treatment Plant, Arklow

Dear Seán,

We refer to the above and to our recent correspondence and discussions.

We understand that you require a property cost ranking assessment of the proposed sites for the Arklow treatment plant together with associated wayleaves.

We understand that there are three number of sites under consideration at the following locations:

- Ferrybank
- Kilbride
- Shelton Abbey

We understand in each case that a two hectare site is required together with wayleaves of varying lengths depending on location as follows:

- Ferrybank - Nil
- Kilbride – 1897 metres
- Shelton Abbey – 1950 metres

We understand that the wayleaves required for Shelton Abbey & Kilbride will largely be within the conservation area zoned lands and once they enter the urban area of Arklow will be within the public road.

We have briefly described the sites separately hereunder.

1. **Ferrybank:**

- Town centre location
- Located to the east of Arklow town centre and Bridgewater shopping centre
- High profile waterside location
- Lands zoned waterfront zone which is to provide for mixed use development. This zone permits high value use such as hotels, offices, residential, shopping.

2. **Kilbride:**

- The lands at Kilbride are located between the public road and the Avoca River, immediately to the east of the N11 and are zoned as an Action Area 3, Kilbride.
- The Kilbride Action Area extends to approx. 70 ha. and envisages mixed development including up to 1,500 residential units, neighbourhood centre, community services etc. The development specifies that piecemeal development will not be permitted and an overall plan must be agreed for the entire area before development commences unless a proposed development delivers commensurate facilities and infrastructure.
- While the zoning is generally positive the scale of development required do get planning permission is restrictive in a market which is only beginning to see new development in Dublin and the immediate environs.
- The length of wayleaves required for the Kilbride lands is approximately 1897 linear metres.

3. **Shelton Abbey:**

- The Shelton Abbey site is located to the west of the N11 adjacent to the former chemical plant.
- The lands are zoned as employment one in the Arklow Town and Environs Development Plan which generally permits more industrial type uses such as heavy vehicle parking, industrial light, laboratories, motor sale outlets, offices, public service buildings, retail warehousing, service garages, warehouses, wholesale outlets.
- The location is somewhat removed from the town centre, however it does enjoy a profile to the existing N11.
- Given its proximity to the former chemical plant there may be issues with development, extra over development costs of a potential brownfield site.

Site Assessment:

In considering the cost assessment we have estimated the compensation based on a current CPO and Notice to Treat (April 2015) and have assessed each case based on the statutory heading of claim which include the following;

(a) Market Value of Land to be Acquired

(b) Injurious Affection / Severance

(c) Disturbance

In terms of assessing the injurious affection / severance it is difficult to properly consider as we do not have details of land ownership and the extent of land held with the property acquired does have a material impact on the level of compensation under this particular heading.

We have assumed that the acquiring authority will provide proper accommodation works to the affected parties and that the Plant will be properly screened.

If we consider the foregoing and rank the sites only (that is ignoring the wayleave element) and ranking the most expensive as number one and least expensive as number three, we would rank them as follows:

1. Ferrybank – We would consider Ferrybank to be the most high cost site to be acquired, having regard to its town centre waterfront location.

   We would anticipate that this site will be over four times more expensive to acquire than Shelton Abbey and at least twice as expensive as Kilbride.

2. Kilbride – Lands are zoned for mixed use although given the requirements of the action area plan it is unlikely that they will be developed in the short term.

   We would comment that the presence of the plant on mixed use zoned lands may give rise to larger claims for injurious affection and we expect that such a site would be at least twice as expensive as Shelton Abbey.

3. Shelton Abbey - Lands are zoned for industrial purposes however are situated to the west of the N11 removed from the town centre and are close to the river Avoca which may restrict types of development permitted. Given the heavy industrial nature of the surrounding lands there may be issues with contamination etc. which will have to be dealt with prior to any new development. However, with the industrial type uses the injurious affection in our view is limited.

Wayleave Assessment

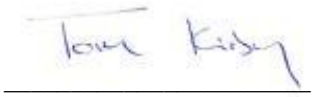
Wayleaves are required for the Shelton Abbey & Kilbride sites only and we understand that once within the built up urban area will be in the public road only.

We note that no wayleaves are required for Ferrybank.

Given that the Shelton Abbey and Kilbride wayleaves follow the same route and that Shelton Abbey is marginally longer it stands to reason that the cost of acquiring wayleaves for the Shleton Abbey site will be nominally more costly than for Kilbride.

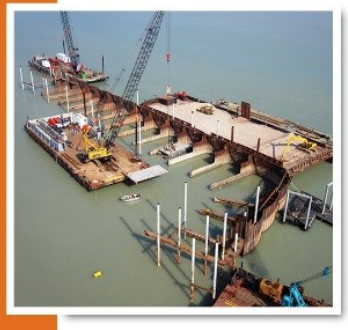
We trust the forgoing is of assistance and if you require any further clarification please do not hesitate to contact the undersigned.

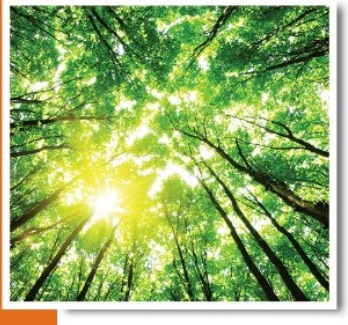
Yours sincerely,



Tom Kirby MSCSI MRICS
pp GVA Donal O Buachalla

cc
Encl. ()





Appendix J – Land Parcel Matrices

1.0	Cultural Heritage	Ferrybank	Kilbride	Shelton Abbey
1.1	Cultural Heritage - Land Parcels			
1.1.1	Potential to impact (direct/indirect) on National Monuments (designated sites)	Imperceptible	Imperceptible	Imperceptible
1.1.2	Potential to impact (direct/indirect) on RMPs (designated sites)	Imperceptible	Imperceptible	Imperceptible
1.1.3	Potential to impact (direct/indirect) on RPS/NIAH (designated sites)	Imperceptible	Imperceptible	Imperceptible
1.1.4	Potential to impact (direct/indirect) on CH sites (previously unrecorded sites)	Imperceptible	Slight - greenfield land parcel	Slight - greenfield land parcel
1.1.5	Potential to impact (direct) on water courses and environs (areas of archaeological potential)	Imperceptible	Imperceptible	Imperceptible
1.1.6	Potential to impact (direct/indirect) on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
1.1.7	Potential to impact (direct) on townland boundaries (cultural heritage significance)	Imperceptible	Imperceptible	Imperceptible
1.2	Cultural Heritage - Route Corridors	Ferrybank	Kilbride	Shelton Abbey
1.2.1	Potential to impact on RMPs	Imperceptible	Imperceptible	Imperceptible
1.2.2	Potential to impact on National Monuments	Imperceptible	Imperceptible	Imperceptible
1.2.3	Potential to impact on RPS/NIAH	Imperceptible	Imperceptible	Imperceptible
1.2.4	Potential to impact on CH sites	Imperceptible	Moderate - corridor thorugh greenfield lands	Moderate - corridor thorugh greenfield lands
1.2.5	Potential to impact on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
1.2.6	Potential to impact on ACA	Imperceptible	Imperceptible	Imperceptible
1.3	Cultural Heritage - Outfalls	Ferrybank	Kilbride	Shelton Abbey
1.3.1	Potential to impact on RMPs	Imperceptible	Imperceptible	Imperceptible
1.3.2	Potential to impact on National Monuments	Imperceptible	Imperceptible	Imperceptible
1.3.3	Potential to impact on RPS/NIAH	Imperceptible	Imperceptible	Imperceptible
1.3.4	Potential to impact on CH sites	Imperceptible	Imperceptible	Imperceptible
1.3.5	Potential to impact on Recorded shipwreck sites	Imperceptible	Imperceptible	Imperceptible
1.3.6	Potential to impact on inter-tidal archaeology (previously unknown)	Imperceptible	Imperceptible	Imperceptible
2.0	Landscape & Visual	Ferrybank	Kilbride	Shelton Abbey
2.1	Landscape & Visual - Land Parcels			
2.1.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.1.2	Potential to impact on areas of 'Highly Sensitive Landscape' (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.1.3	Potential to impact on views from heritage/tourist/amenity features	Imperceptible	Imperceptible	Imperceptible
2.1.4	Potential to impact on the character of the landscape	Imperceptible	Slight - existing 'rural' character	Imperceptible
2.1.5	Potential that landscape screening will be ineffective or contribute to landscape and visual impacts	Imperceptible	Imperceptible	Imperceptible
2.1.6	Potential to impact on views from settlements	Imperceptible	Imperceptible	Imperceptible
2.1.7	Potential to impact on views from dwellings / local roads	Moderate - Closest land parcel to Arklow town centre	Slight - Elevated land parcel visible form surrounds	Imperceptible
2.1.8	Potential to impact on views from M11 motorway	Imperceptible	Slight - visible from M11 bridge (northbound)	Slight - visible from M11 bridge (northbound)
2.1.9	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Slight - visible from railway line	Moderate - visible from railway line
2.1.10	Potential to impact on views from other major roads (national or regional roads)	Imperceptible	Imperceptible	Imperceptible
2.1.11	Potential to disrupt landscape structure (hedgerows / field pattern etc.)	Imperceptible	Slight - Site placing will determine extent of disruption	Slight - Site placing will determine extent of disruption
2.1.12	Potential to impact on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
2.1.13	Potential to impact on woodlands and significant tree groups	Imperceptible	Imperceptible	Imperceptible

2.2	Landscape & Visual - Route Corridors - Pipelines	Ferrybank	Kilbride	Shelton Abbey
2.2.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.2.2	Potential to impact on areas of 'Highly Sensitive Landscape' (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.2.3	Potential to impact on views from settlements	Imperceptible	Imperceptible	Imperceptible
2.2.4	Potential to impact on views from dwellings / local roads	Imperceptible	Imperceptible	Imperceptible
2.2.5	Potential to impact on views from motorways	Imperceptible	Imperceptible	Imperceptible
2.2.6	Potential to impact on views from other major roads (national or regional roads)	Imperceptible	Imperceptible	Imperceptible
2.2.7	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Imperceptible
2.2.8	Potential to impact on views from heritage/tourist features	Imperceptible	Imperceptible	Imperceptible
2.2.9	Potential to disrupt landscape structure (treelines / hedgerows / field pattern etc.)	Imperceptible	Slight - Changes during construction phase along route	Slight - Changes during construction phase along route
2.2.10	Potential to impact on woodlands and significant tree groups	Imperceptible	Imperceptible	Imperceptible
2.2.11	Potential to impact on rivers and streams	Imperceptible	Imperceptible	Imperceptible
2.2.12	Potential to impact on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
2.3	**Landscape & Visual - Outfalls (Landward side)**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.3.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.2	Potential to impact on 'Highly Sensitive Landscape' (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.3	Potential to impact on coastal walks (indicated in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.4	Potential to impact on bathing locations (indicated in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.5	Potential to impact on views from settlements	Imperceptible	Imperceptible	Imperceptible
2.3.6	Potential to impact on views from dwellings / local roads	Imperceptible	Imperceptible	Imperceptible
2.3.7	Potential to impact on views from major roads (national or regional roads)	Imperceptible	Imperceptible	Imperceptible
2.3.8	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Imperceptible
2.3.9	Potential to impact on views from heritage/tourist features	Imperceptible	Imperceptible	Imperceptible
2.3.10	Potential to Impact on Character of the Coastal Landscape	Imperceptible	Imperceptible	Imperceptible

3.0	Ecology 3.1 Ecology - Land Parcels	Ferrybank	Kilbride	Shelton Abbey
3.1.1	Potential to impact on Natura 2000 Sites	Imperceptible	Imperceptible	Imperceptible
3.1.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.3	Potential to impact on Habitats Directive Annex II listed species in coastal and marine waters	Imperceptible	Imperceptible	Imperceptible
3.1.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented given the size of individual field areas within the land parcel.	Imperceptible
3.1.6	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Imperceptible	Imperceptible
3.1.7	Potential to impact on IWeBS identified areas of importance	Imperceptible	Imperceptible	Imperceptible

3.2	Ecology - Route Corridors/Pipelines	Ferrybank	Kilbride	Shelton Abbey
3.2.1	Potential to impact on Natura 2000 sites	Imperceptible	Imperceptible	Imperceptible
3.2.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.2.3	Potential to impact on Habitats Directive Annex II listed species in coastal and marine waters	Imperceptible	Imperceptible	Imperceptible
3.2.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh.	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.2.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Imperceptible - Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented in the context of a revised pipeline corridor	Imperceptible
3.2.6	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Imperceptible	Imperceptible
3.2.7	Potential to impact on IWeBS identified areas of importance	Imperceptible	Imperceptible	Imperceptible

3.3	Ecology - Outfalls	Ferrybank	Kilbride	Shelton Abbey
3.3.1	Marine Outfall; Coastal Natura 2000 sites	Slight - Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests	Slight - Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests	Slight - Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests
3.3.2	Marine Outfall; Marine Natura 2000 sites	Imperceptible	Imperceptible	Imperceptible
3.3.3	Marine Outfall; Habitats Directive Annex II listed species	Imperceptible - Marine Mammal Observer (MMO) is to be employed during any geophysical survey or piling operations for the protection of individual marine mammals from noise-related injury or disturbance	Imperceptible	Imperceptible
3.3.4	Marine Outfall; Birds Directive Annex 1 listed species	Imperceptible	Imperceptible	Imperceptible
3.3.5	Potential to impact on IWeBS identified areas of importance	Imperceptible	Imperceptible	Imperceptible
3.3.6	River outfall; Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible - A river outfall option from the Kilbride land parcel will be required to be subject to appropriate treatment levels and licencing requirements in order to maintain or improve the conservation status of Habitats Directive Annex II listed fish species that occur in the Avoca river and its estuary; Salmon, Sea lamprey and River lamprey.	Imperceptible - A river outfall option from the Shelton Abbey land parcel will be required to be subject to appropriate treatment levels and licencing requirements in order to maintain or improve the conservation status of Habitats Directive Annex II listed fish species that occur in the Avoca river and its estuary; Salmon, Sea lamprey and River lamprey.
3.3.7	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage
4.0	**Hydrology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.1	**Hydrology - Land Parcels**			
4.1.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.1.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged
4.1.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the land parcel as well as up and downstream locations)	Imperceptible. No recorded instance of flooding	Imperceptible. No recorded instance of flooding	Imperceptible. No recorded instance of flooding
4.1.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Imperceptible	Imperceptible
4.2	**Hydrology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.2.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.2.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged
4.2.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the land parcel as well as up and downstream locations)	Slight - historic instances of flooding along route of pipeline corridor	Slight - historic instances of flooding along route of pipeline corridor	Slight - historic instances of flooding along route of pipeline corridor
4.2.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Slight - Arklow Marsh - pNHA	Slight - Arklow Marsh - pNHA

4.3	Hydrology - Outfalls	Ferrybank	Kilbride	Shelton Abbey
4.3.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.3.2	Potential to impact Shellfish Waters	Imperceptible. Study Area is not located within the designated shellfish waters	Imperceptible. Study Area is not located within the designated shellfish waters	Imperceptible. Study Area is not located within the designated shellfish waters
4.3.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the land parcel as well as up and downstream locations)	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.3.4	Potential Impact on ecologically important and designated sites	Imperceptible	Slight - Arklow Marsh - pNHA	Slight - Arklow Marsh - pNHA
5.0	**Hydrogeology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.1	**Hydrogeology - Land Parcels**			
5.1.1	Aquifer Classification - importance of the groundwater resource to a given area	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer
5.1.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Moderate - "High" to "Extreme" to "Rock at near Surface or Karst"	Slight - "Moderate"
5.1.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI records.	Imperceptible - 1 no. well - ID:3217SWW051 Accuracy: 2km	Imperceptible - 1 no. well - ID:3217SWW043 Accuracy: 100m	Imperceptible - No wells
5.1.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI data	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity
5.1.5	Identification of hydrogeological features from the GSI karst database	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km
5.2	**Hydrogeology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.2.1	Aquifer Classification - importance of the groundwater resource to a given area	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer
5.2.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Imperceptible - "Low"	Imperceptible - "Moderate" to "Low"
5.2.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI records.	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
5.2.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI data	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity
5.2.5	Identification of hydrogeological features from the GSI karst database	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km
5.3	**Hydrogeology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.3.1	Aquifer Classification - importance of the groundwater resource to a given area	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer
5.3.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low" rating	Imperceptible - "Moderate" rating	Imperceptible - "Moderate" rating
5.3.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI records.	Imperceptible - No groundwater supplies	Imperceptible - No groundwater supplies	Imperceptible - No groundwater supplies
5.3.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI data	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity
5.3.5	Identification of hydrogeological features from the GSI karst database	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km

6.0	Soils and Geology	Ferrybank	Kilbride	Shelton Abbey
6.1	Soils and Geology - Land Parcels			
6.1.1	Potential to impact on Geological Heritage Sites / County Geological Sites	Imperceptible - No such sites in close proximity	Imperceptible - No such sites in close proximity	Imperceptible - No such sites in close proximity
6.1.2	Potential to interact with contaminated land	Moderate - Chance of encountering heavy metals & PAH Compounds	Imperceptible - Greenfield Land Parcel	Significant - Brownfield Site. EPA Landfill & history of industrial activities.
6.1.3	Potential to sterilise mineral resource	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity
6.1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible- Bedrock estimated at 10m bgl	Significant - Outcrop in western portion of the land parcel	Slight - Moderate vulnerability indicates modrately deep bedrock
6.1.5	Potential impact on karst features	Imperceptible	Imperceptible	Imperceptible
6.1.6	Potential to encounter soft ground	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Imperceptible - No alluvial deposits mapped within land parcel	Slight - Alluvial deposits which may include soft silts mapped in eastern portion of land parcel
6.1.7	Soils Types	Made Ground	Acidic deep poorly drained mineral	Made Ground
6.1.8	Sub Soil Types	Made Ground/Alluvial Gravel Deposits	Sandstone and shale till	Made Ground
6.1.9	Depth to rock	~10m	0 - 10m	5-10m
6.2	Soils and Geology - Route Corridors	Ferrybank	Kilbride	Shelton Abbey
6.2.1	Potential to impact on Geological Heritage Sites / County Geological Sites	Imperceptible	Imperceptible	Imperceptible
6.2.2	Potential to interact with contaminated land	Slight - Chance of encountering heavy metals & PAH Compounds (associated with made ground)	Significant - Pipeline route near existing EPA landfill site	Significant - Pipeline route near existing EPA landfill site
6.2.3	Potential to sterilize mineral resource	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity
6.2.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway
6.2.5	Potential impact on karst features	Imperceptible	Imperceptible	Imperceptible
6.2.6	Potential to encounter soft ground	Slight - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh

6.3	**Soils and Geology - Outfalls**		**Kilbride**	**Shelton Abbey**
6.3.1	Potential to impact on Geological Heritage Sites / County Geological Sites	Imperceptible	Imperceptible	Imperceptible
6.3.2	Potential to interact with contaminated land	Imperceptible - Ensure avoidance of river dregde dump site offshore	Imperceptible - Negociate exact location away from gypsum/carbon ponds	Imperceptible - Negociate exact location away from gypsum/carbon ponds
6.3.3	Potential to sterilize mineral resource	Imperceptible	Imperceptible	Imperceptible
6.3.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible	Imperceptible	Imperceptible
6.3.5	Potential impact on karst features	Imperceptible	Imperceptible	Imperceptible
6.3.6	Potential to encounter soft ground	Moderate - Banks of Avoca River/ Coastal Location	Moderate - Banks of Avoca River	Moderate - Banks of Avoca River
7.0	**Agronomy & Landuse - Land Parcels**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
7.1	Approximate % Reduction in overall farm holding	Imperceptible	Slight - approx. 6.5% reduction	Imperceptible
7.2	Farming Enterprise	Imperceptible - no farming enterprise	Moderate - farming enterprise	Imperceptible - no farming enterprise
7.3	Number of landowners impacted within land parcel boundary	Slight - 1	Moderate - >1	Slight - 1
7.4	Land Quality	Imperceptible - Poor Land Quality	Slight - Good Land Quality	Imperceptible - Poor Land Quality
7.5	Severance based on site location within overall land holdings	TBC - Step 2/3	TBC - Step 2/3	TBC - Step 2/3
7.6	Potential Impacts on landholdings	Imperceptible	Reduction in farm size	Imperceptible
7.7	Crop rotation practiced	No	Yes	No
7.8	Overall Impact	Imperceptible	Moderate	Imperceptible
8.0	**Noise & Vibration**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
8.1	Potential for Construction phase noise impact at Sensitive receptors	Significant - 204 dwellings (PIR Weighted) within 300 m	Significant - 365 dwellings (PIR Weighted) within 300 m	Slight - 26 dwellings (PIR Weighted) within 300 m
8.2	Potential for Operational phase noise impact at Sensitive receptors	Slight -Facility shall reach 55db(A) Daytime and 45 db(A) night at closest receptor	Slight - Facility shall reach 55db(A) Daytime and 45 db(A) night at closest receptor	Slight - Facility shall reach 55db(A) Daytime and 45 db(A) night at closest receptor
8.3	Existing Ambient Noise Climate in the Area (significant noise sources)	Close to Arklow Town Centre	Relatively rural farmland area. Borders M11 motorway	Relatively rural farmland area. Borders M11 motorway
8.4	Construction Phase Impact rating	Imperceptible	Imperceptible	Imperceptible
8.5	Operational Phase Impact rating	Imperceptible	Imperceptible	Imperceptible

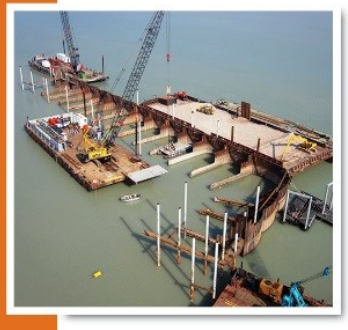
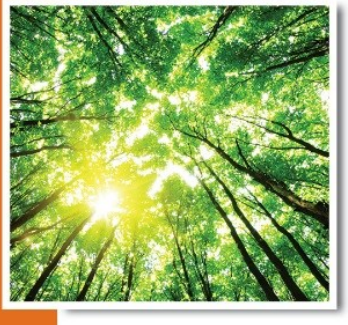
9.0	Air and Odour	Ferrybank	Kilbride	Shelton Abbey
9.1	Potential for Construction Phase Air Quality Impact at Sensitive Receptors	Significant - Approx. 714 Dwellings within 500m of Land Parcel Boundary	Significant - Approx. 415 Dwellings within 500m of Land Parcel Boundary	Slight - Approx. 66 Dwellings within 500m of Land Parcel Boundary
9.2	Potential for Operational Phase Air Quality Impact at Sensitive Receptors	Facility shall reach Appropriate Air Quality Standards at Emission Points	Facility shall reach Appropriate Air Quality Standards at Emission Points	Facility shall reach Appropriate Air Quality Standards at Emission Points
9.3	Potential for Odour Impacts at Operational phase	Significant - Approx. 714 Dwellings within 500m of Land Parcel Boundary	Significant - Approx. 415 Dwellings within 500m of Land Parcel Boundary	Slight - Approx. 66 Dwellings within 500m of Land Parcel Boundary
9.4	Potential for Odour impacts at Construction phase	Slight – Potential to cause odour during plant commissioning	Slight – Potential to cause odour during plant commissioning	Slight – Potential to cause odour during plant commissioning
9.5	Proximity to EPA Waste Licensed facility	Imperceptible - No EPA Waste Licensed Facility within 1km of the Land Parcel	Imperceptible - No EPA Waste Licensed Facility within 1km of the Land Parcel	Imperceptible - No EPA Waste Licensed Facility within 1km of the Land Parcel
9.6	Proximity to EPA IPPC Licensed Intensive Agriculture Facility	Imperceptible - No EPA Licensed Intensive Agricultural Facilities within 1km of the Land Parcel	Imperceptible - No EPA Licensed Intensive Agricultural Facilities within 1km of the Land Parcel	Imperceptible - No EPA Licensed Intensive Agricultural Facilities within 1km of the Land Parcel
9.7	EPA Air Quality Zone Classification	Zone D Rest of the Country (Rural Air Quality Classification)	Zone D Rest of the Country (Rural Air Quality Classification)	Zone D Rest of the Country (Rural Air Quality Classification)
9.8	Wind Rose Assessment	Given the Small Area, the Wind Rose Assessment is considered to be the same for all 3 Shortlisted Land Parcels	Given the Small Area, the Wind Rose Assessment is considered to be the same for all 3 Shortlisted Land Parcels	Given the Small Area, the Wind Rose Assessment is considered to be the same for all 3 Shortlisted Land Parcels
10.0	**People and Communities - Land Parcels**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
10.1	Number of residential & commercial buildings 100-200m from parcel boundary	Slight - Approx. 29	Moderate - Approx. 127	Slight - Approx. 6
10.1	Number of residential & commercial buildings within 500m from parcel boundary	Significant - Approx. 714	Significant - Approx. 415	Slight - Approx. 66
10.1	Potential to impact on known community amenities and facilities within 1km from parcel boundary.	Moderate - Arklow leisure centre, skate park/BMX, running track & playing pitches is c. 200 m to the north and the golf links c. 500 m to the south. Bridgewater shopping centre is located c. 520 m from the boundary of the parcel while the Marina Village residential development lies 200 m from the parcel boundary	Slight - The Kilbride historic graveyard borders this land parcel and the Arklow Town Marsh is c. 600 m to the south.	Slight - The Kilbride historic graveyard lies c. 600 m North East of this land parcel and the Arklow Town Marsh is c. 700 m to the East.
10.1	Potential to impact on areas of Significant Population Densities	Slight	Imperceptible	Imperceptible
11.0	**Traffic - Land Parcels**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
11.1	Length of access road required	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
11.2	Number of crossings required	0	1- R772	2 - M11 Motorway & R772
11.3	Potential Impact on landowners	Moderate - Construction Phase	Slight - Construction Stage	Slight - Construction Stage
11.4	Works required to provide safe access entrance	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
11.5	Potential impact on surrounding local road network	Imperceptible	Imperceptible	Imperceptible
11.7	Frequency of accidents near entrance	Low	Low	Low
11.8	Frequency of accidents on surrounding network (indication of general road safety issues)	Low	Low	Low
11.9	Road link impacted upon by all construction traffic (excluding major routes)	Moderate	Moderate	Moderate

12.0	12.0 Planning Policy - Land Parcels	Ferrybank	Kilbride	Shelton Abbey
12.1	Existing Land Use on land parcel	Derelict	Agricultural	Agricultural/Landfill/Commercial
12.2	Land parcel zoning	Waterfront Zone	Action Area	Employment
12.3	Local Objectives/Constraints on land parcel	Imperceptible - No Objectives/Contraints	Imperceptible - No Objectives/Contraints	Significant - Zone B – Flood Plain. Justification Test Required
12.4	Land Uses present within 100m of land parcel boundary	Imperceptible Impact: Varied - No Significant Difference	Imperceptible Impact: Varied - No Significant Difference	Imperceptible Impact: Varied - No Significant Difference
12.5	Zoning present within 100m of land parcel boundary	Commercial Uses	Agricultural Uses	Agricultural Uses
12.6	Zoning present within 1km of land parcel boundary	Active Open Space/Existing Residential	Conservation Zone / Employment (E2) / Existing Residential	Amenity/Existing Residential/Conservation Zone
12.7	Other Local Objectives present within 1km of land parcel boundary	Imperceptible - None	Slight - SEVESO II – Inside 1000m buffer. Consultation required	Slight - SEVESO II – Inside 1000m buffer. Consultation required
13.0	**Engineering Design - Pipelines**			
13.1	**Pipeline Length**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total Length as Open Cut	520 m	2870 m	2950 m
	Total Length as Tunnel	0 m	0 m	0 m
	Total Length in Marine Outfall	1000 m	0 m	0 m
	Total Length in River Outfall	0 m	25 m	25 m
	Total Pipeline Length	1520 m	2895 m	2975 m
13.2	**Power Requirements**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Power Requirement from Load Centre to WwTP Parcelv (18,000 pe)	22000	235000	235000
	Power Requirement from Load Centre to WwTP Parcel (36,000 pe)	51000	507000	507000
	Total Average Power Requirements	36500	371000	371000
13.3	**Carbon Emissions**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total embodied Carbon	120,826.38	246,332.66	253,139.78
	Total Lifetime Operational Carbon	783.98	7,905.09	7,905.09
	Total Carbon (tonnes CO_2)	121,610.36	254,237.75	261,044.87
13.4	**Health and Safety - Pipeline Construction**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Health & Safety	Moderate - Construction of long sea outfall.	Imperceptible - no significant difference	Imperceptible - no significant difference
13.5	**Access / Right of Way / Wayleaves along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Restrictions Along Pipeline Corridors to WwTP Parcels	2	2	2
13.6	**Crossings - Waterways, Rail, etc. along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Main River Crossings	0	0	0
	Stream Crossings	0	0	1
	Canal Crossings	0	1	1
	Motorway Crossings	0	0	1
	National Road Crossings	0	0	0
	Regional Road Crossings	0	1	1
	Railway Crossings	0	0	0
	Total Crossings	0	2	4
13.7	**Potential to Impact on Physical Infrastructure along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		More Impact on Local Roads	More Impact on Regional Roads	More Impact on Regional Roads
13.8	**Potential to Impact on Strategic Utility Services along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - no significant differecne	Imperceptible - no significant differecne	Imperceptible - no significant differecne

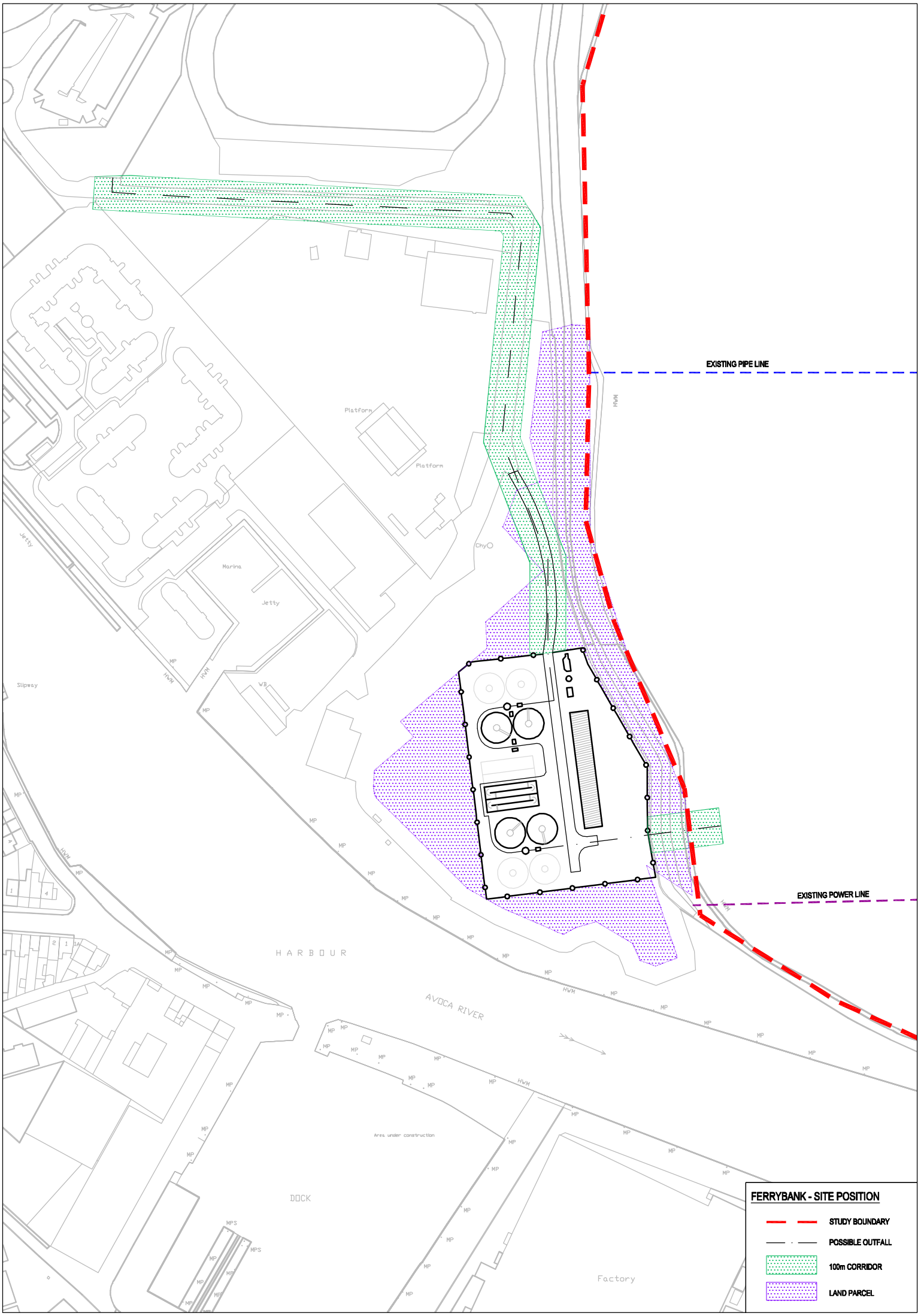
13.9	**Presence of Public Utilities within Land Parcels**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Public Utilities within the Land Parcel	38kV station & associated underground/submarine power cables in close proximity to land parcel	No major public utilities within the land parcel	220 kV overhead power cables
13.10	**Land Ownership and Titles along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Least Ownerships	Most Ownerships	Most Ownerships
13.11	**Route Traffic Management**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		No Significant Impact after Construction Stage	No Significant Impact after Construction Stage	No Significant Impact after Construction Stage
13.12	**Construction Risk along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - tunelling works not necessary	Imperceptible - tunelling works not necessary	Imperceptible - tunelling works not necessary
13.13	**Operation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
14.0	**Engineering Design - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.1	**Engineering Design/Treatment Processes Required - WwTP**			
		Moderate - Assumed need for further odour control	Significant - Assumed need for tertiary treatment	Profound - Assumed need for tertiary treatment & flood mitigation works
14.2	**Health & Safety - WwTP Construction**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
14.3	**Remediation Works -WwTP & Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Moderate - asbestos removal required	Moderate - EPA landfill remediation required (outfall pipeline)	Moderate - EPA landfill remediation required (rising main)
14.4	**Capital & Operational Costs**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Energy Costs - SBR Treatment Process	€161,000.00	€319,000.00	€319,000.00
	Annual Sludge Disposal Costs - SBR Treatment Process	€364,000.00	€284,000.00	€284,000.00
	Annual Labour & Maintenance Costs - SBR Treatment Process	€289,000.00	€289,000.00	€289,000.00
	Total Annual Operational Costs	€814,000.00	€892,000.00	€892,000.00
	Capital Costs of WwTP	€7,030,000.00	€12,332,000.00	€12,332,000.00
14.5	**Carbon Emissions - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Carbon Emissions associated with SBR Treatment Process	824,000 kg/year	1,631,000 kg/year	1,631,000 kg/year
15.0	**Land Valuation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
15.1	**Land Valuation - Land Parcels & Wayleaves**			
	Price per area - Land Parcel	Most Expensive – 4 times more than Shelton Abbey	Lower than Ferrybank, Higher than Shelton Abbey – 2 times more expensive	Least Expensive
	Price - Wayleaves Required for Pipelines	Least Expensive (Smaller pipe lengths all laid in public roads)	Higher that Ferrybank, lower than Shelton Abbey (Longer pipe lengths)	Most Expensive (Longest pipe lengths)
	Summary	Most Expensive	Higher than Shelton Abbey, Lower than Ferrybank	Least Expensive





Appendix K – WwTP Site Locations


EXISTING PIPE LINE
EXISTING POWER LINE
HWM
Platform
Platform
Marina
Jetty
Jetty
Slipway
ChyO
WB
HARBOUR
AVOCA RIVER
Area under construction
DOCK
Factory
FERRYBANK - SITE POSITION
STUDY BOUNDARY
POSSIBLE OUTFALL
100m CORRIDOR
LAND PARCEL

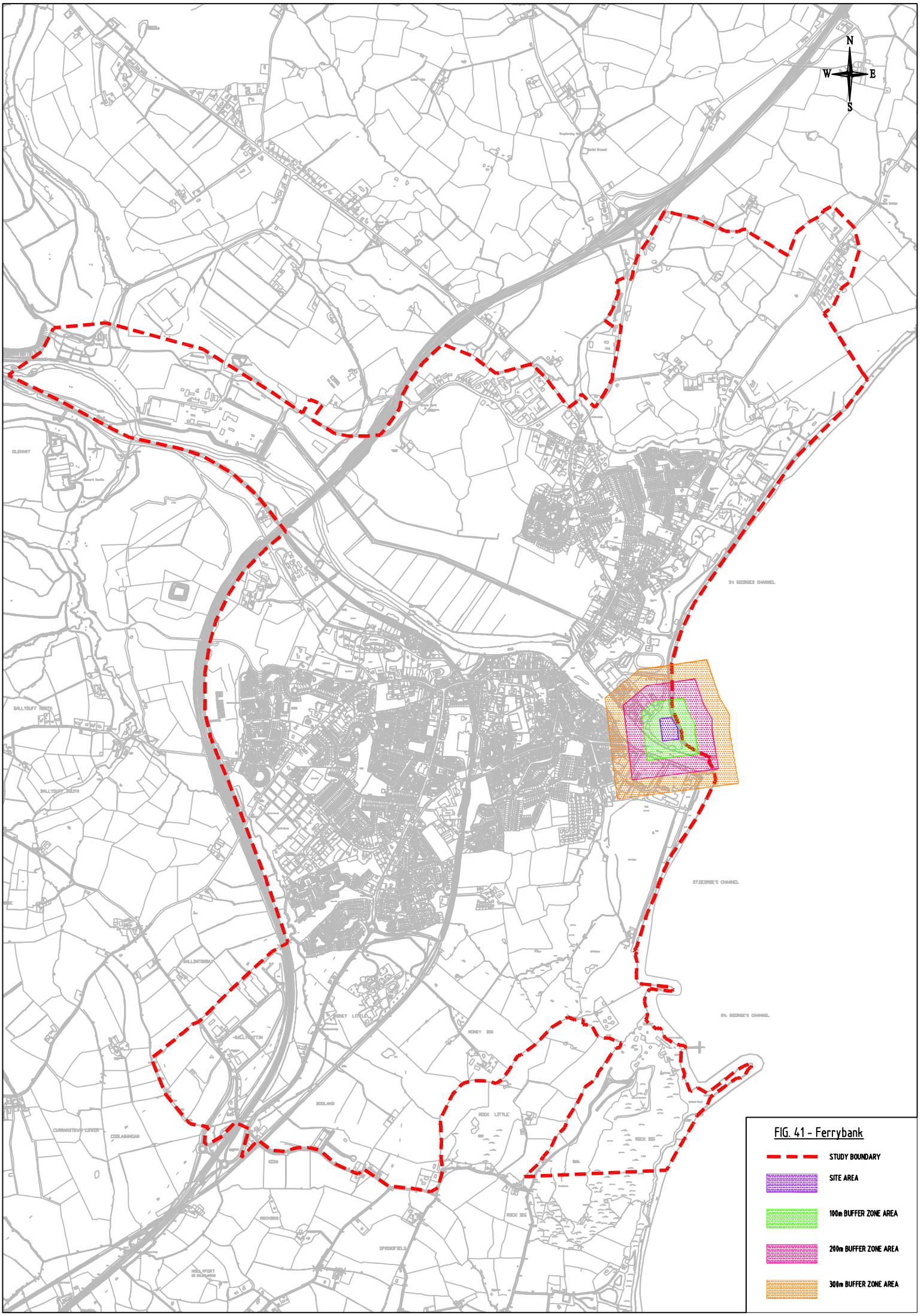

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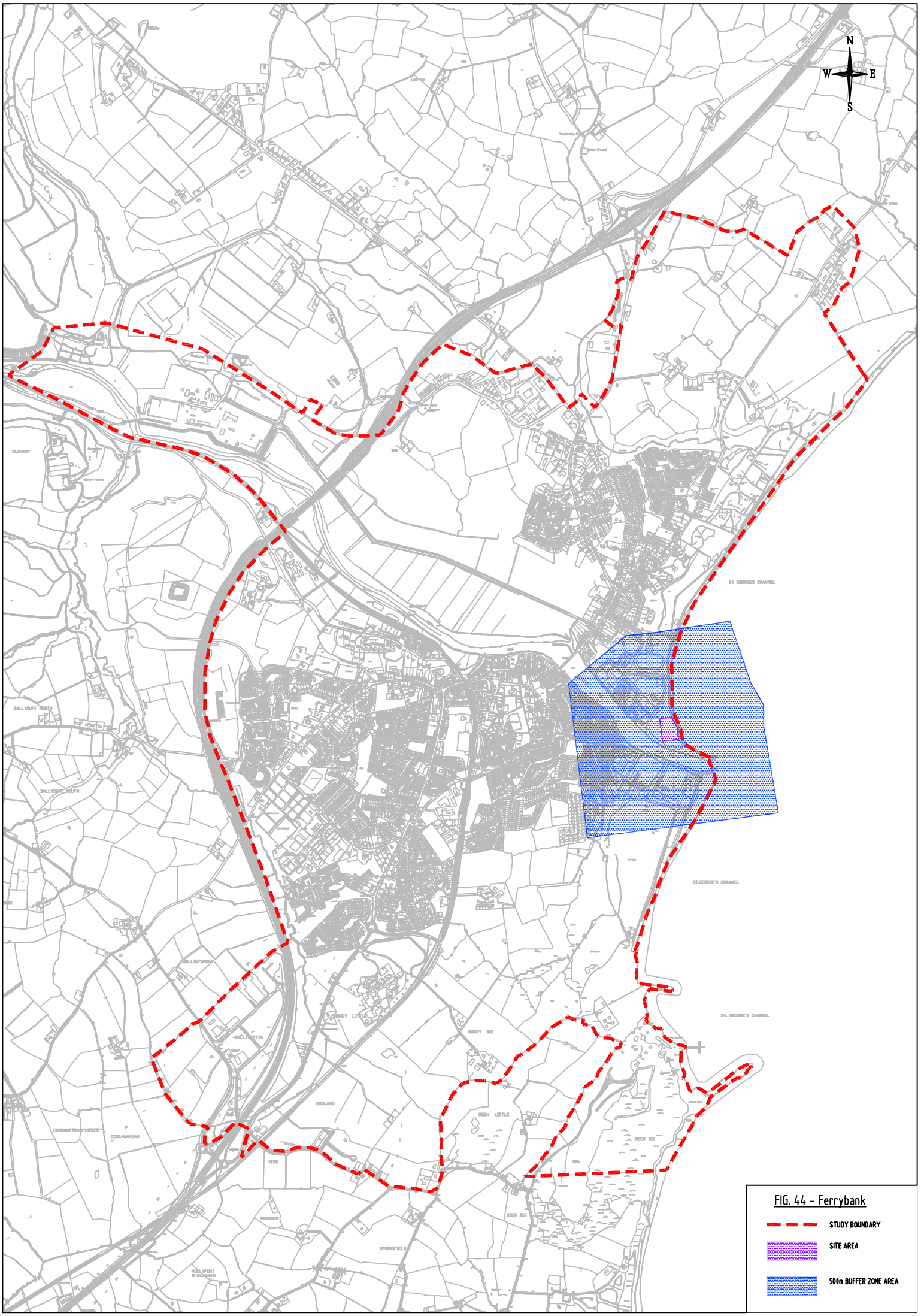
FIG. 41 - Ferrybank
STUDY BOUNDARY
SITE AREA
100m BUFFER ZONE AREA
200m BUFFER ZONE AREA
300m BUFFER ZONE AREA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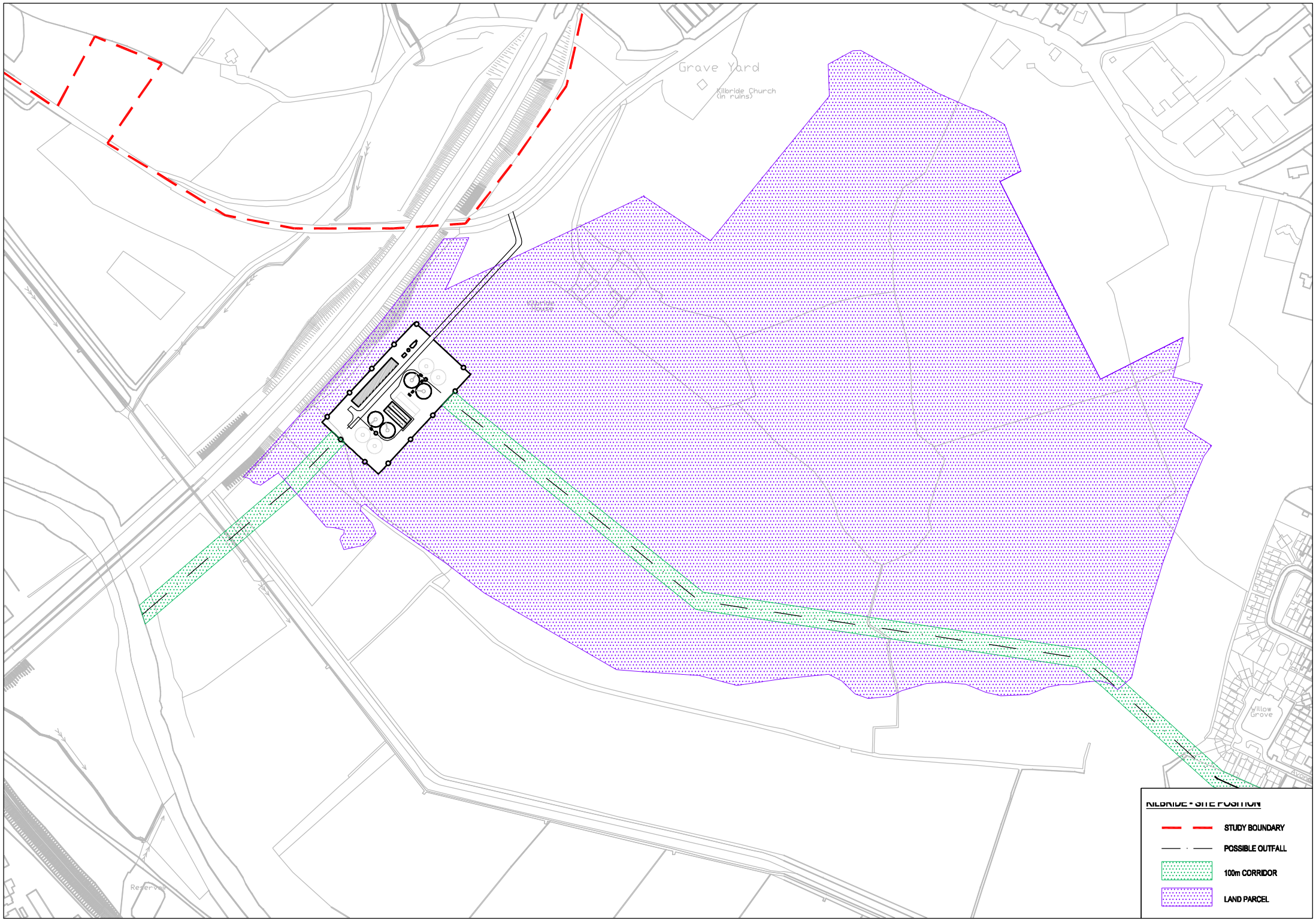
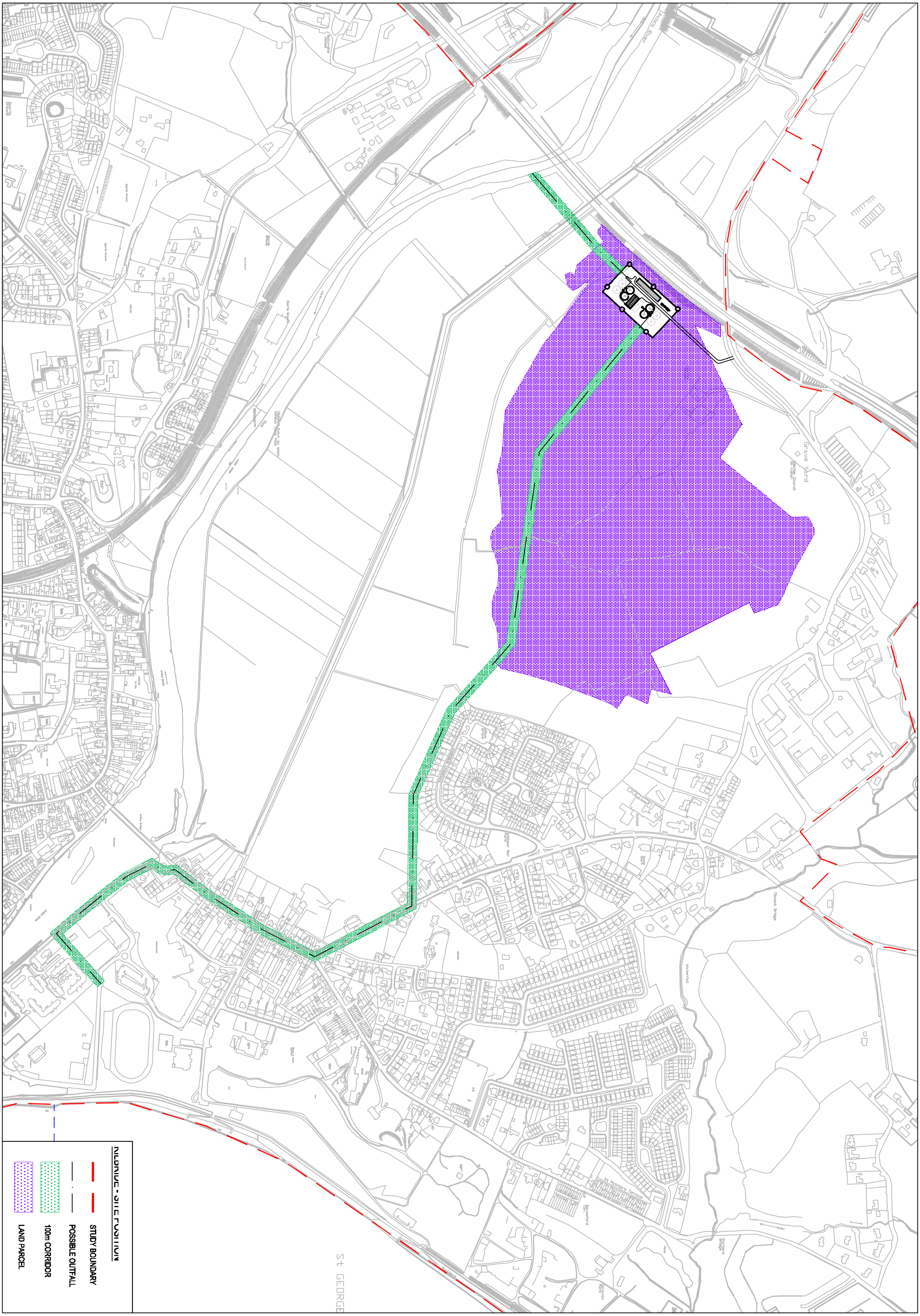
St GEORGE'S CHANNEL
ST.GEORGE'S CHANNEL
St. GEORGE'S CHANNEL
FIG. 44 - Ferrybank
STUDY BOUNDARY
SITE AREA
500m BUFFER ZONE AREA


Grave Yard
Kilbride Church
(in ruins)
Willow
Grove
Reservoir
KILBRIDE - SITE POSITION
STUDY BOUNDARY
POSSIBLE OUTFALL
100m CORRIDOR
LAND PARCEL


STUDY BOUNDARY
POSSIBLE OUTFALL
100m CORRIDOR
LAND PARCEL

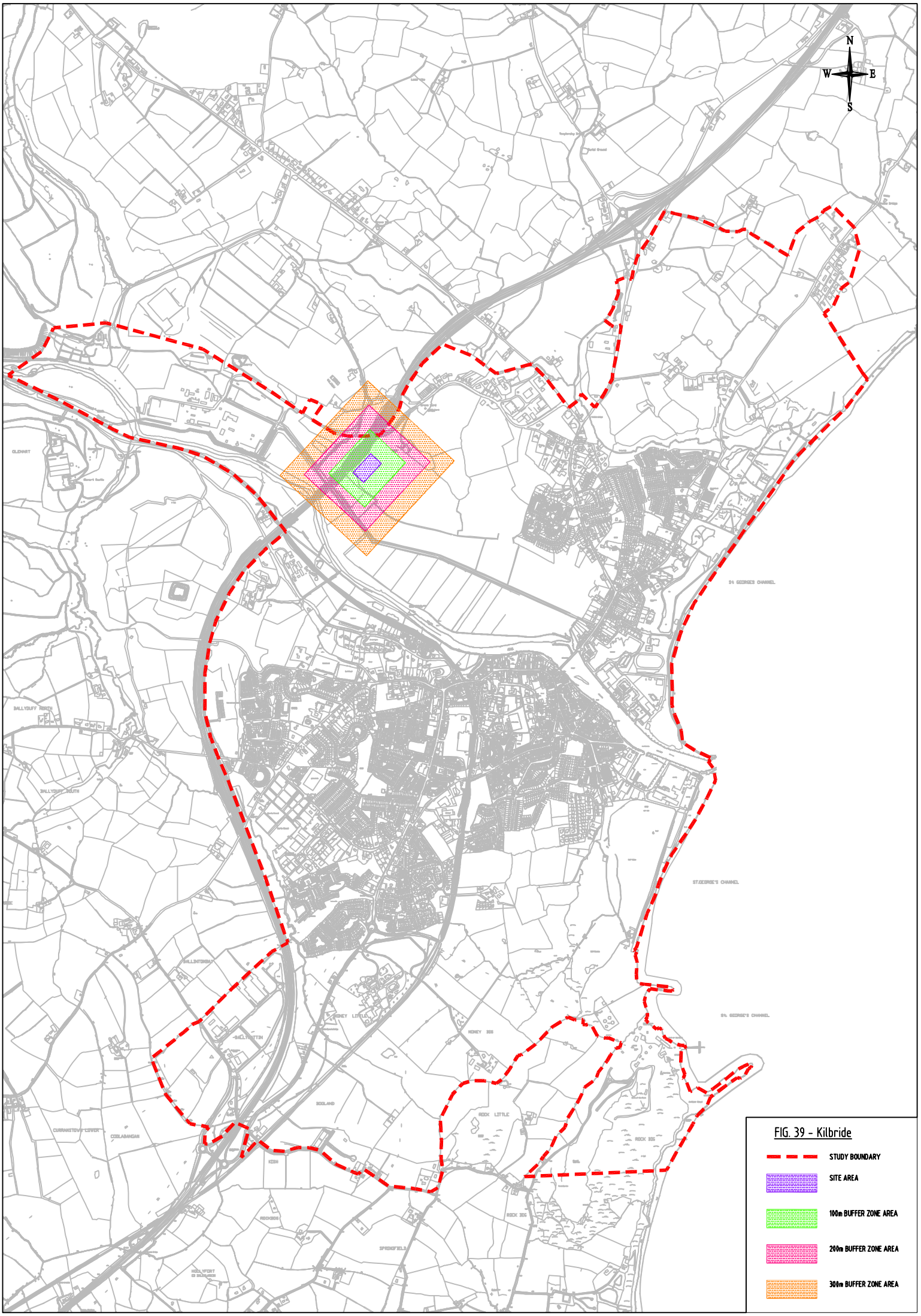

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FIG. 39 - Kilbride
STUDY BOUNDARY
SITE AREA
100m BUFFER ZONE AREA
200m BUFFER ZONE AREA
300m BUFFER ZONE AREA

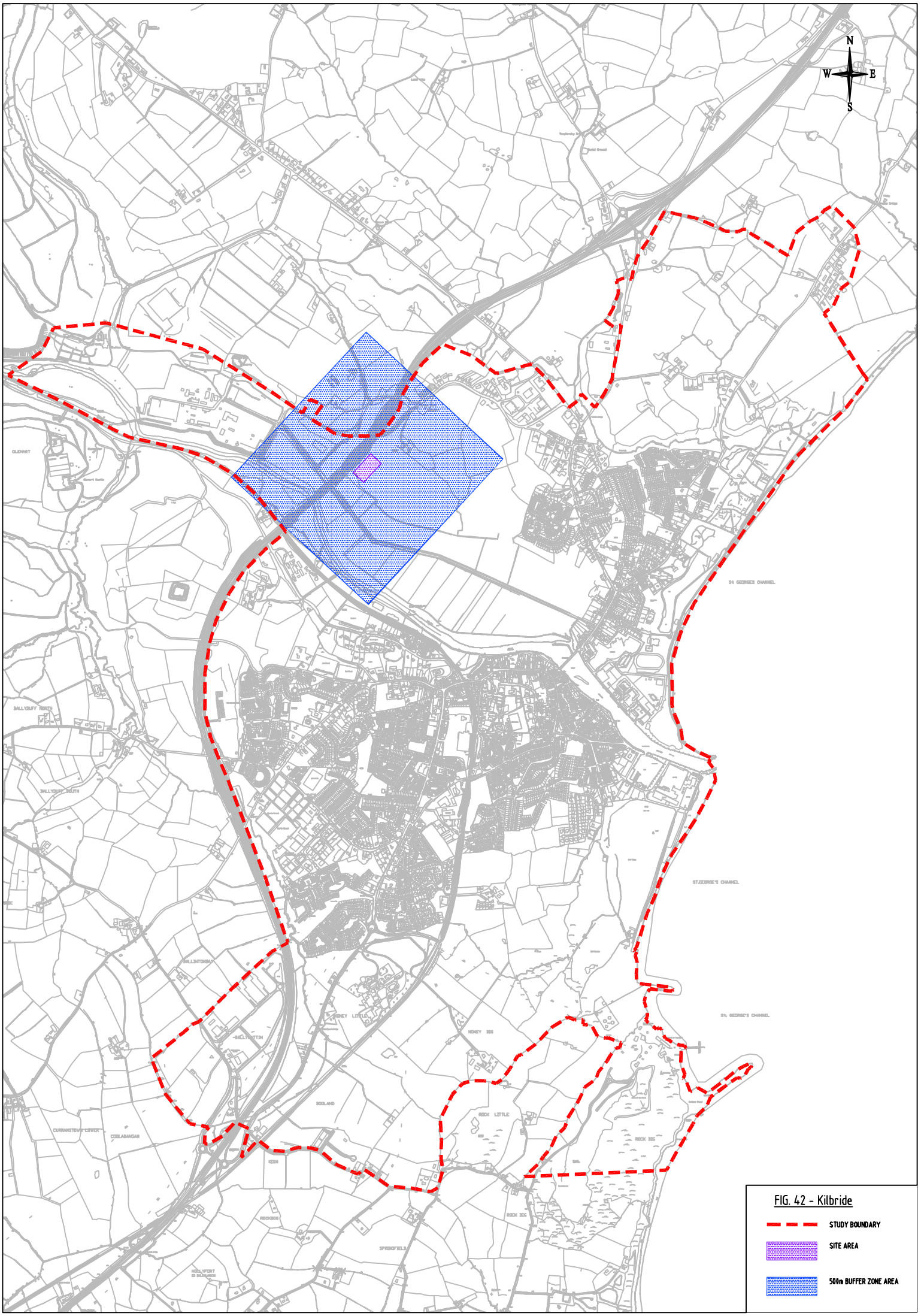
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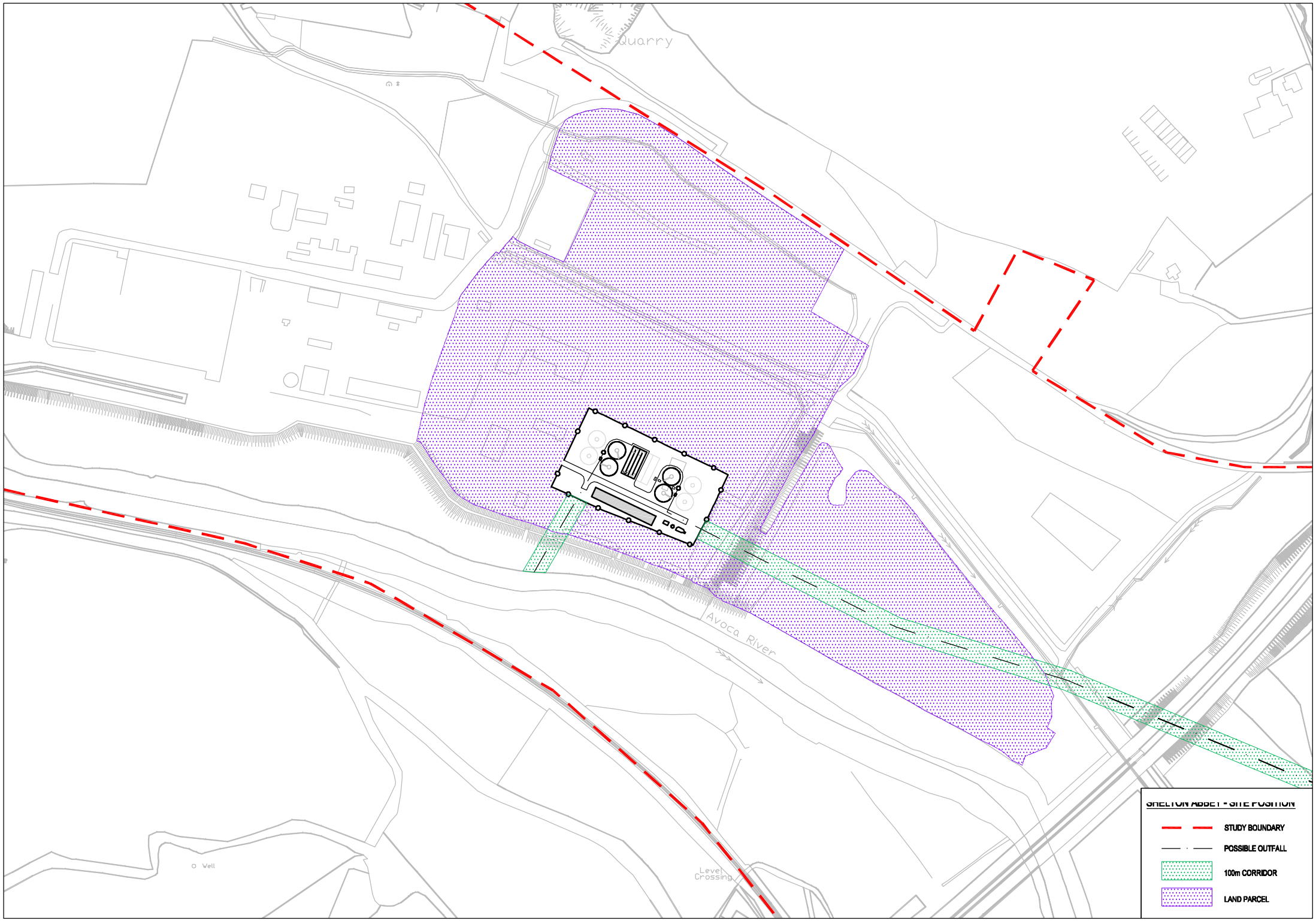
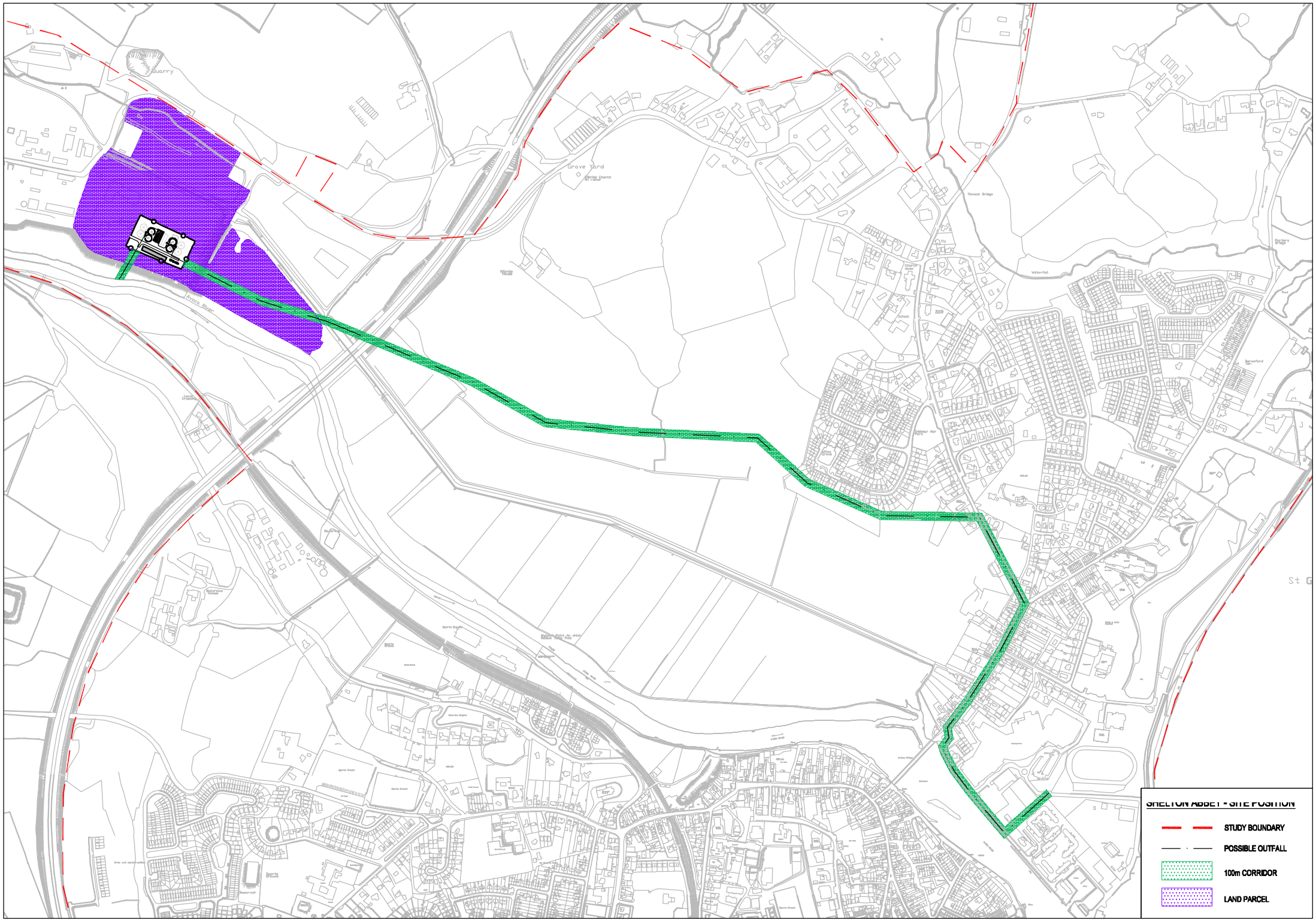
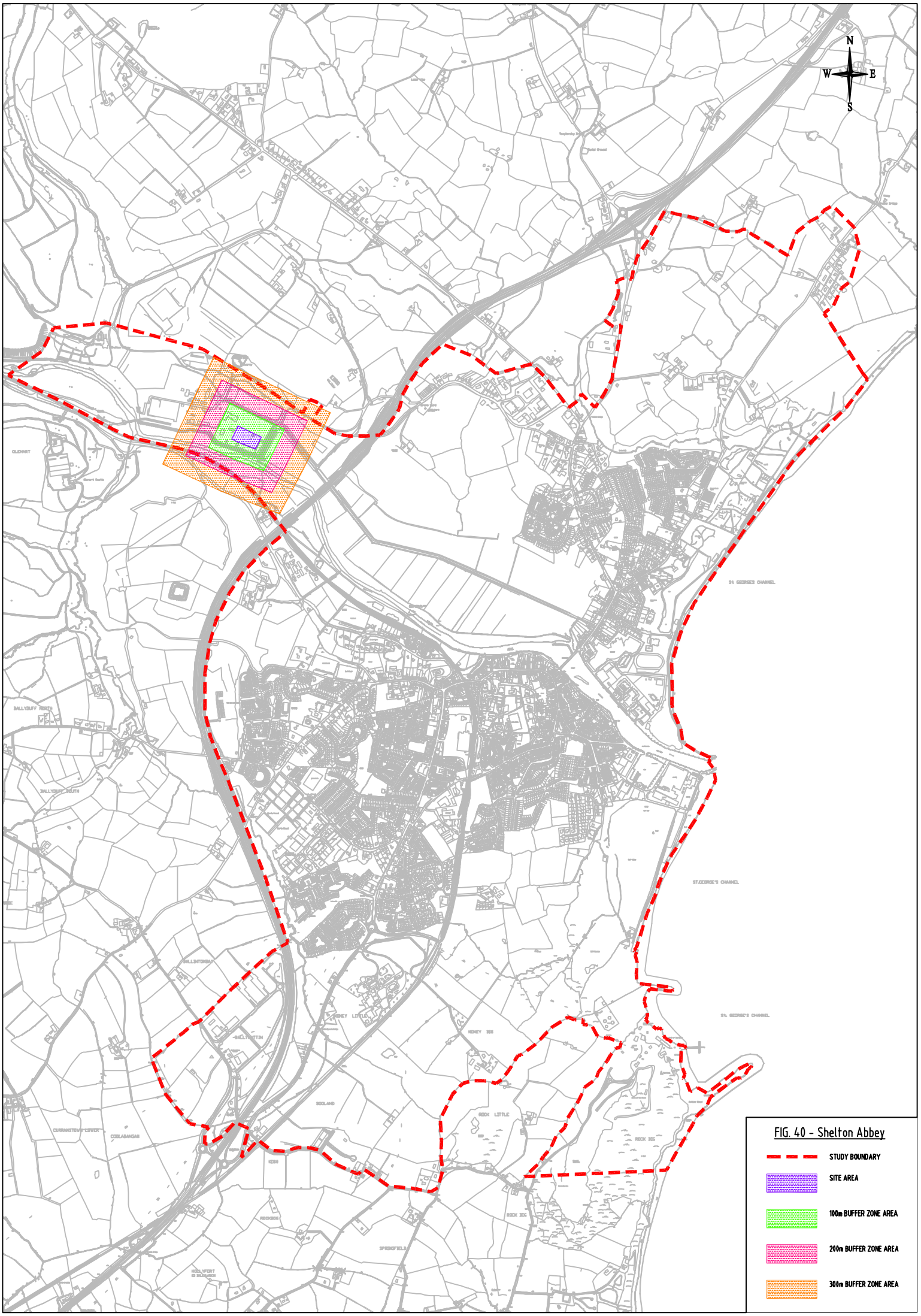
FIG. 42 - Kilbride
STUDY BOUNDARY
SITE AREA
500m BUFFER ZONE AREA


Quarry
Avoca River
Level Crossing
Well
SHELTON ABBEY - SITE POSITION
STUDY BOUNDARY
POSSIBLE OUTFALL
100m CORRIDOR
LAND PARCEL


SHELTON ABBEY - SITE POSITION
STUDY BOUNDARY
POSSIBLE OUTFALL
100m CORRIDOR
LAND PARCEL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ST.GEORGE'S CHANNEL
FIG. 40 - Shelton Abbey
STUDY BOUNDARY
SITE AREA
100m BUFFER ZONE AREA
200m BUFFER ZONE AREA
300m BUFFER ZONE AREA

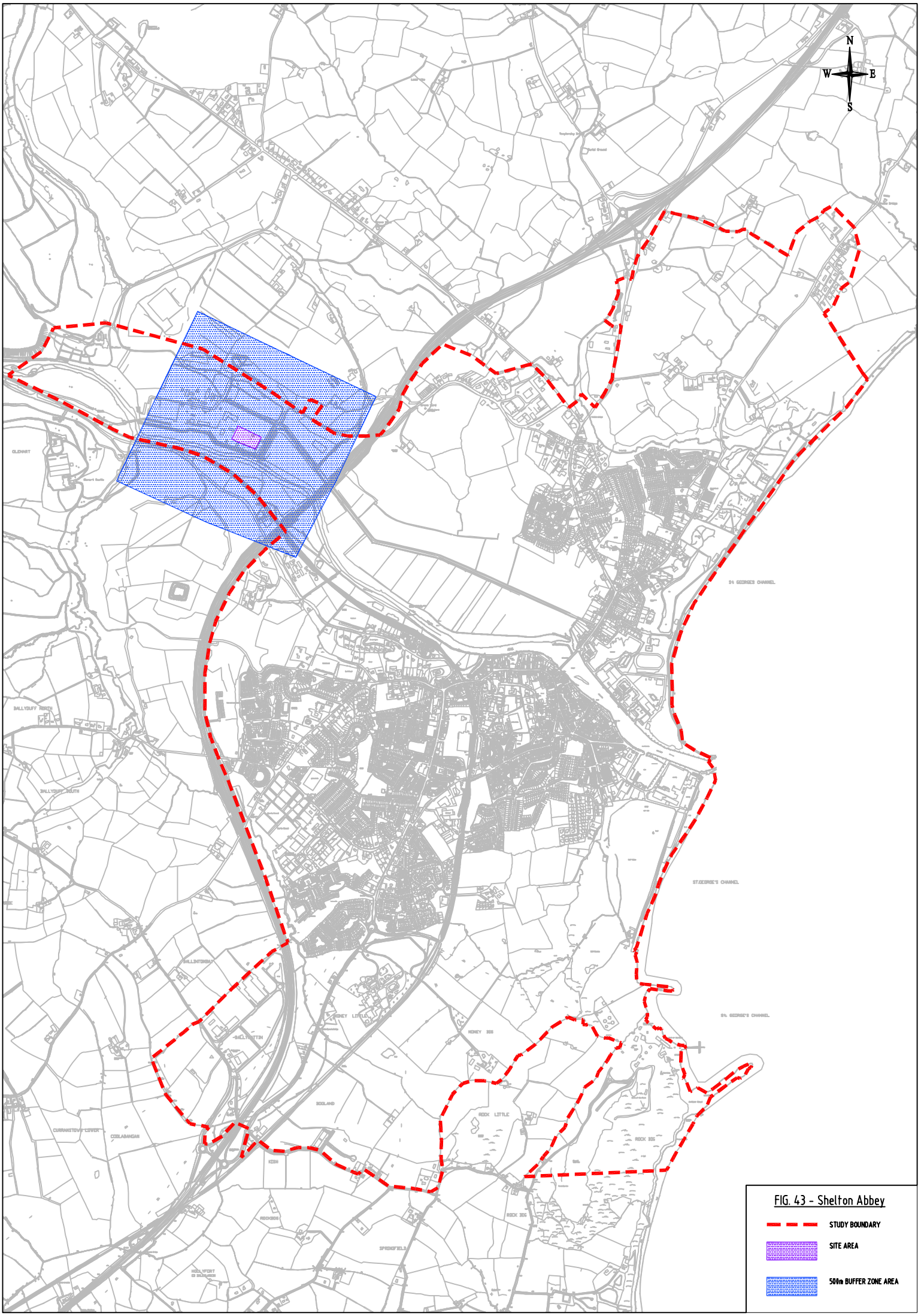
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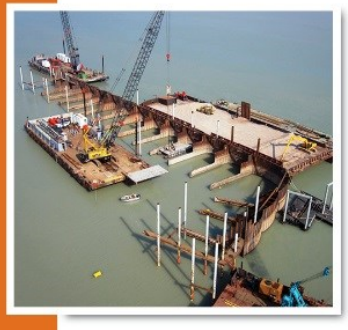
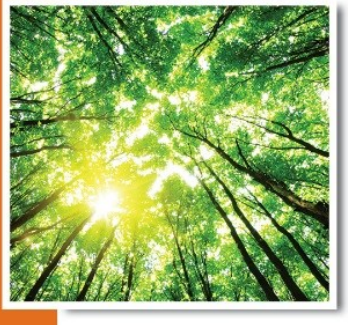
FIG. 43 - Shelton Abbey
STUDY BOUNDARY
SITE AREA
500m BUFFER ZONE AREA





Appendix L – Updated Matrices

1.0	**Cultural Heritage**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
1.1	**Cultural Heritage - Sites**			
1.1.1	Potential to impact (direct/indirect) on National Monuments (designated sites)	Imperceptible	Imperceptible	Imperceptible
1.1.2	Potential to impact (direct/indirect) on RMPs (designated sites)	Imperceptible	Imperceptible	Imperceptible
1.1.3	Potential to impact (direct/indirect) on RPS/NIAH (designated sites)	Imperceptible	Imperceptible	Imperceptible
1.1.4	Potential to impact (direct/indirect) on CH sites (previously unrecorded sites)	Imperceptible	Slight - greenfield site	Imperceptible
1.1.5	Potential to impact (direct) on water courses and environs (areas of archaeological potential)	Imperceptible	Imperceptible	Imperceptible
1.1.6	Potential to impact (direct/indirect) on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
1.1.7	Potential to impact (direct) on townland boundaries (cultural heritage significance)	Imperceptible	Imperceptible	Imperceptible
1.2	**Cultural Heritage - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
1.2.1	Potential to impact on RMPs	Imperceptible	Imperceptible	Imperceptible
1.2.2	Potential to impact on National Monuments	Imperceptible	Imperceptible	Imperceptible
1.2.3	Potential to impact on RPS/NIAH	Imperceptible	Imperceptible	Imperceptible
1.2.4	Potential to impact on CH sites	Imperceptible	Moderate - corridor thorugh greenfield lands	Moderate - corridor thorugh greenfield lands
1.2.5	Potential to impact on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
1.2.6	Potential to impact on ACA	Imperceptible	Imperceptible	Imperceptible
1.3	**Cultural Heritage - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
1.3.1	Potential to impact on RMPs	Imperceptible	Imperceptible	Imperceptible
1.3.2	Potential to impact on National Monuments	Imperceptible	Imperceptible	Imperceptible
1.3.3	Potential to impact on RPS/NIAH	Imperceptible	Imperceptible	Imperceptible
1.3.4	Potential to impact on CH sites	Imperceptible	Imperceptible	Imperceptible
1.3.5	Potential to impact on Recorded shipwreck sites	Imperceptible	Imperceptible	Imperceptible
1.3.6	Potential to impact on inter-tidal archaeology (previously unknown)	Imperceptible	Imperceptible	Imperceptible
2.0	**Landscape & Visual**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.1	**Landscape & Visual - Sites**			
2.1.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.1.2	Potential to impact on areas of 'Highly Sensitive Landscape' (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.1.3	Potential to impact on views from heritage/tourist/amenity features	Imperceptible	Imperceptible	Imperceptible
2.1.4	Potential to impact on the character of the landscape	Imperceptible	Slight - existing 'rural' character	Imperceptible
2.1.5	Potential that landscape screening will be ineffective or contribute to landscape and visual impacts	Imperceptible	Imperceptible	Imperceptible
2.1.6	Potential to impact on views from settlements	Imperceptible	Imperceptible	Imperceptible
2.1.7	Potential to impact on views from dwellings / local roads	Moderate - Closest site to Arklow town centre	Slight - Elevated site visible form surrounds	Imperceptible
2.1.8	Potential to impact on views from M11 motorway	Imperceptible	Imperceptible	Slight - visible from M11 bridge (northbound)
2.1.9	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Slight - visible from railway line
2.1.10	Potential to impact on views from other major roads (national or regional roads)	Imperceptible	Imperceptible	Imperceptible
2.1.11	Potential to disrupt landscape structure (hedgerows / field pattern etc.)	Imperceptible	Imperceptible	Imperceptible
2.1.12	Potential to impact on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
2.1.13	Potential to impact on woodlands and significant tree groups	Imperceptible	Imperceptible	Imperceptible

2.2	Landscape & Visual - Route Corridors - Pipelines	Ferrybank	Kilbride	Shelton Abbey
2.2.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.2.2	Potential to impact on areas of 'Highly Sensitive Landscape' (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.2.3	Potential to impact on views from settlements	Imperceptible	Imperceptible	Imperceptible
2.2.4	Potential to impact on views from dwellings / local roads	Imperceptible	Imperceptible	Imperceptible
2.2.5	Potential to impact on views from motorways	Imperceptible	Imperceptible	Imperceptible
2.2.6	Potential to impact on views from other major roads (national or regional roads)	Imperceptible	Imperceptible	Imperceptible
2.2.7	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Imperceptible
2.2.8	Potential to impact on views from heritage/tourist features	Imperceptible	Imperceptible	Imperceptible
2.2.9	Potential to disrupt landscape structure (treelines / hedgerows / field pattern etc.)	Imperceptible	Slight - Changes during construction phase along route	Slight - Changes during construction phase along route
2.2.10	Potential to impact on woodlands and significant tree groups	Imperceptible	Imperceptible	Imperceptible
2.2.11	Potential to impact on rivers and streams	Imperceptible	Imperceptible	Imperceptible
2.2.12	Potential to impact on historic designed landscapes	Imperceptible	Imperceptible	Imperceptible
2.3	**Landscape & Visual - Outfalls (Landward side)**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.3.1	Potential to impact on views from scenic routes (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.2	Potential to impact on 'Highly Sensitive Landscape' (designation in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.3	Potential to impact on coastal walks (indicated in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.4	Potential to impact on bathing locations (indicated in Wicklow CDP)	Imperceptible	Imperceptible	Imperceptible
2.3.5	Potential to impact on views from settlements	Imperceptible	Imperceptible	Imperceptible
2.3.6	Potential to impact on views from dwellings / local roads	Imperceptible	Imperceptible	Imperceptible
2.3.7	Potential to impact on views from major roads (national or regional roads)	Imperceptible	Imperceptible	Imperceptible
2.3.8	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Imperceptible
2.3.9	Potential to impact on views from heritage/tourist features	Imperceptible	Imperceptible	Imperceptible
2.3.10	Potential to Impact on Character of the Coastal Landscape	Imperceptible	Imperceptible	Imperceptible

3.0	Ecology 3.1 Ecology - Sites	Ferrybank	Kilbride	Shelton Abbey
3.1.1	Potential to impact on Natura 2000 Sites	Imperceptible	Imperceptible	Imperceptible
3.1.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.3	Potential to impact on Habitats Directive Annex II listed species in coastal and marine waters	Imperceptible	Imperceptible	Imperceptible
3.1.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented given the size of individual field areas within the land parcel.	Imperceptible
3.1.6	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Imperceptible	Imperceptible
3.1.7	Potential to impact on IWeBS identified areas of importance	Imperceptible	Imperceptible	Imperceptible

3.2	Ecology - Route Corridors/Pipelines	Ferrybank	Kilbride	Shelton Abbey
3.2.1	Potential to impact on Natura 2000 sites	Imperceptible	Imperceptible	Imperceptible
3.2.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.2.3	Potential to impact on Habitats Directive Annex II listed species in coastal and marine waters	Imperceptible	Imperceptible	Imperceptible
3.2.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.2.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Imperceptible - Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented in the context of a revised pipeline corridor	Imperceptible
3.2.6	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Imperceptible	Imperceptible
3.2.7	Potential to impact on IWeBS identified areas of importance	Imperceptible	Imperceptible	Imperceptible

3.3	Ecology - Outfalls	Ferrybank	Kilbride	Shelton Abbey
3.3.1	Marine Outfall; Coastal Natura 2000 sites	Slight - Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests	Slight - Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests	Slight - Potential impacts on the coastal SACs Magharabeg Dunes SAC, Buckroney – Brittas Dunes and Fen SAC, and Kilpatrick Sandhills SAC and their conservation interests
3.3.2	Marine Outfall; Marine Natura 2000 sites	Imperceptible	Imperceptible	Imperceptible
3.3.3	Marine Outfall; Habitats Directive Annex II listed species	Imperceptible - Marine Mammal Observer (MMO) is to be employed during any geophysical survey or piling operations for the protection of individual marine mammals from noise-related injury or disturbance	Imperceptible	Imperceptible
3.3.4	Marine Outfall; Birds Directive Annex 1 listed species	Imperceptible	Imperceptible	Imperceptible
3.3.5	Potential to impact on IWeBS identified areas of importance	Imperceptible	Imperceptible	Imperceptible
3.3.6	River outfall; Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible - A river outfall option from the Kilbride land parcel will be required to be subject to appropriate treatment levels and licencing requirements in order to maintain or improve the conservation status of Habitats Directive Annex II listed fish species that occur in the Avoca river and its estuary; Salmon, Sea lamprey and River lamprey.	Imperceptible - A river outfall option from the Shelton Abbey land parcel will be required to be subject to appropriate treatment levels and licencing requirements in order to maintain or improve the conservation status of Habitats Directive Annex II listed fish species that occur in the Avoca river and its estuary; Salmon, Sea lamprey and River lamprey.
3.3.7	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage
4.0	**Hydrology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.1	**Hydrology - Sites**			
4.1.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.1.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged
4.1.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)	Imperceptible. No recorded instance of flooding	Imperceptible. No recorded instance of flooding	Imperceptible. No recorded instance of flooding
4.1.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Imperceptible	Imperceptible
4.2	**Hydrology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.2.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.2.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged	Imperceptible - no culverting requirement envisaged
4.2.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)	Slight - historic instances of flooding along route of pipeline corridor	Slight - historic instances of flooding along route of pipeline corridor	Slight - historic instances of flooding along route of pipeline corridor
4.2.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Slight - Arklow Marsh - pNHA	Slight - Arklow Marsh - pNHA

4.3	Hydrology - Outfalls	Ferrybank	Kilbride	Shelton Abbey
4.3.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.3.2	Potential to impact Shellfish Waters	Imperceptible. Study Area is not located within the designated shellfish waters	Imperceptible. Study Area is not located within the designated shellfish waters	Imperceptible. Study Area is not located within the designated shellfish waters
4.3.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
4.3.4	Potential Impact on ecologically important and designated sites	Imperceptible	Imperceptible	Imperceptible
5.0	**Hydrogeology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.1	**Hydrogeology - Sites**			
5.1.1	Aquifer Classification - importance of the groundwater resource to a given area	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer
5.1.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Moderate - "High" to "Extreme" to "Rock at near Surface or Karst"	Slight - "Moderate"
5.1.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI & EPA records.	Imperceptible - 1 no. well - ID:3217SWW051 Accuracy: 2km	Imperceptible - 1 no. well - ID:3217SWW043 Accuracy: 100m	Imperceptible - No wells
5.1.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI & EPA data	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity
5.1.5	Identification of hydrogeological features from the GSI karst database	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km
5.2	**Hydrogeology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.2.1	Aquifer Classification - importance of the groundwater resource to a given area	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer
5.2.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Imperceptible - "Low"	Imperceptible - "Moderate" to "Low"
5.2.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI records.	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
5.2.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI data	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity
5.2.5	Identification of hydrogeological features from the GSI karst database	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km
5.3	**Hydrogeology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.3.1	Aquifer Classification - importance of the groundwater resource to a given area	Slight - Locally Important Bedrock Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer	Slight - Locally Important Bedrock Aquifer & Locally Important Gravel Aquifer
5.3.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low" rating	Imperceptible - "Moderate" rating	Imperceptible - "Moderate" rating
5.3.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI records.	Imperceptible - No groundwater supplies	Imperceptible - No groundwater supplies	Imperceptible - No groundwater supplies
5.3.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI data	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity	Imperceptible - No SPA's of ZOC's in close proximity
5.3.5	Identification of hydrogeological features from the GSI karst database	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km	Imperceptible - No karst feature within 2 km

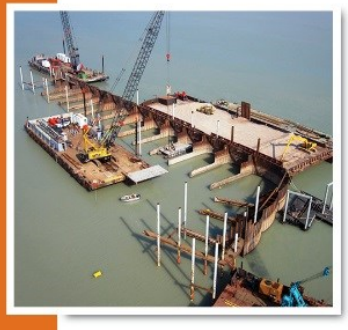
6.0	Soils and Geology 6.1 Soils and Geology - Sites	Ferrybank	Kilbride	Shelton Abbey
6.1.1	Potential to impact on Geological Heritage Sites / County Geological Sites	Imperceptible - No such sites in close proximity	Imperceptible - No such sites in close proximity	Imperceptible - No such sites in close proximity
6.1.2	Potential to interact with contaminated land	Moderate - Chance of encountering heavy metals & PAH Compounds	Imperceptible - Greenfield Site	Slight - Brownfield Site. History of industrial activities.
6.1.3	Potential to sterilise mineral resource	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity
6.1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible- Bedrock estimated at 10m bgl	Moderate - Outcrop in western portion of the site	Imperceptible- Bedrock estimated at 10m bgl
6.1.5	Potential impact on karst features	Imperceptible	Imperceptible	Imperceptible
6.1.6	Potential to encounter soft ground	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Imperceptible - No alluvial deposits mapped within Site	Imperceptible - No alluvial deposits mapped within Site
6.1.7	Soils Types	Made Ground	Acidic deep poorly drained mineral	Made Ground
6.1.8	Sub Soil Types	Made Ground/Alluvial Gravel Deposits	Sandstone and shale till	Made Ground
6.1.9	Depth to rock	~10m	0 - 10m	5-10m
6.2	**Soils and Geology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
6.2.1	Potential to impact on Geological Heritage Sites / County Geological Sites	Imperceptible	Imperceptible	Imperceptible
6.2.2	Potential to interact with contaminated land	Slight - Chance of encountering heavy metals & PAH Compounds (associated with made ground)	Significant - Pipeline route near existing EPA landfill site	Significant - Pipeline route near existing EPA landfill site
6.2.3	Potential to sterilize mineral resource	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity	Imperceptible - No known mineral sources or registered quarries in close proximity
6.2.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway
6.2.5	Potential impact on karst features	Imperceptible	Imperceptible	Imperceptible
6.2.6	Potential to encounter soft ground	Slight - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh

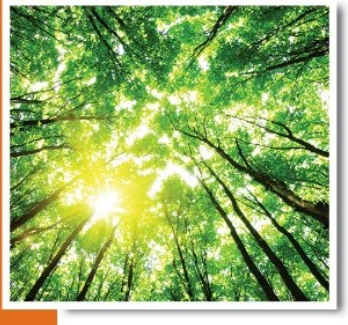
6.3	**Soils and Geology - Outfalls**		**Kilbride**	**Shelton Abbey**
6.3.1	Potential to impact on Geological Heritage Sites / County Geological Sites	Imperceptible	Imperceptible	Imperceptible
6.3.2	Potential to interact with contaminated land	Imperceptible - Ensure avoidance of river dregde dump site offshore	Imperceptible - Negociate exact location away from gypsum/carbon ponds	Imperceptible - Negociate exact location away from gypsum/carbon ponds
6.3.3	Potential to sterilize mineral resource	Imperceptible	Imperceptible	Imperceptible
6.3.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible	Imperceptible	Imperceptible
6.3.5	Potential impact on karst features	Imperceptible	Imperceptible	Imperceptible
6.3.6	Potential to encounter soft ground	Moderate - Banks of Avoca River/ Coastal Location	Moderate - Banks of Avoca River	Moderate - Banks of Avoca River
7.0	**Agronomy & Landuse - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
7.1	Approximate % Reduction in overall farm holding	Imperceptible	Slight - approx. 6.5% reduction	Imperceptible
7.2	Farming Enterprise	Imperceptible - no farming enterprise	Moderate - farming enterprise	Imperceptible - no farming enterprise
7.3	Number of landowners impacted within site boundary	Slight - 1	Slight - 1	Slight - 1
7.4	Land Quality	Imperceptible - Poor Land Quality	Slight - Good Land Quality	Imperceptible - Poor Land Quality
7.5	Severance based on site location within overall land holdings	Imperceptible	Slight	Imperceptible
7.6	Potential Impacts on landholdings	Imperceptible	Reduction in farm size	Imperceptible
7.7	Crop rotation practiced	No	Yes	No
7.8	Overall Impact	Imperceptible	Moderate	Imperceptible
8.0	**Noise & Vibration**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
8.1	Potential for Construction phase noise impact at Sensitive receptors	Moderate - 90 dwellings (PIR Weighted) within 300 m	Imperceptible - 0 dwellings (PIR Weighted) within 300 m	Slight - 6 dwellings (PIR Weighted) within 300 m
8.2	Potential for Operational phase noise impact at Sensitive receptors	Slight -Facility shall reach 55db(A) Daytime and 45 db(A) night at closest receptor	Slight - Facility shall reach 55db(A) Daytime and 45 db(A) night at closest receptor	Slight - Facility shall reach 55db(A) Daytime and 45 db(A) night at closest receptor
8.3	Existing Ambient Noise Climate in the Area (significant noise sources)	Close to Arklow Town Centre	Relatively rural farmland area. Borders M11 motorway	Relatively rural farmland area. Borders M11 motorway
8.4	Construction Phase Impact rating	Imperceptible	Imperceptible	Imperceptible
8.5	Operational Phase Impact rating	Imperceptible	Imperceptible	Imperceptible

9.0	Air and Odour	Ferrybank	Kilbride	Shelton Abbey
9.1	Potential for Construction Phase Air Quality Impact at Sensitive Receptors	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary	Slight - Approx. 10 Dwellings within 500m of Site Boundary
9.2	Potential for Operational Phase Air Quality Impact at Sensitive Receptors	Facility shall reach Appropriate Air Quality Standards at Emission Points	Facility shall reach Appropriate Air Quality Standards at Emission Points	Facility shall reach Appropriate Air Quality Standards at Emission Points
9.3	Potential for Odour Impacts at Operational phase	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary	Slight - Approx. 10 Dwellings within 500m of Site Boundary
9.4	Potential for Odour impacts at Construction phase	Slight – Potential to cause odour during plant commissioning	Slight – Potential to cause odour during plant commissioning	Slight – Potential to cause odour during plant commissioning
9.5	Proximity to EPA Waste Licensed facility	Imperceptible - No EPA Waste Licensed Facility within 1km of the Site	Imperceptible - No EPA Waste Licensed Facility within 1km of the Site	Imperceptible - No EPA Waste Licensed Facility within 1km of the Site
9.6	Proximity to EPA IPPC Licensed Intensive Agriculture Facility	Imperceptible - No EPA Licensed Intensive Agricultural Facilities within 1km of the Site	Imperceptible - No EPA Licensed Intensive Agricultural Facilities within 1km of the Site	Imperceptible - No EPA Licensed Intensive Agricultural Facilities within 1km of the Site
9.7	EPA Air Quality Zone Classification	Zone D Rest of the Country (Rural Air Quality Classification)	Zone D Rest of the Country (Rural Air Quality Classification)	Zone D Rest of the Country (Rural Air Quality Classification)
9.8	Wind Rose Assessment	Given the Small Area, the Wind Rose Assessment is considered to be the same for all 3 Shortlisted Sites	Given the Small Area, the Wind Rose Assessment is considered to be the same for all 3 Shortlisted Sites	Given the Small Area, the Wind Rose Assessment is considered to be the same for all 3 Shortlisted Sites
10.0	**People and Communities - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
10.1	Number of residential & commercial buildings 100-200m from site boundary	Slight - Approx. 13	Imperceptible - 0	Slight - 1
10.1	Number of residential & commercial buildings within 500m from site boundary	Moderate - Approx. 339	Slight - Approx. 5	Slight - Approx. 10
10.1	Potential to impact on known community amenities and facilities within 1km from site boundary.	Moderate - Arklow leisure centre, skate park/BMX, running track & playing pitches is c. 200 m to the north and the golf links c. 500 m to the south. Bridgewater shopping centre is located c. 520 m from the boundary of the site while the Marina Village residential development lies 200 m from the site boundary	Slight - The Kilbride historic graveyard is within 500m of this site and the Arklow Town Marsh is c. 600 m to the south.	Slight - The Kilbride historic graveyard lies c. 750 m North East of this site and the Arklow Town Marsh is c. 750 m to the East.
10.1	Potential to impact on areas of Significant Population Densities	Slight	Imperceptible	Imperceptible
11.0	**Traffic - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
11.1	Length of access road required	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
11.2	Number of crossings required	0	1- R772	2 - M11 Motorway & R772
11.3	Potential Impact on landowners	Moderate - Construction Phase	Slight - Construction Stage	Slight - Construction Stage
11.4	Works required to provide safe access entrance	Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
11.5	Potential impact on surrounding local road network	Imperceptible	Imperceptible	Imperceptible
11.7	Frequency of accidents near entrance	Low	Low	Low
11.8	Frequency of accidents on surrounding network (indication of general road safety issues)	Low	Low	Low
11.9	Road link impacted upon by all construction traffic (excluding major routes)	Moderate	Moderate	Moderate

12.0	12.0 Planning Policy - Sites	Ferrybank	Kilbride	Shelton Abbey
12.1	Existing Land Use on site	Derelict	Agricultural	Commercial/Landfill
12.2	Site zoning	Waterfront Zone	Action Area	Employment
12.3	Local Objectives/Constraints on site	Imperceptible - No Objectives/Contraints	Imperceptible - No Objectives/Contraints	Significant - Zone B – Flood Plain. Justification Test Required
12.4	Land Uses present within 100m of site boundary	Imperceptible Impact: Varied - No Significant Difference	Imperceptible Impact: Varied - No Significant Difference	Imperceptible Impact: Varied - No Significant Difference
12.5	Zoning present within 100m of site boundary	Commercial Uses	Agricultural Uses	Agricultural Uses
12.6	Zoning present within 1km of site boundary	Active Open Space/Existing Residential	Conservation Zone / Employment (E2) / Existing Residential	Amenity/Existing Residential/Conservation Zone
12.7	Other Local Objectives present within 1km of site boundary	Imperceptible - None	Slight - SEVESO II – Inside 1000m buffer. Consultation required	Slight - SEVESO II – Inside 1000m buffer. Consultation required
13.0	**Engineering Design - Pipelines**			
13.1	**Pipeline Length**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total Length as Open Cut	510 m	2530 m	3250 m
	Total Length as Tunnel	0 m	0 m	0 m
	Total Length in Marine Outfall	900 m	0 m	0 m
	Total Length in River Outfall	0 m	340 m	125 m
	Total Pipeline Length	1410 m	2870 m	3375 m
13.2	**Power Requirements**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Power Requirement from Load Centre to WwTP Site (18,000 pe)	22154	188262	190292
	Power Requirement from Load Centre to WwTP Site (36,000 pe)	51156	409271	423455
	Total Average Power Requirements	36655	298766.5	306873.5
13.3	**Carbon Emissions**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total embodied Carbon	119,975.49	244,205.43	287,175.38
	Total Lifetime Operational Carbon	780.24	6367.01	6367.01
	Total Carbon (tonnes CO_2)	120755.73	250572.44	293542.39
13.4	**Health and Safety**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Health & Safety	Moderate - Construction of long sea outfall.	Imperceptible - no significant difference	Imperceptible - no significant difference
13.5	**Access / Right of Way / Wayleaves along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Restrictions Along Pipeline Corridors to WwTP Sites	2	2	2
13.6	**Crossings - Waterways, Rail, etc. along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Main River Crossings	0	0	0
	Stream Crossings	0	0	1
	Canal Crossings	0	1	1
	Motorway Crossings	0	0	1
	National Road Crossings	0	0	0
	Regional Road Crossings	0	1	1
	Railway Crossings	0	0	0
	Total Crossings	0	2	4
13.7	**Potential to Impact on Physical Infrastructure along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		More Impact on Local Roads	More Impact on Regional Roads	More Impact on Regional Roads
13.8	**Potential to Impact on Strategic Utility Services along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - no significant differecne	Imperceptible - no significant differecne	Imperceptible - no significant differecne

13.9	**Presence of Public Utilities within Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Public Utilities within the Site	38kV station & associated underground/submarine power cables in close proximity to site	No major public utilities within the site	No major public utilities within the site
13.10	**Land Ownership and Titles along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Least Ownerships	Most Ownerships	Most Ownerships
13.11	**Route Traffic Management**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		No Significant Impact after Construction Stage	No Significant Impact after Construction Stage	No Significant Impact after Construction Stage
13.12	**Construction Risk along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - tunelling works not necessary	Imperceptible - tunelling works not necessary	Imperceptible - tunelling works not necessary
13.13	**Operation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
14.0	**Engineering Design - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.1	**Engineering Design/Treatment Processes Required - WwTP**			
		Moderate - Assumed need for further odour control	Significant - Assumed need for tertiary treatment	Profound - Assumed need for tertiary treatment & flood mitigation works
14.2	**Health & Safety - WwTP Construction**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Imperceptible - no significant difference	Imperceptible - no significant difference	Imperceptible - no significant difference
14.3	**Remediation Works -WwTP & Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Moderate - asbestos removal required	Moderate - EPA landfill remediation required (outfall pipeline)	Moderate - EPA landfill remediation required (rising main)
14.4	**Capital & Operational Costs**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Energy Costs - SBR Treatment Process	€161,000.00	€319,000.00	€319,000.00
	Annual Sludge Disposal Costs - SBR Treatment Process	€364,000.00	€284,000.00	€284,000.00
	Annual Labour & Maintenance Costs - SBR Treatment Process	€289,000.00	€289,000.00	€289,000.00
	Total Annual Operational Costs	€814,000.00	€892,000.00	€892,000.00
	Capital Costs of WwTP	€7,030,000.00	€12,332,000.00	€12,332,000.00
14.5	**Carbon Emissions - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Carbon Emissions associated with SBR Treatment Process	824,000 kg/year	1,631,000 kg/year	1,631,000 kg/year
15.0	**Land Valuation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
15.1	**Land Valuation - Sites & Wayleaves**			
	Price per area - Site	Most Expensive – 4 times more than Shelton Abbey	Lower than Ferrybank, Higher than Shelton Abbey – 2 times more expensive	Least Expensive
	Price - Wayleaves Required for Pipelines	Least Expensive (Smaller pipe lengths all laid in public roads)	Higher that Ferrybank, lower than Shelton Abbey (Longer pipe lengths)	Most Expensive (Longest pipe lengths)
	Summary	Most Expensive	Higher than Shelton Abbey, Lower than Ferrybank	Least Expensive





Appendix M – Combined Matrix

1.0	**Cultural Heritage**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
1.1	**Cultural Heritage - Sites**			
1.1.4	Potential to impact (direct/indirect) on CH sites (previously unrecorded sites)	Imperceptible	Slight - greenfield site	Imperceptible
1.2	**Cultural Heritage - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
1.2.4	Potential to impact on CH sites	Imperceptible	Moderate - corridor thorugh greenfield lands	Moderate - corridor thorugh greenfield lands
1.3	**Cultural Heritage - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.0	**Landscape & Visual**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.1	**Landscape & Visual - Sites**			
2.1.4	Potential to impact on the character of the landscape	Imperceptible	Slight - existing 'rural' character	Imperceptible
2.1.7	Potential to impact on views from dwellings / local roads	Moderate - Closest site to Arklow town centre	Slight - Elevated site visible form surrounds	Imperceptible
2.1.8	Potential to impact on views from M11 motorway	Imperceptible	Imperceptible	Slight - visible from M11 bridge (northbound)
2.1.9	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Slight - visible from railway line
2.2	**Landscape & Visual - Route Corridors - Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.2.9	Potential to disrupt landscape structure (treelines / hedgerows / field pattern etc.)	Imperceptible	Slight - Changes during construction phase along route	Slight - Changes during construction phase along route
2.3	**Landscape & Visual - Outfalls (Landward side)**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.0	**Ecology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.1	**Ecology - Sites**			
3.1.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented given the size of individual field areas within the land parcel.	Imperceptible

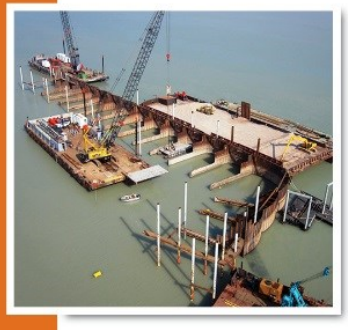
3.2	**Ecology - Route Corridors/Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.2.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.2.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.3	**Ecology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.3.7	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage
4.0	**Hydrology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.1	**Hydrology - Sites**			
4.2	**Hydrology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.2.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Slight - Arklow Marsh - pNHA	Slight - Arklow Marsh - pNHA
4.3	**Hydrology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.0	**Hydrogeology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.1	**Hydrogeology - Sites**			
5.1.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Moderate - "High" to "Extreme" to "Rock at near Surface or Karst"	Slight - "Moderate"
5.2	**Hydrogeology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.3	**Hydrogeology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**

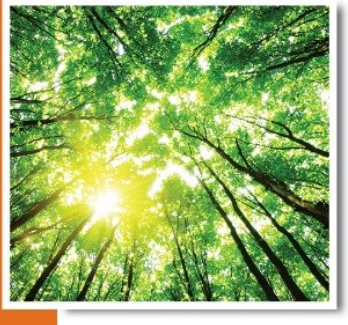
6.0	**Soils and Geology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
6.1	**Soils and Geology - Sites**			
6.1.2	Potential to interact with contaminated land	Moderate - Chance of encountering heavy metals & PAH Compounds	Imperceptible - Greenfield Site	Slight - Brownfield Site. History of industrial activities.
6.1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible- Bedrock estimated at 10m bgl	Moderate - Outcrop in western portion of the site	Imperceptible- Bedrock estimated at 10m bgl
6.1.6	Potential to encounter soft ground	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Imperceptible - No alluvial deposits mapped within Site	Imperceptible - No alluvial deposits mapped within Site
6.1.7	Soils Types	Made Ground	Acidic deep poorly drained mineral	Made Ground
6.1.8	Sub Soil Types	Made Ground/Alluvial Gravel Deposits	Sandstone and shale till	Made Ground
6.1.9	Depth to rock	~10m	0 - 10m	5-10m
6.2	**Soils and Geology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
6.2.2	Potential to interact with contaminated land	Slight - Chance of encountering heavy metals & PAH Compounds (associated with made ground)	Significant - Pipeline route near existing EPA landfill site	Significant - Pipeline route near existing EPA landfill site
6.2.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway
6.2.6	Potential to encounter soft ground	Slight - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh
6.3	**Soils and Geology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
7.0	**Agronomy & Landuse - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
7.1	Approximate % Reduction in overall farm holding	Imperceptible	Slight - approx. 6.5% reduction	Imperceptible
7.2	Farming Enterprise	Imperceptible - no farming enterprise	Moderate - farming enterprise	Imperceptible - no farming enterprise
7.4	Land Quality	Imperceptible - Poor Land Quality	Slight - Good Land Quality	Imperceptible - Poor Land Quality
7.5	Severance based on site location within overall land holdings	Imperceptible	Slight	Imperceptible
7.6	Potential Impacts on landholdings	Imperceptible	Reduction in farm size	Imperceptible
7.7	Crop rotation practiced	No	Yes	No
7.8	Overall Impact	Imperceptible	Moderate	Imperceptible
8.0	**Noise & Vibration**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
8.1	Potential for Construction phase noise impact at Sensitive receptors	Moderate - 90 dwellings (PIR Weighted) within 300 m	Imperceptible - 0 dwellings (PIR Weighted) within 300 m	Slight - 6 dwellings (PIR Weighted) within 300 m
8.3	Existing Ambient Noise Climate in the Area (significant noise sources)	Close to Arklow Town Centre	Relatively rural farmland area. Borders M11 motorway	Relatively rural farmland area. Borders M11 motorway
9.0	**Air and Odour**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
9.1	Potential for Construction Phase Air Quality Impact at Sensitive Receptors	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary	Slight - Approx. 10 Dwellings within 500m of Site Boundary

9.3	Potential for Odour Impacts at Operational phase	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary	Slight - Approx. 10 Dwellings within 500m of Site Boundary

10.0	**People and Communities - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
10.1	Number of residential & commercial buildings 100-200m from site boundary	Slight - Approx. 13	Imperceptible - 0	Slight - 1
10.1	Number of residential & commercial buildings within 500m from site boundary	Moderate - Approx. 339	Slight - Approx. 5	Slight - Approx. 10
10.1	Potential to impact on known community amenities and facilities within 1km from site boundary.	Moderate - Arklow leisure centre, skate park/BMX, running track & playing pitches is c. 200 m to the north and the golf links c. 500 m to the south. Bridgewater shopping centre is located c. 520 m from the boundary of the site while the Marina Village residential development lies 200 m from the site boundary	Slight - The Kilbride historic graveyard is within 500m of this site and the Arklow Town Marsh is c. 600 m to the south.	Slight - The Kilbride historic graveyard lies c. 750 m North East of this site and the Arklow Town Marsh is c. 750 m to the East.
10.1	Potential to impact on areas of Significant Population Densities	Slight	Imperceptible	Imperceptible
11.0	**Traffic - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
11.2	Number of crossings required	0	1- R772	2 - M11 Motorway & R772
11.3	Potential Impact on landowners	Moderate - Construction Phase	Slight - Construction Stage	Slight - Construction Stage
12.0	**12.0 Planning Policy - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
12.1	Existing Land Use on site	Derelict	Agricultural	Commercial/Landfill
12.2	Site zoning	Waterfront Zone	Action Area	Employment
12.3	Local Objectives/Constraints on site	Imperceptible - No Objectives/Contraints	Imperceptible - No Objectives/Contraints	Significant - Zone B – Flood Plain. Justification Test Required
12.5	Zoning present within 100m of site boundary	Commercial Uses	Agricultural Uses	Agricultural Uses
12.6	Zoning present within 1km of site boundary	Active Open Space/Existing Residential	Conservation Zone / Employment (E2) / Existing Residential	Amenity/Existing Residential/Conservation Zone
12.7	Other Local Objectives present within 1km of site boundary	Imperceptible - None	Slight - SEVESO II – Inside 1000m buffer. Consultation required	Slight - SEVESO II – Inside 1000m buffer. Consultation required
13.0	**Engineering Design - Pipelines**			
13.1	**Pipeline Length**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total Length as Open Cut	510 m	2530 m	3250 m
	Total Length in Marine Outfall	900 m	0 m	0 m
	Total Length in River Outfall	0 m	340 m	125 m
	Total Pipeline Length	1410 m	2870 m	3375 m
13.2	**Power Requirements**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Power Requirement from Load Centre to WwTP Site (18,000 pe)	22154	188262	190292
	Power Requirement from Load Centre to WwTP Site (36,000 pe)	51156	409271	423455
	Total Average Power Requirements	36655	298766.5	306873.5
13.3	**Carbon Emissions**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total embodied Carbon	119,975.49	244,205.43	287,175.38
	Total Lifetime Operational Carbon	780.24	6367.01	6367.01
	Total Carbon (tonnes CO_2)	120755.73	250572.44	293542.39
13.4	**Health and Safety**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Health & Safety	Moderate - Construction of long sea outfall.	Imperceptible - no significant difference	Imperceptible - no significant difference
13.5	**Access / Right of Way / Wayleaves along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**

13.6	**Crossings - Waterways, Rail, etc. along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Stream Crossings	0	0	1
	Canal Crossings	0	1	1
	Motorway Crossings	0	0	1
	Regional Road Crossings	0	1	1
	Total Crossings	0	2	4
13.7	**Potential to Impact on Physical Infrastructure along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		More Impact on Local Roads	More Impact on Regional Roads	More Impact on Regional Roads
13.8	**Potential to Impact on Strategic Utility Services along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
13.9	**Presence of Public Utilities within Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Public Utilities within the Site	38kV station & associated underground/submarine power cables in close proximity to site	No major public utilities within the site	No major public utilities within the site
13.10	**Land Ownership and Titles along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Least Ownerships	Most Ownerships	Most Ownerships
13.11	**Route Traffic Management**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
13.12	**Construction Risk along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
13.13	**Operation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.0	**Engineering Design - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.1	**Engineering Design/Treatment Processes Required - WwTP**			
		Moderate - Assumed need for further odour control	Significant - Assumed need for tertiary treatment	Profound - Assumed need for tertiary treatment & flood mitigation works
14.2	**Health & Safety - WwTP Construction**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.3	**Remediation Works -WwTP & Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.4	**Capital & Operational Costs**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Energy Costs - SBR Treatment Process	€161,000.00	€319,000.00	€319,000.00
	Annual Sludge Disposal Costs - SBR Treatment Process	€364,000.00	€284,000.00	€284,000.00
	Annual Labour & Maintenance Costs - SBR Treatment Process	€289,000.00	€289,000.00	€289,000.00
	Total Annual Operational Costs	€814,000.00	€892,000.00	€892,000.00
	Capital Costs of WwTP	€7,030,000.00	€12,332,000.00	€12,332,000.00
14.5	**Carbon Emissions - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Carbon Emissions Associated with SBR Treatment Process	824,000 kg/year	1,631,000 kg/year	1,631,000 kg/year
15.0	**Land Valuation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
15.1	**Land Valuation - Sites & Wayleaves**			
	Price per area - Site	Most Expensive – 4 times more than Shelton Abbey	Lower than Ferrybank, Higher than Shelton Abbey – 2 times more expensive	Least Expensive
	Price - Wayleaves Required for Pipelines	Least Expensive (Smaller pipe lengths all laid in public roads)	Higher that Ferrybank, lower than Shelton Abbey (Longer pipe lengths)	Most Expensive (Longest pipe lengths)
	Summary	Most Expensive	Higher than Shelton Abbey, Lower than Ferrybank	Least Expensive





Appendix N – First Iteration Matrix

N

1.0	**Cultural Heritage**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
1.1	**Cultural Heritage - Sites**			
1.1.4	Potential to impact (direct/indirect) on CH sites (previously unrecorded sites)	Imperceptible	Slight - greenfield site	Imperceptible
1.2	**Cultural Heritage - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
1.2.4	Potential to impact on CH sites	Imperceptible	Moderate - corridor thorugh greenfield lands	Moderate - corridor thorugh greenfield lands
1.3	**Cultural Heritage - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.0	**Landscape & Visual**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.1	**Landscape & Visual - Sites**			
2.1.4	Potential to impact on the character of the landscape	Imperceptible	Slight - existing 'rural' character	Imperceptible
2.1.7	Potential to impact on views from dwellings / local roads	Moderate - Closest site to Arklow town centre	Slight - Elevated site visible form surrounds	Imperceptible
2.1.8	Potential to impact on views from M11 motorway	Imperceptible	Imperceptible	Slight - visible from M11 bridge (northbound)
2.1.9	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Slight - visible from railway line
2.2	**Landscape & Visual - Route Corridors - Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.2.9	Potential to disrupt landscape structure (treelines / hedgerows / field pattern etc.)	Imperceptible	Slight - Changes during construction phase along route	Slight - Changes during construction phase along route
2.3	**Landscape & Visual - Outfalls (Landward side)**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.0	**Ecology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.1	**Ecology - Sites**			
3.1.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented given the size of individual field areas within the land parcel.	Imperceptible

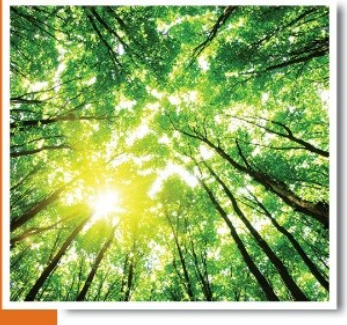
3.2	Ecology - Route Corridors/Pipelines	Ferrybank	Kilbride	Shelton Abbey
3.2.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.2.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.3	**Ecology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.3.7	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage
4.0	**Hydrology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.1	**Hydrology - Sites**			
4.2	**Hydrology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.2.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Slight - Arklow Marsh - pNHA	Slight - Arklow Marsh - pNHA
4.3	**Hydrology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.0	**Hydrogeology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.1	**Hydrogeology - Sites**			
5.1.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Moderate - "High" to "Extreme" to "Rock at near Surface or Karst"	Slight - "Moderate"
5.2	**Hydrogeology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.3	**Hydrogeology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**

6.0	**Soils and Geology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
6.1	**Soils and Geology - Sites**			
6.1.2	Potential to interact with contaminated land	Moderate - Chance of encountering heavy metals & PAH Compounds	Imperceptible - Greenfield Site	Slight - Brownfield Site. History of industrial activities.
6.1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible- Bedrock estimated at 10m bgl	Moderate - Outcrop in western portion of the site	Imperceptible- Bedrock estimated at 10m bgl
6.1.6	Potential to encounter soft ground	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Imperceptible - No alluvial deposits mapped within Site	Imperceptible - No alluvial deposits mapped within Site
6.1.7	Soils Types	Made Ground	Acidic deep poorly drained mineral	Made Ground
6.1.8	Sub Soil Types	Made Ground/Alluvial Gravel Deposits	Sandstone and shale till	Made Ground
6.1.9	Depth to rock	~10m	0 - 10m	5-10m
6.2	**Soils and Geology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
6.2.2	Potential to interact with contaminated land	Slight - Chance of encountering heavy metals & PAH Compounds (associated with made ground)	Significant - Pipeline route near existing EPA landfill site	Significant - Pipeline route near existing EPA landfill site
6.2.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway
6.2.6	Potential to encounter soft ground	Slight - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh
6.3	**Soils and Geology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
7.0	**Agronomy & Landuse - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
7.1	Approximate % Reduction in overall farm holding	Imperceptible	Slight - approx. 6.5% reduction	Imperceptible
7.2	Farming Enterprise	Imperceptible - no farming enterprise	Moderate - farming enterprise	Imperceptible - no farming enterprise
7.4	Land Quality	Imperceptible - Poor Land Quality	Slight - Good Land Quality	Imperceptible - Poor Land Quality
7.5	Severance based on site location within overall land holdings	Imperceptible	Slight	Imperceptible
7.6	Potential Impacts on landholdings	Imperceptible	Reduction in farm size	Imperceptible
7.7	Crop rotation practiced	No	Yes	No
7.8	Overall Impact	Imperceptible	Moderate	Imperceptible
8.0	**Noise & Vibration**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
8.1	Potential for Construction phase noise impact at Sensitive receptors	Moderate - 90 dwellings (PIR Weighted) within 300 m	Imperceptible - 0 dwellings (PIR Weighted) within 300 m	Slight - 6 dwellings (PIR Weighted) within 300 m
8.3	Existing Ambient Noise Climate in the Area (significant noise sources)	Close to Arklow Town Centre	Relatively rural farmland area. Borders M11 motorway	Relatively rural farmland area. Borders M11 motorway
9.0	**Air and Odour**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
9.1	Potential for Construction Phase Air Quality Impact at Sensitive Receptors	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary	Slight - Approx. 10 Dwellings within 500m of Site Boundary

9.3	Potential for Odour Impacts at Operational phase	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary	Slight - Approx. 10 Dwellings within 500m of Site Boundary

10.0	**People and Communities - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
10.1	Number of residential & commercial buildings 100-200m from site boundary	Slight - Approx. 13	Imperceptible - 0	Slight - 1
10.1	Number of residential & commercial buildings within 500m from site boundary	Moderate - Approx. 339	Slight - Approx. 5	Slight - Approx. 10
10.1	Potential to impact on known community amenities and facilities within 1km from site boundary.	Moderate - Arklow leisure centre, skate park/BMX, running track & playing pitches is c. 200 m to the north and the golf links c. 500 m to the south. Bridgewater shopping centre is located c. 520 m from the boundary of the site while the Marina Village residential development lies 200 m from the site boundary	Slight - The Kilbride historic graveyard is within 500m of this site and the Arklow Town Marsh is c. 600 m to the south.	Slight - The Kilbride historic graveyard lies c. 750 m North East of this site and the Arklow Town Marsh is c. 750 m to the East.
10.1	Potential to impact on areas of Significant Population Densities	Slight	Imperceptible	Imperceptible
11.0	**Traffic - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
11.2	Number of crossings required	0	1- R772	2 - M11 Motorway & R772
11.3	Potential Impact on landowners	Moderate - Construction Phase	Slight - Construction Stage	Slight - Construction Stage
12.0	**12.0 Planning Policy - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
12.1	Existing Land Use on site	Derelict	Agricultural	Commercial/Landfill
12.2	Site zoning	Waterfront Zone	Action Area	Employment
12.3	Local Objectives/Constraints on site	Imperceptible - No Objectives/Contraints	Imperceptible - No Objectives/Contraints	Significant - Zone B – Flood Plain. Justification Test Required
12.5	Zoning present within 100m of site boundary	Commercial Uses	Agricultural Uses	Agricultural Uses
12.6	Zoning present within 1km of site boundary	Active Open Space/Existing Residential	Conservation Zone / Employment (E2) / Existing Residential	Amenity/Existing Residential/Conservation Zone
12.7	Other Local Objectives present within 1km of site boundary	Imperceptible - None	Slight - SEVESO II – Inside 1000m buffer. Consultation required	Slight - SEVESO II – Inside 1000m buffer. Consultation required
13.0	**Engineering Design - Pipelines**			
13.1	**Pipeline Length**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total Length as Open Cut	510 m	2530 m	3250 m
	Total Length in Marine Outfall	900 m	0 m	0 m
	Total Length in River Outfall	0 m	340 m	125 m
	Total Pipeline Length	1410 m	2870 m	3375 m
13.2	**Power Requirements**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Power Requirement from Load Centre to WwTP Site (18,000 pe)	22154	188262	190292
	Power Requirement from Load Centre to WwTP Site (36,000 pe)	51156	409271	423455
	Total Average Power Requirements	36655	298766.5	306873.5
13.3	**Carbon Emissions**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total embodied Carbon	119,975.49	244,205.43	287,175.38
	Total Lifetime Operational Carbon	780.24	6367.01	6367.01
	Total Carbon (tonnes CO_2)	120755.73	250572.44	293542.39
13.4	**Health and Safety**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Health & Safety	Moderate - Construction of long sea outfall.	Imperceptible - no significant difference	Imperceptible - no significant difference
13.5	**Access / Right of Way / Wayleaves along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**

13.6	**Crossings - Waterways, Rail, etc. along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Stream Crossings	0	0	1
	Canal Crossings	0	1	1
	Motorway Crossings	0	0	1
	Regional Road Crossings	0	1	1
	Total Crossings	0	2	4
13.7	**Potential to Impact on Physical Infrastructure along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		More Impact on Local Roads	More Impact on Regional Roads	More Impact on Regional Roads
13.8	**Potential to Impact on Strategic Utility Services along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
13.9	**Presence of Public Utilities within Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Public Utilities within the Site	38kV station & associated underground/submarine power cables in close proximity to site	No major public utilities within the site	No major public utilities within the site
13.10	**Land Ownership and Titles along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Least Ownerships	Most Ownerships	Most Ownerships
13.11	**Route Traffic Management**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
13.12	**Construction Risk along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
13.13	**Operation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.0	**Engineering Design - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.1	**Engineering Design/Treatment Processes Required - WwTP**			
		Moderate - Assumed need for further odour control	Significant - Assumed need for tertiary treatment	Profound - Assumed need for tertiary treatment & flood mitigation works
14.2	**Health & Safety - WwTP Construction**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.3	**Remediation Works -WwTP & Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.4	**Capital & Operational Costs**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Energy Costs - SBR Treatment Process	€161,000.00	€319,000.00	€319,000.00
	Annual Sludge Disposal Costs - SBR Treatment Process	€364,000.00	€284,000.00	€284,000.00
	Annual Labour & Maintenance Costs - SBR Treatment Process	€289,000.00	€289,000.00	€289,000.00
	Total Annual Operational Costs	€814,000.00	€892,000.00	€892,000.00
	Capital Costs of WwTP	€7,030,000.00	€12,332,000.00	€12,332,000.00
14.5	**Carbon Emissions - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Carbon Emissions Associated with SBR Treatment Process	824,000 kg/year	1,631,000 kg/year	1,631,000 kg/year
15.0	**Land Valuation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
15.1	**Land Valuation - Sites & Wayleaves**			
	Price per area - Site	Most Expensive – 4 times more than Shelton Abbey	Lower than Ferrybank, Higher than Shelton Abbey – 2 times more expensive	Least Expensive
	Price - Wayleaves Required for Pipelines	Least Expensive (Smaller pipe lengths all laid in public roads)	Higher that Ferrybank, lower than Shelton Abbey (Longer pipe lengths)	Most Expensive (Longest pipe lengths)
	Summary	Most Expensive	Higher than Shelton Abbey, Lower than Ferrybank	Least Expensive



Appendix O – Second Iteration Matrix

1.0	**Cultural Heritage**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
1.1	**Cultural Heritage - Sites**			
1.1.4	Potential to impact (direct/indirect) on CH sites (previously unrecorded sites)	Imperceptible	Slight - greenfield site	Imperceptible
1.2	**Cultural Heritage - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
1.2.4	Potential to impact on CH sites	Imperceptible	Moderate - corridor thorugh greenfield lands	Moderate - corridor thorugh greenfield lands
1.3	**Cultural Heritage - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.0	**Landscape & Visual**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.1	**Landscape & Visual - Sites**			
2.1.4	Potential to impact on the character of the landscape	Imperceptible	Slight - existing 'rural' character	Imperceptible
2.1.7	Potential to impact on views from dwellings / local roads	Moderate - Closest site to Arklow town centre	Slight - Elevated site visible form surrounds	Imperceptible
2.1.8	Potential to impact on views from M11 motorway	Imperceptible	Imperceptible	Slight - visible from M11 bridge (northbound)
2.1.9	Potential to impact on views from Dublin - Rosslare rail line	Imperceptible	Imperceptible	Slight - visible from railway line
2.2	**Landscape & Visual - Route Corridors - Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
2.2.9	Potential to disrupt landscape structure (treelines / hedgerows / field pattern etc.)	Imperceptible	Slight - Changes during construction phase along route	Slight - Changes during construction phase along route
2.3	**Landscape & Visual - Outfalls (Landward side)**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.0	**Ecology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.1	**Ecology - Sites**			
3.1.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.1.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented given the size of individual field areas within the land parcel.	Imperceptible

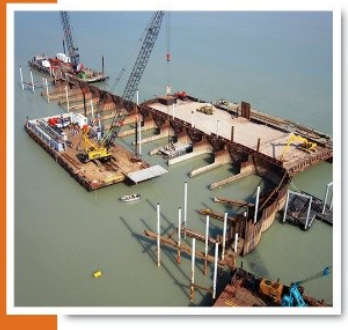
3.2	**Ecology - Route Corridors/Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.2.2	Potential to impact on Habitats Directive Annex II listed species in freshwater	Imperceptible	Imperceptible	Slight - Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.2.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation
3.3	**Ecology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
3.3.7	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage
4.0	**Hydrology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.1	**Hydrology - Sites**			
4.2	**Hydrology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
4.2.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Slight - Arklow Marsh - pNHA	Slight - Arklow Marsh - pNHA
4.3	**Hydrology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.0	**Hydrogeology**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.1	**Hydrogeology - Sites**			
5.1.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Moderate - "High" to "Extreme" to "Rock at near Surface or Karst"	Slight - "Moderate"
5.2	**Hydrogeology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
5.3	**Hydrogeology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**

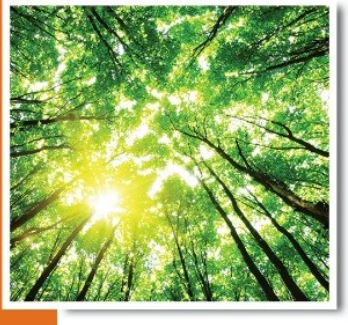
		Ferrybank	Kilbride	Shelton Abbey
6.0	**Soils and Geology**			
6.1	**Soils and Geology - Sites**			
6.1.2	Potential to interact with contaminated land	Moderate - Chance of encountering heavy metals & PAH Compounds	Imperceptible - Greenfield Site	Slight - Brownfield Site. History of industrial activities.
6.1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible- Bedrock estimated at 10m bgl	Moderate - Outcrop in western portion of the site	Imperceptible- Bedrock estimated at 10m bgl
6.1.6	Potential to encounter soft ground	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Imperceptible - No alluvial deposits mapped within Site	Imperceptible - No alluvial deposits mapped within Site
6.1.7	Soils Types	Made Ground	Acidic deep poorly drained mineral	Made Ground
6.1.8	Sub Soil Types	Made Ground/Alluvial Gravel Deposits	Sandstone and shale till	Made Ground
6.1.9	Depth to rock	~10m	0 - 10m	5-10m
6.2	**Soils and Geology - Route Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
6.2.2	Potential to interact with contaminated land	Slight - Chance of encountering heavy metals & PAH Compounds (associated with made ground)	Significant - Pipeline route near existing EPA landfill site	Significant - Pipeline route near existing EPA landfill site
6.2.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway
6.2.6	Potential to encounter soft ground	Slight - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh
6.3	**Soils and Geology - Outfalls**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
7.0	**Agronomy & Landuse - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
7.1	Approximate % Reduction in overall farm holding	Imperceptible	Slight - approx. 6.5% reduction	Imperceptible
7.2	Farming Enterprise	Imperceptible - no farming enterprise	Moderate - farming enterprise	Imperceptible - no farming enterprise
7.4	Land Quality	Imperceptible - Poor Land Quality	Slight - Good Land Quality	Imperceptible - Poor Land Quality
7.5	Severance based on site location within overall land holdings	Imperceptible	Slight	Imperceptible
7.6	Potential Impacts on landholdings	Imperceptible	Reduction in farm size	Imperceptible
7.7	Crop rotation practiced	No	Yes	No
7.8	Overall Impact	Imperceptible	Moderate	Imperceptible
8.0	**Noise & Vibration**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
8.1	Potential for Construction phase noise impact at Sensitive receptors	Moderate - 90 dwellings (PIR Weighted) within 300 m	Imperceptible - 0 dwellings (PIR Weighted) within 300 m	Slight - 6 dwellings (PIR Weighted) within 300 m
8.3	Existing Ambient Noise Climate in the Area (significant noise sources)	Close to Arklow Town Centre	Relatively rural farmland area. Borders M11 motorway	Relatively rural farmland area. Borders M11 motorway
9.0	**Air and Odour**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
9.1	Potential for Construction Phase Air Quality Impact at Sensitive Receptors	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary	Slight - Approx. 10 Dwellings within 500m of Site Boundary

9.3	Potential for Odour Impacts at Operational phase	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary	Slight - Approx. 10 Dwellings within 500m of Site Boundary

10.0	**People and Communities - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
10.1	Number of residential & commercial buildings 100-200m from site boundary	Slight - Approx. 13	Imperceptible - 0	Slight - 1
10.1	Number of residential & commercial buildings within 500m from site boundary	Moderate - Approx. 339	Slight - Approx. 5	Slight - Approx. 10
10.1	Potential to impact on known community amenities and facilities within 1km from site boundary.	Moderate - Arklow leisure centre, skate park/BMX, running track & playing pitches is c. 200 m to the north and the golf links c. 500 m to the south. Bridgewater shopping centre is located c. 520 m from the boundary of the site while the Marina Village residential development lies 200 m from the site boundary	Slight - The Kilbride historic graveyard is within 500m of this site and the Arklow Town Marsh is c. 600 m to the south.	Slight - The Kilbride historic graveyard lies c. 750 m North East of this site and the Arklow Town Marsh is c. 750 m to the East.
10.1	Potential to impact on areas of Significant Population Densities	Slight	Imperceptible	Imperceptible
11.0	**Traffic - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
11.2	Number of crossings required	0	1- R772	2 - M11 Motorway & R772
11.3	Potential Impact on landowners	Moderate - Construction Phase	Slight - Construction Stage	Slight - Construction Stage
12.0	**12.0 Planning Policy - Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
12.1	Existing Land Use on site	Derelict	Agricultural	Commercial/Landfill
12.2	Site zoning	Waterfront Zone	Action Area	Employment
12.3	Local Objectives/Constraints on site	Imperceptible - No Objectives/Contraints	Imperceptible - No Objectives/Contraints	Significant - Zone B – Flood Plain. Justification Test Required
12.5	Zoning present within 100m of site boundary	Commercial Uses	Agricultural Uses	Agricultural Uses
12.6	Zoning present within 1km of site boundary	Active Open Space/Existing Residential	Conservation Zone / Employment (E2) / Existing Residential	Amenity/Existing Residential/Conservation Zone
12.7	Other Local Objectives present within 1km of site boundary	Imperceptible - None	Slight - SEVESO II – Inside 1000m buffer. Consultation required	Slight - SEVESO II – Inside 1000m buffer. Consultation required
13.0	**Engineering Design - Pipelines**			
13.1	**Pipeline Length**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total Length as Open Cut	510 m	2530 m	3250 m
	Total Length in Marine Outfall	900 m	0 m	0 m
	Total Length in River Outfall	0 m	340 m	125 m
	Total Pipeline Length	1410 m	2870 m	3375 m
13.2	**Power Requirements**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Power Requirement from Load Centre to WwTP Site (18,000 pe)	22154	188262	190292
	Power Requirement from Load Centre to WwTP Site (36,000 pe)	51156	409271	423455
	Total Average Power Requirements	36655	298766.5	306873.5
13.3	**Carbon Emissions**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Total embodied Carbon	119,975.49	244,205.43	287,175.38
	Total Lifetime Operational Carbon	780.24	6367.01	6367.01
	Total Carbon (tonnes CO_2)	120755.73	250572.44	293542.39
13.4	**Health and Safety**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Health & Safety	Moderate - Construction of long sea outfall.	Imperceptible - no significant difference	Imperceptible - no significant difference
13.5	**Access / Right of Way / Wayleaves along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**

13.6	**Crossings - Waterways, Rail, etc. along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Stream Crossings	0	0	1
	Canal Crossings	0	1	1
	Motorway Crossings	0	0	1
	Regional Road Crossings	0	1	1
	Total Crossings	0	2	4
13.7	**Potential to Impact on Physical Infrastructure along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		More Impact on Local Roads	More Impact on Regional Roads	More Impact on Regional Roads
13.8	**Potential to Impact on Strategic Utility Services along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
13.9	**Presence of Public Utilities within Sites**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Public Utilities within the Site	38kV station & associated underground/submarine power cables in close proximity to site	No major public utilities within the site	No major public utilities within the site
13.10	**Land Ownership and Titles along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
		Least Ownerships	Most Ownerships	Most Ownerships
13.11	**Route Traffic Management**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
13.12	**Construction Risk along Pipeline Corridors**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
13.13	**Operation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.0	**Engineering Design - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.1	**Engineering Design/Treatment Processes Required - WwTP**			
		Moderate - Assumed need for further odour control	Significant - Assumed need for tertiary treatment	Profound - Assumed need for tertiary treatment & flood mitigation works
14.2	**Health & Safety - WwTP Construction**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.3	**Remediation Works -WwTP & Pipelines**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
14.4	**Capital & Operational Costs**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Energy Costs - SBR Treatment Process	€161,000.00	€319,000.00	€319,000.00
	Annual Sludge Disposal Costs - SBR Treatment Process	€364,000.00	€284,000.00	€284,000.00
	Annual Labour & Maintenance Costs - SBR Treatment Process	€289,000.00	€289,000.00	€289,000.00
	Total Annual Operational Costs	€814,000.00	€892,000.00	€892,000.00
	Capital Costs of WwTP	€7,030,000.00	€12,332,000.00	€12,332,000.00
14.5	**Carbon Emissions - WwTP**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
	Annual Carbon Emissions associated with SBR Treatment Process	824,000 kg/year	1,631,000 kg/year	1,631,000 kg/year
15.0	**Land Valuation**	**Ferrybank**	**Kilbride**	**Shelton Abbey**
15.1	**Land Valuation - Sites & Wayleaves**			
	Price per area - Site	Most Expensive – 4 times more than Shelton Abbey	Lower than Ferrybank, Higher than Shelton Abbey – 2 times more expensive	Least Expensive
	Price - Wayleaves Required for Pipelines	Least Expensive (Smaller pipe lengths all laid in public roads)	Higher that Ferrybank, lower than Shelton Abbey (Longer pipe lengths)	Most Expensive (Longest pipe lengths)
	Summary	Most Expensive	Higher than Shelton Abbey, Lower than Ferrybank	Least Expensive





Appendix P – Third Iteration Matrix

1.0	**Cultural Heritage**	**Ferrybank**	**Kilbride**
1.1	**Cultural Heritage - Sites**		
1.1.4	Potential to impact (direct/indirect) on CH sites (previously unrecorded sites)	Imperceptible	Slight - greenfield site
1.2	**Cultural Heritage - Route Corridors**	**Ferrybank**	**Kilbride**
1.2.4	Potential to impact on CH sites	Imperceptible	Moderate - corridor thorugh greenfield lands
1.3	**Cultural Heritage - Outfalls**	**Ferrybank**	**Kilbride**
2.0	**Landscape & Visual**	**Ferrybank**	**Kilbride**
2.1	**Landscape & Visual - Sites**		
2.1.4	Potential to impact on the character of the landscape	Imperceptible	Slight - existing 'rural' character
2.1.7	Potential to impact on views from dwellings / local roads	Moderate - Closest site to Arklow town centre	Slight - Elevated site visible form surrounds
2.2	**Landscape & Visual - Route Corridors - Pipelines**	**Ferrybank**	**Kilbride**
2.2.9	Potential to disrupt landscape structure (treelines / hedgerows / field pattern etc.)	Imperceptible	Slight - Changes during construction phase along route
2.3	**Landscape & Visual - Outfalls (Landward side)**	**Ferrybank**	**Kilbride**
3.0	**Ecology**	**Ferrybank**	**Kilbride**
3.1	**Ecology - Sites**		
3.1.5	Potential to impact upon ecological corridors, nature development area or high value habitats	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives: BD1, BD2, BD3, BD4, BD5, BD6 are considered to be capable of being implemented given the size of individual field areas within the land parcel.
3.2	**Ecology - Route Corridors/Pipelines**	**Ferrybank**	**Kilbride**
3.2.4	Potential to impact on pNHAs and Conservation Zones	Imperceptible	Slight - Arklow Town and Environs Development Plan 2011-2017 Objectives BD2, WS2 require avoidance of construction within Arklow Town Marsh, and avoidance of hydrological impacts on the Marsh. Disturbance of previously land-filled areas may have a potential to mobilise contaminants that could enter watercourses connected to Arklow Town Marsh and the Avoca river and may require additional geotechnical site investigation

3.3	**Ecology - Outfalls**	**Ferrybank**	**Kilbride**
3.3.7	Potential to impact on breeding habitat for Annex 1 bird species	Imperceptible	Slight - Kingfisher survey of river banks near outfall location required at detailed design stage
4.0	**Hydrology**	**Ferrybank**	**Kilbride**
4.1	**Hydrology - Sites**		
4.2	**Hydrology - Route Corridors**	**Ferrybank**	**Kilbride**
4.2.4	Potential Impact on ecologically important and designated sites.	Imperceptible	Slight - Arklow Marsh - pNHA
4.3	**Hydrology - Outfalls**	**Ferrybank**	**Kilbride**
5.0	**Hydrogeology**	**Ferrybank**	**Kilbride**
5.1	**Hydrogeology - Sites**		
5.1.2	Vulnerability Classification - potential for groundwater contamination	Imperceptible - "Low"	Moderate - "High" to "Extreme" to "Rock at near Surface or Karst"
5.2	**Hydrogeology - Route Corridors**	**Ferrybank**	**Kilbride**
5.3	**Hydrogeology - Outfalls**	**Ferrybank**	**Kilbride**
6.0	**Soils and Geology**	**Ferrybank**	**Kilbride**
6.1	**Soils and Geology - Sites**		
6.1.2	Potential to interact with contaminated land	Moderate - Chance of encountering heavy metals & PAH Compounds	Imperceptible - Greenfield Site
6.1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible- Bedrock estimated at 10m bgl	Moderate - Outcrop in western portion of the site
6.1.6	Potential to encounter soft ground	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Imperceptible - No alluvial deposits mapped within Site
6.1.7	Soils Types	Made Ground	Acidic deep poorly drained mineral
6.1.8	Sub Soil Types	Made Ground/Alluvial Gravel Deposits	Sandstone and shale till
6.1.9	Depth to rock	~10m	0 - 10m

6.2	**Soils and Geology - Route Corridors**	**Ferrybank**	**Kilbride**
6.2.2	Potential to interact with contaminated land	Slight - Chance of encountering heavy metals & PAH Compounds (associated with made ground)	Significant - Pipeline route near existing EPA landfill site
6.2.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	Imperceptible	Moderate - Outcrop shown on GSI Mapping in the vicinity of M11 motorway
6.2.6	Potential to encounter soft ground	Slight - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers	Moderate - Quaternary mapping has noted the subsoil to be an alluvium gravel deposit consistent with the nature of soils located near rivers/marsh
6.3	**Soils and Geology - Outfalls**	**Ferrybank**	**Kilbride**
7.0	**Agronomy & Landuse - Sites**	**Ferrybank**	**Kilbride**
7.1	Approximate % Reduction in overall farm holding	Imperceptible	Slight - approx. 6.5% reduction
7.2	Farming Enterprise	Imperceptible - no farming enterprise	Moderate - farming enterprise
7.4	Land Quality	Imperceptible - Poor Land Quality	Slight - Good Land Quality
7.5	Severance based on site location within overall land holdings	Imperceptible	Slight
7.6	Potential Impacts on landholdings	Imperceptible	Reduction in farm size
7.7	Crop rotation practiced	No	Yes
7.8	Overall Impact	Imperceptible	Moderate
8.0	**Noise & Vibration**	**Ferrybank**	**Kilbride**
8.1	Potential for Construction phase noise impact at Sensitive receptors	Moderate - 90 dwellings (PIR Weighted) within 300 m	Imperceptible - 0 dwellings (PIR Weighted) within 300 m
8.3	Existing Ambient Noise Climate in the Area (significant noise sources)	Close to Arklow Town Centre	Relatively rural farmland area. Borders M11 motorway

9.0	**Air and Odour**	**Ferrybank**	**Kilbride**
9.1	Potential for Construction Phase Air Quality Impact at Sensitive Receptors	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary
9.3	Potential for Odour Impacts at Operational phase	Moderate - Approx. 339 Dwellings within 500m of Site Boundary	Slight - Approx. 5 Dwellings within 500m of Site Boundary
10.0	**People and Communities - Sites**	**Ferrybank**	**Kilbride**
10.1	Number of residential & commercial buildings 100-200m from site boundary	Slight - Approx. 13	Imperceptible - 0
10.1	Number of residential & commercial buildings within 500m from site boundary	Moderate - Approx. 339	Slight - Approx. 5
10.1	Potential to impact on known community amenities and facilities within 1km from site boundary.	Moderate - Arklow leisure centre, skate park/BMX, running track & playing pitches is c. 200 m to the north and the golf links c. 500 m to the south. Bridgewater shopping centre is located c. 520 m from the boundary of the site while the Marina Village residential development lies 200 m from the site boundary	Slight - The Kilbride historic graveyard is within 500m of this site and the Arklow Town Marsh is c. 600 m to the south.
10.1	Potential to impact on areas of Significant Population Densities	Slight	Imperceptible
11.0	**Traffic - Sites**	**Ferrybank**	**Kilbride**
11.2	Number of crossings required	0	1- R772
11.3	Potential Impact on landowners	Moderate - Construction Phase	Slight - Construction Stage
12.0	**12.0 Planning Policy - Sites**	**Ferrybank**	**Kilbride**
12.1	Existing Land Use on site	Derelict	Agricultural
12.2	Site zoning	Waterfront Zone	Action Area
12.5	Zoning present within 100m of site boundary	Commercial Uses	Agricultural Uses
12.6	Zoning present within 1km of site boundary	Active Open Space/Existing Residential	Conservation Zone / Employment (E2) / Existing Residential
12.7	Other Local Objectives present within 1km of site boundary	Imperceptible - None	Slight - SEVESO II – Inside 1000m buffer. Consultation required
13.0	**Engineering Design - Pipelines**	**Ferrybank**	**Kilbride**
13.1	**Pipeline Length**		
	Total Length as Open Cut	510 m	2530 m
	Total Length in Marine Outfall	900 m	0 m
	Total Length in River Outfall	0 m	340 m
	Total Pipeline Length	1410 m	2870 m

13.2	**Power Requirements**	**Ferrybank**	**Kilbride**
	Power Requirement from Load Centre to WwTP Site (18,000 pe)	22154	188262
	Power Requirement from Load Centre to WwTP Site (36,000 pe)	51156	409271
	Total Average Power Requirements	36655	298766.5
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	Total embodied Carbon	119,975.49	244,205.43
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	Total Carbon (tonnes CO_2)	120755.73	250572.44
13.4	**Health and Safety**	**Ferrybank**	**Kilbride**
	Health & Safety	Moderate - Construction of long sea outfall.	Imperceptible - no significant difference
13.5	**Access / Right of Way / Wayleaves along Pipeline Corridors**	**Ferrybank**	**Kilbride**
13.6	**Crossings - Waterways, Rail, etc. along Pipeline Corridors**	**Ferrybank**	**Kilbride**
	Canal Crossings	0	1
	Regional Road Crossings	0	1
	Total Crossings	0	2
13.7	**Potential to Impact on Physical Infrastructure along Pipeline Corridors**	**Ferrybank**	**Kilbride**
		More Impact on Local Roads	More Impact on Regional Roads
13.8	**Potential to Impact on Strategic Utility Services along Pipeline Corridors**	**Ferrybank**	**Kilbride**
13.9	**Presence of Public Utilities within Sites**	**Ferrybank**	**Kilbride**
	Public Utilities within the Site	38kV station & associated underground/submarine power cables in close proximity to site	No major public utilities within the site
13.10	**Land Ownership and Titles along Pipeline Corridors**	**Ferrybank**	**Kilbride**
		Least Ownerships	Most Ownerships
13.11	**Route Traffic Management**	**Ferrybank**	**Kilbride**
13.12	**Construction Risk along Pipeline Corridors**	**Ferrybank**	**Kilbride**
13.13	**Operation**	**Ferrybank**	**Kilbride**
14.0	**Engineering Design - Pipelines**	**Ferrybank**	**Kilbride**
14.1	**Engineering Design/Treatment Processes Required - WwTP**		
		Moderate - Assumed need for further odour control	Significant - Assumed need for tertiary treatment
14.2	**Health & Safety - WwTP Construction**	**Ferrybank**	**Kilbride**
14.3	**Remediation Works -WwTP & Pipelines**	**Ferrybank**	**Kilbride**
14.4	**Capital & Operational Costs**	**Ferrybank**	**Kilbride**
	Annual Energy Costs - SBR Treatment Process	€161,000.00	€319,000.00
	Annual Sludge Disposal Costs - SBR Treatment Process	€364,000.00	€284,000.00
	Annual Labour & Maintenance Costs - SBR Treatment Process	€289,000.00	€289,000.00
	Total Annual Operational Costs	€814,000.00	€892,000.00
	Capital Costs of WwTP	€7,030,000.00	€12,332,000.00
14.5	**Carbon Emissions - WwTP**	**Ferrybank**	**Kilbride**
	Annual Carbon Emissions associated with SBR Treatment Process	824,000 kg/year	1,631,000 kg/year

15.0	Land Valuation	Ferrybank	Kilbride
15.1	Land Valuation - Sites & Wayleaves		
	Price per area - Site	Most Expensive – 4 times more than Shelton Abbey	Lower than Ferrybank, Approx. half the price
	Price - Wayleaves Required for Pipelines	Least Expensive (Smaller pipe lengths all laid in public roads)	Higher that Ferrybank
	Summary	Most Expensive	Least Expensive