Planning & Development Act, 2000 - 2020,
European Communities (Environmental Impact Assessment) Regulations 1989 (as amended), Planning & Development Regulations, 2001 (as amended)

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

APPENDICES

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Data Centre (DUB05)
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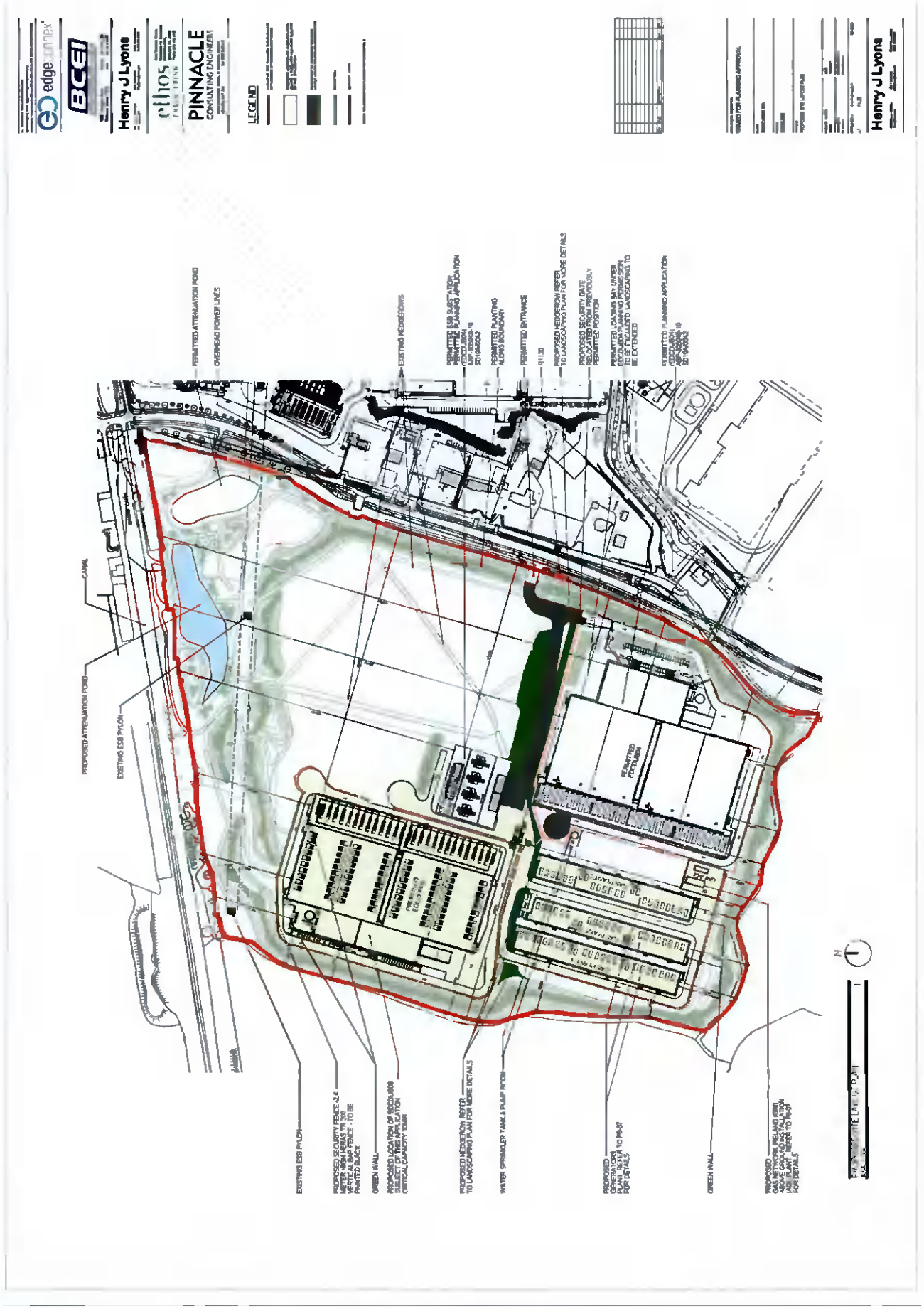
MARSTON
PLANNING CONSULTANCY

CONTENTS

CHAPTER 2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

Appendix 2.1 Proposed site layout plan (not to scale)



Appendix 2.2 Schedule of mitigation measures

Project Phase	Mitigation Measures
	Biodiversity
Construction - Nationally designated sites, *Non-native invasive species*	The following mitigation measures will ensure that there will be no impacts from non-native invasive species on the adjacent Grand Canal pNHA. It is recommended that *Buddleia davidii* is removed prior to construction works onsite. *Buddleja davidii* is a highly invasive species that is widespread in urban environments. It can grow in very poor, shallow soil, along railways and even on walls and buildings. Each plant can produce up to three million seeds that can remain viable in the soil for many years. It creates competition for resources such as pollinators, light and space and poses a threat to native plant species within the lands. Only two plants of this species were located in the north of the site during the field surveys. There are two options for the removal and control of *B. davidii*. The first option is for the physical removal of *B. davidii* is only suitable for very small infestations of this species. If this is the chosen method of removal, care should be taken to remove all parts of the plant as branches are capable of re-rooting from cuttings. The plants should not be removed when in seed as there would be a risk of spreading the seeds further. Where removal of mature plants is not immediately feasible, the flower heads should be removed in June before they go to seed. It is essential to plant the ground with native species immediately following removal to prevent new seedlings taking hold. The second option is to cut back the plants to a stump during active growth (late spring to early summer) and then immediately treated with a systemic weed killer (brushed on). Foliar application of herbicide may be adequate for smaller infestations of younger plants but must be followed up on a six-monthly basis. The measures outlined above to control the spread of the non-native invasive species *B. davidii* will also mitigate against their spread within the habitats in the Proposed Development site.
Construction – *Habitats – Water quality*	The following mitigation measures will ensure there are no impacts on water quality in the immediate vicinity of the Proposed Development from release of hydrocarbons, polluting chemicals, sediment/silt and contaminated waters control during the construction stage of the Proposed Development and therefore no potential impacts on the downstream receiving water courses, *i.e.* the Griffeen River: • Specific measures to prevent the release of sediment over baseline conditions to the existing surface water drainage network, during the construction work, which will be implemented as the need arises. These measures include, but are not limited to. the use of silt fences, silt curtains, settlement lagoons and filter materials. • Provision of exclusion zones and barriers (e.g. silt fences) between earthworks, stockpiles and temporary surfaces to prevent sediment washing into the existing drainage systems and hence the downstream receiving water environment. • Provision of temporary construction surface drainage and sediment control measures to be in place before earthworks commence. • Weather conditions will be taken into account when planning construction activities to minimise risk of run-off from the site. • Prevailing weather and environmental conditions will be taken into account prior to the pouring of cementitious materials for the works adjacent to any surface water drainage features, or drainage features connected to same. Pumped concrete will be monitored to ensure no accidental discharge. Mixer washings and excess concrete will not be discharged to existing surface water drainage systems. Concrete washout areas will be located remote any surface water drainage features, where feasible, to avoid accidental discharge to watercourses. Washing out of any concrete trucks on site will be avoided (dry brush shoots will be used instead). • Any fuels of chemicals (including hydrocarbons or any polluting chemicals) will be stored in a designated, secure bunded area(s) to prevent any seepage of potential pollutants into the local surface water network. These designated areas will be clearly sign-posted and all personnel on site will be made aware of their locations and associated risks. • All mobile fuel bowsers shall carry a spill kit and operatives must have spill response training. All fuel containing equipment such as portable generators shall be placed on drip trays. All fuels and chemicals required to be stored on-site will be clearly marked. Care and attention should be taken during refuelling and maintenance operations. Particular attention should be paid to gradient and ground conditions, which could increase risk of

	discharge to waters. • A register of all hazardous substances, which will either be used on site or expected to be present (in the form of soil and/or groundwater contamination) will be established and maintained. This register will be available at all times and shall include as a minimum: - Valid Safety Data Sheets; - Health & Safety, Environmental controls to be implemented when storing, handling, - using and in the event of spillage of materials; - Emergency response procedures/precautions for each material; and, - The Personal Protective Equipment (PPE) required when using the material. - Implementation of response measures to potential pollution incidents. • Robust and appropriate Spill Response Plan and Environmental Emergency Plan will be prepared prior to works commencing and they will be communicated, resourced and implemented for the duration of the works. Emergency procedures/precautions and spillage kits will be available and construction staff will be trained and experienced in emergency procedures in the event of accidental fuel spillages. • All trucks will have a built-on tarpaulin that will cover excavated material as it is being hauled off-site and wheel wash facilities will be provided at all site egress points. • Water supplies shall be recycled for use in the wheel wash. All waters shall be drained through appropriate filter material prior to discharge from the construction sites. • The removal of any made ground material, which may be contaminated, from the construction site and transportation to an appropriate licenced facility shall be carried out in accordance with the Waste Management Act, best practice and guidelines for same. • A discovery procedure for contaminated material will be prepared and adopted by the appointed contractor prior to excavation works commencing on site. These documents will detail how potentially contaminated material will be dealt with during the excavation phase. • Implementation of measures to minimise waste and ensure correct handling, storage and disposal of waste (most notably wet concrete, pile arisings and asphalt). • All of the above measures implemented on site will be monitored throughout the duration of construction to ensure that they are working effectively, to implement maintenance measures if required and applicable, and to address any potential issues that may arise.
Construction phase – *Birds – vegetation clearance / demolition*	The following mitigation measures are proposed to comply with the legal protection afforded to breeding birds and their nests under the Wildlife Acts: • In order to avoid disturbance or harm to breeding birds, their nests, eggs and/or their unflown young, all works involving the removal of trees, hedgerows, grasslands or the demolition of the structure will be undertaken outside of the nesting season (i.e. 1 March to 31 August inclusive); or where this seasonal restriction cannot be observed then: • A breeding bird survey will be undertaken by a suitably experienced ecologist in order to assess whether birds are nesting within suitable habitat affected by or immediately adjacent to the proposed works. Should nesting birds be encountered during surveys, it may be necessary to delay the removal of trees or hedgerows or the demolition of the buildings until after the nesting season (i.e. 1 March to 31 August inclusive), or until the chicks have fully fledged.
Construction phase – *Bats - lighting*	During construction, any external lighting to be installed, including facilitating night-time working or security lighting, on the site shall be sensitive to the presence of bats in the area, downlighting, and time limited where possible. Lighting of sensitive wildlife areas and primary ecological corridors (*e.g.* Grand Canal) and light pollution in general should be avoided. Lighting of the site during construction is designed in accordance with the following guidance: • Guidance Notes for the Reduction of Obtrusive Light GN01 (Institute of Lighting Professionals, 2020) • Bats & Lighting - Guidance Notes for Planners, Engineers, Architects and Developers (Bat Conservation Ireland, December 2010) • Bats and Lighting in the UK – Bats and the Built Environment Series (Bat Conservation Trust UK, January 2008).
Construction phase – *Bats, Vegetation clearance*	The following mitigation measures are proposed in relation to those trees identified as having potential to support roosting bats (see Figure 6.15). Bats could occupy suitable roosting features at any time prior to the commencement of works. Therefore, there is an inherent risk that bats could be affected by felling works. The following mitigation procedures will be followed: • Felling of potential tree roosts will be undertaken during the periods April to May or

	September to October as during this period bats are capable of flight and may avoid the risks from tree felling if proper measures are undertaken, but also are neither breeding nor in hibernation • Use of detectors alone may not be sufficient to record bat emergence and re-entry in darkness. Therefore, prior to felling of confirmed and potential tree roosts, an emergence survey using infra-red illumination and video camera(s) and bat detectors will be carried out on the night immediately preceding the felling operation to determine if bats are present • Where it is safe and appropriate to do so for both bats and humans, such trees may be felled using heavy plant to push over the tree. In order to ensure the optimum warning for any roosting bats that may still be present, the tree will be pushed lightly two to three times, with a pause of approximately 30 seconds between each nudge to allow bats to become active. The tree should then be pushed to the ground slowly and should remain in place until it is inspected by a bat specialist • Trees should only be felled "in section" where the sections can be rigged to avoid sudden movements or jarring of the sections • Where remedial works (e.g. pruning of limbs) is to be undertaken to trees deemed to be suitable for bats, the affected sections of the tree will be checked by a bat specialist (using endoscope under a separate derogation licence held by that individual) for potential roost features before removal. For limbs containing potential roost features high in the tree canopy, this will necessitate the rigging and lowering of the limb to the ground (with the potential roost feature intact) for inspection by the bat specialist before it is cut up or mulched. If bats are found to be present, they will be removed by a bat specialist licenced to handle bats and released in the area in the evening following capture • If any bat tree roosts are confirmed, and will be removed by the proposed felling works, then a derogation licence will be required from the NPWS and appropriate alternative roosting sites will be provided in the form of bat boxes.
Construction phase – *Common frog*	If works to clear any of the habitat features suitable to support common frog are to begin during the season where frogspawn or tadpoles may be present (*i.e.* February to mid-summer), a pre-construction survey will be undertaken to determine whether breeding common frogs are present. If required, a licence permitting their removal should be applied for from the NPWS. Any frog spawn, tadpoles, juvenile or adult frogs present will be captured and removed from affected habitat by hand net and translocated to suitable alternative habitat within the environs of the site. Any capture and translocation works shall be undertaken immediately in advance of site clearance and construction works commencing.
Construction phase – *Fish and white clawed crayfish*	Mitigation measures outlined above for the protection of water quality in the downstream receiving water courses, *i.e.* Griffeen River, and its immediate environs will mitigate against impacts of water pollution on fish and white-clawed crayfish during construction stage.
Construction phase - badgers	Before works to clear any of the habitat features suitable to supporting badgers commence, a pre-construction survey will be undertaken to determine whether badgers are present on site. If required, a licence permitting their filming to assess locations of activity and their subsequent removal should be applied for from the NPWS. Any active badger setts located within the development or 30m from the development must be safely closed with the use of one-way badger gates and (infra-red camera) monitoring to ensure that all badgers have left the sett(s) and that it is no longer occupied, prior to sett removal. Any sett closing works shall be undertaken between the months of July to November inclusive (to avoid peak breeding season for this species and therefore avoid risk of disturbance to or mortality of cubs), in advance of site clearance and construction works commencing.
Operational phase - *habitats*	The landscape plans (see Chapter 11) of the Proposed Development site will implement appropriate measures such as using plants of native origin in planting/meadows and by leaving unmanaged and/or enhanced areas for biodiversity. To offset the loss of habitats, the proposed landscape plans include the planting of native treelines and also woody hedgerow species to fill in gaps in existing hedgerows/treelines in the northern buffer area of the site, the construction of a new pond wetland habitat in the north-eastern corner of the site with wetland planting (c.1.7ha) and the planting of wildflower hay meadows, also in the northern buffer area of the site. The planted hedgerow species will mainly consist of *Corylus avellana, Crataegus monogyna* and *Prunus avium,* whilst the treelines will mainly consist of *Alnus glutinosa, Betula pendula, Pinus sylvestris* and *Quercus petraea.* The pond will be planted with *Phragmites australis, Sparganium erectum* and *Typha latifolia*, amongst other species. Any remaining hedgerows will be preserved, retained and protected in accordance with the arborist's report and where feasible. Landscaping will also include extensive areas of wildflower hay meadow throughout the Proposed Development.

Operational phase - *birds*	The Proposed Development will result in foraging and breeding habitat loss of various bird species. The landscape planting includes planting of treeline, hedgerow, pond wetland and wildflower hay meadow grassland habitats, which will mitigate the loss of pre-existing habitats for breeding and wintering bird species. In addition, landscaping will also include extensive areas of wildflower hay meadow throughout the Proposed Development, which will especially benefit granivorous (e.g. finches) and wintering bird species (*i.e.* snipe). The Proposed Development will create a barrier to bird movement through the previously undeveloped lands. The landscape plans include treeline/hedgerow retention and also treeline planting in the north of the site, which will encourage birds to fly at higher flight lines near the buildings, and thus help to prevent bird collision and mortality associated with building collision.
Operational phase – *bats, lighting*	The lighting plans take into consideration sensitive wildlife areas (*e.g.* Grand Canal and areas of high bat activity marked in Figure 6.16), and are downlighting, and time limited where possible. The following recommendations have been considered in relation to the detailed operational lighting design, and have been reviewed by a suitably qualified and experienced ecologist: • Lighting levels should be the minimum required for health and safety requirements. • Vertical light spill shall be minimized by the use of suitable cut off luminaires. • No floodlighting should be used, this causes a large amount of light spillage into the sky. The spread of light should be kept below the horizontal. • Lights should be of low intensity. It is better to use several low intensity lights than one strong light spilling light across the entire area. • Narrow spectrum lighting should be used with a low UV component (UV filters can be used to reduce the UV component emitted by lights). Glass also helps reduce the UV component emitted by lights. • The use of LED directional lighting (through the use of hoods, louvres, shields, or cowls) to restrict light to those areas where it is needed. • Consideration the use of automatic sensor or dimming systems to minimise the duration and intensity of lighting on the site. The technical details of the lighting plans for the Proposed Development include the following: • Lighting will be restricted to the building perimeter, plant areas, roadways and car parking; • All pathways will be illuminated using bollards; • All columns will be a maximum of 5 metres high with sharp cut off luminaires, located to minimise light back spill; and. • LED-based lighting. These are in adherence with the guidance presented in relation to bats and lighting previously in this Chapter.
Operational phase – *bats, collision risk*	The Proposed Development will create a barrier to bat movement through the previously undeveloped lands. The landscape plans include treeline/hedgerow retention and also treeline planting in the north of the site, which will encourage birds to fly at higher flight lines near the buildings, and thus help to prevent bat collision and mortality associated with building collision.
	Land, Soil and Geology
Construction phase – *Soil removal and compaction*	Reuse of excavated soil on site and capping with hardstand will minimise any increase in aquifer vulnerability. Construction works will require local removal of soil cover where levelling of the site is required and its use for re-instatement elsewhere on site. According to the GSI database the bedrock vulnerability is already extreme due to the thin cover of overburden on the site, removal of soil cover will increase the vulnerability of the underlying bedrock. However due to levelling works imported fill will need to be deposited over a sizable proportion of the proposed development site. Overall vulnerability would not alter across the site. It is envisaged that any soil excavated will be retained on site and reused as fill material or landscaping. Temporary storage of soil will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment and the material will be stored away from any open surface water drains. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust.

	Although there is no evidence of historical contamination in the proposed development site. all excavated materials will be visually assessed for signs of possible contamination such as staining or strong odours. Should any unusual staining or odour be noticed, samples of this soil will be analysed for the presence of possible contaminants in order to ensure that historical pollution of the soil has not occurred. Should it be determined that any of the soil excavated is contaminated, this will be disposed of by a licensed waste disposal contractor.
Construction phase – Fuel and chemical handling	To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas. Oil and fuel storage tanks shall be stored in designated areas, and these areas shall be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) shall be diverted for collection and safe disposal. Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in a designated area (or where possible off the site) which will be away from surface water gulleys or drains. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as "Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors" (CIRIA 532, 2001) will be complied with. Where feasible all ready-mixed concrete will be brought to site by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil. Wash down and washout of concrete transporting vehicles will take place at an appropriate facility offsite. In the case of drummed fuel or other chemical which may be used during construction, containers should be stored in a dedicated internally bunded chemical storage cabinet and labelled clearly to allow appropriate remedial action in the event of a spillage.
Construction phase – *CEMP*	A Construction Environmental Management Plan (CEMP) has been developed by Winthrop Engineering and Contracting Limited and included with the application documentation. This will be refined by the Applicant and the construction contractor prior to commencement of construction. The CEMP will incorporate the mitigation measures outlined above as they relate to the construction phase. The CEMP will include emergency response procedures in the event of a spill, leak, fire or other environmental incident related to construction. This is an active document which is continuously updated to manage risk during the construction programme. All relevant personnel working on the site will be trained in the implementation of the procedures. As a minimum, the CEMP will be formulated in accordance with best international practice including but not limited to: • CIRIA. (2001), Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors; • Construction Industry Research and Information Association (CIRIA) Environmental Good Practice on Site (C650), 2005; • BPGCS005, Oil Storage Guidelines; • Eastern Regional Fisheries Board, (2006), Fisheries Protection Guidelines: Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites; • CIRIA 697, The SUDS Manual, 2007; and • UK Pollution Prevention Guidelines (PPG) UK Environment Agency, 2004.
Operational phase – *Fuel and chemical handling*	In order to minimise any impact on the underlying subsurface strata from material spillages, each generator will be installed in an externally rated container with a self-contained belly tank (steel double wall type for leak containment and inner tank leak alarm system) with 48 hours diesel fuel storage capacity at full load. Any chemicals, oils, herbicides required for site maintenance will be stored in suitable contained areas. As the site will be paved any accidental emissions from fuel spills or contaminated runoff will be directed through the surface water drainage system through oil

	interceptors prior to discharge to the proposed attenuation tank onsite rather than infiltrate directly to ground.
Operational phase – *Environmental Plan*	An environmental management plan will be prepared and followed during the operational phase incorporating mitigation measures and emergency response measures.
	Hydrology
Construction phase - *CEMP*	A Construction Environmental Management Plan (CEMP) has been developed by Winthrop Engineering and Contracting Limited and included with the application documentation. This will be refined by the Applicant and the construction contractor prior to commencement of construction. The CEMP will incorporate the mitigation measures outlined above as they relate to the construction phase. The CEMP will include emergency response procedures in the event of a spill, leak, fire or other environmental incident related to construction. This is an active document which is continuously updated to manage risk during the construction programme. All relevant personnel working on the site will be trained in the implementation of the procedures. As a minimum, the CEMP will be formulated in accordance with best international practice including but not limited to: • CIRIA. (2001), Control of Water Pollution from Construction Sites. Guidance for Consultants and Contractors; • Construction Industry Research and Information Association (CIRIA) Environmental Good Practice on Site (C650), 2005; • BPGCS005, Oil Storage Guidelines; • Eastern Regional Fisheries Board, (2006), Fisheries Protection Guidelines: Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites; • CIRIA 697, The SUDS Manual, 2007; and • UK Pollution Prevention Guidelines (PPG) UK Environment Agency, 2004. Project Engineers (Pinnacle) have outlined mitigation measures for the site in their Engineering Planning Report that accompanies this application as a stand-alone document. The following mitigation measures include, but are not limited to. those provided in that report and are designed to address the impacts associated with the construction and operational phase of the project. Due to the inter-relationship between this section and Chapter 7 (Land, Soils, Geology and Hydrogeology) the following mitigation measures discussed will be considered applicable to both.
Construction phase - *Increased run-off and sediment loading*	During the construction phase any drains carrying a high sediment load will be diverted through the settlement ponds. The settlement ponds will be located between the area of construction and the nearest field drain. Surface water runoff will not be discharged directly to local watercourses. The following mitigation measures will be adopted: • the drainage system and settlement ponds will be constructed as a first step; • any excavations required will remain open for as little time as possible before the placement of fill. This will help to minimise potential for groundwater ingress into excavations; • silt traps will be placed in the existing drainage network around the site to minimise silt loss. These should be inspected and cleaned regularly. • weather conditions will be considered when planning construction activities to minimise risk of run off from the site; and • distance between topsoil piles etc. and streams will be maintained – to protect from dampening operations.
Construction phase – *Contamination of local water courses*	To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents, paints and fuels used during construction will be stored within temporary bunded areas and each of these areas will be bunded to a volume of 110% of the capacity of the largest tank/container within it (plus an allowance of 30 mm for rainwater ingress). Filling and draw-off points will be located entirely within the bunded area(s). Drainage from the bunded area(s) will be diverted for collection and safe disposal. Wet concrete operations adjacent to watercourses will be avoided where possible. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water

	to groundwater. The contractor will be required to make provision for removal of any concrete wash waters, most likely by means of tankering off-site and no such wash waters will be discharged to groundwater. Any effluent generated by temporary onsite sanitary facilities will be taken off-site for appropriate treatment. Re-fuelling of construction equipment and the addition of hydraulic oil or lubricants to vehicles/ equipment will take place in designated bunded areas where possible. Re-fuelling will be avoided in so far as possible at the other work sites but where necessary will take place within appropriately bunded areas. If it is not possible to bring a machine to the refuelling point, fuel will be delivered in a double-skinned mobile fuel bowser. A drip tray will be used beneath the fill point during refuelling operations in order to contain any spillages that may occur. The vehicles and equipment will not be left unattended during refuelling. Spill kits and hydrocarbon absorbent packs will be stored in the cab of each vehicle and operators will be fully trained in the use of this equipment. The generation of runoff from stockpiles of soils, excavated during construction, will be prevented from entering watercourses by diverting runoff to the settlement ponds on site, and removing the material off-site as soon as possible to designated storage areas.
Operational phase – *Increased surface water run-off*	The proposed drainage system for the site in outlined in Pinnacle's Engineering Planning Report and has been designed in accordance with Greater Dublin Strategic Design System (GDSDS) specifications. The drainage system will include a Stormtech attenuation system or similar. Roof water will be directed into an onsite reticulation system which will drain, along with road run-off, into the attenuation ponds which is to be located to the north of the site. A hydrobrake will also be installed at the outflow to reduce the ultimate discharge. Pinnacle have identified that the above storm water drainage systems will accommodate a 1:2 year storm frequency. The attenuation system is also designed to accommodate a 1:100 year storm event accounting for a 20% increase with climate change.
Operational phase – *Contamination of surface water*	Due to a variety of measures such as the design of the attenuation system with hydrocarbon interceptors, the speed restrictions in place and the fact that no refuelling will be carried out on site (when practicable), the likelihood of any spills entering the water environment from vehicles on site is negligible. Run-off from the car park areas and access roads / delivery areas will be drained following these options: • A series of on-site gullies and channels draining into a separate system of below ground gravity storm water sewers; and • A Duraflow (or similar approved), porous asphalt product. To minimise any impact from material spillages, all oils, solvents, paints and fuels to be stored onsite will be stored within permanently bunded areas and each of these areas will be bunded to a volume of 110% of the capacity of the largest tank/container within it (plus an allowance of 30mm for rainwater ingress). Drainage from the bunded area(s) will be diverted for collection and safe disposal.
Operational phase – *Foul water*	In their Engineering Planning Report Pinnacle have proposed to discharge foul water from the proposed development, via a 225mm diameter gravity foul sewer outfall and discharge into the existing 450mm diameter connection. The increase in flow to the existing public foul sewer is not expected to have a negative effect on the foul drainage system in the area.
Operational phase – *Water supply*	The water system will be metered to facilitate detection of leakage and the prevention of water loss. Dual & low flush toilets and water economy outlets and water saving measures will also be proposed.
	Noise and vibration
Construction – *Noise and vibration*	With regard to construction activities, reference will be made to BS5228 Parts 1 and 2, which offer detailed guidance on the control of noise and vibration from demolition and construction activities.

	Various mitigation measures will be considered and applied during the construction of the proposed development. Specific examples of such measures are: • limiting the hours during which site activities likely to create high levels of noise or vibration are permitted; • establishing channels of communication between the contractor/developer, Local Authority and residents; • appointing a site representative responsible for matters relating to noise and vibration; • monitoring levels of noise and/or vibration during critical periods and at sensitive locations; and • all site access roads will be kept even so as to mitigate the potential for vibration from lorries. Furthermore, it is envisaged that a variety of practicable noise control measures will be employed. These may include: • selection of plant with low inherent potential for generation of noise and/or vibration; • erection of barriers as necessary around items such as generators or high-duty compressors; • situate any noisy plant as far away from sensitive properties as permitted by site constraints and the use of vibration-isolated support structures where necessary. It is recommended that vibration from construction activities to off-site residences be limited to the values set out in Table 9.6. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage these limits may need to be reduced by up to 50%.
Operational phase - *Building services noise / emergency site operation*	Noise from external plant will be minimised by purchasing low noise generating equipment and incorporating appropriately specified in line attenuators for stacks and exhausts where necessary. With due consideration as part of the detailed design process, this approach will result in the site operating well within the constraints of the best practice guidance noise limits that have been adopted as part of this detailed assessment.
Operational phase - *Additional vehicular traffic on public roads*	The noise impact assessment outlined previously has demonstrated that mitigation measures are not required.
Operational phase – *Noise and human health*	*Guidelines for construction and operational phase*: Noise criteria are provided by relevant bodies with consideration of the likely impact of noise on human health. The construction phase is short-term and therefore any elevated levels of noise will be of limited duration and, as a result, are not expected to pose any risk to human health. In terms of the noise exposure of construction workers and potential hearing damage that may be caused due to exposure to high levels of noise, the Safety, Health and Welfare at Work (General Application) Regulations 2007 (Statutory Instrument No. 299 of 2007) provides guidance in terms of allowable workplace noise exposure levels for employees. The Regulations specify two noise Action Levels at which the employer is legally obliged to reduce the risk of exposure to noise. The appointed contractor will be required to comply with the Regulations and provide appropriate noise exposure mitigation measures where necessary. No significant noise impacts are expected from the operational phase of the proposed development. As such, there is no anticipated risk of long-term exposure to noise on human health resulting from the proposed development.
	Air quality and climate
Construction phase – *Climate*	Construction vehicles, generators etc., may give rise to some CO_2 and N_2O emissions. However, due to short-term and temporary nature of these works the impact on climate will not be significant.
Construction phase – *Air Quality*	The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland and the UK (IAQM (2014), The Scottish Office (1996), UK Office of Deputy Prime Minister (2002) and BRE (2003)) and the USA (USEPA (1997)).

Construction phase – *site management*	The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design and effective control strategies. At the construction planning stage, the siting of activities and storage piles will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance (see Figure 10.1 for the windrose for Casement Aerodrome). As the prevailing wind is predominantly south-westerly, locating construction compounds and storage piles downwind (to the north-east) of sensitive receptors will minimise the potential for dust nuisance to occur at sensitive receptors. Good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or quickly implementing effective control measures before the potential for nuisance occurs. When rainfall is greater than 0.2 mm/day, dust generation is generally suppressed (UK Office of Deputy Prime Minister (2002), BRE (2003)). The potential for significant dust generation is also reliant on threshold wind speeds of greater than 10 m/s (19.4 knots) (at 7m above ground) to release loose material from storage piles and other exposed materials (USEPA, 1986). Particular care should be taken during periods of high winds (gales) as these are periods where the potential for significant dust emissions are highest. The prevailing meteorological conditions in the vicinity of the site are favourable in general for the suppression of dust for a significant period of the year. Nevertheless, there will be infrequent periods were care will be needed to ensure that dust nuisance does not occur. The following measures should be taken in order to avoid dust nuisance occurring under unfavourable meteorological conditions: • The Principal Contractor or equivalent must monitor the contractors' performance to ensure that the proposed mitigation measures are implemented and that dust impacts and nuisance are minimised; • During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions; • The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details; • It is recommended that community engagement be undertaken before works commence on site explaining the nature and duration of the works to local residents and businesses; • A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out; • It is the responsibility of the contractor at all times to demonstrate full compliance with the dust control conditions herein; and • At all times, the procedures put in place will be strictly monitored and assessed. The dust minimisation measures shall be reviewed at regular intervals during the works to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures. In the event of dust nuisance occurring outside the site boundary, site activities will be reviewed and satisfactory procedures implemented to rectify the problem. Specific dust control measures to be employed are described below.
Construction – *site roads / haulage routes*	Movement of construction trucks along site roads (particularly unpaved roads) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80% (UK Office of Deputy Prime Minister, 2002). • A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles using unpaved site roads; • Access gates to the site shall be located at least 10m from sensitive receptors where possible; • Bowsers or suitable watering equipment will be available during periods of dry weather throughout the construction period. Research has found that watering can reduce dust emissions by 50% (USEPA, 1997). Watering shall be conducted during sustained dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use; and • Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.

Construction phase – *Land clearing / earth moving*	Land clearing / earth-moving works during periods of high winds and dry weather conditions can be a significant source of dust. • During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust; and • During periods of very high winds (gales), activities likely to generate significant dust emissions should be postponed until the gale has subsided.
Construction phase – *storage piles*	The location and moisture content of storage piles are important factors which determine their potential for dust emissions. • Overburden material will be protected from exposure to wind by storing the material in sheltered regions of the site. Where possible storage piles should be located downwind of sensitive receptors; • Regular watering will take place to ensure the moisture content is high enough to increase the stability of the soil and thus suppress dust. The regular watering of stockpiles has been found to have an 80% control efficiency (UK Office of Deputy Prime Minister, 2002); and • Where feasible, hoarding will be erected around site boundaries to reduce visual impact. This will also have an added benefit of preventing larger particles from impacting on nearby sensitive receptors.
Construction phase – *Site traffic on public roads*	Spillage and blow-off of debris, aggregates and fine material onto public roads should be reduced to a minimum by employing the following measures: • Vehicles delivering or collecting material with potential for dust emissions shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust; and • In addition, public roads outside the site shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary.
Construction phase – *Dust mitigation*	The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory performance of the contractor. The key features with respect to control of dust will be: • The specification of a site policy on dust and the identification of the site management responsibilities for dust issues; • The development of a documented system for managing site practices with regard to dust control; • The development of a means by which the performance of the dust minimisation plan can be regularly monitored and assessed; • The specification of effective measures to deal with any complaints received.
Operational phase – *Air Quality*	The stack heights of the gas generators have been designed in an iterative fashion to ensure that an adequate height was selected to aid dispersion of the plume. Provided each gas generator flue stack is built to a height of 25m above local ground level and based on the site layout modelled, the air impact assessment has demonstrated that mitigation measures are not required. Similarly, the standby diesel generators have been designed in an iterative fashion to ensure that an adequate height was selected to aid dispersion of the plume. Provided each standby diesel generator flue stack is built to a height of 25m above local ground level and based on the site layout modelled and hours of operation, the air impact assessment has demonstrated that mitigation measures are not required.
Operational phase - *Climate*	On-site emissions of greenhouse gases will mainly derive from the gas generators with infrequent standby emissions due to the diesel generators. However, the emissions from the gas generators will form part of the EU-wide Emission Trading Scheme (ETS) and thus greenhouse gas emission from onsite electricity generation are not included when determining compliance with the targeted 30% reduction in the non-ETS sector. In addition, gas generators have the lowest greenhouse gas emission rate of any fossil fuel. Thus, no mitigation measures for the gas generators will be required.
	Landscape and visual assessment
Operational – *visual impact*	The mitigation of potential negative landscape and visual impacts has influenced the design and layout of the scheme from the beginning of the design process (refer to

	Landscape Mitigation Drawing). As a result, the following landscape design mitigation measures have been made: • earth modelling and large tree planting reinforced with woodland whip planting in belts is proposed to provide a high level of visual screening of the most sensitive views of the development; and • the creation of a large wetland and woodland habitat in a buffer zone between the canal and the built development • the colour palette chosen for the building aims to further reduce any visual impact of the building.
	Traffic and transportation
Construction – *CMP*	The Construction Management Plan prepared by Winthrop (see Appendix 12.1 of the EIAR) incorporates a range of integrated control measures and associated management initiatives with the objective of mitigating the impact of the proposed developments on-site construction activities. To minimise disruption to the surrounding environment, the following mitigation measures will be implemented: • During the pre-construction phase, the site will be securely fenced off from adjacent properties, public footpaths and roads. • All road works will be adequately signposted and enclosed to ensure the safety of all road users and construction personnel. • A dedicated 'construction' site access / egress junction will be provided during all construction phases. This will coincide with the overall site access/ • Provision of sufficient on-site parking and compounding to ensure no potential overflow of construction generated traffic onto the local network. • Site offices and compound will be located within the site boundary. The site will be able to accommodate employee and visitor parking throughout the construction period through the construction of temporary hardstanding areas. • A material storage zone will also be provided in the compound area. This storage zone will include material recycling areas and facilities. • A series of 'way finding' signage will be provided to route staff / deliveries into the site and to designated compound / construction areas. • Dedicated construction haul routes will be identified and agreed with the local authority prior to the commencement of constructions activities on-site. • Truck wheel washes will be installed at construction entrances if deemed necessary and any specific recommendations with regard to construction traffic management made by the Local Authority will be adhered to. • On completion of the works all construction materials, debris, temporary hardstands etc. from the site compound will be removed off site and the site compound area reinstated in full on completion of the works. All construction related parking will be provided on site. Construction traffic will consist of the following two principal categories: • Private vehicles owned and driven by site construction staff and by full time supervisory staff; • Excavation plant and dumper trucks involved in site development works and material delivery vehicles for the following: granular fill materials, concrete pipes, manholes, reinforcement steel, ready mix concrete and mortar, concrete blocks, miscellaneous building materials, etc. It is anticipated that the generation of HGV's during the construction period will be evenly spread throughout the day and as such will not impact significantly during the peak traffic periods.
Operational – *traffic and transportation*	The Adamstown Road (R120) and Nangor Road (R134) Improvement Scheme provides suitable infrastructure and transport services for travel by sustainable modes. A key barrier to modal shift towards sustainable modes of travel is often a lack of information about potential alternatives to the car. As such, it is proposed that staff at the data centre are made aware of potential alternatives including information on walking, cycle routes and public transport. The local area provides suitable infrastructure and transport services for travel by sustainable

	modes. A key barrier to modal shift towards sustainable modes of travel is often a lack of information about potential alternatives to the car. As such, it is proposed that staff and visitors of the proposed development are made aware of potential alternatives including information on walking, cycle routes and public transport. A number of walking and cycling connection points are proposed within the development. These connection points will provide access for pedestrians and cyclists onto the R120. These facilities will provide attractive, convenient and safe routes for staff & visitors. Therefore, there are good links proposed for staff to travel by more sustainable modes. It is proposed to provide car parking that will meet the expected-on site demand. The marketing of new pedestrian & cyclists routes along with public transport information will further reinforce the efforts been made towards a modal shift away from car-based trips. Staff will be encouraged to avail of these facilities for travel to and from work. Provision of this information would be made upon opening of the proposed development, as this represents the best opportunity to secure travel behaviour change. It is anticipated that this measure may help to reduce the level of traffic at the proposed development, thus providing mitigation against the already minimal traffic and transport effects of the development.
Operational phase - *CTMP*	A Construction Traffic Management Plan (CTMP) would be prepared by the appointed contractor in order to minimise the potential impact of the construction phase of the proposed development on the safety and amenity of other users of the public road.
	Cultural heritage
Construction phase - *Archaeology*	A programme of licensed archaeological monitoring will be agreed with the National Monuments Service of the Department of Culture, Heritage and the Gaeltacht, for areas not previously subjected to archaeological testing. A report outlining the results of the programme of archaeological monitoring will be prepared and will include a detailed method statement for any archaeological excavation of features identified, agreed in advance with the National Monuments Service of the Department of Culture, Heritage and the Gaeltacht. The report will include a schedule of works detailing timeframes, personnel and logistical requirements. Any areas that require archaeological excavation will be cordoned off to facilitate the archaeological team to carry out the excavations. A buffer zone will be agreed with National Monuments Service and no construction works will be undertaken in these areas until archaeological excavations have been completed. Provision has been made for all costs associated with archaeological testing, any required excavations and reporting of the results to the standards required by the National Monuments Service of the Department of Culture, Heritage and the Gaeltacht. The remedial or reductive mitigation measures outlined here are subject to the approval of the National Monuments Service of the Department of Culture, Heritage and the Gealtacht.
Operational phase – *cultural heritage*	No remedial or reductive measures are considered necessary during the operational phase of the proposed development, as the operational phase will not give rise to any adverse impacts.
	Waste management
Construction – *C&D WMP*	A project specific C&D WMP has been prepared in line with the requirements of the *Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects* guidance document issued by the Department of Environment, Heritage and Local Government (DoEHLG). Adherence to the high-level strategy presented in this C&D WMP will ensure effective waste management and minimisation, reuse, recycling, recovery and disposal of waste material generated during the construction phase of the Proposed Development. Prior to commencement of construction, the contractor(s) will be required to refine/update this document to detail specific measures to minimise waste generation and resource consumption and provide details of the proposed waste contractors and destinations of each waste stream. The project engineers have estimated that c. 5,875 m^3 soil, subsoil, and stones and up to c. 16,117 m^3 of topsoil will be generated from the excavations to facilitate construction. The main contractor will endeavour to ensure that surplus material is reused on site where possible.

	Surplus material that is not required for reuse onsite, will be reused or recovered off-site insofar as is reasonably practicable. Where there is no suitable reuse or recovery option available, it will be disposed of at an authorised facility. In addition, the following mitigation measures will be implemented: • Building materials will be chosen with an aim to 'design out waste'; • On-site segregation of waste materials will be carried out to increase opportunities for off-site reuse, recycling and recovery – it is anticipated that the following waste types, at a minimum, will be segregated: - Concrete rubble (including ceramics, tiles and bricks); - Plasterboard; - Metals; - Glass; and - Timber. • Left over materials (e.g. timber off-cuts, broken concrete blocks/bricks) and any suitable construction materials shall be re-used on-site, where possible; • All waste materials will be temporarily stored in skips or other suitable receptacles in designated areas of the site; • Any hazardous wastes generated (such as chemicals, solvents, glues, fuels, oils) will also be segregated and will be stored in appropriate receptacles (in suitably bunded areas, where required); • A person responsible for waste management will be appointed by the main contractor(s) to ensure effective management of waste during the excavation and construction works; • All construction staff will be provided with training regarding the waste management procedures: • All waste leaving site will be reused, recycled or recovered where possible to avoid material designated for disposal; • All waste leaving the site will be transported by suitable permitted contractors and taken to suitably registered, permitted or licensed facilities; and • All waste leaving the site will be recorded and copies of relevant documentation maintained. Nearby sites requiring clean fill material will be contacted to investigate reuse opportunities for clean and inert material that requires removal off-site. If any of the material is to be reused on another site as by-product (and not as a waste), this will be completed in accordance with Article 27 of the *EC (Waste Directive) Regulations (2011)* as detailed in the C&D WMP (Appendix 14.1). These mitigation measures will ensure that the waste arising from the construction phase of the development is dealt with in compliance with the provisions of the *Waste Management Act 1996*, as amended, associated Regulations, the *Litter Pollution Act 1997 to 2009* and the *EMR Waste Management Plan (2015 - 2021)*. It will also ensure optimum levels of waste reduction, reuse, recycling and recovery are achieved and will encourage sustainable consumption of resources.
Operational - *Waste*	All waste materials will be segregated into appropriate categories and will be temporarily stored in appropriate bins or other suitable receptacles in a designated, easily accessible areas on the site. In addition, the following mitigation measures will be implemented: • On-site segregation of all waste materials into appropriate categories including (but not limited to): - Dry Mixed Recyclables; - Organic food/green waste; - Mixed Non-Recyclable Waste; - Batteries (non-hazardous and hazardous); - Waste electrical and electronic equipment (WEEE) including computers, printers and other ICT equipment; and - Cleaning chemicals (solvents, pesticides, paints, adhesives, resins, detergents, etc.). • All waste materials will be stored in colour coded bins or other suitable receptacles in designated, easily accessible locations. Bins will be clearly labelled with the approved waste type to ensure there is no cross contamination of waste materials; • All waste collected from the development will be reused, recycled or recovered where possible, with the exception of those waste streams where appropriate facilities are currently not available; • All waste leaving the site will be transported by suitable permitted contractors and taken to

	suitably registered, permitted or licensed facilities; and • All waste leaving the site will be recorded and copies of relevant documentation maintained. These mitigation measures will ensure the waste arising from the development is dealt with in compliance with the provisions of the *Waste Management Act 1996*, as amended, associated Regulations, the *Litter Pollution Act 1997* and the *EMR Waste Management Plan (2015 - 2021)*. It will also ensure optimum levels of waste reduction, reuse, recycling and recovery are achieved.
	Material assets
Construction – *Service providers*	Construction of the Proposed Development will require connections to water supply and drainage infrastructure, power and telecommunications. Ongoing consultation with SDCC, Irish Water, Eirgrid, ESB and other relevant service providers within the locality and compliance with any requirements or guidelines they may have will ensure a smooth construction schedule without disruption to local and business community.
Construction – *Power and Electricity supply*	The power demand for the construction phase will be relatively minor and the temporary connection works are entirely within the Proposed Development site, so that this would not have any potential offsite impact. The excavation of trenches within the vicinity of existing electrical services will be carried out in consultation with ESB Networks to ensure there is no impact on existing users. Once completed, ESB Networks will be mobilised to complete the commissioning in accordance with the ESB Network requirements. No remedial or mitigation measures are required in relation to power supply for the construction phase.
Construction phase - *Telecommunications*	A fibre optic cable distribution network will be installed within the site for the Proposed Development. The connection into the wider telecommunications network will be undertaken by a statutory telecommunications operator. No remedial or mitigation measures are required in relation to telecommunications.
Construction phase – *Water supply, surface water and foul water infrastructure*	Run-off water containing silt will be contained on site and treated to ensure adequate silt removal. The works contractor will be obliged to put best practice measures in place to ensure that there are no interruptions to service in existing surface water drainage network. There will not be any interruptions to service in existing surface water sewers. Should interruptions to surface water infrastructure be anticipated, they will be agreed in advance. Strict quality control measures as outlined under the CEMP of the contractor will be undertaken while laying pipes to minimise or eradicate infiltration (where existing water in the ground enters the surface water infrastructure) and ex-filtration (where water in the surface water infrastructure escapes into the ground). *Foul drainage infrastructure* A temporary connection to the foul water drainage network will be made and is required for the welfare facilities for the construction staff. The foul water drainage network has sufficient available capacity for the wastewater discharges from the welfare facilities for the short term construction phase. The works contractor will be obliged to put a number of measures as outlined in Chapter 2 of this EIA Report and will be detailed within the CEMP in place to ensure that there is no impact on the existing foul drainage network during the construction works. Foul drainage construction for the Proposed Development will be in accordance with the relevant standards for design and construction, including the Irish Water Code of Practice for Wastewater Infrastructure, The Building Regulations Technical Guidance Document 'Part H' & the Regional Code of Practice for Drainage Works. Strict quality control measures that will be outlined within the CEMP will be undertaken while laying pipes to minimise or eradicate infiltration and ex-filtration. Portable toilets will be provided for construction staff. The existing sewer will be extended into the site to facilitate the Proposed Development. As the construction works are entirely within the site boundary and business park, this would not have any offsite impact. The works contractor will be obliged to put a number of measures in place as outlined under the CEMP to ensure that there is no impact on the foul drainage network of the business park. Strict quality control measures as outlined under the CEMP will be undertaken while laying pipes to minimise or eradicate infiltration and ex-filtration.

	Water supply Welfare facilities (canteens, toilets etc.) will be required for the construction staff. A temporary connection will be put in place for the construction phase. As the connection works are entirely within the Proposed Development site, and would therefore not have any potential offsite impact. The works contractor will be obliged to put best practice measures in place as outlined within the CEMP and elsewhere to ensure that there are no interruptions to service from the existing watermain. There will not be any interruptions to service from the existing water main, but should interruptions be required, they will be agreed in advance. Strict quality control measures as set out as best practice and as outlined under the CEMP will be undertaken while laying pipes to minimise or eradicate infiltration and ex-filtration.
Operational – *Power and electricity supply*	Eirgrid's All-Island Generation Capacity Statement 2017-2026 (published April 2017) sets out that Eirgrid has the capacity to provide for such developments and has factored this demand in its projections out to 2026. The Flexible Demand offer from Eirgrid requires an onsite energy generation solution for the site in the case where there are capacity issues on the National Grid. The Power Plants, as well as providing short term permanent power will also provide mitigation back-up power supply in line with the Eirgrid offer for the site. The *Heat Recovery Feasibility Report* that accompanies this planning application also describes how waste heat associated with the facility has the capacity with a future district heating scheme developed by others. Further detail is provided in the *Heat Recovery Feasibility Report by Ethos engineering* which accompanies the planning application.
Operational - *Telecommunications*	There is sufficient capacity available in the area network for the Proposed Development. Therefore, no remedial or mitigation measures are required in relation to telecommunications.
Operational - *water supply, surface water and foul water infrastructure*	*Surface water infrastructure* The surface water drainage system for the Proposed Development incorporates runoff control in the form of attenuation, which will restrict discharge from the Proposed Development to the allowable greenfield runoff rate. The attenuation storage and interceptors allows for any detritus material to be removed from the water and aids in particulate removal, increasing overall storm water quality prior to disposal. To limit the discharges from the attenuation zones to pre-development levels flow control devices are required. It is proposed to use 'Hydrobrake' flow control systems to achieve the required discharge rates. SuDS measures will prevent an increase in the rate of surface water runoff offsite. The allowable greenfield runoff rate has been established by the project engineers, Pinnacle, Consulting Engineers, using the methodology set out in the Water Services Report. A Class 1 Bypass Oil Separator will be used to treat runoff prior to discharging from site. *Foul drainage infrastructure* Foul drainage for the Proposed Development will be in accordance with the Building Regulations Technical Guidance Document H for design and construction and Irish Waters Code of Practice for Wastewater Infrastructure. The foul drainage network will be maintained by maintenance staff to ensure system is fit for purpose and to address any operational issues should they arise over the life time of the Proposed Development. No additional remedial or mitigation measures are required in relation to foul drainage infrastructure. *Water supply* Cold water storage tanks will be provided as part of the Proposed Development; pumps will supply water to the Proposed Development from the storage tanks. The storage tanks will act as break tanks and buffer demand on the public watermain infrastructure. Further discussions are ongoing with Irish Water. No remedial or mitigation measures are required in relation to water supply.

CHAPTER 6 - BIODIVERSITY

Appendix 6.1 Protected sites for Nature Conservation in the Vicinity of the Proposed Development

European sites in the vicinity of the proposed development are listed below in Table 1, along with their qualifying/special conservation interests, reference to the most recent conservation objectives document, and their location relative to the proposed development site.

Other nationally protected sites for nature conservation in the vicinity of the proposed development are listed below in Table 2 along with the nature conservation interests for which they are designated, and their location relative to the proposed development site.

European Site Name [Code] and its Qualifying interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	**Location Relative to the Proposed Development Site**
Special Area of Conservation (SAC)	
Rye Water Valley/Carton SAC [001398] [7220] Petrifying springs with tufa formation (*Cratoneurion*)* [1014] Narrow-mouthed Whorl Snail *Vertigo angustior* [1016] Desmoulin's Whorl Snail *Vertigo moulinsiana* NPWS (2020) Conservation objectives for Rye Water Valley/Carton SAC [001398]. Generic Version 7.0. Department of Culture, Heritage and the Gaeltacht.1	c. 4.1km north-west of the proposed development
Glenasmole Valley SAC [001209] [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) [6410] Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [7220] Petrifying springs with tufa formation (*Cratoneurion*) NPWS (2018) *Conservation objectives for Glenasmole Valley SAC [001209]*. Generic Version 6.0. Department of Culture, Heritage and the Gaeltacht.	c. 9.8km south-east of the proposed development
Wicklow Mountains SAC [002122] [3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3160] Natural dystrophic lakes and ponds [4010] Northern Atlantic wet heaths with *Erica tetralix* [4030] European dry heaths [4060] Alpine and Boreal heaths [6130] *Calaminarian* grasslands of the *Violetalia calaminariae* [6230] Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [7130] Blanket bogs (* if active bog) [8110] Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) [8210] Calcareous rocky slopes with chasmophytic vegetation [8220] Siliceous rocky slopes with chasmophytic vegetation [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [1355] Otter *Lutra lutra*	c. 11.4km south of the proposed development

[1] The versions of the conservation objectives documents referenced in this table are the most recent published versions at the time of writing

European Site Name [Code] and its Qualifying Interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Proposed Development Site
NPWS (2017) *Conservation Objectives: Wicklow Mountains SAC 002122*. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.	
North Dublin Bay SAC [000206] 1140 Mudflats and sandflats not covered by seawater at low tide 1210 Annual vegetation of drift lines 1310 Salicornia and other annuals colonising mud and sand 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) 1395 Petalwort *Petalophyllum ralfsii* 1410 Mediterranean salt meadows (*Juncetalia maritimi*) 2110 Embryonic shifting dunes 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) 2130 Fixed coastal dunes with herbaceous vegetation (grey dunes) 2190 Humid dune slacks NPWS (2013) *Conservation Objectives: North Dublin Bay SAC 000206*. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	c. 18.8km east of the proposed development
Red Bog, Kildare SAC [000397] 7140 Transition mires and quaking bogs NPWS (2019) *Conservation Objectives: Red Bog, Kildare SAC 000397*. Version 1. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht.	c. 15km south of the proposed development
South Dublin Bay SAC [000210] 1140 Mudflats and sandflats not covered by seawater at low tide 1210 Annual vegetation of drift lines 1310 Salicornia and other annuals colonising mud and sand 2110 Embryonic shifting dunes NPWS (2013) *Conservation Objectives: South Dublin Bay SAC 000210*. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	c. 16.4km east of the proposed development
Special Protected Area (SPA)	
North Bull Island SPA [004006] A046 Light-bellied Brent Goose *Branta bernicla hrota* A048 Shelduck *Tadorna tadorna* A052 Teal *Anas crecca* A054 Pintail *Anas acuta* A056 Shoveler *Anas clypeata* A130 Oystercatcher *Haematopus ostralegus* A140 Golden Plover *Pluvialis apricaria* A141 Grey Plover *Pluvialis squatarola* A143 Knot *Calidris canutus* A144 Sanderling *Calidris alba* A149 Dunlin *Calidris alpina* A156 Black-tailed Godwit *Limosa limosa* A157 Bar-tailed Godwit *Limosa lapponica*	c. 15.7km east from the proposed development

European Site Name [Code] and its Qualifying interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Proposed Development Site
A160 Curlew *Numenius arquata* A162 Redshank *Tringa totanus* A169 Turnstone *Arenaria interpres* A179 Black-headed Gull *Croicocephalus ridibundus* A999 Wetlands & Waterbirds NPWS (2015) *Conservation Objectives: North Bull Island SPA 004006.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	
Wicklow Mountains SPA [004040] [A098] Merlin *Falco columbarius* [A103] Peregrine *Falco peregrinus* NPWS (2018) *Conservation objectives for Wicklow Mountains SPA [004040].* Generic Version 6.0. Department of Culture, Heritage and the Gaeltacht.	*c.* 16.4km south-east of the proposed development
South Dublin Bay and River Tolka Estuary SPA [004024] A046 Light-bellied Brent Goose *Branta bernicla hrota* A130 Oystercatcher *Haematopus ostralegus* A137 Ringed Plover *Charadrius hiaticula* A141 Grey Plover *Pluvialis squatarola* A143 Knot *Calidris canutus* A144 Sanderling *Calidris alba* A149 Dunlin *Calidris alpina* A157 Bar-tailed Godwit *Limosa lapponica* A162 Redshank *Tringa totanus* A179 Black-headed Gull *Croicocephalus ridibundus* A192 Roseate Tern *Sterna dougallii* A193 Common Tern *Sterna hirundo* A194 Arctic Tern *Sterna paradisaea* A999 Wetland and Waterbirds NPWS (2015) *Conservation Objectives: South Dublin Bay and River Tolka Estuary SPA 004024.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	*c.* 16.4km east of the proposed development

Table 1: European sites in the vicinity of the proposed development.

Designated Site Name [Code] and its nature conservation features	Location Relative to the Proposed Development Site
proposed Natural Heritage Area (pNHA)	
Grand Canal pNHA [002104] Diversity of flora species the canal ecosystem supports and the presence of legally protected plant species, opposite-leaved pondweed *Groenlandia densa*.	located within a small section of the north-western corner of the proposed development boundary
Liffey Valley pNHA [000128]	*c.* 2.8km north of the proposed development site

Designated Site Name [Code] and its nature conservation features	Location Relative to the Proposed Development Site
The site is important for its diversity of habitats within, ranging from terrestrial to aquatic. A number of rare and threatened plant species, such as *Scrophularia umbrosa*, *Hypericum hirsutum* and *Lamiastrum caleobdolon* have been recorded from the site.	
Rye Water Valley/Carton pNHA [001398] Diversity of flora and fauna species the river ecosystem supports – see also Rye Water Valley/Carton SAC in Table 1 above.	*c.* 4.2km north-west of the proposed development
Royal Canal pNHA [002103] Diversity of flora species the canal ecosystem supports and the presence of legally protected plant species, opposite-leaved pondweed *Groenlandia densa*.	*c.* 4.5km north of the proposed development
Lugmore Glen pNHA [001212] The site is important as it is a fine example of wooded glen with a good representation of woodland flora. This type of habitat is scarce in Co. Dublin. The site also holds a Red Data Book species *Lamiastrum galeobdolon*.	*c.* 7km south of the proposed development site
Dodder Valley pNHA [000991] The site represents the last remaining stretch of natural riverbank vegetation on the River Dodder in the built-up Greater Dublin Area. Includes a diversity of flora and bird species as well.	*c.* 8.8km south-east of the proposed development site
Slade of Saggart and Crooksling Glen pNHA [000211] The site includes a good example of a wooded river valley and a small wetland system. The presence of a rare plant, a rare invertebrate and a variety of wildfowl species adds to the interest of the site.	*c.* 6.7km south of the proposed development site
Glenasmole Valley pNHA [001209] Listed under similar conservation objectives as its SAC designation.	*c.* 9.5km south-east of the proposed development site
Kilteel Wood pNHA [001394] The site is a fine example of a largely deciduous wood. Its elevated position gives it scenic value.	*c.* 10.8km south-west of the proposed development site
Red Bog, Kildare pNHA [000397] Listed under similar conservation objectives as its SAC and SPA designations.	*c.* 15km south of the proposed development site
South Dublin Bay pNHA [000210] Listed under similar conservation objectives as its SAC and SPA designations.	*c.* 16km east of the proposed development site
North Dublin Bay pNHA [000210] Listed under similar conservation objectives as its SAC and SPA designations.	*c.* 15km east of the proposed development site
Booterstown Marsh pNHA [001205] The site is designated for its tidal habitats, rare flora and wintering bird populations.	*c.* 17.1km east of the proposed development site
Dolphins, Dublin Docks pNHA [000201] Listed for similar objectives as the South Dublin Bay and River Tolka Estuary SPA.	*c.* 17.2km east of the proposed development site

Table 2: Nationally protected sites in the vicinity of the proposed development

Appendix 6.2 Desk study Flora and Fauna records

Desktop records of protected, rare, or other notable plant species, from within the same hectad grid square in which the proposed development is located (i.e. O03), are listed below in Table 3. These are plant species which are legally protected under the Flora (Protection) Order, 2015 and/or are listed as Critically Endangered, Endangered or Vulnerable on the relevant national Red Data list for Ireland[2].

Common Name/ Scientific name	Legal Status[3]	Red List Status	Source
Basil thyme *Clinopodium acinos (Acinos arvensis)*	FPO	none	NPWS database record
Betony *Betonica officinalis (Stachys officinalis)*	FPO	none	NPWS database record
Green figwort *Scrophularia umbrosa*	None	Endangered	NPWS database record
Hairy St. John's-wort *Hypericum hirsutum*	FPO	Vulnerable	NPWS database record
Hairy violet *Viola hirta*	FPO	Vulnerable	NPWS database record
Meadow barley *Hordeum secalinum*	FPO	Vulnerable	NPWS database record
Opposite-leaved pondweed *Groenlandia densa*	FPO	Endangered	NBDC online database record NPWS database record
Red-hemp nettle *Galeopsis angustifolia*	FPO	Vulnerable	NPWS database record

Table 3: Records of protected, red-listed or notable flora recorded from the desk study in the vicinity of the study area.

Desktop records of protected, rare, or other notable fauna species are listed below in Table 4. In relation to amphibian, reptile and mammal species those which are protected under the Wildlife Acts, the Habitats Directive and/or are listed as threatened (Vulnerable to Critically Endangered) on the relevant national Red Lists are included. In the case of bird species, only those species listed in Annex I of the *Birds Directive or on the Birds of Conservation Concern in Ireland* (BoCCI) Red List are included in the table below. For invertebrate species, those which are listed as threatened (Vulnerable to Critically Endangered) on the relevant national Red List are included.

[2] Vascular flora from Wyse Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M. & Wright, M. (2016) *Ireland Red List No. 10: Vascular Plants*. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin, Ireland.

Bryophytes from Lockhart, N., Hodgetts, N. & Holyoak, D. (2012) *Ireland Red List No.8: Bryophytes*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

[3] HDII/IV/V = Habitats Directive Annexes II/IV/V; FPO = Flora (Protection) Order, 2015; WA = Wildlife Acts

Common Name/ Scientific Name	Legal Status[4]	Red List Status[5]	Source
Amphibians and Reptiles			
Common frog *Rana temporaria*	HD_V, WA	Least concern	NBDC online database record NPWS database record
Common lizard *Zootoca vivipara*	WA	Least concern	NPWS database record
Smooth newt *Lissotriton vulgaris*	WA	Least concern	NBDC online database record NPWS database record
Mammals (Terrestrial)			
Badger *Meles meles*	WA	Least concern	NBDC online database record NPWS database record
Brown long-eared bat *Plecotus auritus*	HD_IV, WA	Least concern	NBDC online database record
Common pipistrelle *Pipistrellus pipistrellus*	HD_IV, WA	Least concern	NBDC online database record
Daubenton's bat *Myotis daubentonii*	HD_IV, WA	Least concern	NBDC online database record
Hedgehog *Erinaceus europaeus*	WA	Least concern	NBDC online database record NPWS database record
Irish hare *Lepus timidus* subsp. *hibernicus*	WA	Least concern	NBDC online database record NPWS database record
Irish stoat *Mustela erminea* subsp. *hibernica*	WA	Least concern	NBDC online database record NPWS database record
Leisler's bat *Nyctalus leisleri*	HD_IV, WA	Least concern	NBDC online database record

[4] HD_II/IV/V = Habitats Directive Annexes II/IV/V; WA = Wildlife Acts; BD_I/II/III = Birds Directive Annex I/II/III; OSPAR = Convention for the protection of the marine environment of the North-east Atlantic 1992

[5] Mammals from Marnell, F., Looney, D. & Lawton, C. (2019) *Ireland Red List No. 12: Terrestrial Mammals*. National Parks and Wildlife Service, Department of the Culture, Heritage and the Gaeltacht, Dublin, Ireland.

Birds from Colhoun, K. & Cummins, S. (2013) *Birds of Conservation Concern in Ireland 2014-2019*. Irish Birds 9:523-544.

Amphibians, reptiles and fish from King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., Fitzpatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011) *Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish*.

Non-Marine Molluscs from Byrne, A., Moorkens, E.A., Anderson, R., Killeen, I.J. & Regan, E.C. (2009) *Ireland Red List No. 2: Non-Marine Molluscs*.

Butterflies from Regan, E.C., Nelson, B., Aldwell, B., Bertrand, C., Bond, K., Harding, J., Nash, D., Nixon, D., & Wilson, C.J. (2010) *Ireland Red List No. 4: Butterflies*.

Moths from Allen, D., O'Donnell, M., Nelson, B., Tyner, A., Bond, K.G.M., Bryant, T., Crory, A., Mellon, C., O'Boyle, J., O'Donnell, E., Rolston, T., Sheppard, R., Strickland, P., Fitzpatrick, U., & Regan, E. (2016) *Ireland Red List No. 9: Macro-moths (Lepidoptera)*.

Damselflies and dragonflies from Nelson, B., Ronayne, C. & Thompson, R. (2011) *Ireland Red List No.6: Damselflies & Dragonflies (Odonata)*.

Water beetles from Foster, G. N., Nelson, B. H. & O Connor, Á. (2009) *Ireland Red List No. 1: Water beetles*.

Common Name/ Scientific Name	Legal Status[4]	Red List Status[5]	Source
Otter *Lutra lutra*	HD_II, V, WA	Least concern	NBDC online database record NPWS database record
Pine marten *Martes martes*	WA	Least concern	NPWS database record
Pygmy shrew *Sorex minutus*	WA	Least concern	NBDC online database record
Red squirrel *Sciurus vulgaris*	WA	Least concern	NBDC online database record NPWS database record
Soprano pipistrelle *Pipistrellus pygmaeus*	HD_IV, WA	Least concern	NBDC online database record
Birds			
Barn swallow *Hirundo rustica*	WA	Amber	NBDC online database record
Black-headed gull *Chroicocephalus ridibundus*	WA	Red	NBDC online database record
Common coot *Fulica atra*	WA	Red	NBDC online database record
Common kingfisher *Alcedo atthis*	BD_I, WA	Amber	NBDC online database record
Common Pheasant *Phasianus colchicus*	BD_II (I), III (I), WA	Green	NBDC online database record
Common redshank *Tringa totanus*	WA	Red	NBDC online database record
Common starling *Sturnus vulgaris*	WA	Amber	NBDC online database record
Common Wood Pigeon *Columba palumbus*	BD_II (I), III (I), WA	Green	NBDC online database record
European greenfinch *Pluvialis apricaria*	WA	Amber	NBDC online database record
European robin *Erithacus rubecula*	WA	Amber	NBDC online database record
Great black-backed gull *Larus marinus*	WA	Amber	NBDC online database record
Great cormorant *Phalacrocorax carbo*	WA	Amber	NBDC online database record
Herring gull *Larus argentatus*	WA	Red	NBDC online database record
House martin *Delichon urbicum*	WA	Amber	NBDC online database record
House sparrow *Passer domesticus*	WA	Amber	NBDC online database record
Lesser black-backed gull *Larus fuscus*	WA	Amber	NBDC online database record
Little egret *Egretta garzetta*	BD_I, WA	Green	NBDC online database record

Common Name/ Scientific Name	Legal Status[4]	Red List Status[5]	Source
Little grebe *Tachybaptus ruficollis*	WA	Amber	NBDC online database record
Mistle thrush *Turdus viscivorus*	WA	Amber	NBDC online database record
Mute swan *Cygnus olor*	WA	Amber	NBDC online database record
Northern lapwing *Vanellus vanellus*	BD_II (II), WA	Red	NBDC online database record
Peregrine falcon *Falco peregrinus*	BD_I, WA	Red	NBDC online database record
Red kite *Milvus milvus*	WA	Amber	NBDC online database record
Tufted duck *Aythya fuligula*	BD_II (I), III (I), WA	Amber	NBDC online database record
Invertebrates			
Chaetarthria seminulum	none	Data Deficient	NBDC online database record
Trimmer's Mining Bee *Andrena trimmerana*	none	Critically Endangered	NBDC online database record
Andrena nigroaenea	none	Vulnerable	NBDC online database record
Desmoulin's whorl snail *Vertigo moulinsiana*	HB_II	Endangered	NPWS database record
Freshwater white-clawed crayfish *Austropotamobius pallipes*	HB_II, V, WA	Not evaluated for Ireland.	NBDC online database record NPWS database record

Table 4: Records of protected, red-listed or notable fauna from the desktop study in the vicinity of the study area.

Appendix 6.3 Examples of valuing important ecological features

International Importance:
'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation.
Proposed Special Protection Area (pSPA).
Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended).
Features essential to maintaining the coherence of the Natura 2000 Network.[6]
Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive.
Resident or regularly occurring populations (assessed to be important at the national level)[7] of the following:
Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or
Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.
Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).
World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).
Biosphere Reserve (UNESCO Man & The Biosphere Programme).
Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).
Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).
Biogenetic Reserve under the Council of Europe.
European Diploma Site under the Council of Europe.
Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 1988).[8]

National Importance:
Site designated or proposed as a Natural Heritage Area (NHA).
Statutory Nature Reserve.
Refuge for Fauna and Flora protected under the Wildlife Acts.
National Park.

[6] See Articles 3 and 10 of the Habitats Directive

[7] It is suggested that, in general, 1% of the national population of such species qualifies as an internationally important population. However, a smaller population may qualify as internationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

[8] Note that such waters are designated based on these waters' capabilities of supporting salmon (*Salmo salar*), trout (*Salmo trutta*), char (*Salvelinus*) and whitefish (*Coregonus*)

Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park.

Resident or regularly occurring populations (assessed to be important at the national level)[9] of the following:

Species protected under the Wildlife Acts; and/or

Species listed on the relevant Red Data list.

Site containing 'viable areas'[10] of the habitat types listed in Annex I of the Habitats Directive

County Importance:

Area of Special Amenity.[11]

Area subject to a Tree Preservation Order.

Area of High Amenity, or equivalent, designated under the County Development Plan.

Resident or regularly occurring populations (assessed to be important at the County level)[12] of the following:

Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;

Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;

Species protected under the Wildlife Acts; and/or

Species listed on the relevant Red Data list.

Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.

County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local Biodiversity Action Plan, if this has been prepared.

Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county.

Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.

Local Importance (higher value):

Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared;

[9] It is suggested that, in general, 1% of the national population of such species qualifies as a nationally important population. However, a smaller population may qualify as nationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

[10] A 'viable area' is defined as an area of a habitat that, given the particular characteristics of that habitat, was of a sufficient size and shape, such that its integrity (in terms of species composition, and ecological processes and function) would be maintained in the face of stochastic change (for example, as a result of climatic variation).

[11] It should be noted that whilst areas such as Areas of Special Amenity, areas subject to a Tree Preservation Order and Areas of High Amenity are often designated on the basis of their ecological value, they may also be designated for other reasons, such as their amenity or recreational value. Therefore, it should not be automatically assumed that such sites are of County importance from an ecological perspective.

[12] It is suggested that, in general, 1% of the County population of such species qualifies as a County important population. However, a smaller population may qualify as County important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

Resident or regularly occurring populations (assessed to be important at the Local level)[13] of the following:
Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
Species protected under the Wildlife Acts; and/or
Species listed on the relevant Red Data list.
Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality;
Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (lower value):
Sites containing small areas of semi-natural habitat that are of some local importance for wildlife;
Sites or features containing non-native species that are of some importance in maintaining habitat links.

[13] It is suggested that, in general, 1% of the local population of such species qualifies as a locally important population. However, a smaller population may qualify as locally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

Appendix 6.4 Flora Species List by Habitat

Dry meadows and grassy verges (GS2)		Hedgerows (WL1)		Treelines (WL2)	
Scientific Name	**DAFOR**	**Scientific Name**	**DAFOR**	**Scientific Name**	**DAFOR**
Dactylis glomerata	A	*Acer pseudoplatanus*	A	*Acer pseudoplatanus*	A
Urtica dioica	O	*Rubus fruticosus agg.*	A	*Rubus fruticosus agg.*	A
Ranunculus repens	F	*Hedera helix*	F	*Hedera helix*	F
Vicia sepium	R	*Vicia sepium*	R	*Crataegus monogyna*	F
Epilobium parviflorum	O	*Rosa canina agg.*	O	*Brachypodium sylvaticum*	O
Epilobium hirsutum	R	*Crataegus monogyna*	F	*Sambucus nigra*	O
Trifolium pratense	O	*Galium aparine*	R	*Anthriscus sylvestris*	O
Agrostis stolonifera	A	*Brachypodium sylvaticum*	O	*Urtica dioica*	O
Rumex obtusifolius	F	*Dactylis glomerata*	O	*Salix alba*	F
Taraxacum agg.	R	*Sonchus arvensis*	R		
Plantago lanceolata	R	*Sambucus nigra*	O		
Arctium minus	F	*Buddleia davidii*	R		
Triticum aestivum	R	*Prunus spinosa*	O		
Carex flacca	R	*Ilex aquifolium*	O		
Cirsium arvense	F				
Conyza floribunda	O				
Cirsium vulgare	R				
Rubus fruticosus agg.	R				
Crepis capillaris	R				
Conium maculatum	O				
Buddleia davidii	R				
Potentilla reptans	R				
Arrhenatherum elatius	F				
Senecio jacobaea	R				

Drainage Ditches (FW4)		Improved agricultural grassland (GA1)	
Scientific Name	**DAFOR**	**Scientific Name**	**DAFOR**
Agrostis stolonifera	A	*Holcus lanatus*	A
Ranunculus repens	A	*Urtica dioica*	O
Rubus fruticosus agg.	A	*Ranunculus repens*	O
		Trifolium pratense	O
		Rumex obtusifolius	O
		Taraxacum agg.	R

Recolonising bare ground (ED3)	
Scientific Name	**DAFOR**
Trifolium dubium	O
Conyza floribunda	O
Epilobium	R
Sagina procumbens	R
Rumex obtusifolius	O
Syntrichia ruralis	R
Didymodon species	A
Brachythecium rutabulum	O
Calliergonella cuspidata	R
Lolium perenne	F
Sonchus oleraceus	R
Cirsium vulgare	R
Bellis perennis	R
Bryum capillare	O
Senecio vulgaris	R
Agrostis stolonifera	O
Crepis capillaris	R
Arabidopsis tholiana	R
Cerastium fontanum	R
Euphorbia peplus	R
Cardamine hirsuta	R
Matricaria discoidea	R
Mercurialis annua	R
Galium aparine	O
Stellaria media	O
Lamium purpureum	O
Brassica rapa	O
Veronica persica	R

Recolonising bare ground (ED3)	
Sisymbrium officinale	R
Ranunculus repens	F
Trifolium dubium	O
Conyza floribunda	O

Appendix 6.5 Relevant Policies and objectives

Policies and objectives relevant to the proposed development and referenced in the chapter are presented in the following tables. Table 1 covers relevant policies and objectives found in the South Dublin County Development Plan 2016-2022, and includes those covering designated sites, water quality and biodiversity. Table 2 covers additional land use plan policies and objectives that are relevant in the wider area, together with the South Dublin County Development Plan 2016-2022, on European sites and water quality within Dublin Bay.

South Dublin County Development Plan 2016-2022
G Policy 1 Green Infrastructure It is the policy of the Council to protect, enhance and further develop a multifunctional Green Infrastructure network by building an interconnected network of parks, open spaces, hedgerows, grasslands, protected areas, and rivers and streams that provide a shared space for amenity and recreation, biodiversity protection, flood management and adaptation to climate change. **G1 Objective 1** To establish a coherent, integrated and evolving Green Infrastructure network across South Dublin County with parks, open spaces, hedgerows, grasslands, protected areas, and rivers and streams forming the strategic links and to integrate the objectives of the Green Infrastructure Strategy throughout all relevant Council plans, such as Local Area Plans and other approved plans. **G2 Objective 1** To reduce fragmentation of the Green Infrastructure network and strengthen ecological links between urban areas, Natura 2000 sites, proposed Natural Heritage Areas, parks and open spaces and the wider regional Green Infrastructure network. **G2 Objective 9** To preserve, protect and augment trees, groups of trees, woodlands and hedgerows within the County by increasing tree canopy coverage using locally native species and by incorporating them within design proposals and supporting their integration into the Green Infrastructure network. **G Policy 3 Watercourses Network** It is the policy of the Council to promote the natural, historical and amenity value of the County's watercourses; to address the long-term management and protection of these corridors and to strengthen links at a regional level. **G3 Objective 1** To promote the natural, historical and amenity value of the County's watercourses and address the long-term management and protection of these corridors in the South Dublin Green Infrastructure Strategy. **G3 Objective 2** To maintain a biodiversity protection zone of not less than 10 metres from the top of the bank of all watercourses in the County, with the full extent of the protection zone to be determined on a case by case basis by the Planning Authority, based on site specific characteristics and sensitivities. Strategic Green Routes and Trails identified in the South Dublin Tourism Strategy, 2015; the Greater Dublin Area Strategic Cycle Network; and other government plans or programmes will be open for consideration within the biodiversity protection zone, subject to appropriate safeguards and assessments, as these routes increase the accessibility of the Green Infrastructure network. **G3 Objective 5** To restrict the encroachment of development on watercourses, and provide for protection measures to watercourses and their banks, including but not limited to: the prevention of pollution of the watercourse, the protection of the river bank from erosion, the retention and/or provision of wildlife corridors and the protection from light spill in sensitive locations, including during construction of permitted development. **G6 Objective 1** To protect and enhance existing ecological features including tree stands, woodlands, hedgerows and watercourses in all new developments as an essential part of the design process. **HCL12 Objective 1**

To prevent development that would adversely affect the integrity of any Natura 2000 site located within and immediately adjacent to the County and promote favourable conservation status of habitats and protected species including those listed under the Birds Directive, the Wildlife Acts and the Habitats Directive.

HCL12 Objective 2

To ensure that projects that give rise to significant direct, indirect or secondary impacts on Natura 2000 sites, either individually or in combination with other plans or projects, will not be permitted unless the following is robustly demonstrated in accordance with Article 6(4) of the Habitats Directive and S.177AA of the Planning and Development Act (2000 – 2010) or any superseding legislation:

1. There are no less damaging alternative solutions available; and
2. There are imperative reasons of overriding public interest (as defined in the Habitats Directive) requiring the project to proceed; and
3. Adequate compensatory measures have been identified that can be put in place.

HCL15 Objective 3

To protect existing trees, hedgerows, and woodlands which are of amenity or biodiversity value and/ or contribute to landscape character and ensure that proper provision is made for their protection and management in accordance with Living with Trees: South Dublin County Council's Tree Management Policy 2015-2020.

IE Policy 1 Water & Wastewater

It is the policy of the Council to work in conjunction with Irish Water to protect existing water and drainage infrastructure and to promote investment in the water and drainage network to support environmental protection and facilitate the sustainable growth of the County.

IE1 Objective 1

To work in conjunction with Irish Water to protect, manage and optimise water supply and foul drainage networks in the County.

IE1 Objective 2

To work in conjunction with Irish Water to facilitate the timely delivery of ongoing upgrades and the expansion of water supply and wastewater services to meet the future needs of the County and the Region.

IE Policy 2 Surface Water & Groundwater

It is the policy of the Council to manage surface water and to protect and enhance ground and surface water quality to meet the requirements of the EU Water Framework Directive.

IE2 Objective 1

To maintain, improve and enhance the environmental and ecological quality of our surface waters and groundwater by implementing the programme of measures set out in the Eastern River Basin District River Basin Management Plan.

IE2 Objective 3

To maintain and enhance existing surface water drainage systems in the County and promote and facilitate the development of Sustainable Urban Drainage Systems (SUDS), including integrated constructed wetlands, at a local, district and County level, to control surface water outfall and protect water quality.

IE2 Objective 4

To incorporate Sustainable Urban Drainage Systems (SUDS) as part of Local Area Plans, Planning Schemes, Framework Plans and Design Statements to address the potential for Sustainable Urban Drainage at a site and/or district scale, including the potential for wetland facilities.

IE2 Objective 5

To limit surface water run-off from new developments through the use of Sustainable Urban Drainage Systems (SUDS) and avoid the use of underground attenuation and storage tanks.

IE2 Objective 6

To promote and support the retrofitting of Sustainable Urban Drainage Systems (SUDS) in established urban areas, including integrated constructed wetlands.
IE2 Objective 9
To protect water bodies and watercourses, including rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains, within the County from inappropriate development. This will include protection buffers in riverine and wetland areas as appropriate (see also Objective G3 Objective 2 – Biodiversity Protection Zone).

Table 1: Relevant land use plan policies/objectives within South Dublin County Development Plan 2016-2022 relating to the protection of designated sites, water quality and biodiversity.

Dún Laoghaire-Rathdown County Development Plan 2016-2022
Policy LHB19: Protection of Natural Heritage and the Environment
It is Council policy to protect and conserve the environment including, in particular, the natural heritage of the County and to conserve and manage Nationally and Internationally important and EU designated sites - such as Special Protection Areas, candidate Special Areas of Conservation, proposed Natural Heritage Areas and Ramsar sites - as well as non-designated areas of high nature conservation value which serve as 'Stepping Stones' for the purposes of Article 10 of the Habitats Directive.
Policy LHB20: Habitats Directive
It is Council policy to ensure the protection of natural heritage and biodiversity, including European sites that form part of the Natura 2000 network, in accordance with relevant EU Environmental Directives and applicable National Legislation, Policies, Plans and Guidelines.
Policy LHB22: Designated Sites
It is Council policy to protect and preserve areas designated as proposed Natural Heritage Areas, candidate Special Areas of Conservation, and Special Protection Areas. It is Council policy to promote the maintenance and as appropriate, delivery of 'favourable' conservation status of habitats and species within these areas.
Policy EI2: Wastewater Treatment and Appropriate Assessment
It is Council policy to provide adequate wastewater treatment facilities to serve the existing and future population of the County, subject to complying with the Water Framework Directive and the associated River Basin Management Plan or any updated version of this document, 'Water Quality in Ireland 2007-2009' (EPA 2011) or any updated version of the document, Pollution Reduction Programmes for Designated Shellfish Areas, the Urban Waste Water Treatment Directive and the Habitats Directive.
Policy EI3: Surface Water Drainage and Appropriate Assessment
It is Council policy to require that a Sustainable Drainage System (SuDS) is applied to any development and that site specific solutions to surface water drainage systems are developed, which meet the requirements of the Water Framework Directive and the associated River Basin Management Plans and 'Water Quality in Ireland 2007-2009' (EPA 2011) or any updated version of the document.
Fingal Development Plan 2017-2023
Objective NH10
Ensure that the Council takes full account of the requirements of the Habitats and Birds Directives, as they apply both within and without European Sites in the performance of its functions.
Objective NH11
Ensure that the Council, in the performance of its functions, takes full account of the objectives and management practices proposed in any management or related plans for European Sites in and adjacent to Fingal published by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.
Objective NH15
Strictly protect areas designated or proposed to be designated as Natura 2000 sites (i.e. Special Areas of Conservation (SACs) and Special Protection Areas (SPAs); also known as European sites) including any areas that may be proposed for designation or designated during the period of this Plan.
Objective SW04

Require the use of sustainable drainage systems (SuDS) to minimise and limit the extent of hard surfacing and paving and require the use of sustainable drainage techniques where appropriate, for new development or for extensions to existing developments, in order to reduce the potential impact of existing and predicted flooding risks.

Objective WQ01

Strive to achieve 'good status' in all waterbodies in compliance with the Water Framework Directive, the Eastern River Basin District Management Plan 2009-2015 and the associated Programme of Measures (first cycle) and to cooperate with the development and implementation of the second cycle national River Basin Management Plan 2017-2021.

Objective WQ04

Protect existing riverine wetland and coastal habitats and where possible create new habitats to maintain naturally functioning ecosystems whilst ensuring they do not impact negatively on the conservation objectives of any European Sites.

Objective WT01

Liaise with and work in conjunction with Irish Water during the lifetime of the plan for the provision, extension and upgrading of waste water collection and treatment systems in all towns and villages of the County to serve existing populations and facilitate sustainable development of the County, in accordance with the requirements of the Settlement Strategy and associated Core Strategy.

Objective WT02

Liaise with Irish Water to ensure the provision of wastewater treatment systems in order to ensure compliance with existing licences, EU Water Framework Directive, River Basin Management Plans, the Urban Wastewater Directive and the EU Habitats Directive.

Wicklow County Development Plan 2016-2022

NH2

No projects giving rise to significant cumulative, direct, indirect or secondary impacts on Natura 2000 sites arising from their size or scale, land take, proximity, resource requirements, emissions (disposal to land, water or air), transportation requirements, duration of construction, operation, decommissioning or from any other effects shall be permitted on the basis of this plan (either individually or in combination with other plans or projects).

Except as provided for in Section 6(4) of the Habitats Directive, viz. There must be a) no alternative solution available, b) imperative reasons of overriding public interest for the project to proceed; and c) Adequate compensatory measures in place.

NH3

To contribute, as appropriate, towards the protection of designated ecological sites including candidate Special Areas of Conservation (cSACs) and Special Protection Areas (SPAs); Wildlife Sites (including proposed Natural Heritage Areas); Salmonid Waters; Flora Protection Order sites; Wildfowl Sanctuaries (see S.I. 192 of 1979); Freshwater Pearl Mussel catchments; and Tree Preservation Orders (TPOs). To contribute towards compliance with relevant EU Environmental Directives and applicable National Legislation, Policies, Plans and Guidelines, including the following and any updated/superseding documents:

- EU Directives, including the Habitats Directive (92/43/EEC, as amended)7 , the Birds Directive (2009/147/EC)8 , the Environmental Liability Directive (2004/35/EC)9 , the Environmental Impact Assessment Directive (85/337/EEC, as amended), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC).
- National legislation, including the Wildlife Act 197610, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development Act 2000 (as amended), the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011) and the European Communities (Environmental Liability) Regulations 200811.

- National policy guidelines (including any clarifying Circulars or superseding versions of same), including the Landscape and Landscape Assessment Draft Guidelines 2000, the Environmental Impact Assessment Sub-Threshold Development Guidelines 2003, Strategic Environmental Assessment Guidelines 2004 and the Appropriate Assessment Guidance 2010.
- Catchment and water resource management Plans, including Eastern and South Eastern River Basin Management Plan 2009-2015 (including any superseding versions of same).
- Biodiversity Plans and guidelines, including Actions for Biodiversity 2011-2016: Ireland's 2nd National Biodiversity Plan (including any superseding version of same).
- Ireland's Environment 2014 (EPA, 2014, including any superseding versions of same), and to make provision where appropriate to address the report's goals and challenges.

NH4

All projects and plans arising from this plan12 (including any associated improvement works or associated infrastructure) will be screened for the need to undertake Appropriate Assessment under Article 6 of the Habitats Directive. A plan or project will only be authorised after the competent authority has ascertained, based on scientific evidence, Screening for Appropriate Assessment, and a Stage 2 Appropriate Assessment where necessary, that:

1) The Plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European site (either individually or in combination with other plans or projects); or

2) The Plan or project will have significant adverse effects on the integrity of any European site (that does not host a priority natural habitat type and / or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or

3) The Plan or project will have a significant adverse effect on the integrity of any European site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons for overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.

NH5

To maintain the conservation value of all proposed and future Natural Heritage Areas (NHAs) and to protect other designated ecological sites in Wicklow.

Along with cSACs, SPAs and pNHA these include Salmonid Waters; Flora Protection Order sites; Wildfowl Sanctuaries (see S.I. 192 of 1979); Freshwater Pearl Mussel catchments; and Tree Preservation Orders (TPOs).

WI2

To protect existing and potential water resources of the County, in accordance with the EU Water Framework Directive, the River Basin Management Plans, the Groundwater Protection Scheme and source protection plans for public water supplies.

WI12

Ensure the implementation of Sustainable Urban Drainage Systems (SUDS) and in particular, to ensure that all surface water generated in a new development is disposed of on-site or is attenuated and treated prior to discharge to an approved surface water system.

WI6

In order to fulfil the objectives of the Core Strategy, Wicklow County Council will work alongside and facilitate the delivery of Irish Water's Water Services Investment Programme, to ensure that all lands zoned for development are serviced by an adequate wastewater collection and treatment system and in particular, to endeavour to secure the delivery of regional and strategic wastewater schemes. In

particular, to support and facilitate the development of a WWTP in Arklow, at an optimal location following detailed technical and environmental assessment and public consultation.

WI7

Permission will be considered for private wastewater treatment plants for single rural houses where: • the specific ground conditions have been shown to be suitable for the construction of a treatment plant and any associated percolation area;

- the system will not give rise to unacceptable adverse impacts on ground waters / aquifers and the type of treatment proposed has been drawn up in accordance with the appropriate groundwater protection response set out in the Wicklow Groundwater Protection Scheme (2003);
- the proposed method of treatment and disposal complies with Wicklow County Council's Policy for Wastewater Treatment & Disposal Systems for Single Houses (PE ≤ 10) and the Environmental Protection Agency "Wastewater Treatment Manuals"; and
- in all cases the protection of ground and surface water quality shall remain the overriding priority and proposals must definitively demonstrate that the proposed development will not have an adverse impact on water quality standards and requirements set out in EU and national legislation and guidance documents.

WI9

Private wastewater treatment plants for commercial / employment generating development will only be considered where:

- Irish Water has confirmed the site is due to be connected to a future public system in the area6 or Irish Water have confirmed there are no plans for a public system in the area;
- it can clearly demonstrated that the proposed system can meet all EPA / Local Authority environmental criteria; and
- an annually renewed contract for the management and maintenance of the system is contracted with a reputable company / person, details of which shall be provided to the Local Authority.

Table 2: Relevant land use plan policies/objectives relating to the protection of European sites and water quality in Dublin Bay.

Appendix 6.6 Appropriate Assessment Screening Report

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Appropriate Assessment Screening Report

for DUB05 EdgeConneX Data Centre Development,

Ballymakaily, Co. Dublin

prepared for EdgeConneX Ireland Ltd.

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1 Introduction

This report, which contains information required for the competent authority (in this instance South Dublin County Council) to undertake a screening for Appropriate Assessment (AA), has been prepared by Scott Cawley Ltd. on behalf of the applicant. It provides information on, and assesses the potential for, the proposed development to impact on the Natura 2000 network (hereafter referred to as European sites)[1]. The proposed development consists of a data centre development, with associated landscaping, lighting and drainage.

An AA is required if significant effects on European sites arising from a proposed development cannot be ruled out at the screening stage, either alone or in combination with other plans or projects. It is the responsibility of the competent authority to make a decision as to whether or not the proposed development is likely to have significant effects on European sites, either individually or in combination with other plans or projects.

For the reasons set out in detail in this AA Screening Report, an **Appropriate Assessment of the proposed development is not required in this instance** as it can be concluded, on the basis of objective information, that the proposed development, either individually or in combination with other plans or projects, will not have a significant effect on any European sites.

2 Methodology

2.1 Guidance

This Appropriate Assessment Screening Report has been prepared with regard to the following guidance documents, as relevant:

- *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities.* (Department of Environment, Heritage and Local Government, 2010 revision)
- *Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities.* Circular NPW 1/10 & PSSP 2/10
- *Assessment of Plans and Projects Significantly Affecting Natura 2000 sites: Methodological Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (European Commission, 2001)
- *Communication from the Commission on the precautionary principle* (European Commission, 2000), and
- *Managing Natura 2000 Sites: The Provisions of Article 6 of the Habitat's Directive 92/43/EEC* (European Commission, 2019)

[1] The Natura 2000 network is a European network of important ecological sites, as defined under Article 3 of the Habitats Directive 92/43/EEC, which comprises both special areas of conservation and special protection areas. Special conservation areas are sites hosting the natural habitat types listed in Annex I, and habitats of the species listed in Annex II, of the Habitats Directive, and are established under the Habitats Directive itself. Special protection areas are established under Article 4 of the Birds Directive 2009/147/EC for the protection of endangered species of wild birds. The aim of the network is to aid the long-term survival of Europe's most valuable and threatened species and habitats.

In Ireland these sites are designed as European sites - defined under the Planning Acts and/or the Birds and Habitats Regulations as (a) a candidate site of Community importance, (b) a site of Community importance, (c) a candidate special area of conservation, (d) a special area of conservation, (e) a candidate special protection area, or (f) a special protection area. They are commonly referred to in Ireland as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

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2.2 Assessment Methodology

The above referenced guidance sets out a staged process for carrying out Appropriate Assessment. To determine if an Appropriate Assessment is required, documented screening is required. Screening identifies the potential for effects on the conservation objectives of European sites, if any, which would arise from a proposed plan or project, either alone or in combination with other plans and projects (i.e. likely significant effects).

Significant effects on a European site are those that would undermine the conservation objectives supporting the favourable conservation condition of the Qualifying Interest (QI) habitats and/or the QI/Special Conservation Interest (SCI) species of a European site(s).

Screening for Appropriate Assessment involves the following steps:

If the conclusions at the end of screening are that there is no likelihood of significant effects occurring on any European sites as a result of the proposed plan or project, either alone or in combination with other plans and projects, then there is no requirement to undertake an Appropriate Assessment.

In establishing which European sites are potentially at risk (in the absence of mitigation) from the proposed development, a source-pathway-receptor approach was applied. In order for an impact to occur, there must be a risk enabled by having a source (e.g. water abstraction or construction works), a receptor (e.g. a European site or its QI(s) or SCI(s)[2]), and a pathway between the source and the receptor (e.g. pathway by air for airborne pollution, or a pathway by a watercourse for mobilisation of pollution). For an impact to occur, all three elements must exist; the absence or removal of one of the elements means there is no possibility for the impact to occur.

The identification of source-pathway-receptor connection(s) between the proposed development and European sites essentially is the process of identifying which European sites are within the Zone of Influence (ZoI) of the proposed development, and therefore potentially at risk of significant effects. The ZoI is the area over which the proposed development could affect the receiving environment such that it could potentially have significant effects on the QI habitats or QI/SCI species of a European site, or on the achievement of their conservation objectives[3].

The identification of a source-pathway-receptor link does not automatically mean that significant effects will arise. The likelihood for significant effects will depend upon the characteristics of the source (e.g. extent and duration of construction works), the characteristics of the pathway (e.g. direction and strength of prevailing winds for airborne pollution) and the characteristics of the receptor (e.g. the sensitivities of the European site and its QIs/SCIs). Where uncertainty exists, the precautionary principle[4] is applied.

2.3 Desktop Data Review

The desktop data sources used to inform the assessment presented in this report are as follows (accessed on the 29th January 2021):

- Online data available on European sites and protected habitats/species as held by the National Parks and Wildlife Service (NPWS) from www.npws.ie[6], including conservation objectives documents

[2] The term qualifying interest is used when referring to the habitats or species for which an SAC is designated; the term special conservation interest is used when referring to the bird species (or wetland habitats) for which an SPA is designated

[3] As defined in the *Guidelines for Ecological Impact Assessment in the UK and Ireland* (CIEEM, 2018)

[4] The precautionary principle is a guiding principle that derives from Article 191 of the Treaty on the Functioning of the European Union and has been developed in the case law of the European Court of Justice (e.g. ECJ case C-127/02 – Waddenzee, Netherlands)

The guidance document *Communication from the Commission on the Precautionary Principle* (European Commission, 2000) notes that the precautionary principle *"covers those specific circumstances where scientific evidence is insufficient, inconclusive or uncertain and there are indications through preliminary objective scientific evaluation that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the chosen level of protection"*.

Applying the precautionary principle in the context of screening for appropriate assessment requires that where there is uncertainty or doubt about the risk of significant effects on a European site(s), it should be assumed that significant effects are possible and AA must be carried out.

[5] The following SAC and SPA GIS boundary datasets are the most recently available at the time of writing: SAC_ITM_2019_12 and SPA_ITM_2019_12

[6] The following SAC and SPA GIS boundary datasets are the most recently available at the time of writing: SAC_ITM_2019_12 and SPA_ITM_2019_12

- Online data available on protected species as held by the National Biodiversity Data Centre (NBDC) from www.biodiversityireland.ie
- Information on the surface water network and surface water quality in the area available from www.epa.ie
- Information on groundwater resources and groundwater quality in the area available from www.epa.ie and www.gsi.ie
- Ordnance Survey of Ireland mapping and aerial photography available from www.osi.ie
- Information on the location, nature and design of the proposed development supplied by the applicant's design team
- *Environmental Impact Assessment Report for DUB05 EdgeConnex Data Centre Development* (Marston Planning Consultancy, 2021)
- *Environmental Impact Assessment Report for EdgeConneX Ireland Ltd., Data Centre (Phase 4), Newcastle Road, Grange Castle* (Marston Planning Consultancy, 2018)
- *Environmental Impact Assessment Report for Road Infrastructure Development at Clonburris Strategic Development Zone, Co. Dublin* (Stephen Little & Associates, 2020)
- *Ecological Survey of Clonburris Strategic Development Zone, Clondalkin, Co. Dublin* (FERS, 2018)

2.4 Consultations

Consultation letters were submitted by email to the Development Applications Unit of the Department of Culture, Heritage and the Gaeltacht (DAU Ref: G Pre 00014/2021) on the 25th January 2021. The letters included an outline description of the proposed development and a request for any comments on the proposal. No response from either authority was received by Scott Cawley Ltd. prior to submission of the planning application for the proposed development.

Inland Fisheries Ireland was also contacted on the 25th January 2021 to request additional data on species which may use the Griffeen River and for any comments they may have on the proposal. No response was received by Scott Cawley Ltd. prior to submission of the planning application for the proposed development.

2.5 Baseline Surveys

This section describes the ecological surveys carried out to inform the assessment of likely significant effects on European sites.

2.5.1 Habitats and Flora Survey

A habitat survey was undertaken of the proposed development site on the 26th January 2021 by Alexis Fitzgerald B.A. (Hons) MSc and Síofra Quigley BSc (Hons) MSc of Scott Cawley Ltd. following the methodology described in *Best Practice Guidance for Habitat Survey and Mapping*[7]. All habitat types were classified using the *Guide to Habitats in Ireland*[8], recording the indicator species and abundance using the DAFOR scale[9] and recording any species of conservation interest. Vascular and bryophyte plant

[7] Smith, G.F., O'Donoghue, P., O'Hora, K. & Delaney, E. (2011) *Best Practice Guidance for Habitat Survey and Mapping*. The Heritage Council Church Lane, Kilkenny, Ireland.

[8] Fossitt, J.A. (2000) *A Guide to Habitats in Ireland*. Heritage Council, Kilkenny.

[9] The DAFOR scale is an ordinal or semi-quantitative scale for recording the relative abundance of plant species. The name DAFOR is an acronym for the abundance levels recorded: Dominant, Abundant, Frequent, Occasional and Rare.

nomenclature generally follow that of *The National Vegetation Database*[10], having regard to more recent taxonomic changes to species names after the *New Flora of the British Isles*[11] and the British Bryological Society's *Mosses and Liverworts of Britain and Ireland: A Field Guide*[12].

2.5.2 Fauna Surveys

2.5.2.1 Terrestrial Mammals (excl. Bats)

A terrestrial fauna survey (excluding bats) was undertaken on the 26th of January 2021 by Alexis Fitzgerald B.A. (Hons) MSc and Siofra Quigley BSc (Hons) MSc of Scott Cawley Ltd. The presence/absence of terrestrial fauna species were surveyed through the detection of field signs such as tracks, markings, feeding signs, and droppings, as well as by direct observation. The habitats on site were assessed for signs of usage by protected/red-listed fauna species, and their potential to support these species. Surveys to check for the presence of badger setts and otter holts within the study area, and to record any evidence of use, were undertaken on the 26th of January 2021.

3 Provision of Information for Screening for Appropriate Assessment

The following sections provide information to facilitate the Appropriate Assessment screening of the proposed development to be undertaken by the competent authority.

A description of the proposed development and the receiving environment is provided to identify the potential ecological impacts. The environmental baseline conditions are discussed, as relevant to the assessment of ecological impacts where they may highlight potential pathways for impacts associated with the proposed development to affect the receiving ecological environment (e.g. hydrological data).

The potential impacts are examined in order to define the potential zone of influence of the proposed development on the receiving environment. This then informs the assessment of whether the proposed development will result in significant effects on any European sites; i.e. affect the conservation objectives supporting the favourable conservation condition of the European site's QIs or SCIs.

3.1 Description of the Proposed Development

The proposed development of 22.1 hectares is to be located to the west of Grange Castle Business Park located in the townland of Ballymakaily between the N4 and N7 in west Dublin. The Grand Canal runs along the northern boundary of the site.

The development will consist of the construction of two no. single storey data centres with associated office and service areas; and three no. gas powered generation plant buildings with an overall gross floor area of 24,624sqm that will comprise of the following:

- Demolition of abandoned single storey dwelling, remaining agricultural shed and derelict former farm building;
- Construction of 2 no. single storey data centres (12,797sqm), both with associated plant at roof level; with 24 no. standby diesel generators with associated flues (each 25m high) that will be attached to a single storey goods receiving area / store and single storey office area (2,404sqm)

[10] Weekes, L.C. & FitzPatrick, U. (2010) The National Vegetation Database: Guidelines and Standards for the Collection and Storage of Vegetation Data in Ireland. Version 1.0. Irish Wildlife Manuals, No. 49. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

[11] Stace, C. (2019) *New Flora of the British Isles. 4th Edition*. C&M Floristics.

[12] Atherton, I., Bosanquet, S. & Lawley, M. (2010) *Mosses and Liverworts of Britain and Ireland. A Field Guide*. Latimer Trend & Co., Plymouth.

located to the west of the data centres as well as associated water tower and sprinkler tank and other services;

- amendments to the internal access road and omission of access to loading bay permitted under SDCC Planning Ref. SD19A/0042 / ABP Ref. PL06S.305948 that include the relocation of permitted, and new, internal security gates; and new internal access roads to serve the proposed development that will provide access to 39 no. new car parking spaces (including 4 no. electric and 2 no. disabled spaces) and sheltered bicycle parking to serve the new data centres;
- The development will also include the phased development of 3 no. two storey gas powered generation plants (9,286sqm) within three individual buildings and ancillary development to provide power to facilitate the development of the overall site to be located within the south-west part of the overall site. Gas Plant 1 (3,045sqm) will contain 20 no. generator units (18+2) with associated flues (each 25m high) will facilitate, once operational the decommissioning of the temporary Gas Powered Generation Plant within its open compound as granted under SDCC Planning Ref. SD19A/0042 / ABP Ref. PL06S.305948. Gas Plant 2 (3,045sqm) will contain 20 no. generator units (18+2) with associated flues (each 25m high); and Gas Plant 3 (3,196sqm) will contain 21 no. generator units (19+2) with associated flues (each 25m high). These Plants will be built to provide power to each data centre, if and, when required. The Gas Plants will be required as back-up power generation once the permanent power connection via the permitted substation is achieved;
- Green walls are proposed to the southern elevation of each Power plant, as well as to the northern elevation of the generator compound of the data centres, and enclosing the water tower/pump room compound; and a new hedgerow is proposed linking the east and west of the site; and
- Proposed Above Ground Gas Installation compound to contain single storey kiosk (93sqm) and boiler room (44sqm).

The development will also include ancillary site works, connections to existing infrastructural services as well as fencing and signage. The development will include minor modifications to the permitted landscaping to the west of the site as granted under SDCC Planning Ref. SD19A/0042 / ABP Ref. PL06S.305948. The site will remain enclosed by landscaping to all boundaries. The development will be accessed off the R120 via the permitted access granted under SDCC Planning Ref. SD19A/0042 / ABP Ref. PL06S.305948.

The site will be positively drained and surface water will be contained within the overall sites drainage network and managed in a sustainable manner, in accordance with all relevant guidelines and specifications.

Stormwater will discharge through an adequately sized attenuation pond at the northern end of the site ultimately discharging to the existing storm sewer to the north east of the site. The outflow from the attenuation pond, will be restricted by way of a Hydrobrake facility, which will limit the discharge to 9.60l/s, which is the calculated QBAR greenfield run-off rate. A connection to the existing off site Irish Water foul sewer and potable water network will be established.

The proposed development will result in an increased demand for water of c. 7.4 m3/day (average). A confirmation by Irish Water that this resource is available within the existing network is required.

With regard to foul water, the proposed development is proposed to discharge foul water from the proposed development, via a 225mm Ø gravity foul sewer outfall and discharge into the existing 450mm Ø connection. It is proposed that all foul condensate effluent from the proposed new data halls, will be connected into head manholes adjacent to the data halls. The peak wastewater flow will not be in excess of c. 0.54l/s. A confirmation by Irish Water that this discharge on the existing network is feasible is required.

There will be no blasting or other works that may impact groundwater.

The construction programme is expected to last 18 months.

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See *Environmental Impact Assessment Report for DUB05 EdgeConnex Data Centre Development* (Marston Planning Consultancy, 2021) Chapter 2 for a comprehensive description of the development.

3.2 Overview of the Receiving Environment

3.2.1 European sites

There are nine European sites located within *c.* 15km and downstream of the proposed development. The proposed development does not overlap with any European sites. The nearest European site is Rye Water Valley/Carton SAC, located *c.* 4.1km to the north-west of the proposed development site. The proposed development is hydrologically connected via the surface and foul water network to European sites further downstream in Dublin Bay (North Dublin Bay SAC, South Dublin Bay SAC, North Bull Island SPA and South Dublin Bay and River Tolka Estuary SPA).

All of the European sites present in the vicinity of the proposed development are shown on Figure 1 below. The QIs/SCIs of the European sites in the vicinity of the proposed development are provided in Appendix I.

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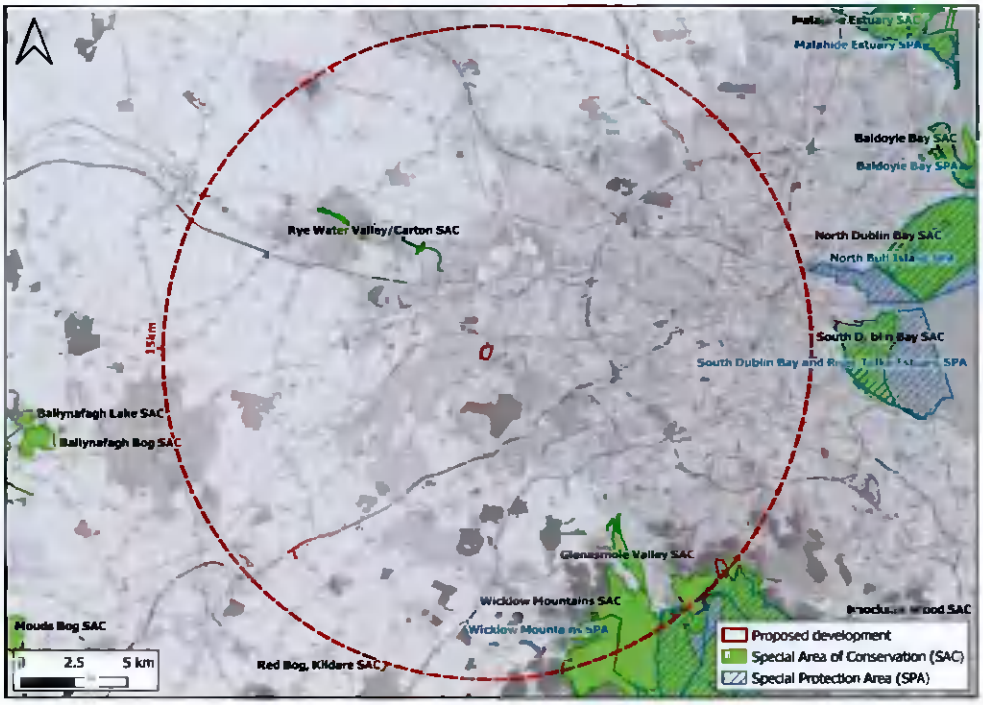
Figure 1 European sites in the vicinity of the proposed development



3.2.2 Habitats

32 The proposed development is flanked by the agricultural lands to the west and south, and by commercial areas to the east and north. The Grand Canal runs along the northern boundary.

33 The following habitat types assigned using the Heritage Council classification system[8] were identified within the proposed development site:

- Improved agricultural grassland (GA1)
- Dry meadows and grassy verges (GS2)
- Hedgerows (WL1)
- Treelines (WL2)
- Buildings and artificial surfaces (BL3)
- Recolonising bare ground (ED3)
- Drainage ditches (FW4)

34 At the time of survey, the habitats on site largely comprised of improved agricultural grassland (GA1), dry meadows and grassy verges (GS2) and recolonising bare ground (ED3).

35 There are no Annex I habitats present within the proposed development site or immediate environs. The hedgerows, treelines and dry meadows and grassy verges habitats within the proposed development are

considered to be of local importance (higher value). The habitat types are described in greater detail in Chapter 6 of the EIAR accompanying this application[13].

3.2.3 Flora and Fauna Species

The desktop study found did not find records for any Annex II flora within *c.* 2km of the proposed development. Field surveys undertaken at the proposed development site did not record any Annex II flora.

Otter & Desmoulin's whorl snail

The desktop study found records for two Annex II species, Desmoulin's whorl snail *Vertigo moulinsiana* and otter *Lutra lutra*, for which European sites in the vicinity of the proposed development are designated. There are two records for Desmoulin's whorl snail and three records for otter within *c.* 2km of the proposed development. The most recent record for Desmoulin's whorl snail is from the same grid square, O03, in which the proposed development site is located in, from 1945. The nearest European site designated for the species is the Rye Water Valley/Carton SAC, located *c.* 4.1km north-west, along the Rye Water, a tributary of the River Liffey. There is no suitable habitat for Desmoulin's whorl snail within the proposed development site.

The most recent record for otter in the NBDC database is from along the Grand Canal, *c.* 50m east of the proposed development, in 1980. The most recent observation of otter by Scott Cawley ecologists along the Grand Canal and near the proposed development is from the 1st February 2021. They have also previously observed otter in the Baldonnell stream that lies upstream of the Griffeen and are aware that artificial otter holts were installed along the Griffeen River when it was realigned as part of the Grangecastle area development (L. Higgins 2021, pers. comm. 1 February 2021). Otters are also known to use the River Liffey and the Camac River (Macklin *et al.*, 2019) and have been recorded on the Grand Canal. No evidence of otter was recorded within the proposed development site during field surveys undertaken in 2021. The closest European site for which otter is a QI is the Wicklow Mountains SAC, *c.* 14.3km south-east of the proposed development site.

Freshwater white-clawed crayfish

The NBDC data search yielded no records for Annex II species freshwater white-clawed crayfish *Austropotamobius pallipes* within c. 2km of the proposed development site. However, ecological studies[14] carried out in the Clonburris Strategic Development Zone (SDZ) in 2018 found populations of freshwater white-clawed crayfish in the Grand Canal and the Griffeen River. Freshwater white-clawed crayfish is also known from downstream River Liffey. There are no European sites designated upstream or downstream of the proposed development site. The nearest designated site for the species is the Lough Lene SAC, *c.* 60.8km north-west of the proposed development site.

Atlantic salmon

The NBDC did not yield any records for Atlantic salmon *Salmo salar* within *c.* 2km of the proposed development, however, previous reports[15] for the Clonburris SDZ provided records for Atlantic salmon *Salmo salar* in the Griffeen River. The nearest designated site for Atlantic salmon is the River Boyne and River Blackwater SAC, *c.* 30.9km north-west of the proposed development.

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[13] *Environmental Impact Assessment Report for DUB05 EdgeConnex Data Centre Development* (Marston Planning Consultancy, 2021)

[14] *Ecological Survey of Clonburris Strategic Development Zone, Clondalkin, Co. Dublin* (FERS, 2018).

[15] *Environmental Impact Assessment Report for Road Infrastructure Development at Clonburris Strategic Development Zone, Co. Dublin* (Stephen Little & Associates, 2020)

Wintering birds

41 The desktop study found records for 12 SCI wintering bird within *c.* 2km of the proposed development. A full list of SCI species from the desktop study is represented in Appendix III.

42 A single wintering bird survey was carried out for an EIAR[16] completed in 2018 on the 22nd November 2018 within the proposed development site. A flock of *c.* 300 lapwing *Vanellus vanellus* was recorded in the most southerly fields within the site boundary. The nearest designated site for lapwing is the Boyne Estuary SPA, located *c.* 43.9km north-east of the proposed development.

43 The proposed development is within the normal foraging range of SCI species of North Bull Island SPA and South Dublin Bay and River Tolka Estuary SPA; however, it comprises of limited areas of suitable foraging habitat due to grasslands being enclosed by hedgerows and/or treelines and lack of suitable foraging grounds (e.g. open amenity grassland). No other SCI species of any European sites were recorded in the vicinity of the proposed development site during field surveys.

Raptors

44 The desktop study found records for one SCI raptor species, peregrine *Falco peregrinus*, within *c.* 2km of the proposed development.

45 There is suitable foraging habitat for peregrine within the proposed development site. The nearest SPA designated for this species is the Wicklow Mountains SAC, located *c.* 14.3km south-east of the proposed development.

Non-native invasive species

46 With regards to records for non-native invasive species within *c.* 2km of the proposed development, the NBDC database search returned records for the following non-native invasive species:

- *Elodea nuttallii*, and,
- Eastern grey squirrel *Sciurus carolinensis*.

47 Both of these species are listed on the Third Schedule of the *European Communities (Birds and Natural Habitats) Regulations, 2011*. *Elodea nuttallii* has been recorded once in 2020, *c.* 1km east of the proposed development along the Grand Canal.

48 There are three records for Eastern grey squirrel, of which the most recent one is from the Finnstown Castle Hotel, *c.* 1.1km north, from 2015.

49 In addition to the NBDC data records, *Reynoutria japonica* was recorded by the Scott Cawley Ltd. surveyors along the Kishoge Road, *c.* 1.4km north-east during field surveys in 2020. *Reynoutria japonica* is listed on the Third Schedule of the *European Communities (Birds and Natural Habitats) Regulations, 2011*.

50 No non-native invasive species listed on the Third Schedule of the *European Communities (Birds and Natural Habitats) Regulations, 2011* were recorded within the proposed development site during the surveys in 2021.

3.2.4 Hydrology

51 There are no major waterbodies within the proposed development site, however, a network of drainage ditches connects the site to the Lucan Stream to the west, and the Griffeen River to the east. The nearest waterbody to the proposed development site is the Ballymakaily Stream, *c.* 150m, east of the proposed development. It joins the Griffeen River, *c.* 330m, east from its origin. The Griffeen River flows c. 180m east of the proposed development site towards north. It is joined by the Adamstown stream, *c.* 1km, the

[16] *Environmental Impact Assessment Report for EdgeConneX Ireland Ltd., Data Centre (Phase 4), Newcastle Road, Grange Castle* (Marston Planning Consultancy, 2018)

Laraghcon, *c.* 3.4km, and the Moat stream, *c.* 3.5km, north of the proposed development site, before its confluence with the River Liffey, *c.* 4km downstream of the proposed development site. The Lucan Stream is located *c.* 300m west of the proposed development. It runs northerly and is joined by the Tobermaclugg and Backtown Streams, *c.* 1.5km and *c.* 3km north, respectively, before merging into the River Liffey, *c.* 4.1km downstream of the proposed development. The Griffeen River, the Lucan Stream and all their adjoining streams, all have *'Good'* WFD status and are listed as *'At risk'* waterbodies by the EPA. Kilmahuddrick stream, not shown on the EPA maps, starts at the southern edge of the Griffeen Valley Park, before joining the Griffeen River, *c.* 330m north-west of its starting point in the park. The River Liffey has a *'Good'* WFD status until just downstream of the Lucan village, where it has a WFD status of *'Unassigned'* until Chapelizod, changing to *'Moderate'* and then to *'Good'* WFD status before joining the Upper and Lower Liffey Estuary waterbodies, *c.* 15.5km downstream and east of the proposed development site.

The Grand Canal runs along the northern boundary of the proposed development. It merges with the Lower Liffey Estuary waterbody *c.* 16km east of the proposed development site. It has a *'Good'* WFD status and is listed as being *'At Risk'* by the EPA. There is no direct hydrological connection between the Grand Canal and the proposed development site.

The Upper and Lower Liffey Estuary waterbodies have *'Good'* WFD status and are listed as *'At risk'* by the EPA. Dublin Bay, located *c.* 23.3km downstream of the proposed development site, is considered to be *'Unpolluted'* with a 'Good' WFD status and belongs to the *'Not at risk'* category.

The site is located within the Liffey sub-catchment and sub-basin in the Liffey and Dublin Bay catchment, which drain to Dublin Bay.

The waterbodies present in the vicinity of the proposed development are shown on Figure 2.

Figure 2 Waterbodies in the vicinity of the proposed development

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3.2.5 *Hydrogeology*

56 Geological Survey of Ireland (GSI) data indicates that the site is underlain by a Locally Important Bedrock Aquifer (Ll), which is moderately productive only in local zones. The site is located in an area of *'Extreme'* vulnerability, with bedrock close to surface at places, in relation to the underlying aquifer.

57 The Groundwater Body (GWB) underlying the site is the Dublin GWB, which is currently classified by the EPA as having *'Good Status'* and *'Not at risk'*. There is only one European site within the Dublin GWB designated for groundwater dependent terrestrial habitats and species, Rye Water Valley/Carton SAC, *c.* 4.1km north-west of the proposed development site.

3.3 Assessment of Effects on European Sites

58 This section identifies all the potential impacts associated with the proposed development, examines whether there are any European sites within the ZoI of effects from the proposed development, and assesses whether there is any risk of the proposed development resulting in a significant effect on any European site, either alone or in combination with other plans or projects.

59 In assessing the potential for the proposed development to result in a significant effect on any European sites, any measures intended to avoid or reduce the harmful effects of the project on European sites are not taken into account.

3.3.1 *Habitat loss and fragmentation*

60 The proposed development does not overlap with the boundary of any European site. Therefore, there are no European sites at risk of direct habitat loss impacts.

61 As the proposed development does not traverse any European sites there is no potential for habitat fragmentation to occur.

62 The proposed development site does not support populations of any fauna species linked with the QI populations of any European site.

- Otter - while the Griffeen River and the River Liffey are known to support otter, the population is not considered to form part of the QI population of any European sites. The closest European site for which otter is a QI is the Wicklow Mountains SAC, *c.* 14.3km south-west of the proposed development site. Due to distance and estimated foraging ranges for otter (estimated as 7.5 ± 1.5km in length for females, and 13.2 ± 5.3km in length for males)[17] the local population of otter is not considered to form part of the Wicklow Mountains SAC population.
- Freshwater white-clawed crayfish - there are no European sites designated for freshwater white-clawed crayfish hydrologically connected to the proposed development. The nearest European site for the species is the Lough Lene SAC, *c.* 60.8km north-west of the proposed development site.
- Atlantic salmon - the nearest European site for Atlantic salmon is the River Boyne and River Blackwater SAC, *c.* 30.9km north-west of the proposed development. Considering that the Griffeen River is located in a different sub-catchment than the River Boyne and River Blackwater SAC and its location relative to the proposed development site, Atlantic salmon populations found in this river do not form part of any SAC population.

63 The SCI species recorded within the proposed development site are not considered to be linked with the SCI populations of any European site. The proposed development is within the normal foraging range of SCI species of North Bull Island SPA and South Dublin Bay and River Tolka Estuary SPA; however, it

[17] Reid, N., Hayden, B., Lundy, M.G., Pietravalle, S., McDonald, R.A. & Montgomery, W.I. (2013) *National Otter Survey of Ireland 2010/12*. Irish Wildlife Manuals No. 76. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

comprises of limited areas of suitable foraging habitat (e.g. open amenity grassland) due to grasslands being enclosed by hedgerows and/or treelines, and due to the absence of suitable wetlands used by wintering SCI species.

Although lapwing was recorded during the surveys in 2018, the habitats (improved agricultural grassland (GA1), dry meadows and grassy verges (GS2) and recolonising bare ground (ED3)) recorded within the proposed development site in 2021 are considered sub-optimal habitat for the species, *i.e.* lapwing generally prefer open pastureland and arable fields (*i.e.* tillage) which are currently absent in the proposed development site. At the time of the surveys in 2018, the site was dominated by arable crops (BC1) instead of the grassland habitats recorded in 2021. Land use change that has occurred since 2018, followed by habitat change, has rendered the proposed development site sub-optimal for lapwing. Considering that the nearest designated site for lapwing is c. 43.9km north-east of the proposed development site, the local populations do not form part of SPA populations.

As the proposed development will not result in habitat loss or habitat fragmentation within any European site, there is no potential for any in combination effects to occur in that regard.

3.3.2 Habitat degradation as a result of hydrological impacts

Surface water run-off and discharges from the proposed development will drain to the existing and proposed local surface water drainage network. Foul waters from the proposed development will be discharged to Ringsend WWTP for treatment, via the existing foul water drainage network, prior to discharge into the Liffey Estuary/Dublin Bay. Therefore, the Zone of Influence (ZoI) of potential effects on water quality from the proposed development could extend to Dublin Bay.

Surface water

Surface water run-off and discharges from the proposed development will enter the downstream receiving environment via existing and proposed surface water drainage network. This network will ultimately discharge into the Liffey Estuary and Dublin Bay. Therefore, the Zone of Influence (ZoI) of potential effects on water quality from the proposed development could extend to Dublin Bay.

Surface water runoff from the proposed development will be attenuated to greenfield runoff rates and conveyed to the receiving watercourse, the Griffeen River. The surface drainage network will be designed in accordance with the recommendations of the Greater Dublin Strategic Drainage Study (GDSGS). Attenuation measures include gullies, channels, storage ponds and porous asphalt. All surface water will run through hydrocarbon interceptors before its release to the receiving watercourse.

Chapter 8 Hydrology in the EIAR submitted with this application deals with the hydrology of the proposed development site. The chapter assesses the hydrological and hydrogeological risks associated with the proposed development. The assessment noted that based on the potential sources of pollution from the proposed development during construction and operation phases and distance of c. 20 km downstream, there is no potential for impacts to occur on European sites in Dublin Bay. This conclusion is based on a good understanding of the hydrological and hydrogeological environment, plausible sources of impact and knowledge of receptor requirements. This allowed possible source-pathway-receptor linkages to be identified. Potential sources of impacts during construction and operation were considered in Chapter 8 and all potential sources of contamination were considered in relation to European sites without taking account of any measures intended to avoid or reduce harmful effects of the proposed development (mitigation measures) i.e. a worst-case scenario.

Results of Chapter 8 carried out by AWN and which inform this AA screening report, indicate that surface run-off from the proposed development, during both construction and operational phases respectively, will not result in any impact on water quality in downstream receiving waters in Dublin Bay (and thus in the European sites therein). This is in light of expected hazard loading, dilution and attenuation within the Griffeen River, and considerable distance between the proposed development site and Dublin Bay.

In line with good practice effective mitigation measures have been included in the construction design, management of construction programme and during the operational phase of the proposed development. However, it must be noted that these are included in the design, not for the purposes of avoiding or

reducing any potential harmful effects to any European sites but are required for new developments under the under the objectives of the Greater Dublin Strategic Drainage Study and South Dublin County Council Development Plan and in line with good construction practice.

- It is an objective of the Greater Dublin Strategic Drainage Study, and the South Dublin County Council Development Plan 2016-2022, to incorporate Sustainable Urban Drainage Systems (SUDS) within new developments. The SUDS features associated with the proposed development are not included within the design to avoid or reduce any potential harmful effects to any European sites.
- Therefore, there is no possibility of the proposed development undermining the conservation objectives of any of the qualifying interests or special conservation interests of the European sites in, or associated with, Dublin Bay as a result of surface water run-off or discharges.

Foul water

Foul water, comprising sewage and industrial effluent (and some surface water run-off), from the Dublin area has historically been, and will continue to be, treated at Ringsend WWTP prior to discharge to Dublin Bay. The most recent information from Irish Water indicates that the plant is operating above its capacity of 1.64 million P.E. (Irish Water, 2017), with a current operational loading of *c.* 2.2 million P.E. Ringsend WWTP operates under a discharge licence from the EPA (D0034-01) and must comply with the licence conditions.

Despite the capacity issues associated with the Ringsend WWTP, the Liffey Estuary Lower and Dublin Bay are currently classified by the EPA as being of "Unpolluted" water quality status[18]. The Tolka Estuary is currently classified by the EPA as being "Potentially Eutrophic". The pollutant content of future foul water discharges to Dublin Bay is considered likely to decrease in the long-term for the following reasons:

- An Bord Pleanála granted planning permission for an upgrade to the Ringsend WWTP in April 2019[19], which will increase capacity at the plant, and
- There is a commitment in the National Development Plan 2018-2027[20] to invest in and progress the Greater Dublin Drainage Project which will involve the provision of a new regional wastewater treatment plant at a site in the northern part of the Greater Dublin Area and the provision of a new Orbital Drainage Sewer linking the new plant to the existing regional sewer network, which will enable future connections for identified areas of development within the catchment area. The provision of the Greater Dublin Drainage Project will augment the wastewater treatment capacity currently provided by Ringsend WWTP across the Greater Dublin Area.

It is also an objective of the Greater Dublin Strategic Drainage Study, and all development plans within the catchment of Ringsend WWTP, to include Sustainable Urban Drainage Systems (SUDS) within new developments. The relevant development plans also have protective policies/objectives in place to protect water quality in the receiving freshwater and marine environments, and to implement the Water Framework Directive in achieving good water quality status for Dublin Bay.

Considering the above, particularly the current unpolluted status of Dublin Bay, and that foul water discharges from the proposed development would equate to a very small percentage of the overall discharge volumes sent to Ringsend WWTP for treatment, it is concluded that the proposed development will not impact on the overall water quality status of Dublin Bay.

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[18] Transitional and Coastal Surface Water Quality data (2010-2012) accessed from the EPA Envision Mapviewer www.gis.epa.ie/Envision (accessed May 2019)

[19] An Bord Pleanála Case Reference PL29S.301798 – *10-year permission for development of the Ringsend wastewater treatment plant upgrade project including a regional bio solids storage facility*, Available online at www.pleanala.ie/casenum/301798.htm.

[20] Government of Ireland (2018) *Project Ireland 2040, National Development Plan 2018-2027.*

Therefore, there is no possibility of the proposed development undermining the conservation objectives of any of the qualifying interests or special conservation interests of the European sites in, or associated with, Dublin Bay as a result of foul water discharges.

In Combination

There is potential for *"in-combination"* effects on water quality in Dublin Bay from any other projects carried out within the functional areas of the *Dublin City Development Plan 2016-2022* (Dublin City Council, 2016), the *Dún Laoghaire-Rathdown County Development Plan 2016-2022* (Dún Laoghaire-Rathdown County Council, 2016), the *Fingal Development Plan 2017-2023* (Fingal County Council, 2017), *South Dublin County Council Development Plan 2016-2022* (South Dublin County Council, 2016), or any other land use plans which could influence conditions in Dublin Bay via rivers and other surface water features.

The Eastern & Midland Regional Assembly, Regional Spatial & Economic Strategy 2019-2031[21] (Eastern & Midland Regional Assembly, 2019) includes a range of policy objectives relevant to the protection of European sites and the protection of water quality in Dublin Bay, to which the relevant planning authorities must have regard to in the preparation and adoption of their development plans (included in Appendix II).

The planning authority for the proposed development is South Dublin County Council (SDCC). Plans and developments within the administrative area of South Dublin County Council must comply with the following policy objectives of the *South Dublin County Council Development Plan 2016-2022* (South Dublin County Council, 2016) relevant to the protection of European sites and the protection of water quality in Dublin Bay:

> HCL12 Objective 1: To prevent development that would adversely affect the integrity of any Natura 2000 site located within and immediately adjacent to the County and promote favourable conservation status of habitats and protected species including those listed under the Birds Directive, the Wildlife Acts and the Habitats Directive.
>
> HCL12 Objective 2: To ensure that projects that give rise to significant direct, indirect or secondary impacts on Natura 2000 sites, either individually or in combination with other plans or projects, will not be permitted unless the following is robustly demonstrated in accordance with Article 6(4) of the Habitats Directive and S.177AA of the Planning and Development Act (2000 – 2010) or any superseding legislation:
>
> 1. There are no less damaging alternative solutions available; and
>
> 2. There are imperative reasons of overriding public interest (as defined in the Habitats Directive) requiring the project to proceed; and
>
> 3. Adequate compensatory measures have been identified that can be put in place.
>
> IE Policy 1 Water & Wastewater: It is the policy of the Council to work in conjunction with Irish Water to protect existing water and drainage infrastructure and to promote investment in the water and drainage network to support environmental protection and facilitate the sustainable growth of the County.
>
> IE1 Objective 1: To work in conjunction with Irish Water to protect, manage and optimise water supply and foul drainage networks in the County.
>
> IE1 Objective 2: To work in conjunction with Irish Water to facilitate the timely delivery of ongoing upgrades and the expansion of water supply and wastewater services to meet the future needs of the County and the Region.

[21] Eastern & Midland Regional Assembly (2019) *Regional Spatial & Economic Strategy 2019-2031.*

IE Policy 2 Surface Water & Groundwater: It is the policy of the Council to manage surface water and to protect and enhance ground and surface water quality to meet the requirements of the EU Water Framework Directive.

IE2 Objective 1: To maintain, improve and enhance the environmental and ecological quality of our surface waters and groundwater by implementing the programme of measures set out in the Eastern River Basin District River Basin Management Plan.

IE2 Objective 3: To maintain and enhance existing surface water drainage systems in the County and promote and facilitate the development of Sustainable Urban Drainage Systems (SUDS), including integrated constructed wetlands, at a local, district and County level, to control surface water outfall and protect water quality.

IE2 Objective 4: To incorporate Sustainable Urban Drainage Systems (SUDS) as part of Local Area Plans, Planning Schemes, Framework Plans and Design Statements to address the potential for Sustainable Urban Drainage at a site and/or district scale, including the potential for wetland facilities.

IE2 Objective 5: To limit surface water run-off from new developments through the use of Sustainable Urban Drainage Systems (SUDS) and avoid the use of underground attenuation and storage tanks.

IE2 Objective 6: To promote and support the retrofitting of Sustainable Urban Drainage Systems (SUDS) in established urban areas, including integrated constructed wetlands.

Plans and developments within the other local authority areas which could influence conditions in Dublin Bay via rivers and other surface water features, also must comply with the policies and objectives relevant to the protection of European sites and water quality. These include the *Dún Laoghaire-Rathdown County Development Plan 2016-2022* (Dún Laoghaire-Rathdown County Council, 2016), the *Fingal Development Plan 2017-2023* (Fingal County Council, 2017), the *Dublin City Development Plan 2016 – 2022* (Dublin City Council, 2016), the *Kildare County Development Plan 2017-2023* (Kildare County Council, 2017) and the *Wicklow County Development Plan 2016-2022* (Wicklow County Council, 2016). The relevant policies and objectives in those plans for the protection of European sites and water quality are included in Appendix II.

In conclusion, there are a number of projects referred to above which will upgrade the capacity of Ringsend WWTP which will, over time, address the capacity issues at Ringsend WWTP referred to above.

As noted under the surface water section above, Dublin Bay is currently unpolluted, and the proposed development will not result in any measurable effect on water quality in Dublin Bay. There are also protective policies and objectives in place at a strategic planning level to protect water quality in Dublin Bay.

Therefore, and having regard to the policies and objectives referred to under the relevant development plans, it is concluded that the possibility of any other plans or projects acting in combination with the proposed development to give rise to significant effects on any European site in, or associated with, Dublin Bay can be excluded.

3.3.3 Habitat degradation as a result of hydrogeological impacts

The proposed development lies within the Dublin Groundwater Body (Dublin GWB). The only European site within the Dublin GWB that is designated for groundwater dependant habitats and/or species is the Rye Water Valley/Carton SAC, located *c.* 4.1km north-west of the proposed development. All of the qualifying interests of the Rye Water Valley/Carton SAC, the priority Annex I habitat Petrifying springs and the two whorl snail species, are dependent upon the existing condition and functioning of the groundwater regime.

Based on information published by Geological Survey Ireland (GSI) on the Dublin GWB[22], 'The general groundwater flow direction in this aquifer is towards the coast and also towards the River Liffey and Dublin City'. As the proposed development is separated from the Rye Water Valley/Carton SAC by several waterbodies and located downstream of the SAC, it cannot influence groundwater conditions in the European site.

Therefore, there is no possibility of the proposed development undermining the conservation objectives of any of the qualifying interests or special conservation interests of any European sites, either alone or in combination with any other pans or projects, as a result of hydrogeological effects.

3.3.4 Habitat degradation as a result of introducing/spreading non-native invasive species

No Third Schedule species of the *European Communities (Birds and Natural Habitats) Regulations, 2011* were recorded within, or directly adjacent to, the proposed development site, therefore non-native invasive species poses no risk to any European sites downstream.

3.3.5 Disturbance and displacement impacts

Construction-related disturbance and displacement of fauna species could potentially occur within the vicinity of the proposed development. For mammal species such as otter, disturbance effects would not be expected to extend beyond 150m[23]. For birds, disturbance effects would not be expected to extend beyond a distance of *c.* 300m, as noise levels associated with general construction activities would attenuate to close to background levels at that distance.[24] There are no European sites within the disturbance ZoI; the next nearest European site to the proposed development is the Rye Water Valley/Carton SAC *c.* 4.1km away.

The Griffeen River and the Grand Canal may support populations of Annex II species such as otter and freshwater white-clawed crayfish, however, these local populations are not QI SAC populations. The nearest site designated for otter is the Wicklow Mountains SAC, located *c.* 14.3km south-east of the proposed development site, and for freshwater white-clawed crayfish, the Lough Lene SAC, located *c.* 60.8km north-west of the proposed development site.

The nearest SPA to the proposed development site designated for wintering special conservation interest species is the North Bull Island SPA, located *c.* 15.7km east of the proposed development. The proposed development is within the normal foraging range of SCI species of this European site, however the proposed development site has very limited habitat suitability (i.e. open amenity grasslands) for wintering SCI species such as light-bellied Brent goose *Branta bernicla hrota*. Lapwing, a SCI species, was found using the proposed development site in 2018, however, the nearest designated site for lapwing is the Boyne Estuary SPA, *c.* 43.9km north-east of the proposed development site and considering its location and distance to the proposed development site, it is considered that lapwing recorded within the proposed development site do not form part of any SPA population. Considering the lack of suitable habitat for the

[22] https://secure.dccae.gov.ie/GSI_DOWNLOAD/Groundwater/Reports/GWB/DublinGWB.pdf

[23] This is consistent with Transport Infrastructure Ireland (TII) guidance (Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes and Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes) documents. This is a precautionary distance, and likely to be moderated by the screening effect provided by surrounding vegetation and buildings, with the actual ZoI of construction related disturbance likely to be much less in reality.

[24] The disturbance zone of influence for waterbirds is based on the relationship between the noise levels generated by general construction traffic/works (BS 5228:2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise) and the proximity of those noise levels to birds – as assessed in Cutts, N. Phelps, A. & Burdon, D. (2009) *Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance*, and Wright, M., Goodman, P & Cameron, T. (2010) Exploring Behavioural Responses of Shorebirds to Impulsive Noise. *Wildfowl* (2010) 60: 150–167. At 300m, noise levels are below 60dB or, in most cases, are approaching the 50dB threshold below which no disturbance or displacement effects would arise.

species within the site and no individuals recorded using the site for foraging and/or roosting during the surveys in 2021, the proposed development will not result in displacement of SCI populations of lapwing, or any other SCI species, for which there are European sites designated for within the vicinity of the proposed development.

80 As the proposed development will not result in the disturbance/displacement of the qualifying/special conservation interest species of any European site, there is no potential for any in combination effects to occur in that regard.

3.3.6 Summary

81 The potential impacts associated with the proposed development do not have the potential to affect the receiving environment and, consequently, do not have the potential to affect the conservation objectives supporting the qualifying interest/special conservation interests of any European sites. Therefore, the proposed development is not likely to have significant effects on any European sites.

82 As the proposed development itself will not have any effects on the QIs/SCIs or conservation objectives of any European sites and taking into account the policies and objectives of the statutory plans referred to above, it is concluded that there is no potential for any other plan or project to act in combination with it to result in significant effects on any European sites.

83 The potential impacts of the proposed development on the receiving environment, their ZoI, and the European sites at risk of significant effects are summarised in Table 1 below. In assessing the potential for the proposed development to result in a significant effect on any European sites, any measures intended to avoid or reduce the harmful effects of the project on European sites are not taken into account.

Table 1 Summary of Analysis of Likely Significant Effects on European sites

Potential Direct, Indirect In Combination Effects and the ZoI of the Potential Effects	Are there any European sites within the ZoI of the proposed development?
Habitat loss Habitat loss will be confined to the lands within the proposed development boundary.	No There are no European sites within the proposed development boundary
Habitat degradation as a result of hydrological impacts Habitats and species downstream of the proposed development site and the associated surface water drainage discharge points, and downstream of offsite wastewater treatment plants.	No There are no European sites at risk of hydrological effects associated with the proposed development
Habitat degradation as a result of hydrogeological impacts Groundwater-dependant habitats, and the species those habitats support, in the local area that lie downgradient of the proposed development site.	No There are no European sites at risk of hydrogeological effects associated with the proposed development
Habitat degradation as a result of introducing/spreading non-native invasive species. Habitat areas within, adjacent to, and potentially downstream of the proposed development site.	No There are no non-native invasive species present on the proposed development site and, therefore, no risk associated with the proposed development to any European sites from the spread/introduction of non-native invasive species
Disturbance and displacement impacts Potentially up to several hundred metres from the proposed development boundary, dependent upon the predicted levels of noise, vibration and visual disturbance associated with the proposed development, taking into	No There are no European sites within the potential zone of influence of disturbance effects associated with the construction or operation of the proposed development

Potential Direct, Indirect In Combination Effects and the Zol of the Potential Effects	Are there any European sites within the Zol of the proposed development?
account the sensitivity of the qualifying interest species to disturbance effects	

4 Conclusions of Screening Assessment Process

Following an examination, analysis and evaluation of the best available information, and applying the precautionary principle, it can be concluded that the possibility of any significant effects on any European sites, whether arising from the project alone or in combination with other plans and projects, can be excluded, for the reasons set out in Section 3.3 above. In reaching this conclusion, the nature of the project and its potential relationship with all European sites within the zone of influence. and their conservation objectives, have been fully considered.

Therefore, it is the professional opinion of the authors of this report that the application for consent for the proposed development does not require an Appropriate Assessment or the preparation of a Natura Impact Statement (NIS).

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Appendix I

The Qualifying Interests (QIs) and Special Conservation Interests (SCIs) of the European sites in the vicinity of the proposed development site (see Figure 1)

European Site Name [Code] and its Qualifying Interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Proposed Development Site
Special Area of Conservation (SAC)	
Rye Water Valley/Carton SAC [001398] 7220 Petrifying springs with tufa formation (*Cratoneurion*)* 1014 Narrow-mouthed Whorl Snail *Vertigo angustior* 1016 Desmoulin's Whorl Snail *Vertigo moulinsiana* NPWS (2020) *Conservation objectives for Rye Water Valley/Carton SAC [001398].* Generic Version 7.0. Department of Culture, Heritage and the Gaeltacht.[25]	*c.* 4.1km north-west of the proposed development
Glenasmole Valley SAC [001209] 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) 7220 Petrifying springs with tufa formation (*Cratoneurion*)* NPWS (2020) *Conservation objectives for Glenasmole Valley SAC [001209].* Generic Version 7.0. Department of Culture, Heritage and the Gaeltacht	*c.* 9.8km south-east of the proposed development
Wicklow Mountains SAC [002122] 3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) 3160 Natural dystrophic lakes and ponds 4010 Northern Atlantic wet heaths with *Erica tetralix* 4030 European dry heaths 4060 Alpine and Boreal heaths 6130 *Calaminarian* grasslands of the *Violetalia calaminariae* 6230 Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) 7130 Blanket bogs (* if active bog) 8110 Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) 8210 Calcareous rocky slopes with chasmophytic vegetation 8220 Siliceous rocky slopes with chasmophytic vegetation 91A0 Old sessile oak woods with *Ilex* and Blechnum in the British Isles 1355 Otter *Lutra lutra*	*c.* 11.4km south of the proposed development

[25] The versions of the conservation objectives documents referenced in this table are the most recent published versions at the time of writing.

European Site Name [Code] and its Qualifying Interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Proposed Development Site
NPWS (2017) *Conservation Objectives: Wicklow Mountains SAC 002122.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.	
Red Bog, Kildare SAC [000397] 7140 Transition mires and quaking bogs NPWS (2019) *Conservation Objectives: Red Bog, Kildare SAC 000397.* Version 1. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht.	*c.* 15km south of the proposed development
South Dublin Bay SAC [000210] 1140 Mudflats and sandflats not covered by seawater at low tide 1210 Annual vegetation of drift lines 1310 *Salicornia* and other annuals colonising mud and sand 2110 Embryonic shifting dunes NPWS (2013) *Conservation Objectives: South Dublin Bay SAC 000210.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	*c.* 16.4km east of the proposed development
North Dublin Bay SAC [000206] 1140 Mudflats and sandflats not covered by seawater at low tide 1210 Annual vegetation of drift lines 1310 *Salicornia* and other annuals colonising mud and sand 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) 1395 Petalwort *Petalophyllum ralfsii* 1410 Mediterranean salt meadows (*Juncetalia maritimi*) 2110 Embryonic shifting dunes 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) 2130 Fixed coastal dunes with herbaceous vegetation (grey dunes) 2190 Humid dune slacks NPWS (2013) *Conservation Objectives: North Dublin Bay SAC 000206.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	*c.* 18.8km east of the proposed development
Special Protection Area (SPA)	
North Bull Island SPA [004006] A046 Light-bellied Brent Goose *Branta bernicla hrota* A048 Shelduck *Tadorna tadorna* A052 Teal *Anas crecca* A054 Pintail *Anas acuta* A056 Shoveler *Anas clypeata* A130 Oystercatcher *Haematopus ostralegus* A140 Golden Plover *Pluvialis apricaria* A141 Grey Plover *Pluvialis squatarola* A143 Knot *Calidris canutus*	*c.* 15.7km east of the proposed development

European Site Name [Code] and its Qualifying Interest(s) / Special Conservation Interest(s) (*Priority Annex I Habitats)	Location Relative to the Proposed Development Site
A144 Sanderling *Calidris alba* A149 Dunlin *Calidris alpina* A156 Black-tailed Godwit *Limosa limosa* A157 Bar-tailed Godwit *Limosa lapponica* A160 Curlew *Numenius arquata* A162 Redshank *Tringa totanus* A169 Turnstone *Arenaria interpres* A179 Black-headed Gull *Croicocephalus ridibundus* A999 Wetlands & Waterbirds NPWS (2015) *Conservation Objectives: North Bull Island SPA 004006.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	
Wicklow Mountains SPA [004040] A098 Merlin *Falco columbarius* A103 Peregrine *Falco peregrinus* NPWS (2020) *Conservation objectives for Wicklow Mountains SPA [004040].* Generic Version 7.0. Department of Culture, Heritage and the Gaeltacht.	*c.* 12.3km south-east of the proposed development
South Dublin Bay and River Tolka Estuary SPA [004024] A046 Light-bellied Brent Goose *Branta bernicla hrota* A130 Oystercatcher *Haematopus ostralegus* A137 Ringed Plover *Charadrius hiaticula* A141 Grey Plover *Pluvialis squatarola* A143 Knot *Calidris canutus* A144 Sanderling *Calidris alba* A149 Dunlin *Calidris alpina* A157 Bar-tailed Godwit *Limosa lapponica* A162 Redshank *Tringa totanus* A179 Black-headed Gull *Croicocephalus ridibundus* A192 Roseate Tern *Sterna dougallii* A193 Common Tern *Sterna hirundo* A194 Arctic Tern *Sterna paradisaea* A999 Wetland and Waterbirds NPWS (2015) *Conservation Objectives: South Dublin Bay and River Tolka Estuary SPA 004024.* Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	*c.* 16.4km east of the proposed development

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Appendix II

Planning polices/objectives relating to the protection of European sites and water quality

Eastern & Midland Regional Assembly, Regional Spatial & Economic Strategy 2019-2031
Regional Policy Objective 3.4 Ensure that all plans, projects and activities requiring consent arising from the Regional Spatial and Economic Strategy are subject to the relevant environmental assessment requirements including SEA, EIA and AA as appropriate. In addition the future strategic development of settlements throughout the Region will have full cognisance of the legal requirements pertaining to sites of International Nature Conservation Interest. **Regional Policy Objective 7.2** To achieve and maintain 'Good Environmental Status' for marine waters and to ensure the sustainable use of shared marine resources in the Region, and to promote the development of a cross-boundary and cross-border strategic management and stakeholder engagement framework to protect the marine environment. **Regional Policy Objective 7.10** Support the implementation of the Water Framework Directive in achieving and maintaining at least good environmental status for all water bodies in the Region and to ensure alignment between the core objectives of the Water Framework Directive and other relevant Directives, River Basin Management plans and local authority land use plans. **Regional Policy Objective 7.11** For water bodies with 'high ecological status' objectives in the Region, local authorities shall incorporate measures for both their continued protection and to restore those water bodies that have fallen below high ecological status and areas 'At Risk' into the development of local planning policy and decision making any measures for the continued protection of areas with high ecological status in the Region and for mitigation of threats to waterbodies identified as 'At Risk' as part of a catchment based approach in consultation with the relevant agencies. This shall include recognition of the need to deliver efficient wastewater facilities with sufficient capacity and thus contribute to improved water quality in the Region. **Regional Policy Objective 7.12** Future statutory land use plans shall include Strategic Flood Risk Assessment (SFRA) and seek to avoid inappropriate land use zonings and development in areas at risk of flooding and to integrate sustainable water management solutions (such as SuDS, nonporous surfacing and green roofs) to create safe places in accordance with the Planning System and Flood Risk Assessment Guidelines for Local Authorities. **Regional Policy Objective 7.15** Local authorities shall take opportunities to enhance biodiversity and amenities and to ensure the protection of environmentally sensitive sites and habitats, including where flood risk management measures are planned. **Regional Policy Objective 7.16** Support the implementation of the Habitats Directives in achieving an improvement in the conservation status of protected species and habitats in the Region and to ensure alignment between the core objectives of the EU Birds and Habitats Directives and local authority development plans. **Regional Policy Objective 7.22** Local authority development plan and local area plans, shall identify, protect, enhance, provide and manage Green Infrastructure in an integrated and coherent manner and should also have regard to the required targets in relation to the conservation of European sites, other nature conservation sites, ecological networks and protected species. **Regional Policy Objective 10.6** Delivery and phasing of services shall be subject to the required appraisal, planning and environmental assessment processes and shall avoid adverse impacts on the integrity of the Natura 2000 network. **Regional Policy Objective 10.7** Local authority core strategies shall demonstrate compliance with DHPLG Water Services Guidelines for local authorities and demonstrate phased infrastructure – led growth that is commensurate with the carrying

capacity of water services and prevent adverse impacts on the integrity of water dependent habitats and species within the Natura 2000 network.

Regional Policy Objective 10.10

Support Irish Water and the relevant local authorities in the Region to eliminate untreated discharges from settlements in the short term, while planning strategically for long term growth in tandem with Project Ireland 2040 and in increasing compliance with the requirements of the Urban Waste Water Treatment Directive from 39% today to 90% by the end of 2021, to 99% by 2027 and to 100% by 2040.

Regional Policy Objective 10.11

EMRA supports the delivery of the wastewater infrastructure set out in Table 10.2, subject to appropriate environmental assessment and the planning process.[26]

Regional Policy Objective 10.12

Development plans shall support strategic wastewater treatment infrastructure investment and provide for the separation of foul and surface water networks to accommodate the future growth of the Region.

Regional Policy Objective 10.15

Support the relevant local authorities (and Irish Water where relevant) in the Region to improve storm water infrastructure to improve sustainable drainage and reduce the risk of flooding in the urban environment and in the development and provision at a local level of Sustainable Urban Drainage solutions.

Regional Policy Objective 10.16

Implement policies contained in the Greater Dublin Strategic Drainage Study (GDSDS), including SuDS.

Regional Policy Objective 10.18

Local authorities shall ensure adequate surface water drainage systems are in place which meet the requirements of the Water Framework Directive and the associated River Basin Management Plans.

Dún Laoghaire-Rathdown County Development Plan 2016-2022

Policy LHB19: Protection of Natural Heritage and the Environment

It is Council policy to protect and conserve the environment including, in particular, the natural heritage of the County and to conserve and manage Nationally and Internationally important and EU designated sites - such as Special Protection Areas, candidate Special Areas of Conservation, proposed Natural Heritage Areas and Ramsar sites - as well as non-designated areas of high nature conservation value which serve as 'Stepping Stones' for the purposes of Article 10 of the Habitats Directive.

Policy LHB20: Habitats Directive

It is Council policy to ensure the protection of natural heritage and biodiversity, including European sites that form part of the Natura 2000 network, in accordance with relevant EU Environmental Directives and applicable National Legislation, Policies, Plans and Guidelines.

Policy LHB22: Designated Sites

It is Council policy to protect and preserve areas designated as proposed Natural Heritage Areas, candidate Special Areas of Conservation, and Special Protection Areas. It is Council policy to promote the maintenance and as appropriate, delivery of 'favourable' conservation status of habitats and species within these areas.

Policy EI2: Wastewater Treatment and Appropriate Assessment

It is Council policy to provide adequate wastewater treatment facilities to serve the existing and future population of the County, subject to complying with the Water Framework Directive and the associated River Basin Management Plan or any updated version of this document, 'Water Quality in Ireland 2007-2009' (EPA 2011) or any updated version of the document, Pollution Reduction Programmes for Designated Shellfish Areas, the Urban Waste Water Treatment Directive and the Habitats Directive.

Policy EI3: Surface Water Drainage and Appropriate Assessment

[26] The Greater Dublin Drainage Project, the Regional Wastewater Treatment Plant Project, the Ballyman Main Drainage Project and the Upper Liffey Valley Sewerage Scheme.

It is Council policy to require that a Sustainable Drainage System (SuDS) is applied to any development and that site specific solutions to surface water drainage systems are developed, which meet the requirements of the Water Framework Directive and the associated River Basin Management Plans and 'Water Quality in Ireland 2007-2009' (EPA 2011) or any updated version of the document.

Fingal Development Plan 2017-2023

Objective NH10

Ensure that the Council takes full account of the requirements of the Habitats and Birds Directives, as they apply both within and without European Sites in the performance of its functions.

Objective NH11

Ensure that the Council, in the performance of its functions, takes full account of the objectives and management practices proposed in any management or related plans for European Sites in and adjacent to Fingal published by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.

Objective NH15

Strictly protect areas designated or proposed to be designated as Natura 2000 sites (i.e. Special Areas of Conservation (SACs) and Special Protection Areas (SPAs); also known as European sites) including any areas that may be proposed for designation or designated during the period of this Plan.

Objective SW04

Require the use of sustainable drainage systems (SuDS) to minimise and limit the extent of hard surfacing and paving and require the use of sustainable drainage techniques where appropriate, for new development or for extensions to existing developments, in order to reduce the potential impact of existing and predicted flooding risks.

Objective WQ01

Strive to achieve 'good status' in all waterbodies in compliance with the Water Framework Directive, the Eastern River Basin District Management Plan 2009-2015 and the associated Programme of Measures (first cycle) and to cooperate with the development and implementation of the second cycle national River Basin Management Plan 2017-2021.

Objective WQ04

Protect existing riverine wetland and coastal habitats and where possible create new habitats to maintain naturally functioning ecosystems whilst ensuring they do not impact negatively on the conservation objectives of any European Sites.

Objective WT01

Liaise with and work in conjunction with Irish Water during the lifetime of the plan for the provision, extension and upgrading of waste water collection and treatment systems in all towns and villages of the County to serve existing populations and facilitate sustainable development of the County, in accordance with the requirements of the Settlement Strategy and associated Core Strategy.

Objective WT02

Liaise with Irish Water to ensure the provision of wastewater treatment systems in order to ensure compliance with existing licences, EU Water Framework Directive, River Basin Management Plans, the Urban Waste Water Directive and the EU Habitats Directive.

South Dublin County Council Development Plan 2016-2022

HCL12 Objective 1

To prevent development that would adversely affect the integrity of any Natura 2000 site located within and immediately adjacent to the County and promote favourable conservation status of habitats and protected species including those listed under the Birds Directive, the Wildlife Acts and the Habitats Directive.

HCL12 Objective 2

To ensure that projects that give rise to significant direct, indirect or secondary impacts on Natura 2000 sites, either individually or in combination with other plans or projects, will not be permitted unless the following is robustly demonstrated in accordance with Article 6(4) of the Habitats Directive and S.177AA of the Planning and Development Act (2000 – 2010) or any superseding legislation:

1. There are no less damaging alternative solutions available; and

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2. There are imperative reasons of overriding public interest (as defined in the Habitats Directive) requiring the project to proceed; and

3. Adequate compensatory measures have been identified that can be put in place.

IE Policy 1 Water & Wastewater

It is the policy of the Council to work in conjunction with Irish Water to protect existing water and drainage infrastructure and to promote investment in the water and drainage network to support environmental protection and facilitate the sustainable growth of the County.

IE1 Objective 1

To work in conjunction with Irish Water to protect, manage and optimise water supply and foul drainage networks in the County.

IE1 Objective 2

To work in conjunction with Irish Water to facilitate the timely delivery of ongoing upgrades and the expansion of water supply and wastewater services to meet the future needs of the County and the Region.

IE Policy 2 Surface Water & Groundwater

It is the policy of the Council to manage surface water and to protect and enhance ground and surface water quality to meet the requirements of the EU Water Framework Directive.

IE2 Objective 1

To maintain, improve and enhance the environmental and ecological quality of our surface waters and groundwater by implementing the programme of measures set out in the Eastern River Basin District River Basin Management Plan.

IE2 Objective 3

To maintain and enhance existing surface water drainage systems in the County and promote and facilitate the development of Sustainable Urban Drainage Systems (SUDS), including integrated constructed wetlands, at a local, district and County level, to control surface water outfall and protect water quality.

IE2 Objective 4

To incorporate Sustainable Urban Drainage Systems (SUDS) as part of Local Area Plans, Planning Schemes, Framework Plans and Design Statements to address the potential for Sustainable Urban Drainage at a site and/or district scale, including the potential for wetland facilities.

IE2 Objective 5

To limit surface water run-off from new developments through the use of Sustainable Urban Drainage Systems (SUDS) and avoid the use of underground attenuation and storage tanks.

IE2 Objective 6

To promote and support the retrofitting of Sustainable Urban Drainage Systems (SUDS) in established urban areas, including integrated constructed wetlands.

Dublin City Development Plan 2016-2022

GI23

To protect flora, fauna and habitats, which have been identified by Articles 10 and 12 of Habitats Directive, Birds Directive, Wildlife Acts 1976–2012, the Flora (Protection) Order 2015 S.I No. 356 of 2015. European Communities (Birds and Natural Habitats) Regulations 2011 to 2015.

GI24

To conserve and manage all Natural Heritage Areas, Special Areas of Conservation and Special Protection Areas designated, or proposed to be designated, by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.

GIO17

To seek the continued improvement of water quality, bathing facilities and other recreational opportunities in the coastal, estuarine and surface waters in the city and to protect the ecology and wildlife of Dublin Bay.

GI20

To seek continued improvement in water quality, bathing facilities and other recreational opportunities in the coastal, estuarine and surface waters in the city, having regard to the sensitivities of Dublin Bay and to protect the ecology and wildlife of Dublin Bay.

SI18

To require the use of Sustainable Urban Drainage Systems in all new developments, where appropriate, as set out in the Greater Dublin Regional Code of Practice for Drainage Works. The following measures will apply:

- The infiltration into the ground through the development of porous pavement such as permeable paving, swales, and detention basins
- The holding of water in storage areas through the construction of green roofs, rainwater harvesting, detention basins, ponds, and wetlands
- The slow-down of the movement of water.

Kildare County Development Plan 2017-2023

NH 4

Support the conservation and enhancement of Natura 2000 Sites including any additional sites that may be proposed for designation during the period of this Plan and to protect the Natura 2000 network from any plans and projects that are likely to have a significant effect on the coherence or integrity of a Natura 2000 Site.

NH 5

Prevent development that would adversely affect the integrity of any Natura 2000 site located within and immediately adjacent to the county and promote favourable conservation status of habitats and protected species including those listed under the Birds Directive, the Wildlife Acts and the Habitats Directive.

NH 6

Ensure an Appropriate Assessment, in accordance with Article 6(3) and Article 6(4) of the Habitats Directive and with DEHLG guidance (2009), is carried out in respect of any plan or project not directly connected with or necessary to the management of a Natura 2000 site to determine the likelihood of the plan or project having a significant effect on a Natura 2000 site, either individually or in combination with other plans or projects and to ensure that projects which may give rise to significant cumulative, direct, indirect or secondary impacts on Natura 2000 sites will not be permitted (either individually or in combination with other plans or projects) unless for reasons of overriding public interest.

WQ 1

Co-operate with the EPA and other authorities in the continued implementation of the EU Water Framework Directive and assist and co-operate with the lead authority for the River Basin Management Plan(s).

WQ 2

Ensure, through the implementation of the River Basin Management Plan(s) and the associated Programmes of Measures and any other associated legislation, the protection and improvement of all drinking water, surface water and ground waters throughout the county.

WQ 6

Protect recognised salmonid water courses in conjunction with Inland Fisheries Ireland such as the Liffey catchment, which are recognised to be exceptional in supporting salmonid fish species.

WW 4

Ensure that adequate wastewater services will be available to service development prior to the granting of planning permission. Applicants who are proposing to connect to the public wastewater network should consult with Irish Water regarding available capacity prior to applying for planning permission.

WW 12

Ensure that existing and permitted private wastewater treatment plants are operated in compliance with their wastewater discharge license, in order to protect water quality.

Wicklow County Development Plan 2016-2022

NH2

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No projects giving rise to significant cumulative, direct, indirect or secondary impacts on Natura 2000 sites arising from their size or scale, land take, proximity, resource requirements, emissions (disposal to land, water or air), transportation requirements, duration of construction, operation, decommissioning or from any other effects shall be permitted on the basis of this plan (either individually or in combination with other plans or projects).

Except as provided for in Section 6(4) of the Habitats Directive, viz. There must be: a) no alternative solution available, b) imperative reasons of overriding public interest for the project to proceed; and c) Adequate compensatory measures in place.

NH3

To contribute, as appropriate, towards the protection of designated ecological sites including candidate Special Areas of Conservation (cSACs) and Special Protection Areas (SPAs); Wildlife Sites (including proposed Natural Heritage Areas); Salmonid Waters; Flora Protection Order sites; Wildfowl Sanctuaries (see S.I. 192 of 1979); Freshwater Pearl Mussel catchments; and Tree Preservation Orders (TPOs). To contribute towards compliance with relevant EU Environmental Directives and applicable National Legislation, Policies, Plans and Guidelines, including the following and any updated/superseding documents:

- EU Directives, including the Habitats Directive (92/43/EEC, as amended)7 , the Birds Directive (2009/147/EC)8 , the Environmental Liability Directive (2004/35/EC)9 , the Environmental Impact Assessment Directive (85/337/EEC, as amended), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC).
- National legislation, including the Wildlife Act 197610, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development Act 2000 (as amended), the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011) and the European Communities (Environmental Liability) Regulations 200811.
- National policy guidelines (including any clarifying Circulars or superseding versions of same), including the Landscape and Landscape Assessment Draft Guidelines 2000, the Environmental Impact Assessment Sub-Threshold Development Guidelines 2003, Strategic Environmental Assessment Guidelines 2004 and the Appropriate Assessment Guidance 2010.
- Catchment and water resource management Plans, including Eastern and South Eastern River Basin Management Plan 2009-2015 (including any superseding versions of same).
- Biodiversity Plans and guidelines, including Actions for Biodiversity 2011-2016: Ireland's 2nd National Biodiversity Plan (including any superseding version of same).
- Ireland's Environment 2014 (EPA, 2014, including any superseding versions of same), and to make provision where appropriate to address the report's goals and challenges.

NH4

All projects and plans arising from this plan12 (including any associated improvement works or associated infrastructure) will be screened for the need to undertake Appropriate Assessment under Article 6 of the Habitats Directive. A plan or project will only be authorised after the competent authority has ascertained, based on scientific evidence, Screening for Appropriate Assessment, and a Stage 2 Appropriate Assessment where necessary, that:

1) The Plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European site (either individually or in combination with other plans or projects); or

2) The Plan or project will have significant adverse effects on the integrity of any European site (that does not host a priority natural habitat type and / or a priority species) but there are no alternative solutions, and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or

3) The Plan or project will have a significant adverse effect on the integrity of any European site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan

or project must nevertheless be carried out for imperative reasons for overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.

NH5

To maintain the conservation value of all proposed and future Natural Heritage Areas (NHAs) and to protect other designated ecological sites in Wicklow.

Along with cSACs, SPAs and pNHA these include Salmonid Waters; Flora Protection Order sites; Wildfowl Sanctuaries (see S.I. 192 of 1979); Freshwater Pearl Mussel catchments; and Tree Preservation Orders (TPOs).

WI2

To protect existing and potential water resources of the County, in accordance with the EU Water Framework Directive, the River Basin Management Plans, the Groundwater Protection Scheme and source protection plans for public water supplies.

WI12

Ensure the implementation of Sustainable Urban Drainage Systems (SUDS) and in particular, to ensure that all surface water generated in a new development is disposed of on-site or is attenuated and treated prior to discharge to an approved surface water system.

WI6

In order to fulfil the objectives of the Core Strategy, Wicklow County Council will work alongside and facilitate the delivery of Irish Water's Water Services Investment Programme, to ensure that all lands zoned for development are serviced by an adequate wastewater collection and treatment system and in particular, to endeavour to secure the delivery of regional and strategic wastewater schemes. In particular, to support and facilitate the development of a WWTP in Arklow, at an optimal location following detailed technical and environmental assessment and public consultation.

WI7

Permission will be considered for private wastewater treatment plants for single rural houses where:

- the specific ground conditions have been shown to be suitable for the construction of a treatment plant and any associated percolation area;
- the system will not give rise to unacceptable adverse impacts on ground waters / aquifers and the type of treatment proposed has been drawn up in accordance with the appropriate groundwater protection response set out in the Wicklow Groundwater Protection Scheme (2003);
- the proposed method of treatment and disposal complies with Wicklow County Council's Policy for Wastewater Treatment & Disposal Systems for Single Houses (PE ≤ 10) and the Environmental Protection Agency "Waste Water Treatment Manuals"; and
- in all cases the protection of ground and surface water quality shall remain the overriding priority and proposals must definitively demonstrate that the proposed development will not have an adverse impact on water quality standards and requirements set out in EU and national legislation and guidance documents.

WI9

Private wastewater treatment plants for commercial / employment generating development will only be considered where:

- Irish Water has confirmed the site is due to be connected to a future public system in the area or Irish Water have confirmed there are no plans for a public system in the area;
- it can clearly be demonstrated that the proposed system can meet all EPA / Local Authority environmental criteria; and
- an annually renewed contract for the management and maintenance of the system is contracted with a reputable company / person, details of which shall be provided to the Local Authority.

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Appendix III

Records of SCI species from the desktop study in the vicinity of the study area

Common Name/ Scientific Name	Legal Status[27]	Red List Status[28]	Source
Birds			
Black-headed gull *Chroicocephalus ridibundus*	WA	Red	NBDC online database record
Common coot *Fulica atra*	WA	Red	NBDC online database record
Common kingfisher *Alcedo atthis*	BD_I, WA	Amber	NBDC online database record
Common redshank *Tringa totanus*	WA	Red	NBDC online database record
Great cormorant *Phalacrocorax carbo*	WA	Amber	NBDC online database record
Herring gull *Larus argentatus*	WA	Red	NBDC online database record
Lesser black-backed gull *Larus fuscus*	WA	Amber	NBDC online database record
Little grebe *Tachybaptus ruficollis*	WA	Amber	NBDC online database record
Mallard *Anas platyrhynchos*	BD_II (I), III (I), WA	Green	NBDC online database record
Northern lapwing *Vanellus vanellus*	BD_II (II), WA	Red	NBDC online database record
Peregrine falcon *Falco peregrinus*	BD_I, WA	Red	NBDC online database record
Tufted duck *Aythya fuligula*	BD_II (I), III (II), WA	Amber	NBDC online database record

[27] HD_II/IV/V = Habitats Directive Annexes II/IV/V; WA = Wildlife Acts; BD_I/II/III = Birds Directive Annex I/II/III; OSPAR = Convention for the protection of the marine environment of the North-east Atlantic 1992

[28] Birds from Colhoun, K. & Cummins, S. (2013) Birds of Conservation Concern in Ireland 2014-2019. Irish Birds 9:523-544.

CHAPTER 7 - LAND, SOIL, GEOLOGY AND HYDROGEOLOGY

Appendix 7.1 Criteria for Rating Site Attributes – Estimation of Importance of Hydrogeological Attributes (National Roads Authority (NRA, 2009))

Table 1 Criteria for rating site importance of Geological Features (NRA)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying route is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or high fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/or soft organic soil underlying route is moderate on a local scale	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small on a local scale	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral resource.

Table 2 Criteria for rating impact magnitude at EIS stage – Estimation of magnitude of impact on soil / geology attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

The NRA criteria for estimation of the importance of hydrogeological attributes at the site during the EIA stage are summarised in Table 4 below.

Table 3 Criteria for rating Site Attributes - Estimation of Importance of Hydrogeology Attributes (NRA)

Magnitude of Impact	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple well fields Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source
	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes

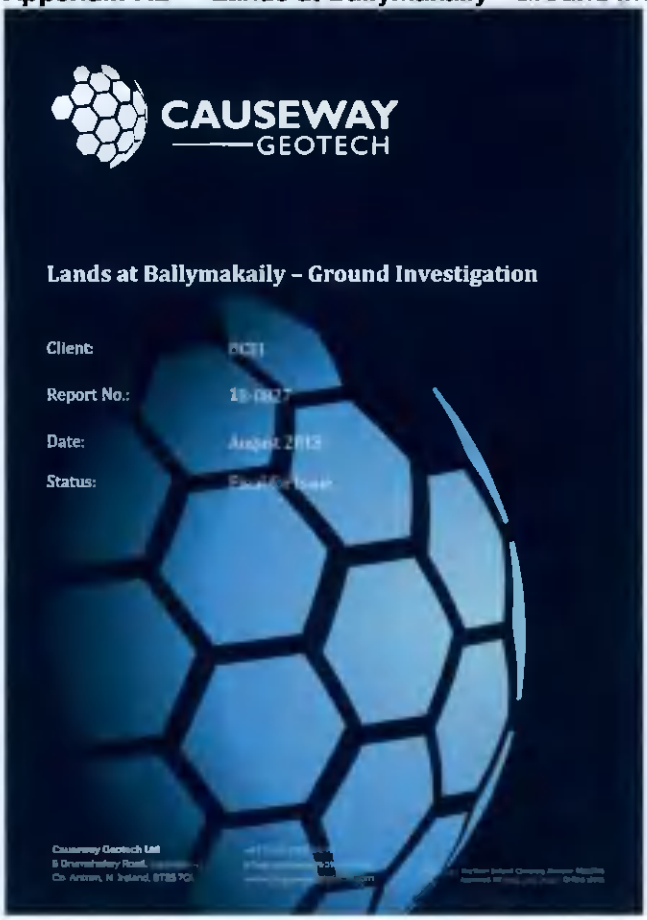
Table 4 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Hydrogeology Attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually.

Table 5: Rating of Significant Environmental Impacts at EIS Stage (NRA)

Importance of Attribute	Magnitude of Importance			
	Neglible	**Small Adverse**	**Moderate Adverse**	**Large Adverse**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

Appendix 7.2 Lands at Ballymakaily - Ground Investigations



CAUSEWAY GEOTECH

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Lands at Ballymakaily
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CAUSEWAY GEOTECH

Lands at Ballymakaily
Report No. 18-0827

Document Control Sheet

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Prepared by:	Reviewed by:	Approved by:	
[redacted] Ross BSc MSc	Stephen Franey BSc (Hons) MSc	Darren O'Mahony BSc MSc MIEI	

The works were conducted in accordance with

- [redacted] Specification for Ground Investigation 2nd Edition published by ICE Publishing (2012)
- British Standards Institute (2015) BS 5930:2015, Code of practice for site investigations
- BS EN 1997-2: 2007 Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing
- Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

Laboratory testing was conducted in accordance with

- British Standards Institute BS 1377:1990 parts 2, 4, 5, 7 and 9

CAUSEWAY GEOTECH

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015, The Code of Practice for Site Investigation.

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler)
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler)
P	Nominal 100mm diameter undisturbed piston sample
B	Bulk disturbed sample
LB	Large bulk disturbed sample
D	Small disturbed sample
C	Core sub-sample (displayed in the Field Records column on the logs)
L	Liner sample from dynamic sampled borehole
W	Water sample
ES / EW	Soil sample for environmental testing / Water sample for environmental testing
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained)
SPT (c)	Standard penetration test using 60 degree solid cone
x/x,x,x,x	Blows per increment during the standard penetration test. The first two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length. The length achieved is stated (mm) for any test increment less than 75mm
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm)
N=X/Z	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm)
V VR	Shear vane test (borehole) / Hand vane test (trial pit) Shear strength stated in kPa V: undisturbed vane shear strength VR: remoulded vane shear strength
dd/mm/yy: 1.0 dd/mm/yy: dry	Date & water level at the borehole depth at the end of shift and the start of the following shift
Abbreviations relating to rock core – reference Clause 36.4.4 of BS5930: 2015	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter uninterrupted by natural discontinuities but not necessarily a full circumference and is measured along the core axis between natural fractures
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring

CAUSEWAY GEOTECH

Lands at Ballymakaily

1 AUTHORITY

On the instructions of ECEI, ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed data centre.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results. A discussion on the recommendations for construction is also provided.

All information given in this report is based upon the ground conditions encountered during the site investigation works, and on the results of the laboratory and field tests performed. However there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client in response to a particular set of instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client, included boreholes, trial pits, dynamic probing, soil and rock core sampling, environmental sampling, in-situ and laboratory testing, and the preparation of a report on the findings including recommendations for construction.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted on the site of agricultural lands in west Dublin, just north of Baldonnell Aerodrome. The site is bounded to the north by the Grand Canal, to the east by the R120 and to the south and west by agricultural fields. The site generally slopes downwards towards the north east.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 23rd July and 21st August 2018, comprised:

- fifteen boreholes by dynamic sampling methods
- a standpipe installation in six boreholes;
- nineteen dynamic probes;
- nineteen machine dug trial pits;
- indirect CBR tests at eighteen locations.

The exploratory holes and in-situ tests were located as instructed by the Client's Representative as shown on the exploratory hole location plan in Appendix A.

4.2 Boreholes

Fifteen boreholes (BH01-BH15) were put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig. The boreholes were put down initially in 150mm diameter reducing in diameter with depth as required, down to 50mm by use of the smallest sampler.

The boreholes were taken to depths ranging between 0.5m and 3.4m where they were terminated on encountering virtual refusal on obstructions above their scheduled depth.

Standard penetration tests were carried out in accordance with BS EN 22476-3 :2005 at standard depth intervals using the split spoon sampler ($SPT_{(S)}$) or solid cone attachment ($SPT_{(C)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The *N* values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix I.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Environmental samples were taken at standard intervals.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded. Details of the water strikes are presented on the individual borehole logs.

Appendix B presents the borehole logs.

4.3 Standpipe Installations

A groundwater monitoring standpipe was installed in boreholes BH05, BH09, BH10, BH11, BH14 and BH15.

Details of the installations, including the depth range of the response zone, are provided in Appendix B on the individual borehole logs.

4.4 Trial Pits

Nineteen trial pits (TP01–TP19) were excavated using an 8t tracked excavator fitted with a 600mm wide bucket, to depths ranging between 0.40m and 2.8m where they were terminated on obstructions.

Disturbed (small jar and bulk bag) samples were taken at standard depth intervals and at change of strata.

Environmental samples were taken at depths of 0.5m and 1.5m in each trial pit.

Any water strikes encountered during excavation were recorded along with any changes in their levels as the excavation proceeded. The stability of the trial pit walls was noted on completion.

Appendix C presents the trial pit logs with photographs of the pits and arising provided in Appendix D.

4.5 Dynamic Probes

Nineteen dynamic probes were conducted adjacent to trial pits using the DPSHB method as described in BS EN ISO 22476-2 :2005. The method entails a 63.5kg hammer falling 0.75m onto a 50.5mm diameter cone with an apex angle of 90°.

Appendix E provides the dynamic probe logs on the sheet following the relevant borehole log in the form of plots, against depth, of the number of blows per 100mm penetration.

4.6 Indirect CBR tests

An indirect CBR test was conducted at eighteen locations (TP02 – TP19) adjacent to the trial pits using a Dynamic Cone Penetrometer (DCP). The equipment was developed in conjunction with the UK Transport Research Laboratory, is used widely throughout the world, and is referred to in the UK Highway Agency Interim Advice Note 73/06. A DCP test was not undertaken at TP01 due to the presence of made ground.

The test results are presented in Appendix F in the form of plots of the variation with depth of the penetration per blow. Straight lines have been fitted to the plots and the CBR for each depth range estimated using the following relationship, as proposed by Kleyn & Van Heerden (1983):

Log CBR = 2.632-1.28 Log (mm/blow)

The frequently elevated CBR values are a consequence of the coarse-grained content of the penetrated soils and are often not representative of the soil matrix.

4.7 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R6 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish National Grid) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these as built positions.

5 LABORATORY WORK

Upon their receipt in the laboratory all disturbed samples were carefully examined and accurately described, and their descriptions incorporated into the borehole logs.

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification**: moisture content measurement, Atterberg Limit tests and particle size distribution analysis
- **soil chemistry**: pH and water-soluble sulphate content

Laboratory testing of soils samples was carried out in accordance with British Standards Institute *BS 1377 Methods of test for soils for civil engineering purposes: Part 1 (2016), and Parts 2-9 (1990).*

The test results are presented in Appendix G.

5.2 Environmental laboratory testing of soils

Environmental testing was conducted on selected environmental soil samples by Chemtest at its laboratory in Newmarket, Suffolk.

Testing was carried out for a range of determinants, including:

- Metals
- Speciated total petroleum hydrocarbons (TPH)

- Speciated polycyclic aromatic hydrocarbons (PAH)
- Cyanides
- Asbestos screen
- pH.

Results of environmental laboratory testing are presented in Appendix H.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise Glacial Till. These deposits are underlain by limestones and shales of the Lucan Formation.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Topsoil**: encountered typically in 200-400mm thickness across the site.
- **Made Ground (fill)**: reworked clay fill with fragments of red brick, plastic, steel, fabric and concrete. Encountered only in TP01 to a depth of 1.8m, close to the canal.
- **Glacial Till**: sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth. Contains localised pockets of granular material, consisting of sandy clayey gravel.

6.3 Groundwater

Groundwater was encountered during percussion boring through soil and in trial pits as water strikes as shown in Table 1 below.

Table 1 Groundwater strikes encountered during ground investigation

GI Ref	Water strike (mbgl)	Comments
TP12	2.2	Seepage
TP14	2.1	Seepage
TP15	2.6	Seepage
TP16	1.9	Seepage

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Groundwater was not noted during drilling at any of the borehole locations. However it should be noted that the casing used to supporting the borehole walls during drilling may have sealed out any groundwater strikes encountered and the possibility of encountering groundwater during excavation works should not be ruled out. Seasonal variation in groundwater levels should also be factored into design considerations.

Continued monitoring of the six installed standpipes will give an indication of the seasonal variation in groundwater level.

7 DISCUSSION

7.1 Proposed construction

It is proposed to construct a new data centre on the site.

No further details were available to Causeway Geotech at the time of preparing this report and any designs based on the recommendations or conclusions within this report should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory holes. Causeway Geotech were commissioned to provide a geotechnical report, and it is out with our remit to advise on structure design.

7.2 Recommendations for construction

7.2.1 Summary

Based on the presence of stiff glacial till and possible bedrock at relatively shallow depths across the footprint of the proposed building, the implementation of traditional shallow (spread) foundations (strip/pad) are considered suitable.

7.2.2 Soil strength parameters

When estimating the shear strength of fine soils (silt/clay), reference is made to the results of Standard Penetration Tests (SPT's) carried out within the boreholes. The undrained shear strength of fine soils can be estimated using the correlation developed by Stroud & Butler

$c_u = fN$

where f is typically in the range 4 to 6. A median f value of 5 is adopted for this report.

For granular soils (sand/gravel), a graphical relationship between SPT "N" value and angle of shearing resistance, φ, has been developed by Peck, Hanson and Thornburn. This is published in *Foundation Design and Construction* (Tomlinson, 2001) and is referenced in this report when deriving angles of shearing resistance for the gravel soils.

7.2.3 Bearing resistance

The ultimate bearing resistance for conventional strip or pad foundations can be obtained from Brinch Hansen's general equation.

$$q_n = cN_c s_c d_c i_c b_c + p_o N_q s_q d_q i_q b_q + \frac{1}{2}\gamma B N_\gamma s_\gamma d_\gamma i_\gamma b_\gamma$$

where:

- q_n = ultimate bearing resistance
- c = undrained cohesion of soil
- B = foundation width
- p_o = effective overburden pressure at foundation level
- N_c, N_q, N_γ = bearing capacity factors
- s_c, s_q, s_γ = shape factors
- d_c, d_q, d_γ = depth factors
- i_c, i_q, i_γ = load inclination factors
- b_c, b_q, b_γ = base inclination factors

For conventional strip and pad foundations constructed on fine soils, the general equation has been simplified by Terzaghi to:

Net ultimate bearing resistance = cN_c

where:

- c = undrained cohesion
- N_c = bearing capacity factor

For cohesionless soils (sand/gravel, c=0), the calculation of ultimate bearing resistance is generally required only for loose sands. This is because coarser gravel soils would not be expected to suffer a bearing capacity failure. However limits are placed on the allowable bearing resistance in order to control settlement. For shallow conventional pad foundations on granular soils, Terzaghi's simplified equation can be used as follows.

$q_n = p_o(N_q - 1) + 0.4BN_\gamma p$

where

p = total overburden pressure

It is obvious from the equations 1 to 3 that some knowledge of the foundation width and depth is required before the ultimate bearing resistance can be calculated.

Table 1 provides an indication of minimum founding depth at each borehole location. Also shown are approximate soil strengths based on the Stroud and Butler (1975) correlations with SPT N-values and visual examination of recovered samples of the clay deposits.

The table also suggests allowable bearing resistance using Equations 2 and 3 for cohesive and cohesionless soils respectively.

This table does not take into account the variations in soil composition, and the effects of differential movement within a particular structure. Calculation of the design bearing resistance over the entire structure will entail a knowledge of the magnitude and distribution of the structural actions.

7.2.4 Foundations and ground floor construction

Foundations should transfer loading to below any Made Ground or subsoil. The recommended foundation construction and allowable bearing pressure (ABP) at the borehole locations are presented in Table 1.

Table 1: Construction recommendations

Borehole	Depth below EGL* to suitable bearing stratum	Estimated ABP (kPa)	Strata description	Foundation type	Ground floor construction	Groundwater
BH01	1.0m	>250	Stiff Glacial Till/Possible bedrock	Strip & pad	Ground bearing	Not encountered
BH02	1.20m	>250	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH03	1.20m	>250	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH04	1.20m	230	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH05	1.20m	160	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH06	0.50m	>250	Possible bedrock	Strip & pad	Ground bearing	Not encountered

Borehole	Depth below EGL* to suitable bearing stratum	Estimated ABP (kPa)	Strata description	Foundation type	Ground floor construction	Groundwater
BH07	2.0m	>250	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH08	1.20m	220	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH09	1.20m	>250	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH10	1.20m	200	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH11	1.20m	>250	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH12	1.20m	>250	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH13	1.20m	>250	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered
BH14	1.20m	130	Firm Glacial Till	Strip & pad	Ground bearing	Not encountered
	2.0m	>250	Stiff Glacial Till			
BH15	1.20m	200	Stiff Glacial Till	Strip & pad	Ground bearing	Not encountered

*Existing Ground Level

Based on the findings of the site investigation, spread foundations (strip/pad) are considered suitable with estimated allowable bearing pressures between 130kPa and >250kPa at depths between 0.5m and 1.5m over stiff glacial till or possible bedrock. If foundations are designed to be constructed on bedrock, it is recommended that rotary drilling is undertaken determine rock strength across the site, as this will aid in design.

The base of foundation excavations should be thoroughly inspected; any soft soils should be removed with the resultant void backfilled with ST1 concrete. A consistent bearing stratum should be provided for any building unit to limit differential settlements.

Given the generally fine grained/cohesive nature of the soils throughout the proposed formation levels, excavations for foundations are likely to be relatively stable. However any instability can be minimised by battering the side slopes at 2 vertical to 1 horizontal and by limiting the duration that the excavation is open. Groundwater control, where required, will be possible by pumping from sumps formed in the base of excavations.

7.2.5 Floor slabs

Floor slabs should not bear directly onto Made Ground or soft soils. The use of ground bearing floor slabs is only appropriate following the removal of any surface Made Ground and soft clay layers and their replacement using well-graded well-compacted granular fill. However, a suspended floor slab should be adopted where the difference in levels of the proposed floor and the base of Made Ground/soft soils is greater than 600mm.

7.2.6 Excavations for services

For the installation of services ducts/trenches, it is suggested that open trenching will be the most practicable construction method. Generally speaking, the ground conditions should render the use of open trenching by backhoe excavator possible. Localised rock breaking may be required depending on the invert level of services in the west of the site. This may be possible using a hydraulic rock breaker depending on the strength of the rock.

Where working in open trenches, it is thought that trench support systems, by way of a trench box may be required to maintain trench stability and safe working conditions. Groundwater control at these locations should be possible by means of sump pumping.

To preclude the eventuality of differential settlements in pipes, they should be laid on a consistent stratum of appropriate allowable bearing capacity and protected with appropriate fill cover.

Where ducts and chambers must be installed in areas where localised soft spots are encountered, the use of geogrid reinforcement along the base of the very soft/soft soil (e.g. peat) below the trench base is recommended. This will stiffen the base of the trench and help control longitudinal differential settlement.

Backfilling of trenches may be completed by using compacted Cl 804 granular fill and reinstated as appropriate.

7.2.7 Soil aggressivity

An assessment of the aggressive Chemical Environment for concrete (ACEC) was undertaken through reference to the Building Research Establishment (BRE) Special Digest 1 (2017).

As noted by BRE Special Digest 1, sulphates in the soil and groundwater are the chemical agents most likely to attack concrete. The extent to which sulphates affect concrete is linked to their concentrations, the type of ground, the presence of groundwater, the type of concrete and the form of construction in which concrete is used.

BRE Special Digest 1 identifies four different categories of site which require specific procedures for investigation for aggressive ground conditions.

- Sites not subjected to previous industrial development and not perceived as containing pyrite;
- Sites not subjected to previous industrial development and perceived as containing pyrite;
- Brownfield sites not perceived as containing pyrite;
- Brownfield sites perceived as containing pyrite.

For the purposes of this report the site was classified as not having been subject to previous industrial development and perceived as potentially containing pyrite.

The results of chemical tests (pH and water-soluble sulphate contents) on soil samples indicate Design Sulphate Class DS-1 and ACEC Class AC-1 – reference Table C1 of BRE Special Digest 1 (Building Research Establishment, 2005). The Special Digest does not require any measures to protect underground concrete elements greater than 140mm thick.

7.2.8 Access roads, car parks and hard standing

Based on the strata descriptions and the results of in-situ indirect CBR tests (DCP), the following design CBR values are appropriate:

- less than 2% at locations where the sub-grade is formed in Made Ground, requiring a 600mm thick capping.
- A value of 4% at depth of 1m, is appropriate where stiff Glacial Till is encountered at sub formation level.

Although the CBR value increases with depth, with a value of above 5% below a depth of 300mm, the required construction thickness should be determined by the minimum long-term equilibrium CBR value of the Glacial Till. The value of 4% stated for a depth of 300mm is based on the soil plasticity, as per Table 2.1 of volume 7 section2 of the Design Manual for Roads and Bridges, assuming average construction conditions. A CBR of 4% requires a 300mm thick capping layer.

The use of geosynthetics in the construction of paved areas, will be beneficial particularly in areas of Made Ground. These could include a geosynthetic (e.g. a geogrid) at subgrade level with further benefit gained by incorporating further layer(s) within the capping/sub-base layer.

7.3 Site contamination and waste disposal

Selected soil samples were analysed for a range of potential contaminants including:

- Metals
- Speciated total petroleum hydrocarbons (TPH);
- Speciated polycyclic aromatic hydrocarbons (PAH)
- Cyanides.

- Sulphates and sulphide;
- Phenols; and
- Asbestos screening

Samples were also tested for a Waste Acceptance Criteria (WAC) suite to assess the potential categorisation of waste from the site.

In the initial examination of the potential risk of site contamination, the laboratory results have been compared to the following available assessment criteria relevant to the proposed land use:

- the Environment Agency Soil Guideline Values (SGVs) published, in 2009. These relate to arsenic, mercury, selenium, cadmium, benzene, toluene, ethylbenzene, xylenes, and phenol

The results from the selected samples do not identify significantly elevated concentrations above the SGVs where criteria are available.

It should be noted that the above assessment is based on the results of the tested soil samples against publicly available criteria. No further assessment has been undertaken where criteria are not available. Any potential contamination identified during site development by visual or olfactory means should be investigated, including further laboratory testing, and appropriate health & safety, waste disposal and remediation measures adopted.

In assessment of the disposal of waste, the test results have been compared with the European Union Directive limits for Inert waste landfill, Stable, Non-reactive hazardous waste in non-hazardous landfill and hazardous waste landfill criteria.

From the thirty samples tested for WAC analysis, material from the site may potentially be classified as inert/non-hazardous. It is noted however that any material excavated for off-site disposal would a Waste Classification following the guidance in the National Hazardous Waste Management Plan (EPA, 2014).

8 REFERENCES

Geotechnical Society of Ireland (2016). Specification & Related Documents for Ground Investigation in Ireland

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

BS 5930: 2015: Code of practice for ground investigations. British Standards Institution.

BS EN 1997-2: 2007: Eurocode 7 – Geotechnical design – Part 2 Ground investigation and testing. British Standards Institution.

BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description. British Standards Institution.

BS EN ISO 14688-2:2004+A1:2013: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

BS EN ISO 22476-3:2005+A1:2011. Geotechnical investigation and testing. Field testing. Standard penetration test.

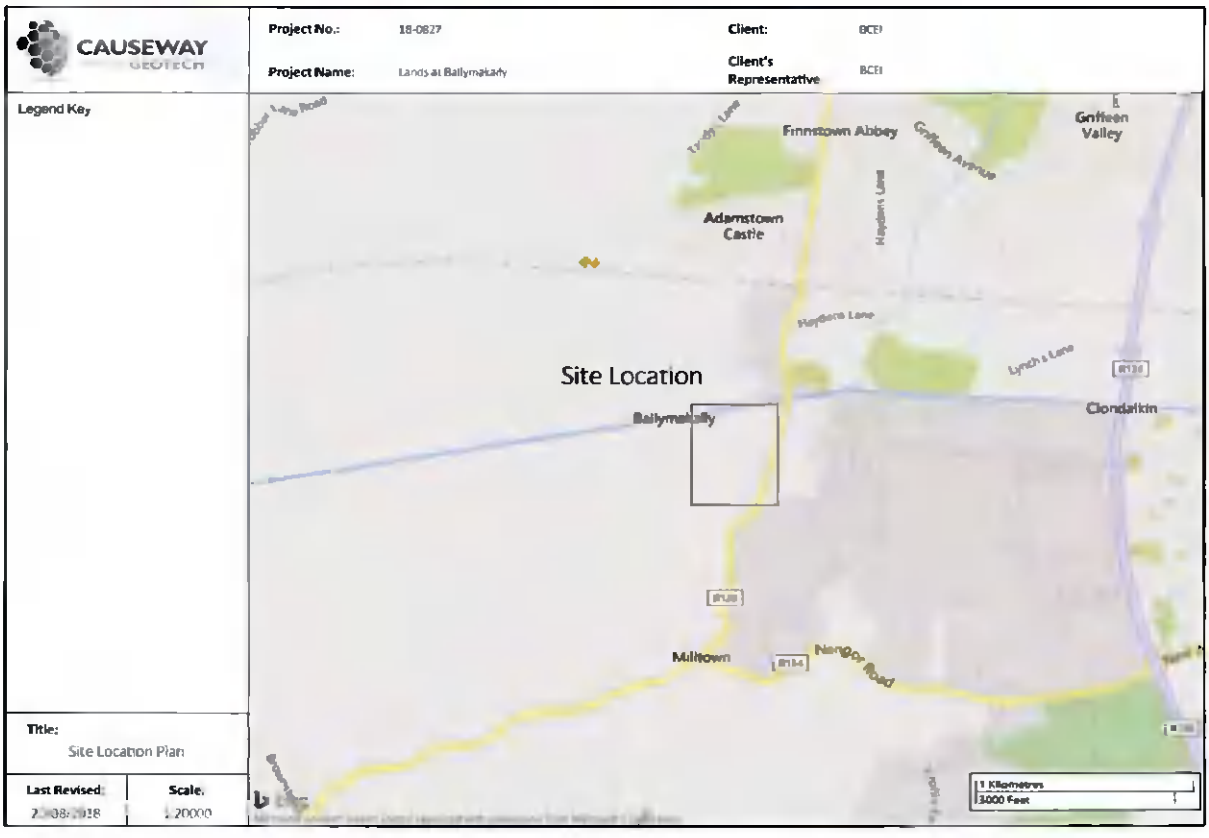
Building Research Establishment (2005) BRE Special Digest 1: Concrete in aggressive ground.

Contaminated Land Report (CLR) 11 (2004) Model Procedures for the Management of Land Contamination. The Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency

CAUSEWAY GEOTECH

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLANS




CAUSEWAY GEOTECH
Project No.: 18-0827
Client: BCEI
Project Name: Lands at Ballynaul
Client's Representative: BCEI
Legend Key
Locations By Type - CP
Locations By Type - TP
TP01
TP06
TP07
BH06
BH07
TP10
TP11
BH10
BH11
TP12
TP14
BH12
TP15
TP16
BH13
BH14
TP18
BH15
TP19
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Last Revised:
31/08/2018
Scale
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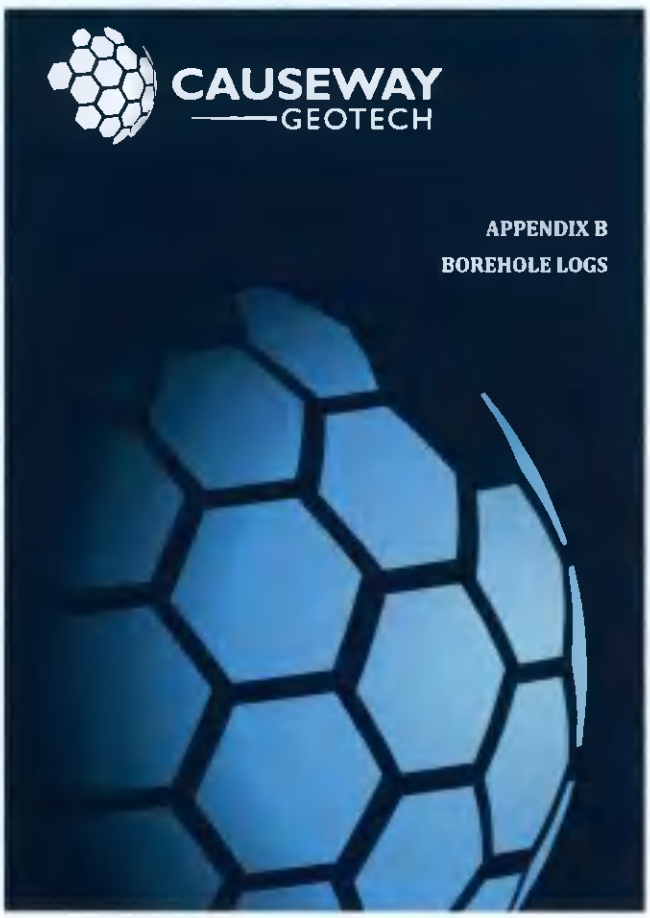
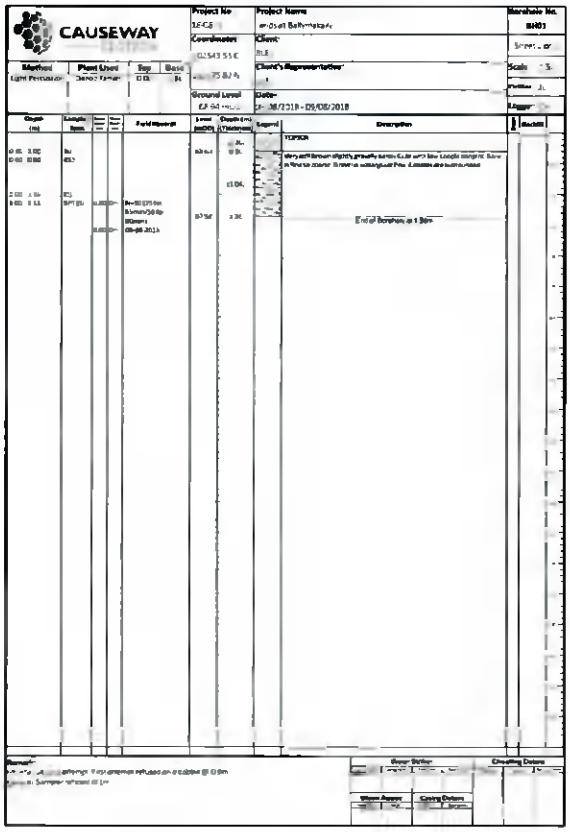
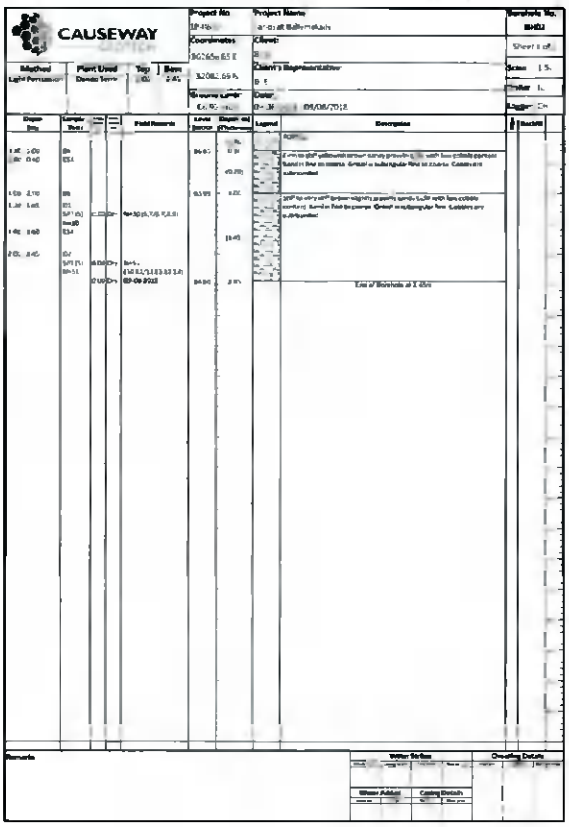
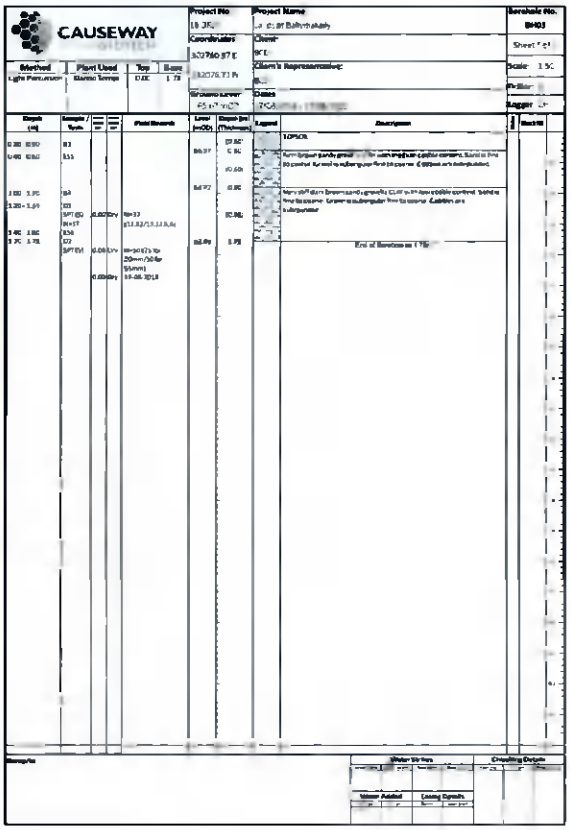
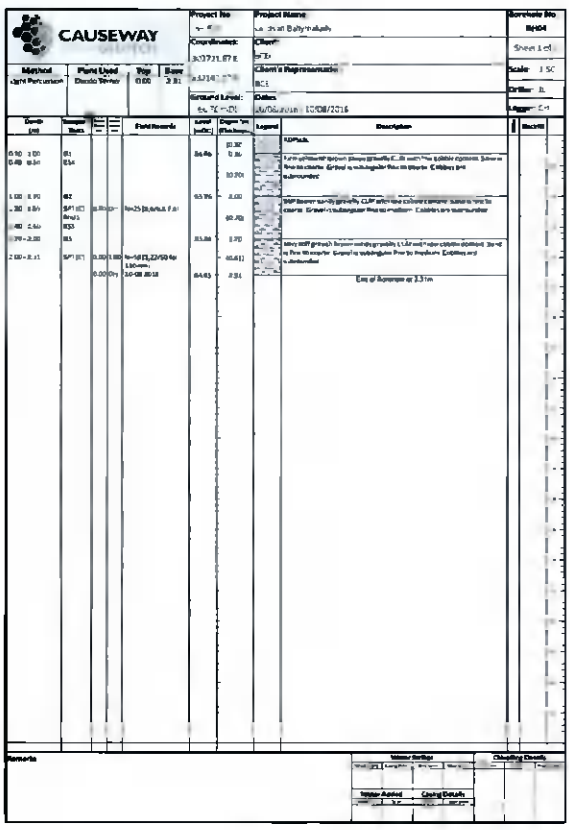
200 Metres
800 Feet


CAUSEWAY GEOTECH
APPENDIX B
BOREHOLE LOGS


CAUSEWAY
Project No
Project Name
Borehole No.
BH01
Coordinates
Client:
Client's Representative
Scale
Method
Plant Used
Top
Base
Light Percussion
Ground Level
Date
Logged
Depth (m)
Length (m)
Field Records
Level (mOD)
Depth (m) (Thickness)
Legend
Description
Backfill
TOPSOI
End of Borehole at 1.00m
Remarks
Water Strikes
Standing Details
Water Added
Casing Details


CAUSEWAY
Project No
Project Name
Borehole No.
BH02
Coordinates
Client:
Client's Representative
Scale
Method
Plant Used
Top
Base
Light Percussion
Ground Level
Date
Logged
Depth (m)
Length (m)
Field Records
Level (mOD)
Depth (m) (Thickness)
Legend
Description
Backfill
End of Borehole at 1.45m
Remarks
Water Strikes
Standing Details
Water Added
Casing Details


CAUSEWAY
Project No
Project Name
Borehole No.
BH03
Coordinates
Client
Client's Representative
Ground Level
Dates
Method
Light Percussion
Plant Used
Top
Base
Scale
Logged
Driller
Depth (m)
Sample / Tests
Field Records
Level (mOD)
Depth (m) (Thickness)
Legend
Description
Backfill
Remarks
Water Strikes
Casing Details
Water Added
Casing Depth
End of Borehole at 1.70m


CAUSEWAY
Project No
Project Name
Borehole No
BH04
Coordinates
Client
Client's Representative
Ground Level
Dates
Method
Light Percussion
Plant Used
Top
Base
Scale
Logged
Driller
Depth (m)
Sample / Tests
Field Records
Level (mOD)
Depth (m) (Thickness)
Legend
Description
Backfill
Remarks
Water Strikes
Casing Details
Water Added
Casing Depth
End of Borehole at 2.31m

CAUSEWAY GEOTECH

Project No	Project Name	Borehole No
[illegible]	[illegible] at Ballymakaily	[illegible]
Coordinates	Client	Sheet 1 of 1
[illegible]	[illegible]	Scale [illegible]
Method / Plant Used / Top / Base	Client's Representative	Driller [illegible]
Ground Level	Dates	Logger [illegible]

Depth (m)	Sample / Tests			Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description		Backfill
[illegible]	[illegible]			[illegible]	[illegible]	[illegible]		[illegible]		
								End of Borehole at [illegible]		

Remarks
[illegible]

Water Strikes	Chiselling Details
[illegible]	[illegible]

Water Added	Casing Details
[illegible]	[illegible]

CAUSEWAY GEOTECH

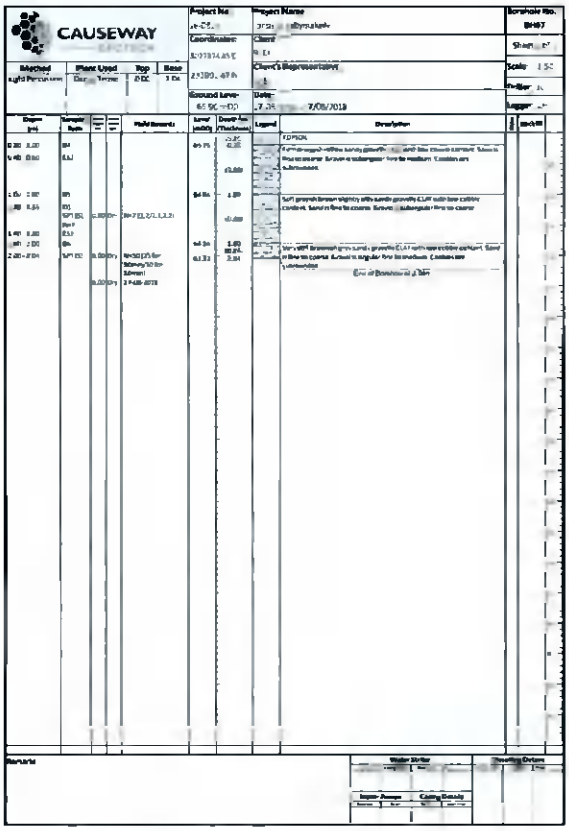
Project No	Project Name	Borehole No
[illegible]	[illegible] at Ballymakaily	[illegible]
Coordinates	Client	Sheet 1 of 1
[illegible]	[illegible]	Scale [illegible]
Method / Plant Used / Top / Base	Client's Representative	Driller [illegible]
Ground Level	Dates	Logger [illegible]
[illegible]	[illegible] 10/08/[illegible]	

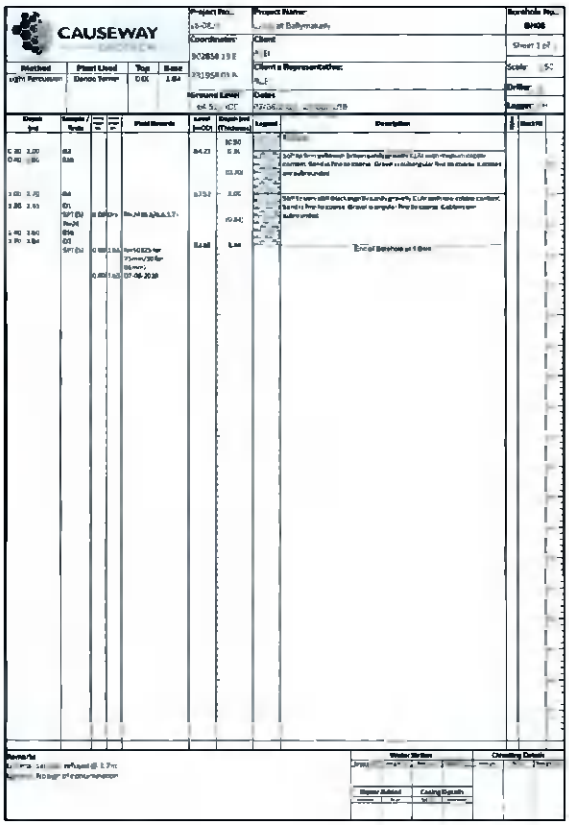
Depth (m)	Sample / Tests			Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description		Backfill
[illegible]	[illegible]			[illegible]	[illegible]	[illegible]		TOPSOIL		
[illegible]	[illegible]			[illegible]	[illegible]	[illegible]		[illegible]		
								End of Borehole at [illegible]		

Remarks
[illegible]

Water Strikes	Chiselling Details
[illegible]	[illegible]

Water Added	Casing Details
[illegible]	[illegible]


CAUSEWAY
BH07
7/08/2018


CAUSEWAY
BH08

CAUSEWAY GEOTECH

Project No.	Project Name	Borehole No.
[illegible]	[illegible] Ballymakaily	BH09
Coordinates	Client	Sheet 1 of 1
302930.16 E	[illegible]	Scale: 1:50
Ground Level	Client's Representative	Driller: [illegible]
[illegible]	Dates: [illegible]/2018 - 08/06/2018	Logger: [illegible]

Method	Plant Used	Top	Base
Light Percussion	Dando [illegible]	0.00	2.44

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
						TOPSOIL
						[illegible]
						[illegible]
				2.44		End of Borehole at 2.44m

Remarks

Water Strikes | Chiselling Details | Water Added | Casing Details

CAUSEWAY GEOTECH

Project No.	Project Name	Borehole No.
[illegible]	[illegible] Ballymakaily	BH10
Coordinates	Client	Sheet 1 of 1
302666.85 E	[illegible]	Scale: 1:50
Ground Level	Client's Representative	Driller: [illegible]
[illegible]	Dates: [illegible]	Logger: [illegible]

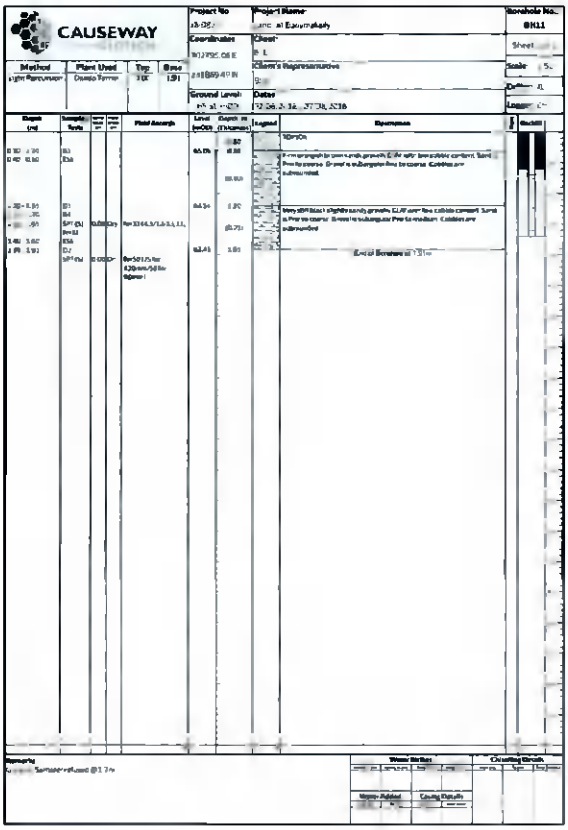
Method	Plant Used	Top	Base
Light Percussion	Dando Terrier	[illegible]	3.25

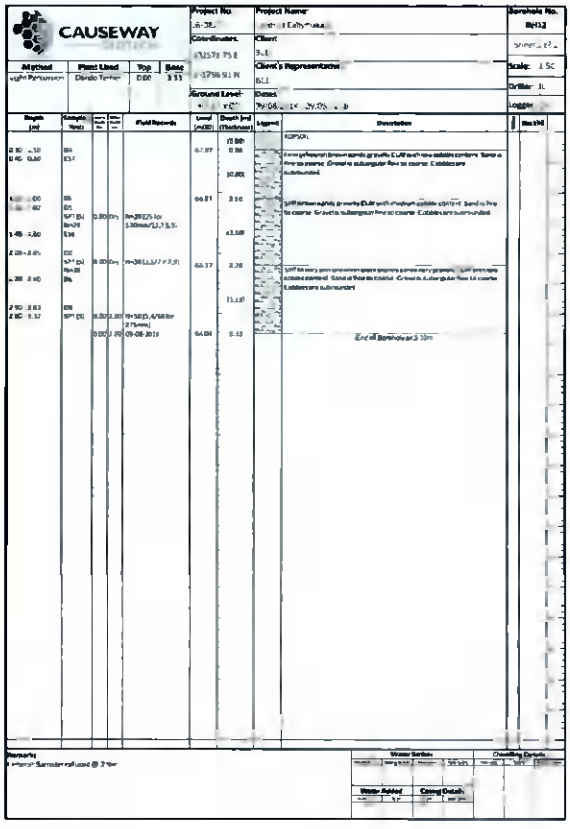
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
						TOPSOIL
						[illegible]
						[illegible]
						[illegible]
				3.25		End of Borehole at 3.25m

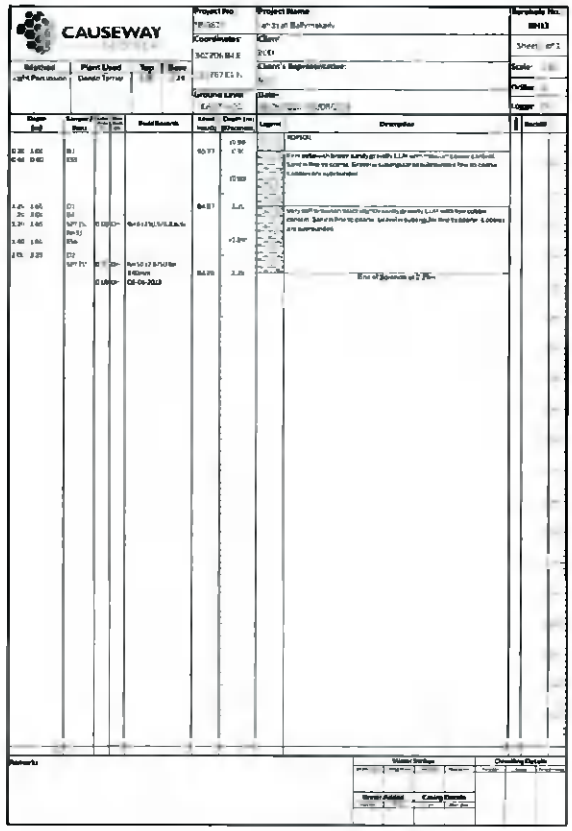
Remarks

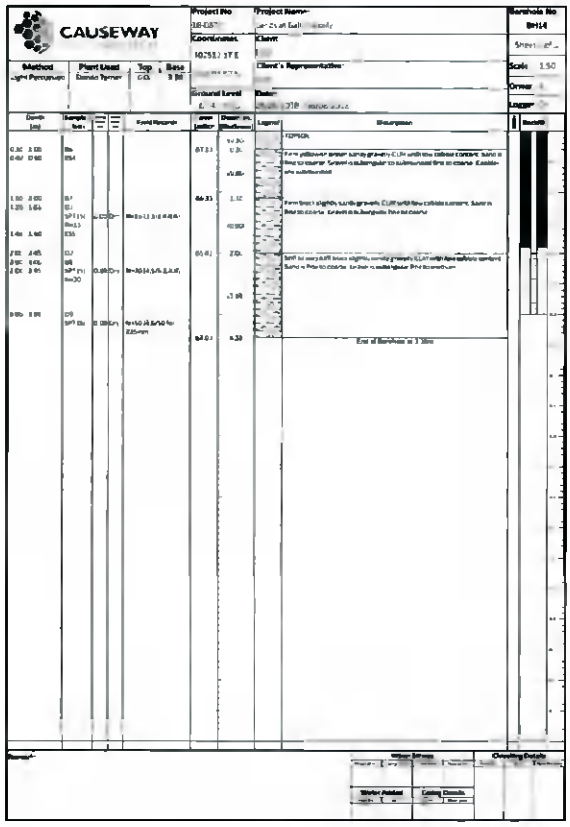
[illegible]

Water Strikes | Chiselling Details | Water Added | Casing Details

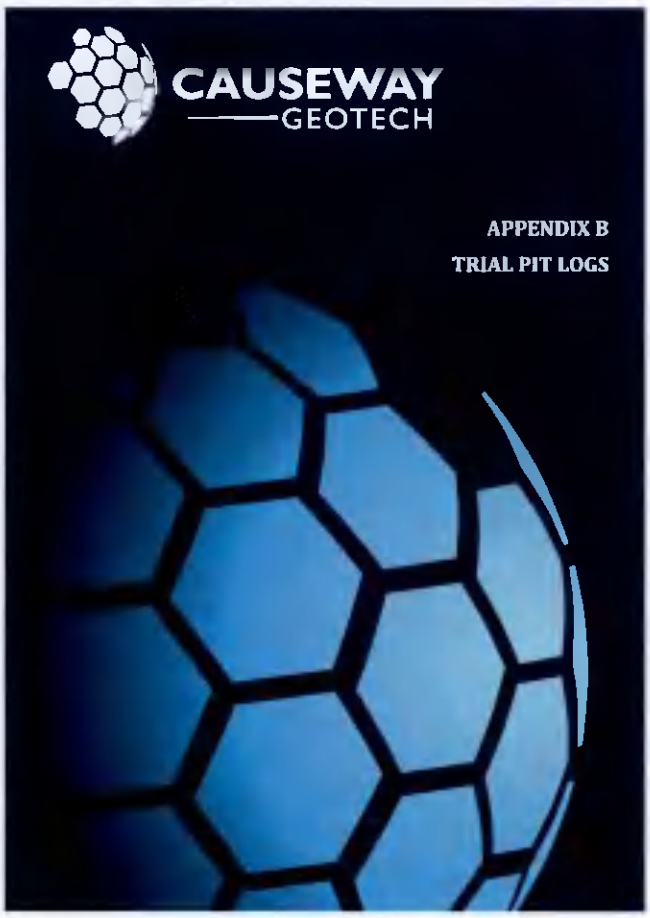

CAUSEWAY
Project No.
Project Name:
Borehole No.
BH11
Coordinates:
Client:
Sheet:
Method
Plant Used
Top
Base
Client's Representative:
Scale:
Ground Level:
Date:
Driller:
Logged:
Depth (m)
Sample/ Tests
Field Records
Level (mOD)
Depth (m) (Thickness)
Legend
Description
Water Strikes
Chiselling Details
Water Added
Casing Details
Remarks:

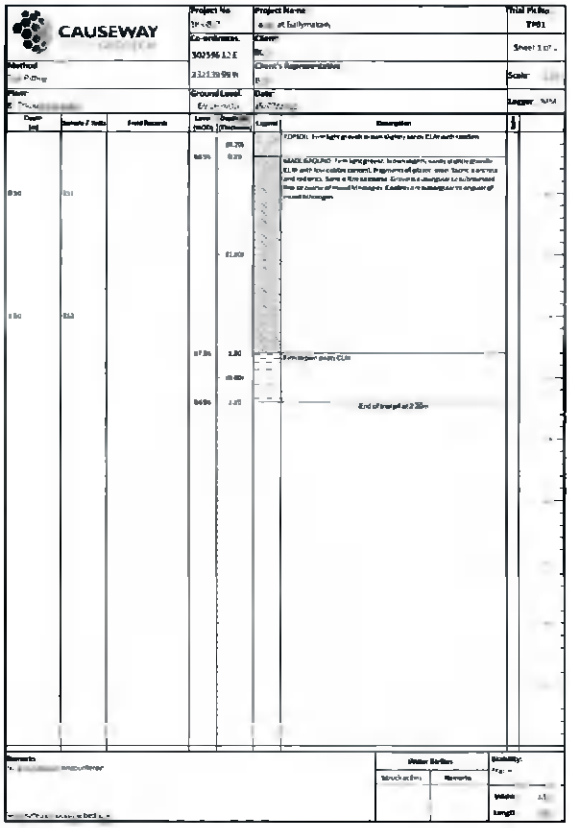

CAUSEWAY
Project No.
Project Name:
Borehole No.
BH12
Coordinates:
Client:
Sheet:
Method
Plant Used
Top
Base
Client's Representative:
Scale:
Ground Level:
Date:
Driller:
Logged:
Depth (m)
Sample/ Tests
Field Records
Level (mOD)
Depth (m) (Thickness)
Legend
Description
Water Strikes
Chiselling Details
Water Added
Casing Details
Remarks:

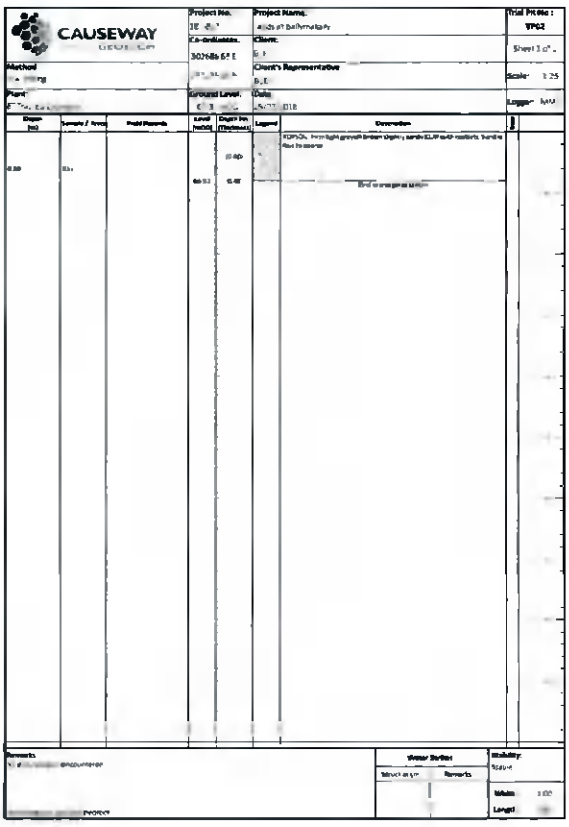

CAUSEWAY

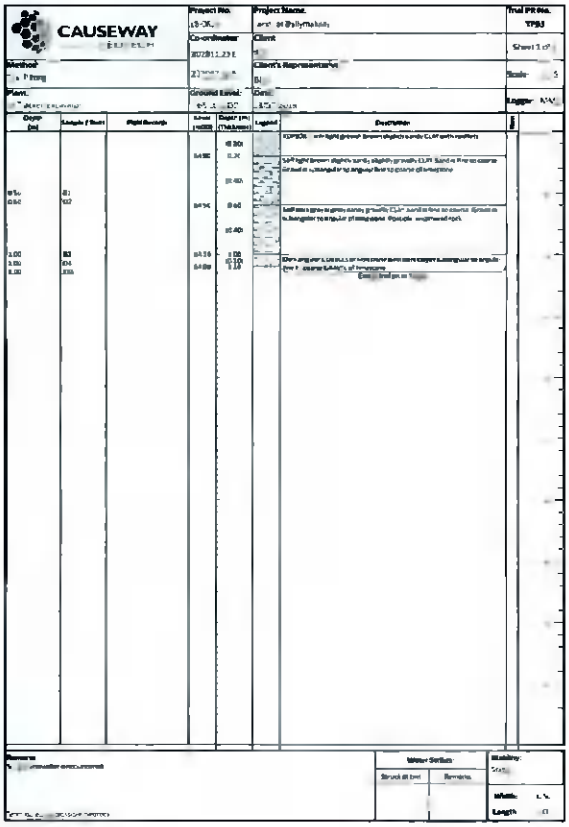

CAUSEWAY

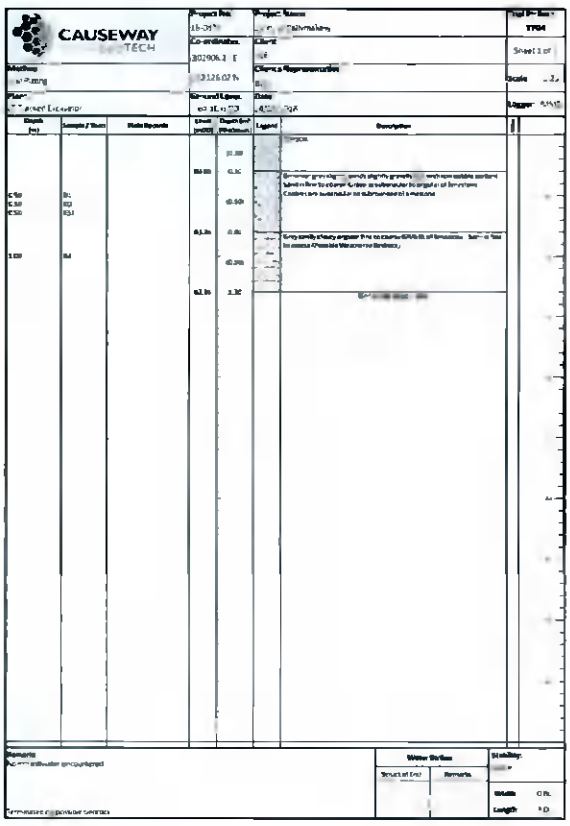

CAUSEWAY

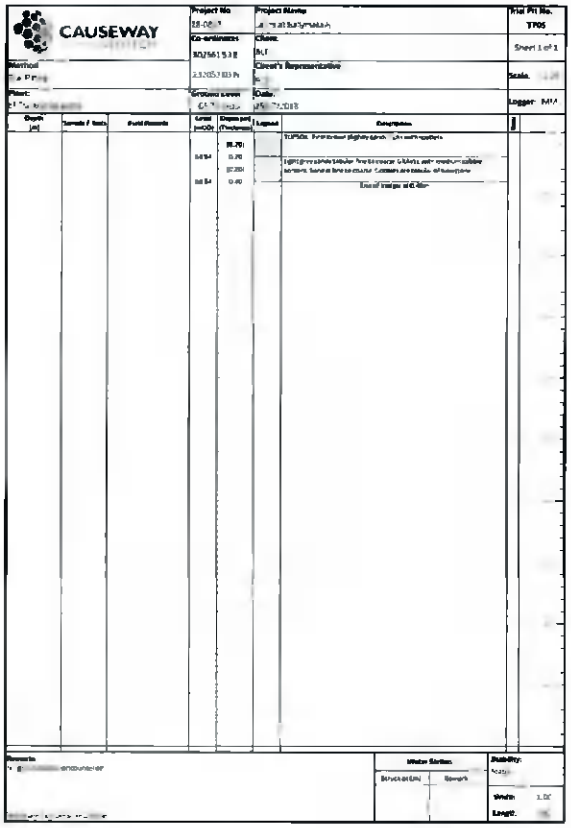

CAUSEWAY
GEOTECH
APPENDIX B
TRIAL PIT LOGS

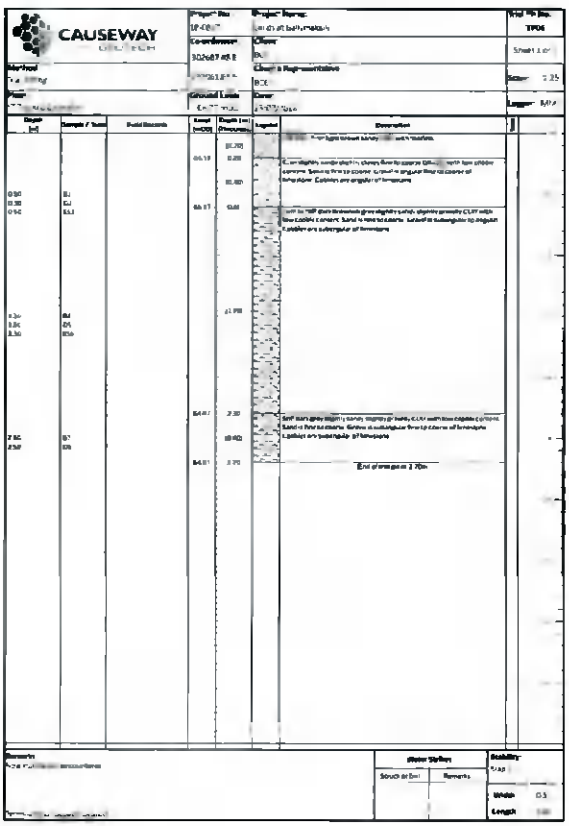

CAUSEWAY
TP01


CAUSEWAY
TP02


CAUSEWAY
TECH
Project No.
Project Name.
Trial Pit No.
TP03
Co-ordinates.
Client
Sheet 1 of
Method
Client's Representative
Scale
Plant
Ground Level.
Date
Logged
Depth (m)
Sample / Tests
Field Records
Level (mOD)
Depth (m) (Thickness)
Legend
Description
Remarks
Water Strikes
Struck at (m)
Remarks
Stability
Width
Length


CAUSEWAY
TECH
Project No.
Project Name.
Trial Pit No.
TP04
Co-ordinates.
Client
Sheet 1 of
Method
Client's Representative
Scale
Plant
Ground Level.
Date
Logged
Depth (m)
Sample / Tests
Field Records
Level (mOD)
Depth (m) (Thickness)
Legend
Description
Remarks
Water Strikes
Struck at (m)
Remarks
Stability
Width
Length


CAUSEWAY
TP05
Sheet 1 of 1


CAUSEWAY
TP06

CAUSEWAY	Project No.	Project Name	Trial Pit No.
	[illegible]	[illegible]	TP07
	Co-ordinates	Client	Sheet 1 of 1
Method	[illegible] E	[illegible]	
[illegible]	[illegible] N	Client's Representative	Scale [illegible]
Plant	Ground Level	Dates	Logger [illegible]
[illegible]	[illegible] mOD	[illegible]	

Depth (m)	Sample / Test	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
				(0.20)		TOPSOIL [illegible]
			[illegible]	0.20		[illegible]
0.50	[illegible]			(0.50)		
0.50	[illegible]					
0.50	[illegible]					
			[illegible]	[illegible]		[illegible]
				[illegible]		
1.20	[illegible]					
1.20	[illegible]		[illegible]	[illegible]		End of trial pit at [illegible]

Remarks	Water Strikes		Stability
[illegible]	Struck at (m)	Remarks	[illegible]
			Width [illegible]
[illegible]			Length [illegible]

CAUSEWAY GEOTECH	Project No.	Project Name	Trial Pit No.
	[illegible]	[illegible]	TP08
	Co-ordinates	Client	Sheet 1 of 1
Method	[illegible] E	[illegible]	
[illegible]	[illegible] N	Client's Representative	Scale [illegible]
Plant	Ground Level	Dates	Logger [illegible]
[illegible] Excavator	[illegible] mOD	[illegible]	

Depth (m)	Sample / Test	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
				(0.30)		[illegible]
			[illegible]	[illegible]		[illegible]
				(0.30)		
			[illegible]	[illegible]		End of trial pit at [illegible]

Remarks	Water Strikes		Stability
[illegible]	Struck at (m)	Remarks	[illegible]
			Width [illegible]
[illegible]			Length [illegible]

CAUSEWAY

Project No.	Project Name	Trial Pit No:
[illegible]	Lands at Ballycalegy [illegible]	TP09
Co-ordinates	Client	Sheet 1 of 1
30251[illegible] E / 231967[illegible] N	[illegible]	
Method	Client's Representative	Scale 1:25
Ground Level	Date	Logger MM
[illegible] mOD	25/[illegible]	

Plant: [illegible] Excavator

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
				(0.20)		[illegible]
			[illegible]	[illegible]		Light brownish sandy [illegible] [illegible]
[illegible]	[illegible]			[illegible]		
			[illegible]	[illegible]		End of trial pit at [illegible]

Remarks: [illegible]

Water Strikes: Struck at (m) | Remarks

Stability: Stable

Width: [illegible] Length: [illegible]

CAUSEWAY

Project No.	Project Name	Trial Pit No
[illegible]	Lands at Ballymakaily	TP10
Co-ordinates	Client	Sheet 1 of 1
302627.64 E / 231930.93 N	[illegible]	
Method	Client's Representative	Scale 1:25
Trial Pitting	[illegible]	
Ground Level	Date	Logger MM
[illegible] mOD	25/[illegible]	

Plant: [illegible]

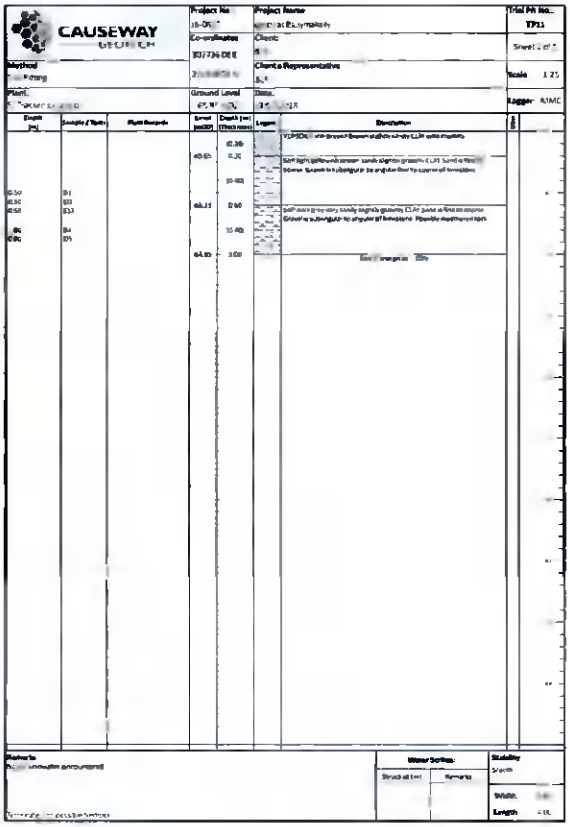
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
				(0.20)		TOPSOIL: [illegible]
			[illegible]	0.20		[illegible] brown slightly sandy slightly gravelly CLAY [illegible]
0.30 0.50 0.50	B1 D2 ES3			[illegible]		
			[illegible]	[illegible]		[illegible] COBBLES [illegible]
				(0.40)		
			[illegible]	[illegible]		Dark greyish brown slightly sandy slightly gravelly CLAY [illegible]
[illegible]	[illegible]			[illegible]		
			[illegible]	[illegible]		End of trial pit at [illegible]

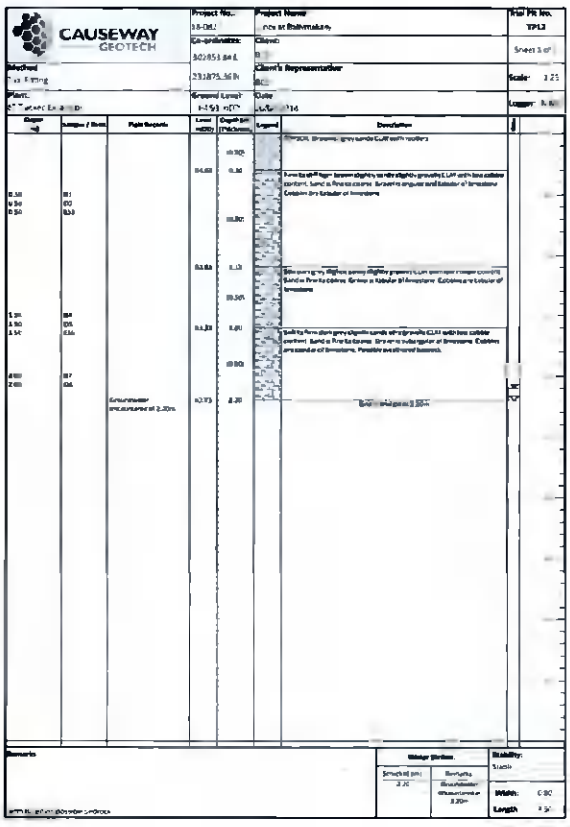
Remarks: [illegible]

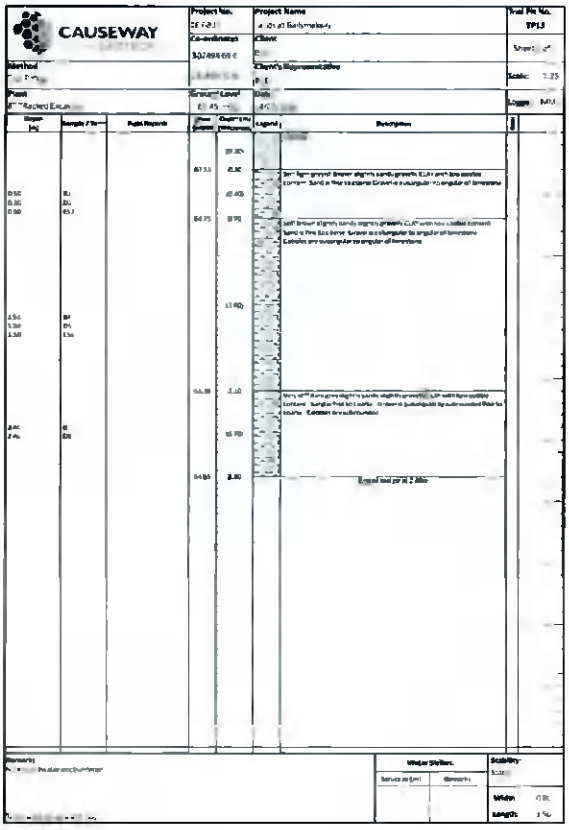
Water Strikes: Struck at (m) | Remarks

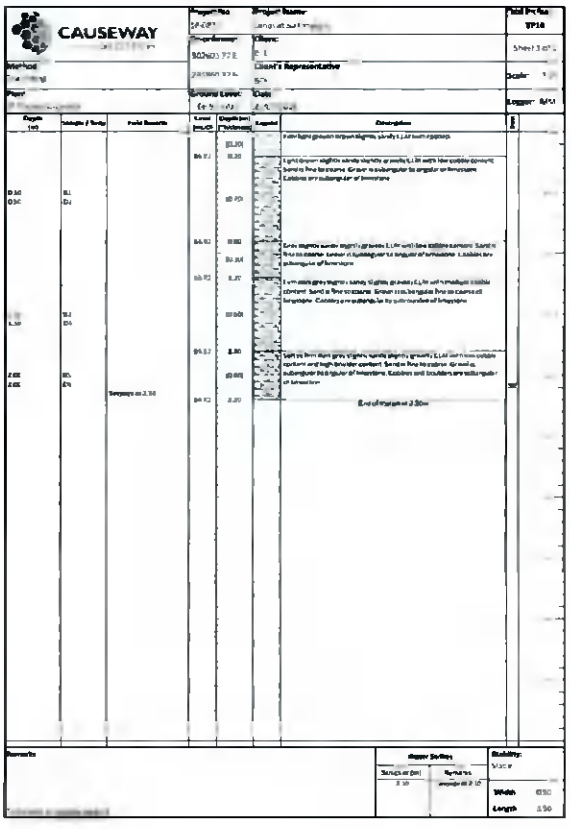
Stability: Stable

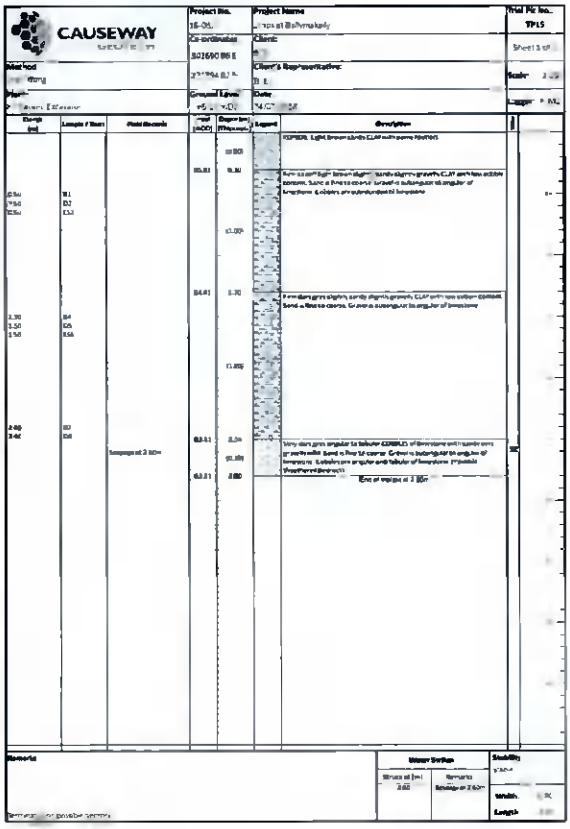
Width: [illegible] Length: [illegible]

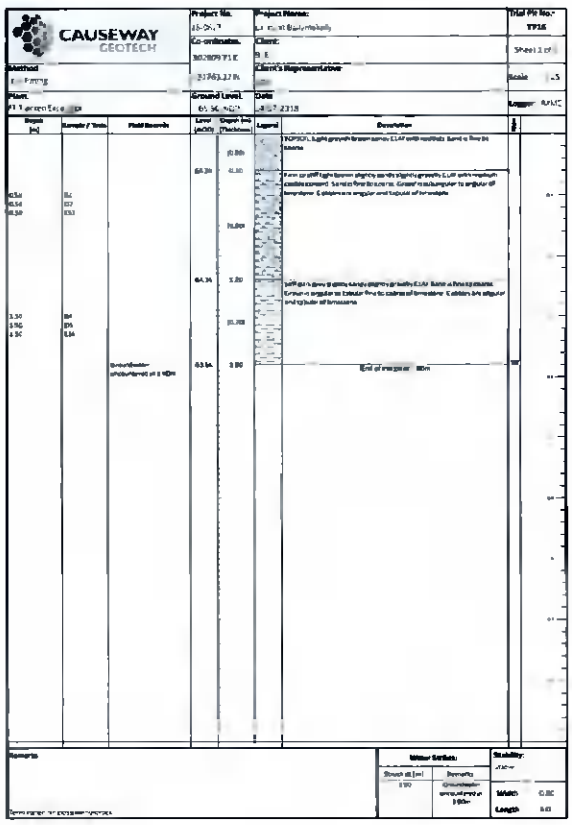

CAUSEWAY
GEOTECH
TP11

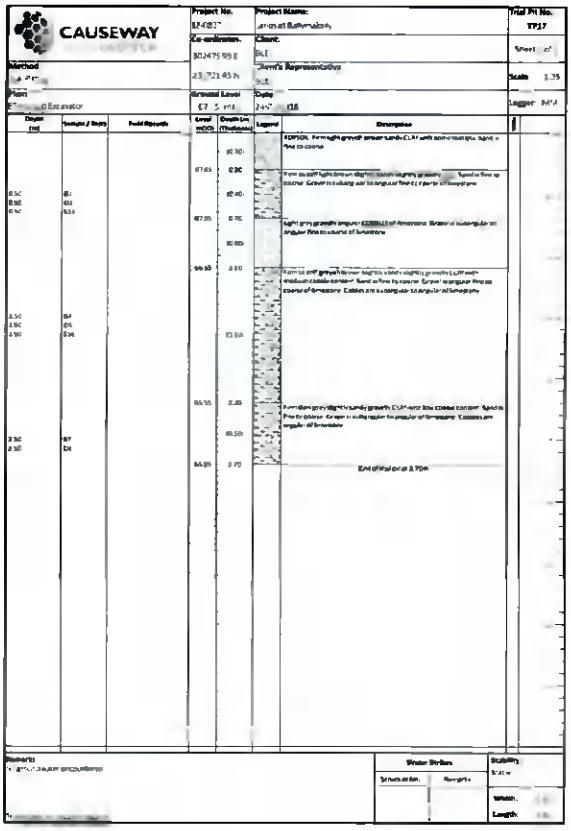

CAUSEWAY
GEOTECH
TP13

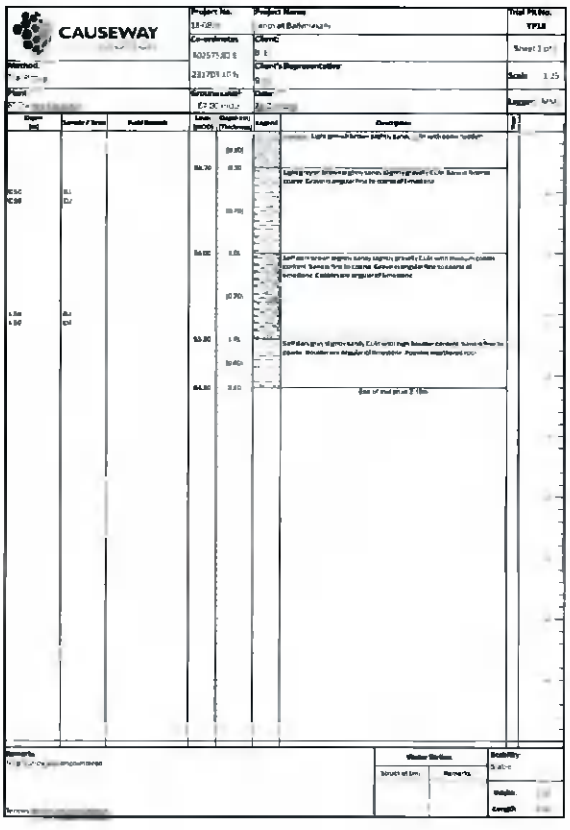

CAUSEWAY
TP13

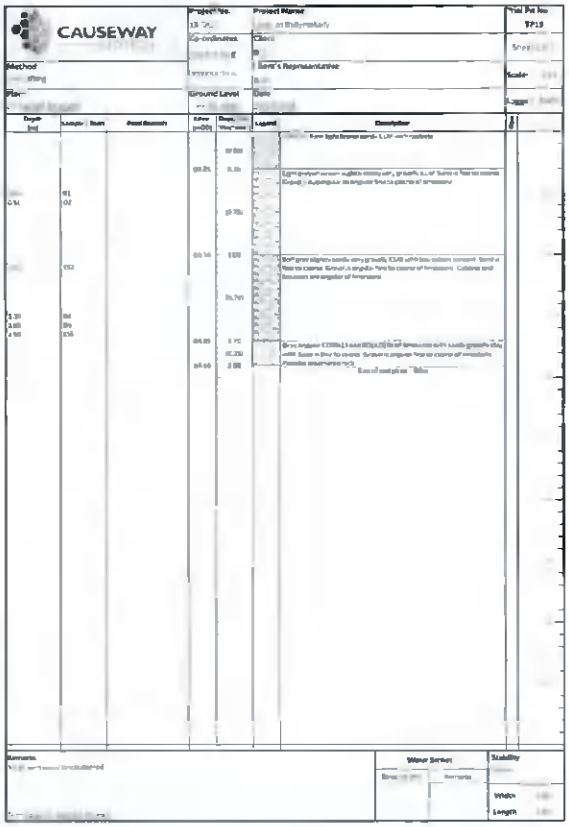

CAUSEWAY
TP18

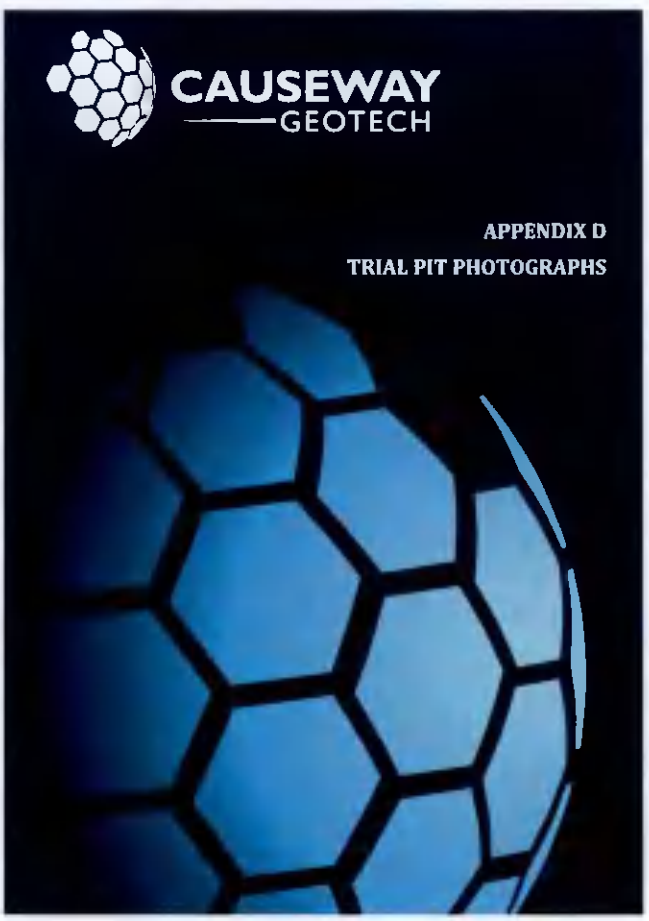

CAUSEWAY
GEOTECH
Project No.
Project Name
Trial Pit No.
TP15
Co-ordinates
Client:
Sheet 1 of
Method
Client's Representative:
Scale
Plant
Ground Level:
Date:
Logged
Depth (m)
Sample / Test
Field Records
Level (mOD)
Depth (Thickness)
Legend
Description
Groundwater encountered at 2.40m
End of trial pit at 3.80m
Remarks
Water Strikes
Strike at (m)
Remarks
Stability
Width
Length


CAUSEWAY
GEOTECH
Project No.
Project Name:
Trial Pit No.
TP16
Co-ordinates:
Client:
Sheet 1 of
Method
Client's Representative:
Scale
Plant:
Ground Level:
Date:
Logged
Depth (m)
Sample / Tests
Field Records
Level (mOD)
Depth (Thickness)
Legend
Description
Groundwater encountered at 1.90m
End of trial pit at 3.80m
Remarks
Water Strikes
Strike at (m)
Remarks
Stability
Width
Length


CAUSEWAY
Project No.
Project Name:
Trial Pit No.
TP17
Co-ordinates:
Client:
Method
Client's Representative
Scale
Plant
Ground Level
Date
Logged
Depth (m)
Sample / Tests
Field Records
Level mOD
Depth (m) Thickness
Legend
Description
Remarks
Water Strikes
Stability
Width
Length


CAUSEWAY
Project No.
Project Name
Trial Pit No.
Co-ordinates
Client
Method
Client's Representative
Scale
Plant
Ground Level
Date
Logged
Depth (m)
Sample / Tests
Field Records
Level (mOD)
Depth (m) Thickness
Legend
Description
Remarks
Water Strikes
Stability
Width
Length


CAUSEWAY


CAUSEWAY
GEOTECH
APPENDIX D
TRIAL PIT PHOTOGRAPHS

TP01

TP01

CAUSEWAY GEOTECH

August 2018

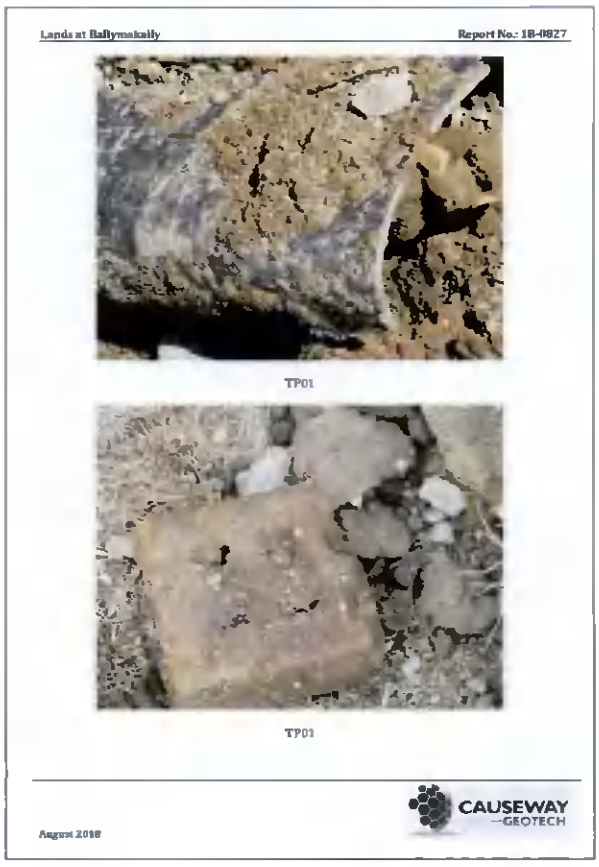
TP01

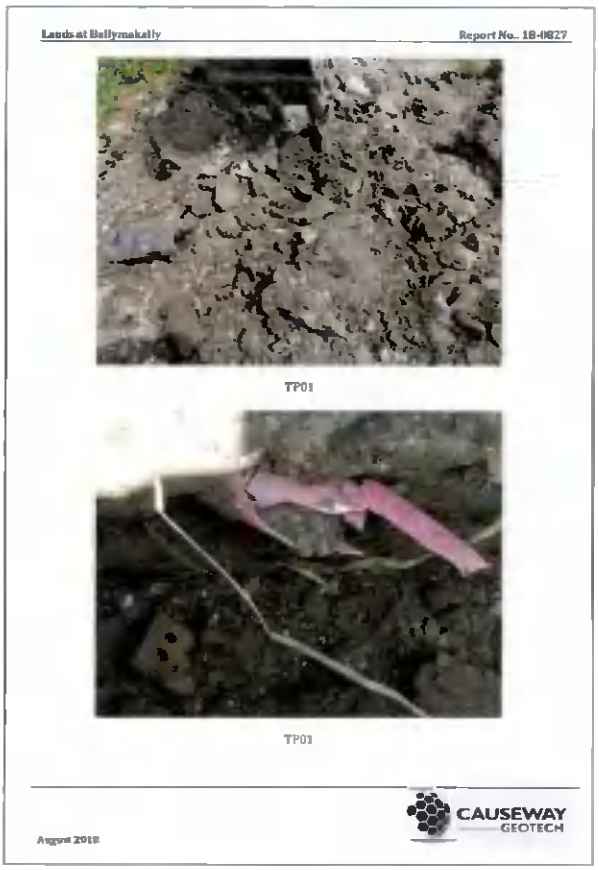
TP01

CAUSEWAY GEOTECH

August 2018

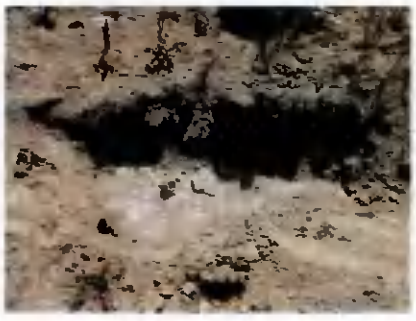

Lands at Ballymakaily
Report No.: 18-0827
TP01
TP01
CAUSEWAY GEOTECH
August 2018


Lands at Ballymakaily
Report No.: 18-0827
TP01
TP01
CAUSEWAY GEOTECH
August 2018


Lands at Ballymakaily
Report No.. 18-0827
TP01
TP01
CAUSEWAY GEOTECH
August 2018

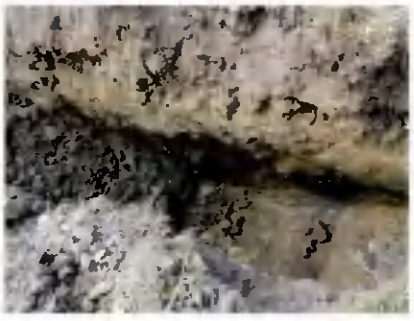

Lands at Ballymakaily
Report No.. 18-0827
TP01
TP01
CAUSEWAY GEOTECH
August 2018

TP02



TP02

TP02



TP03

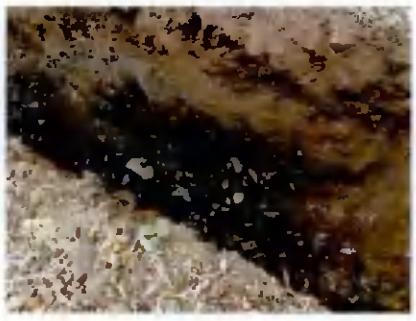
TP03

TP03

TP03

Lands at Ballymakelly Report No.: 18-0827

TP04



TP04

August 2018

CAUSEWAY GEOTECH

Lands at Ballymakelly Report No.: 18-0827

TP04

TP04

August 2018

CAUSEWAY GEOTECH

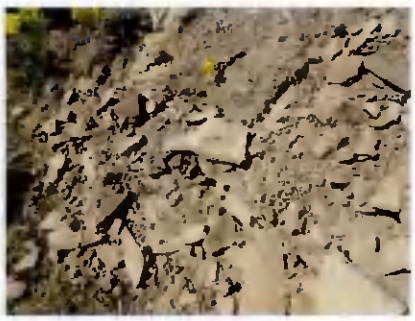
TP04

CAUSEWAY GEOTECH

TP05

TP05

CAUSEWAY GEOTECH



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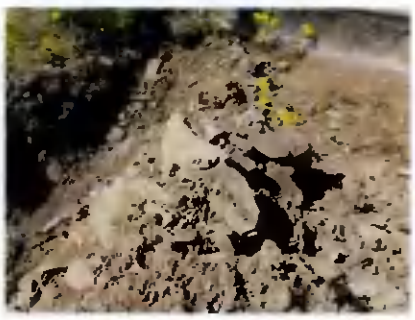
TP05

CAUSEWAY GEOTECH

August 2018

TP05



TP05

CAUSEWAY GEOTECH

August 2018

TP06

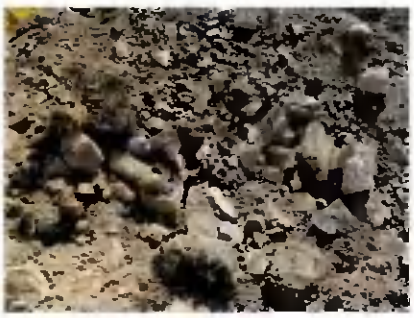
TP06

CAUSEWAY GEOTECH

August 2018

Lands at Ballymakally Report No.: 18-0827

TP06



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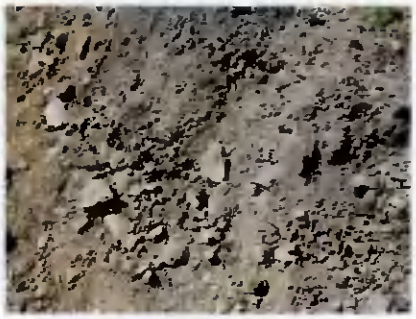
CAUSEWAY GEOTECH

August 2018



TP06

TP06

TP07

TP07

TP07

TP07

CAUSEWAY GEOTECH

August 2018

TP08

CAUSEWAY GEOTECH

August 2018

TP08

TP09

TP09

TP09

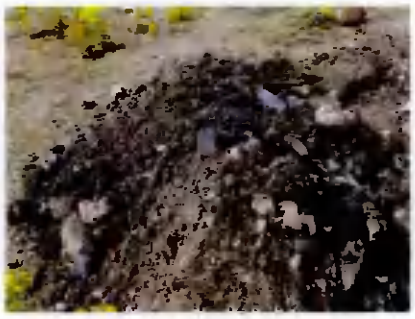
CAUSEWAY GEOTECH

TP10

TP10

CAUSEWAY GEOTECH

TP10



TP10

CAUSEWAY GEOTECH

August 2018

TP11

TP11

CAUSEWAY GEOTECH

August 2018

TP11

TP11

Lands at Ballymakaily Report No.: 18-0827

TP11

TP12

TP12

TP12

TP12

TP12

CAUSEWAY GEOTECH

August 2018

TP13

TP13

CAUSEWAY GEOTECH

August 2018

TP13

TP13

CAUSEWAY GEOTECH

August 2018

Lands at Ballymakally Report No.: 18-0827

TP13

CAUSEWAY GEOTECH

August 2018

TP14

TP14

Lands at Ballymakatly Report No. 18-0827

TP14

TP14

Lands at Ballymakally Report No. 18-0827

TP15

TP15

CAUSEWAY GEOTECH

August 2018

Lands at Ballymakally Report No.: 18-0827

TP15

TP15

CAUSEWAY GEOTECH

August 2018

TP16

TP16

CAUSEWAY GEOTECH

August 2018

TP16

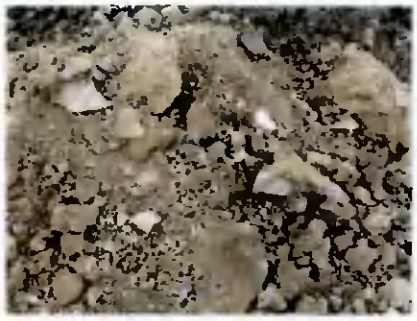
TP16

CAUSEWAY GEOTECH

August 2018


Lands at Ballymakaily
Report No.: 18-0827
TP16
CAUSEWAY GEOTECH
August 2018


Lands at Ballymakaily
Report No.: 18-0827
TP17
TP17
CAUSEWAY GEOTECH
August 2018



TP17

TP17

CAUSEWAY GEOTECH

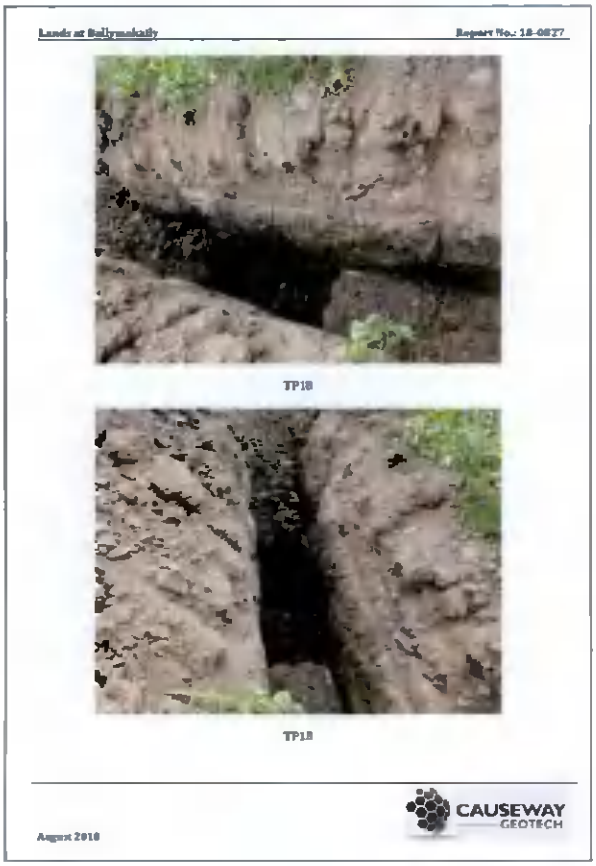
August 2018

Lands at Ballymakeady Report No. 18-0827

TP17

CAUSEWAY GEOTECH

August 2018


Lands at Ballymakaily
Report No.: 18-0827
TP18
TP18
CAUSEWAY GEOTECH
August 2018


Lands at Ballymakaily
Report No.: 18-0827
TP18
TP18
CAUSEWAY GEOTECH
August 2018

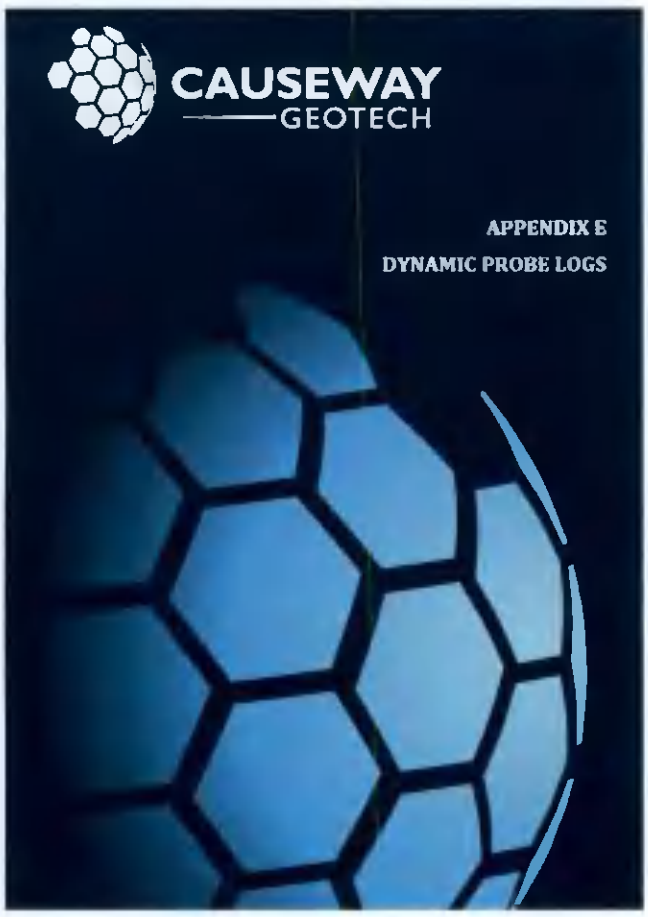
TP19

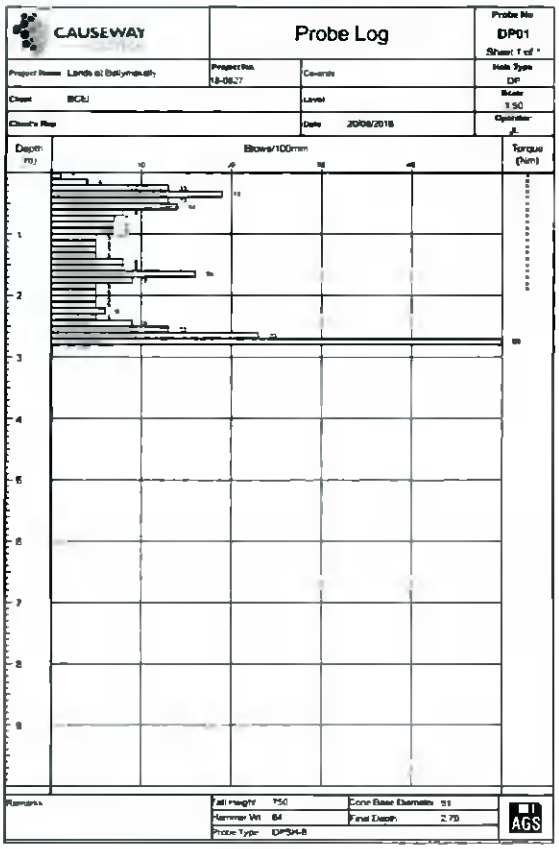
TP19

TP19

TP19


Lands at Ballymakeady
Report No.: 18-0827
TP19
CAUSEWAY
GEOTECH
August 2018


CAUSEWAY
GEOTECH
APPENDIX E
DYNAMIC PROBE LOGS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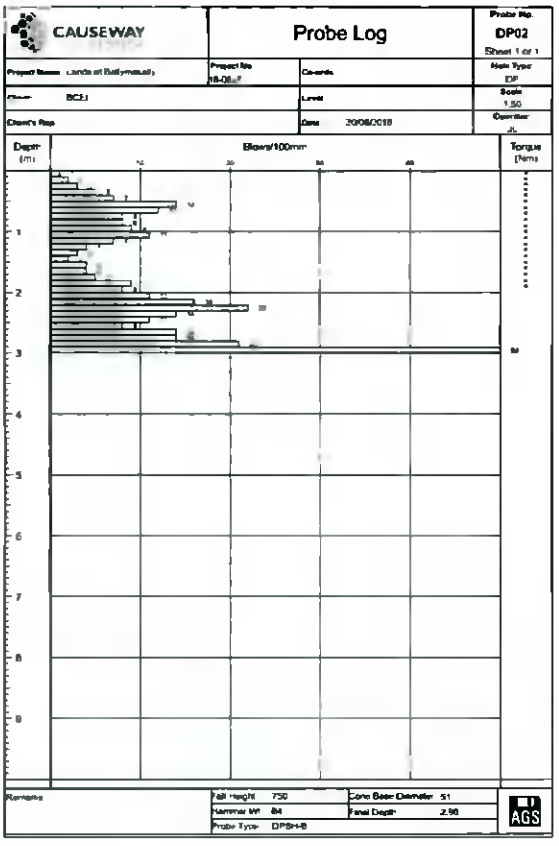
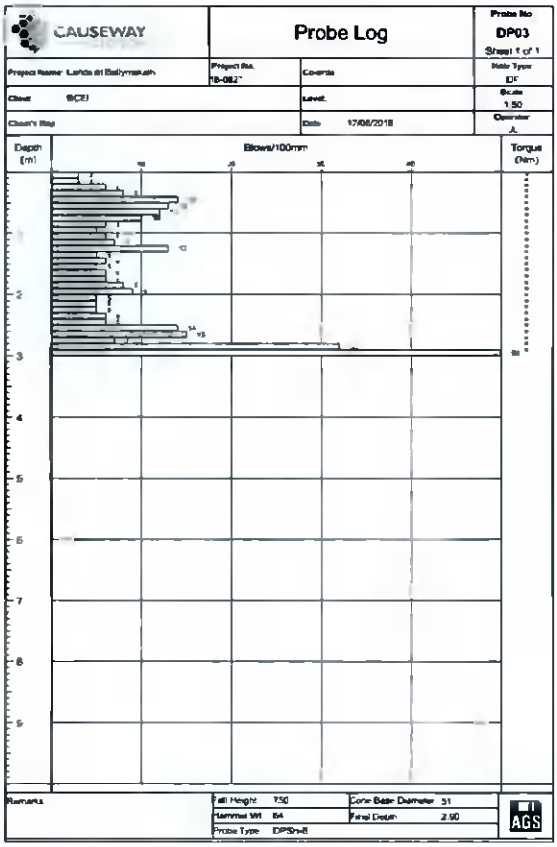
Probe Log
DP01
Blows/100mm
Torque (Nm)
AGS


CAUSEWAY
Probe Log
DP02
Blows/100mm
Torque (Nm)
AGS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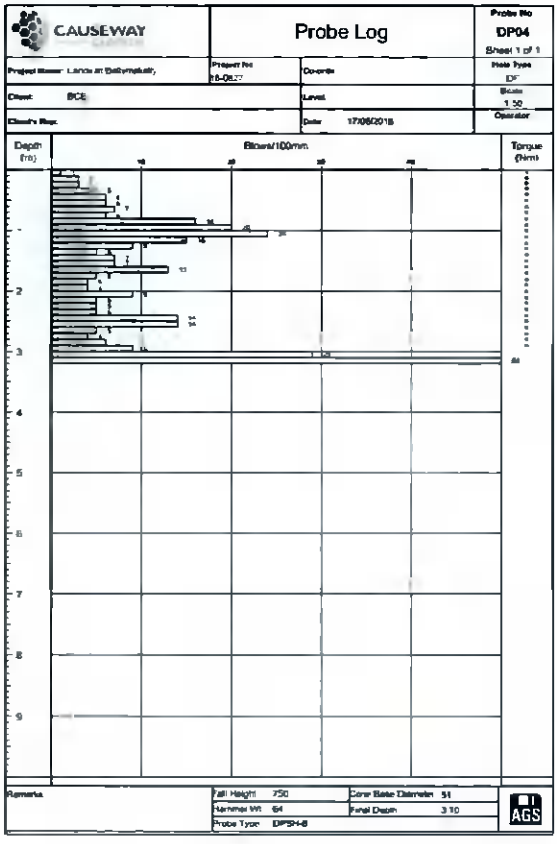
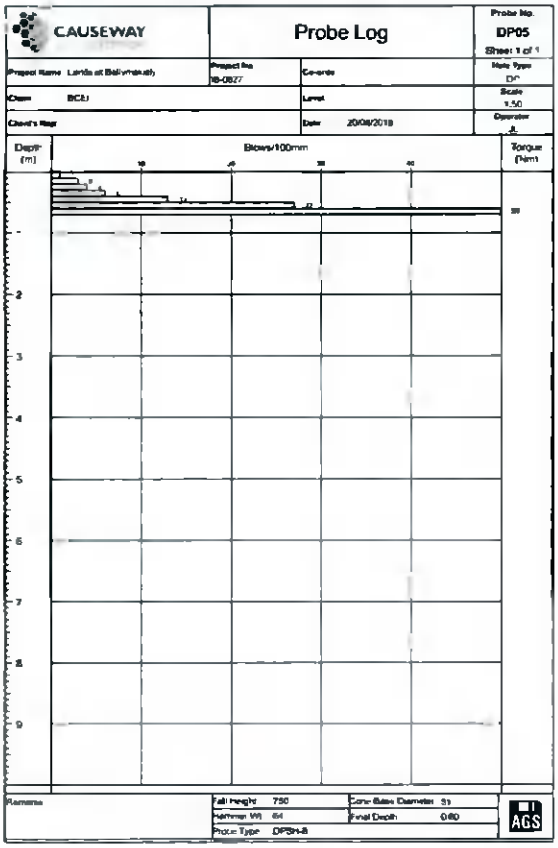
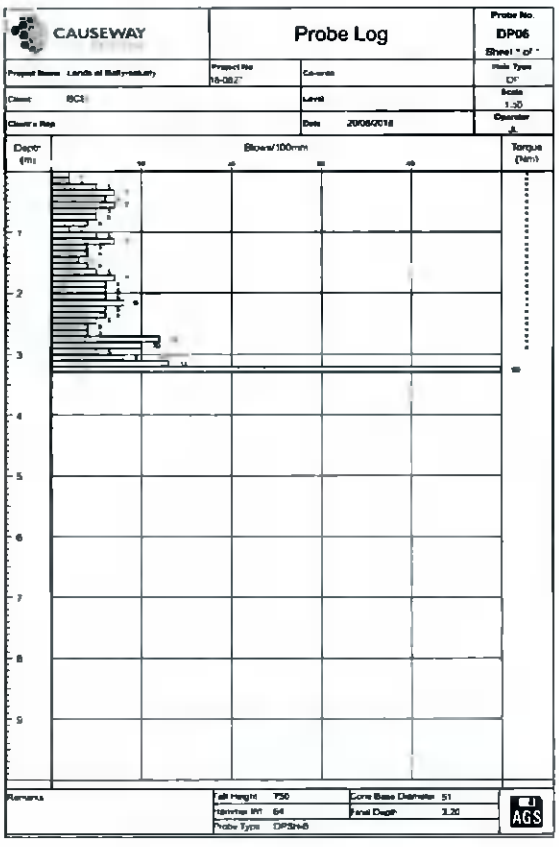
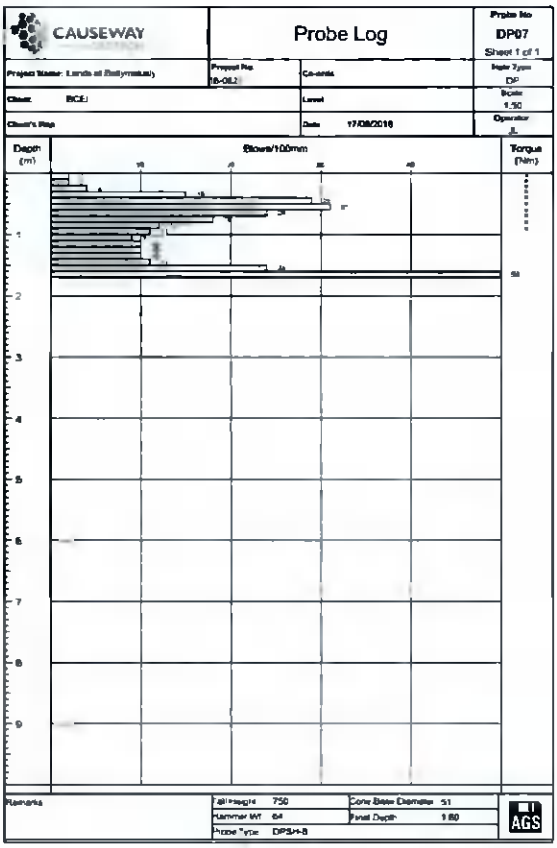
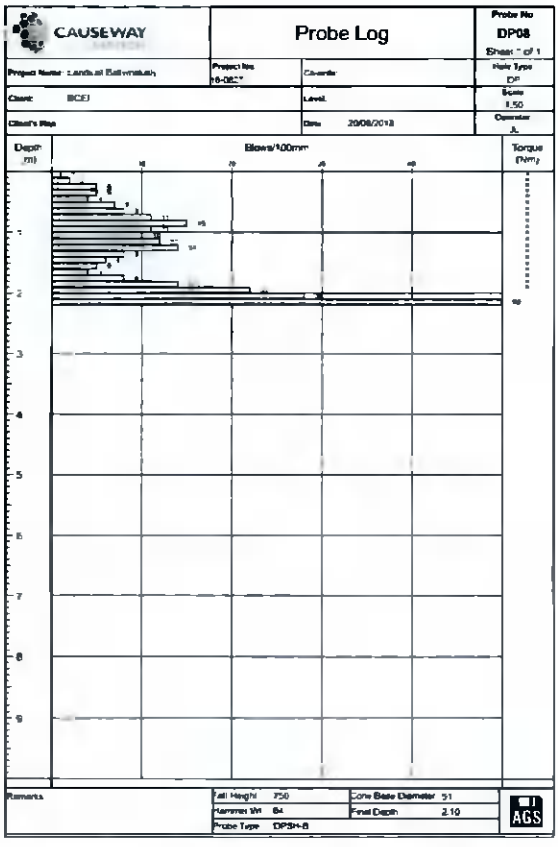
Probe Log
Probe No
DP03
Sheet 1 of 1
Project Name: Lands at Ballymakeath
Project No.
18-082
Co-ords
Hole Type
DP
Client: BCE
Level
Scale
1:50
Client's Rep.
Date 17/05/2018
Operator
A.
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Cone Base Diameter 51
Hammer Wt 64
Final Depth 2.90
Probe Type DPSH-B
AGS

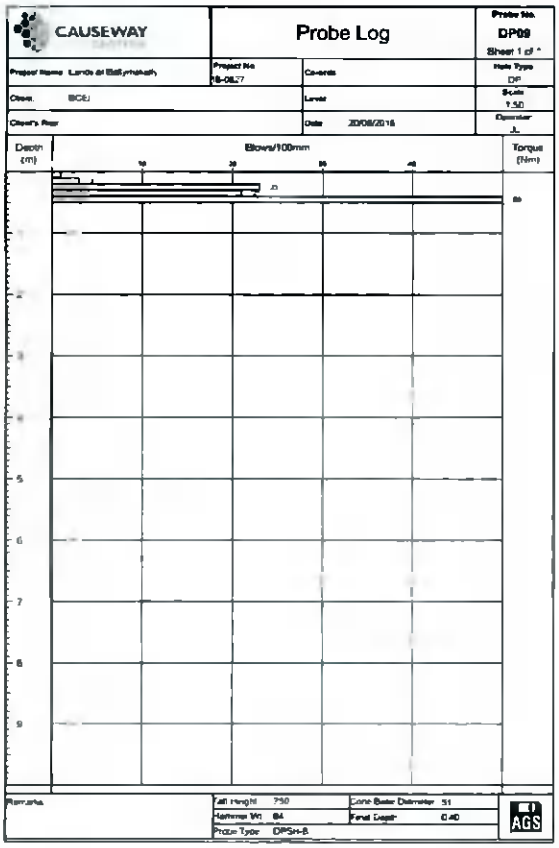

CAUSEWAY
Probe Log
Probe No
DP04
Sheet 1 of 1
Project Name: Lands at Ballymakeath,
Project No
18-082
Co-ords
Hole Type
DP
Client: BCE
Level
Scale
1:50
Client's Rep.
Date 17/05/2018
Operator
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Cone Base Diameter 51
Hammer Wt 64
Final Depth 3.10
Probe Type DPSH-B
AGS


CAUSEWAY
Probe Log
Probe No.
DP05
Sheet 1 of 1
Project Name Lands at Ballymakaily
Project No
18-0827
Co-ords
Hole Type
DP
Client BCEI
Level
Scale
1:50
Client's Rep
Date 20/06/2018
Operator
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Core Base Diameter 51
Hammer Wt 64
Final Depth 0.60
Probe Type DPSH-B
AGS


CAUSEWAY
Probe Log
Probe No.
DP06
Sheet 1 of 1
Project Name Lands at Ballymakaily
Project No
18-0827
Co-ords
Hole Type
DP
Client BCEI
Level
Scale
1:50
Client's Rep
Date 20/06/2018
Operator
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Core Base Diameter 51
Hammer Wt 64
Final Depth 3.20
Probe Type DPSH-B
AGS


CAUSEWAY
Probe Log
Probe No
DP07
Sheet 1 of 1
Project Name: Lands at Ballymakaily
Project No
18-082
Co-ords
Hole Type
DP
Client: BCEJ
Level
Scale
1:50
Client's Rep
Date 17/08/2018
Operator
JL
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Cone Base Diameter 51
Hammer Wt 64
Final Depth 1.80
Probe Type DPSH-B
AGS


CAUSEWAY
Probe Log
Probe No
DP08
Sheet 1 of 1
Project Name: Lands at Ballymakaily
Project No
18-082
Co-ords
Hole Type
DP
Client: BCEJ
Level
Scale
1:50
Client's Rep
Date 29/08/2018
Operator
JL
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Cone Base Diameter 51
Hammer Wt 64
Final Depth 2.10
Probe Type DPSH-B
AGS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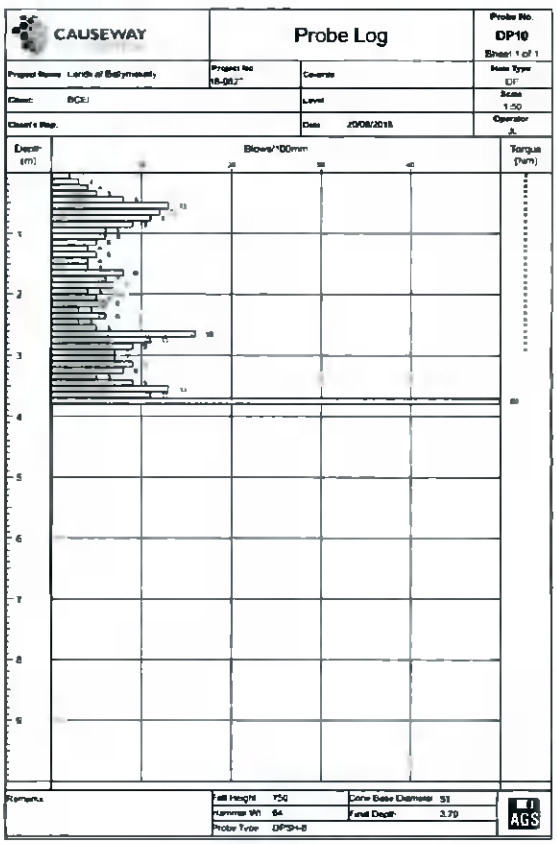
Probe Log
DP09
Depth (m)
Blows/100mm
Torque (Nm)
AGS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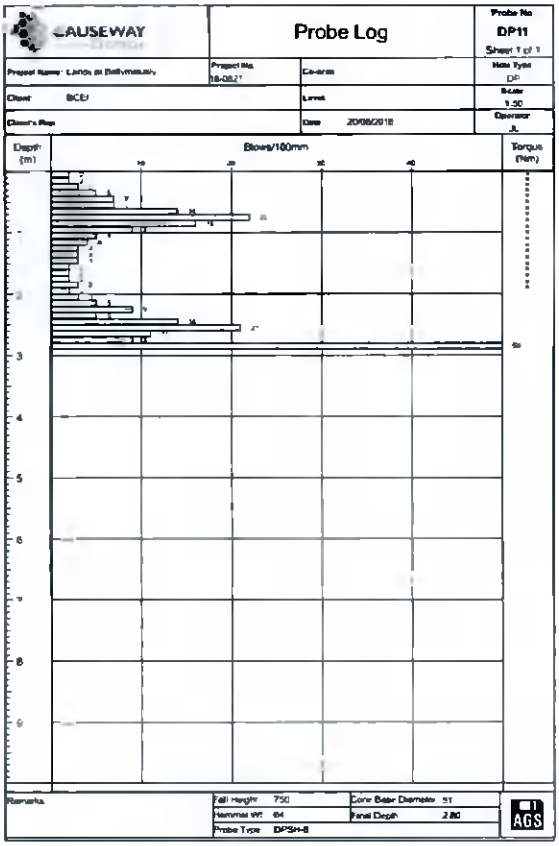
Probe Log
DP10
Depth (m)
Blows/100mm
Torque (Nm)
AGS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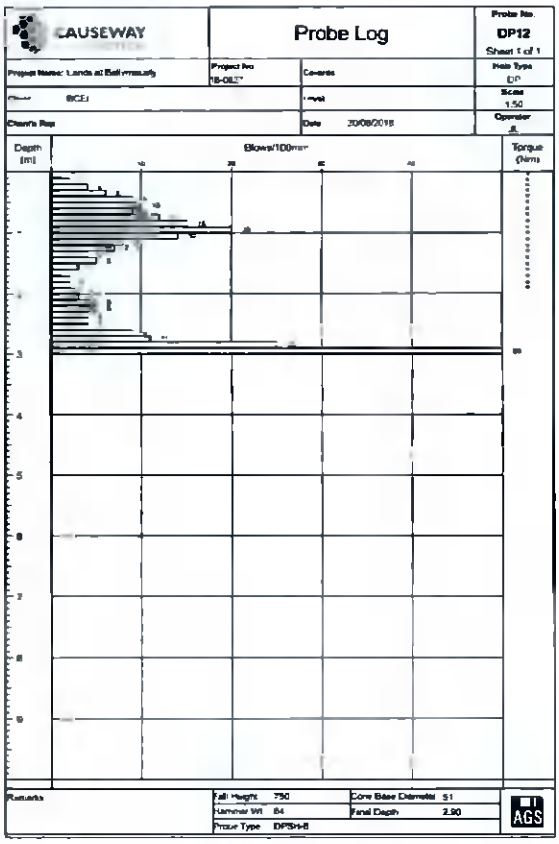
Probe Log
Probe No
DP11
Depth (m)
Blows/100mm
Torque (Nm)
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Core Base Diameter 51
Final Depth 2.80
AGS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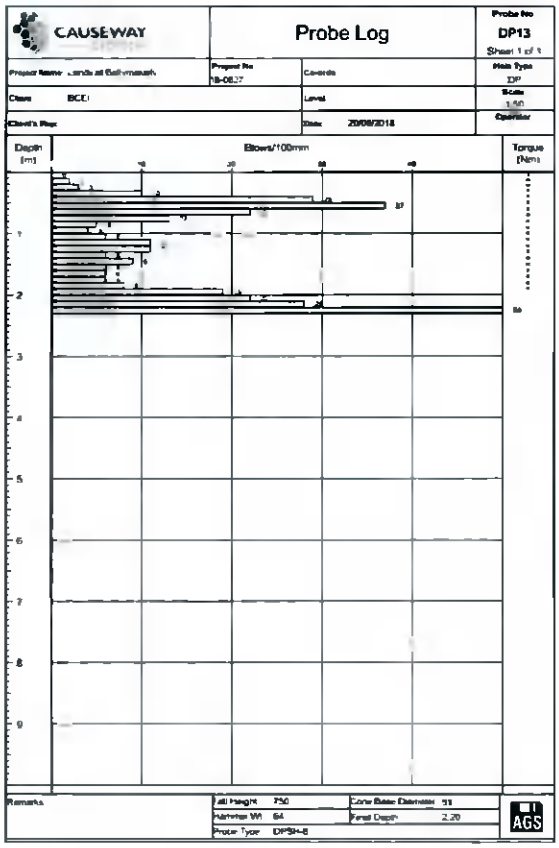
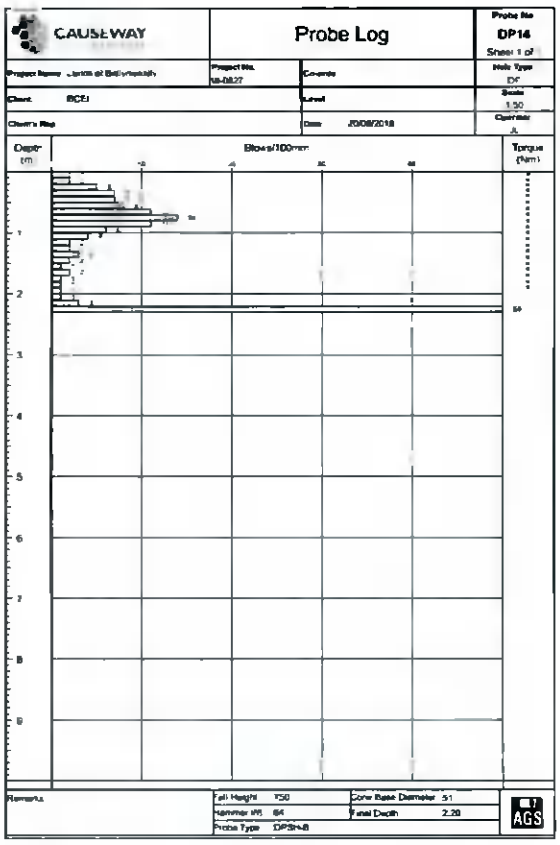
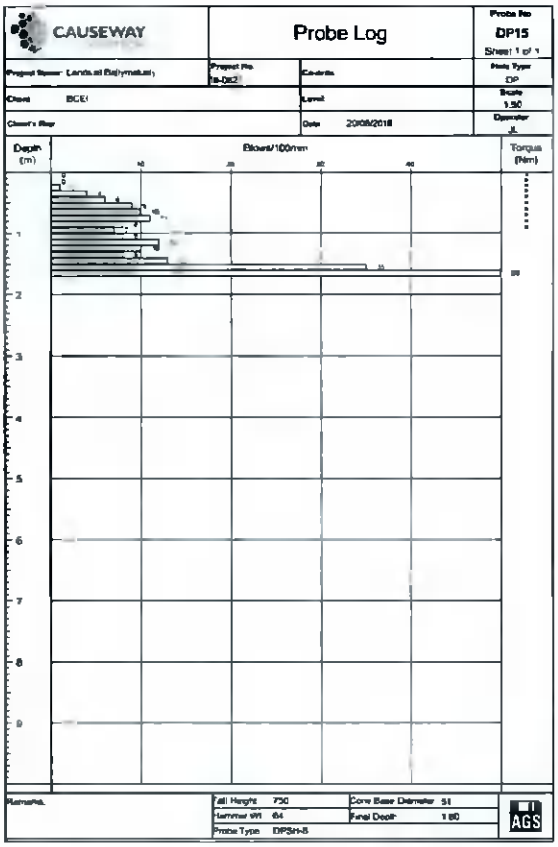
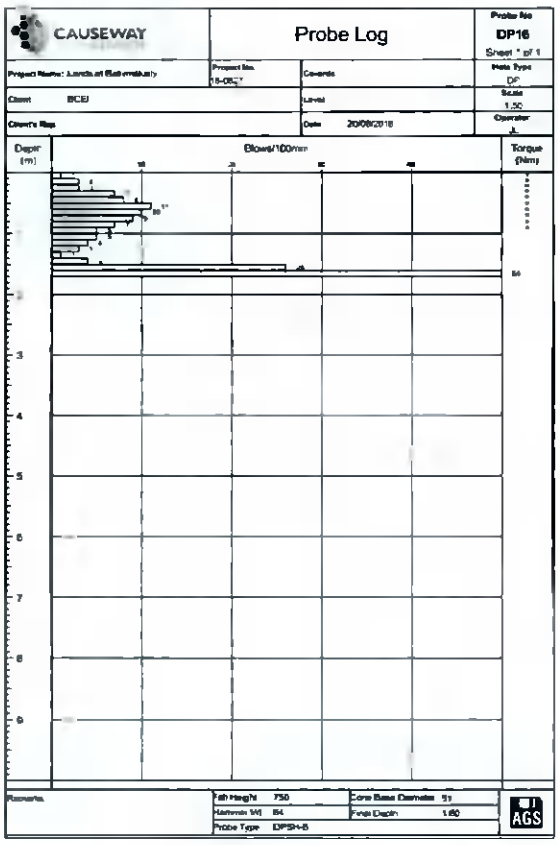
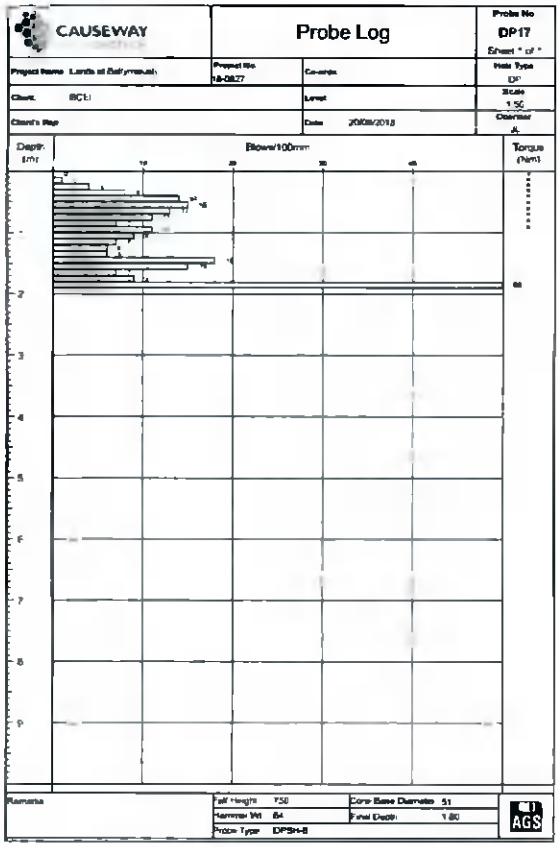
Probe Log
Probe No
DP12
Depth (m)
Torque (Nm)
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Core Base Diameter 51
Final Depth 2.90
AGS

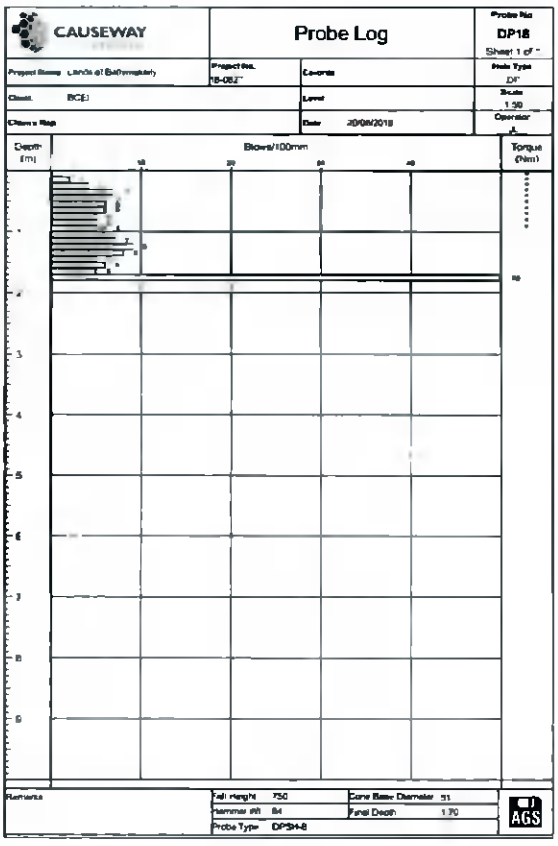

CAUSEWAY
Probe Log
DP13
Client BCEI
Date 20/08/2018
Depth (m)
Blows/100mm
Torque (Nm)
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter 51
Final Depth 2.20
AGS

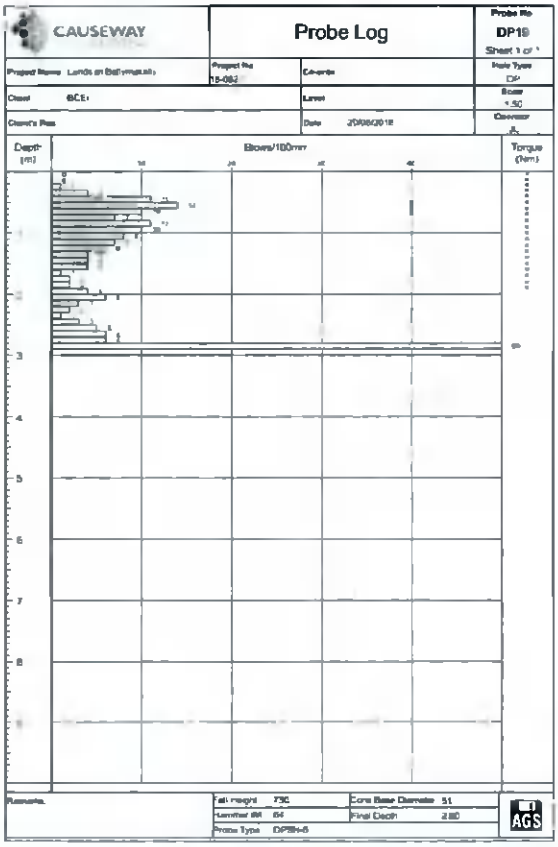

CAUSEWAY
Probe Log
DP14
Client BCEI
Date 20/08/2018
Depth (m)
Blows/100mm
Torque (Nm)
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter 51
Final Depth 2.20
AGS

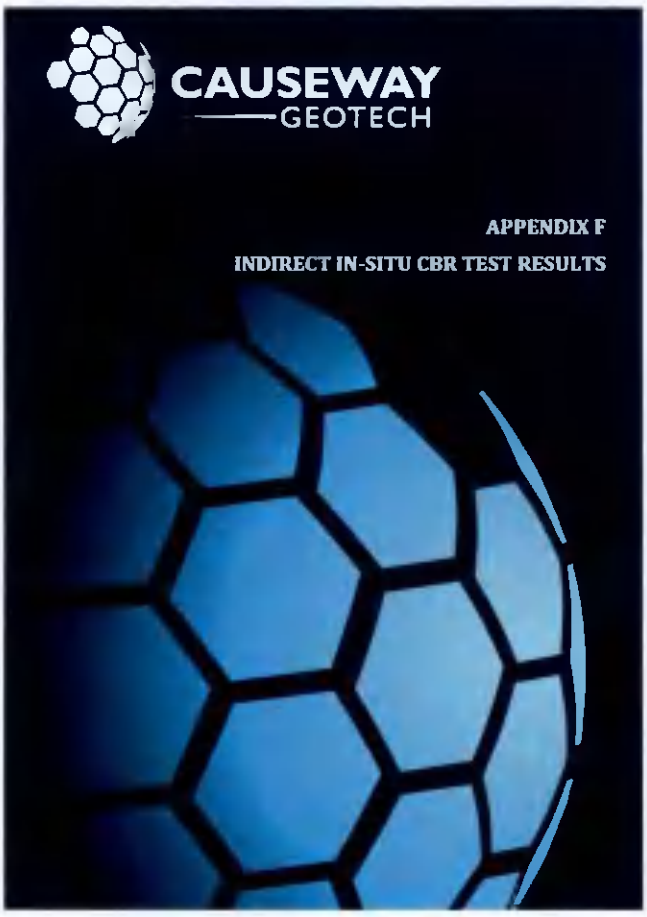

CAUSEWAY
Probe Log
DP15
Client BCEI
Date 20/08/2018
Depth (m)
Blows/100mm
Torque (Nm)
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Core Base Diameter 51
Final Depth 1.80
AGS


CAUSEWAY
Probe Log
DP16
Client BCEI
Date 20/08/2018
Depth (m)
Blows/100mm
Torque (Nm)
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Core Base Diameter 51
Final Depth 1.80
AGS


CAUSEWAY
Probe Log
Probe No
DP17
Sheet 1 of 1
Project Name Lands at Ballymakaily
Project No.
18-082
Co-ords
Hole Type
DP
Client BCEI
Level
Scale
1:50
Client's Rep
Date 20/09/2018
Operator
A
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Cone Base Diameter 51
Hammer Wt 64
Final Depth 1.80
Probe Type DPSH-B
AGS


CAUSEWAY
Probe Log
Probe No
DP18
Sheet 1 of 1
Project Name Lands at Ballymakaily
Project No.
18-082
Co-ords
Hole Type
DP
Client BCEI
Level
Scale
1:50
Client's Rep
Date 20/09/2018
Operator
A
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Cone Base Diameter 51
Hammer Wt 64
Final Depth 1.70
Probe Type DPSH-B
AGS


CAUSEWAY
Probe Log
DP19
Blows/100mm
Depth (m)
Torque (Nm)
AGS


CAUSEWAY
GEOTECH
APPENDIX F
INDIRECT IN-SITU CBR TEST RESULTS

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

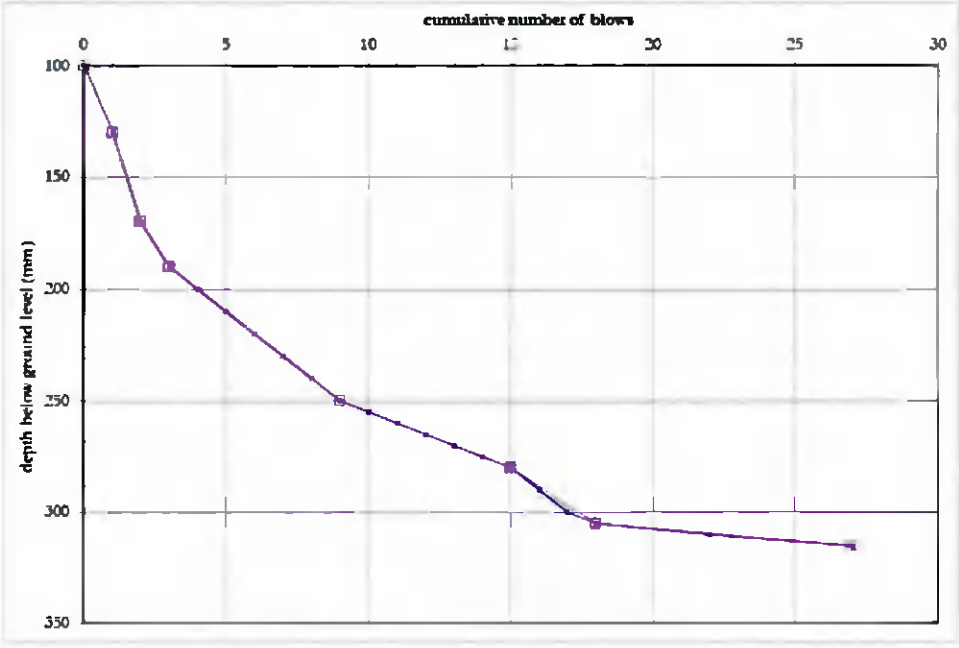
Test Number: TP02

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.057 Log (mm/blow)

Project No: 18-0827

Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100		
130	30	8.5
130		
170	40	6.1
170		
190	20	15
190		
250	10	26
250		
280	5	55
280		
305	8.3	32
305		
315	1.1	>100

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

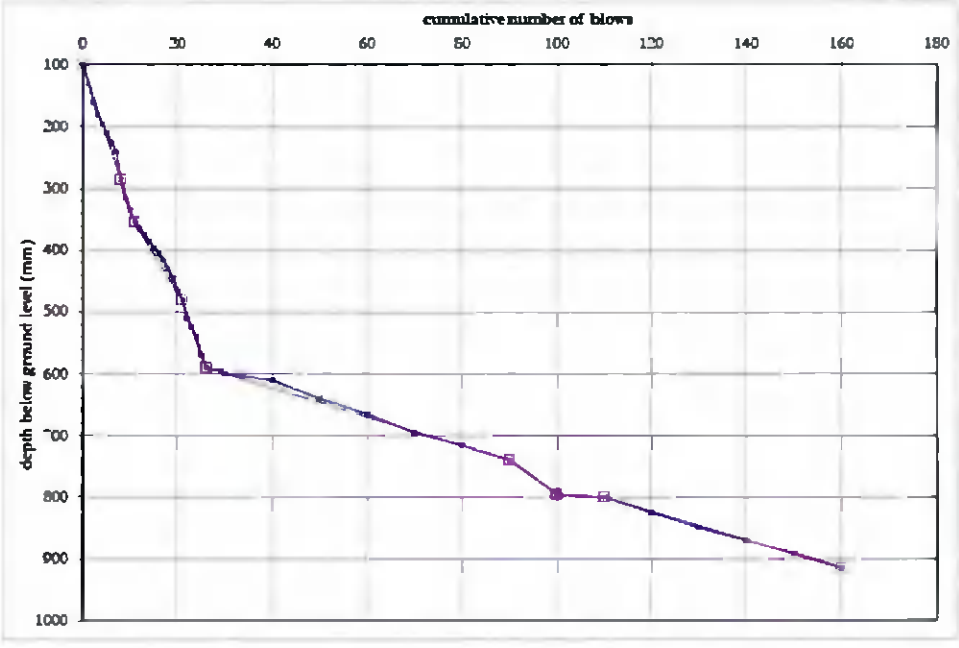
Test Number: TP03

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.057 Log (mm/blow)

Project No: 18-0827

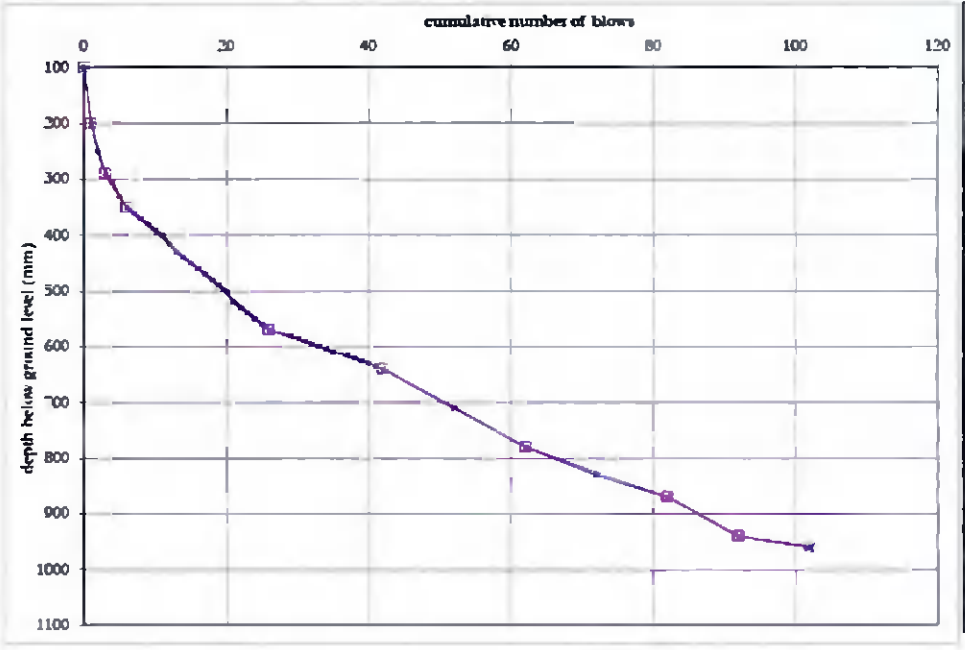
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100		
285	23	11
285		
355	23	11
355		
480	13	21
480		
590	22	12
590		
740	2.3	>100
740		
795	5.5	50
795		
800	0.5	>100
800		
915	2.3	>100

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP04

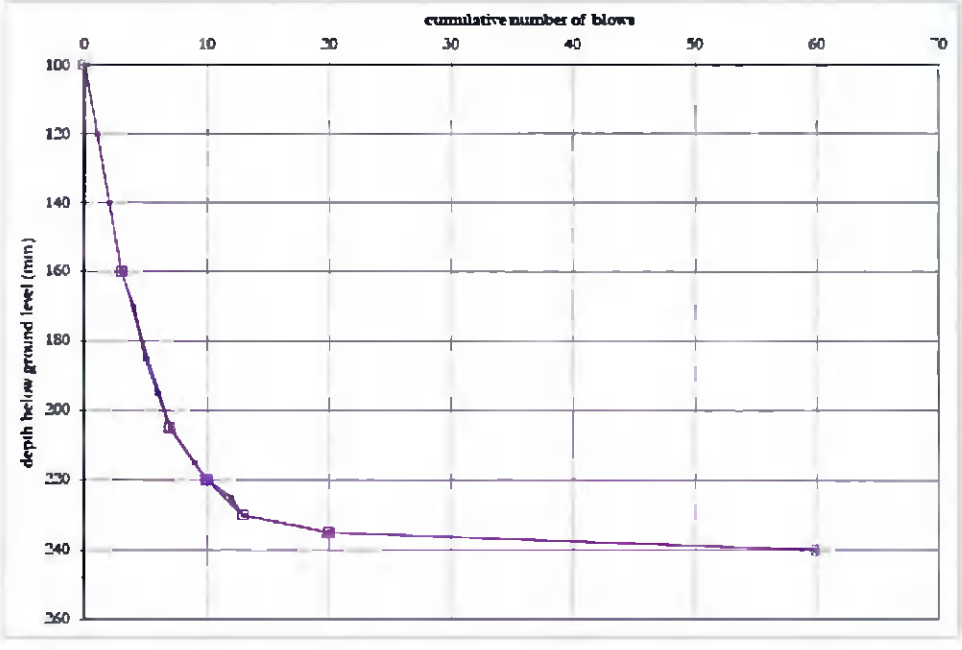
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	100	2.3
200		
200	45	5.4
290		
290	20	13
350		
350	11	24
570		
570	4.4	63
640		
640	-	39
780		
780	4.5	62
870		
870	-	39
940		
940	2	>100
960		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP05

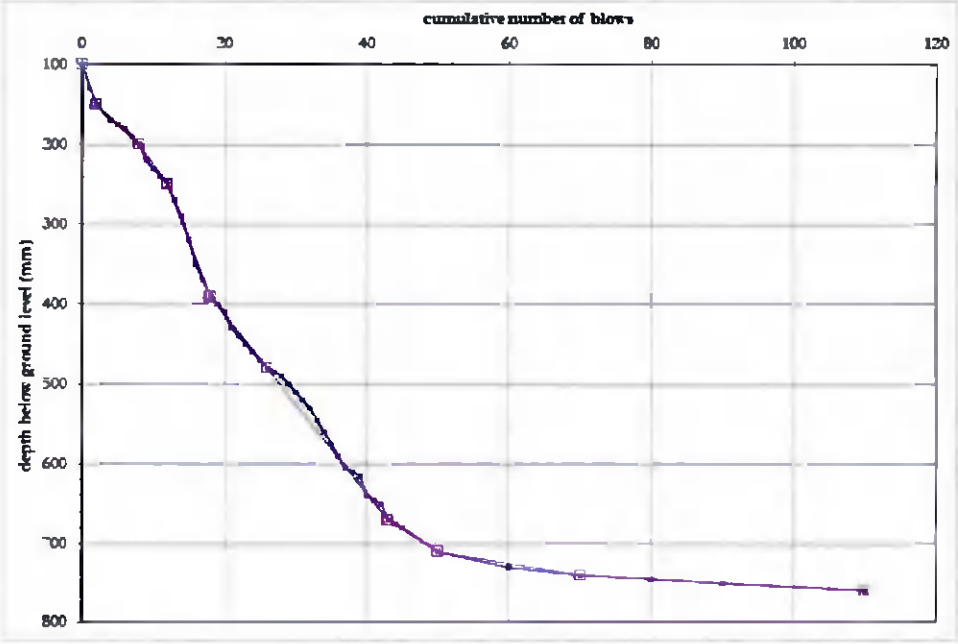
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	20	13
160		
160	11	25
205		
205	5	55
230		
230	3.3	85
330		
330	0.7	>100
235		
235	0.1	>100
240		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP06

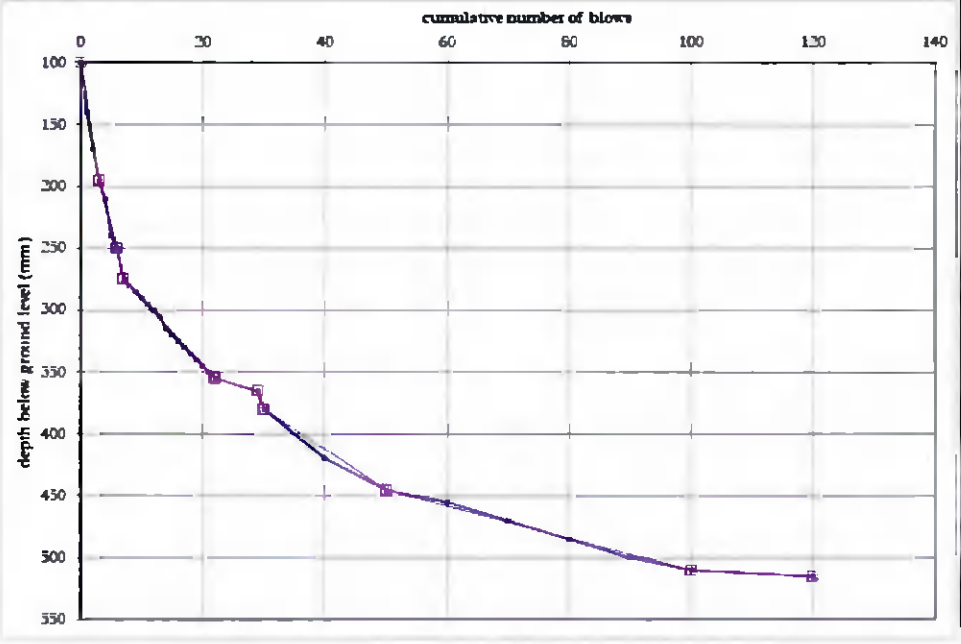
CBR estimated using TRL Road Note 8
Log CBR = 2.48-1.05* Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	25	10
150		
150	8.3	32
200		
200	13	21
250		
250	23	11
390		
390	11	23
480		
480	11	24
670		
670	5.7	48
710		
710	1.5	>100
740		
740	0.5	>100
759		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP07

CBR estimated using TRL Road Note 8
Log CBR = 2.48-1.05* Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	32	7.8
195		
195	18	14
250		
250	25	10
275		
275	5.3	51
355		
355	1.4	>100
365		
365	15	17
380		
380	3.3	8*
445		
445	1.5	>100
510		
510	0.3	>100
515		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

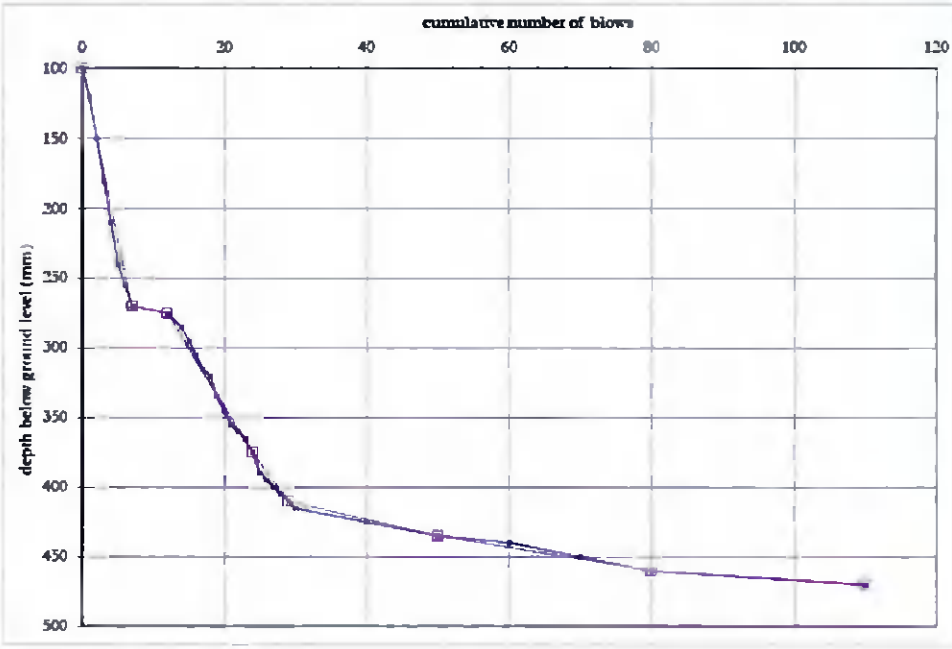
Test Number: TP08

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.057 Log (mm/blow)

Project No: 18-0827

Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	24	10
270		
270	1	>100
275		
275	8.3	32
375		
375	-	39
410		
410	1.2	>100
435		
435	0.8	>100
460		
460	0.6	>100
470		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

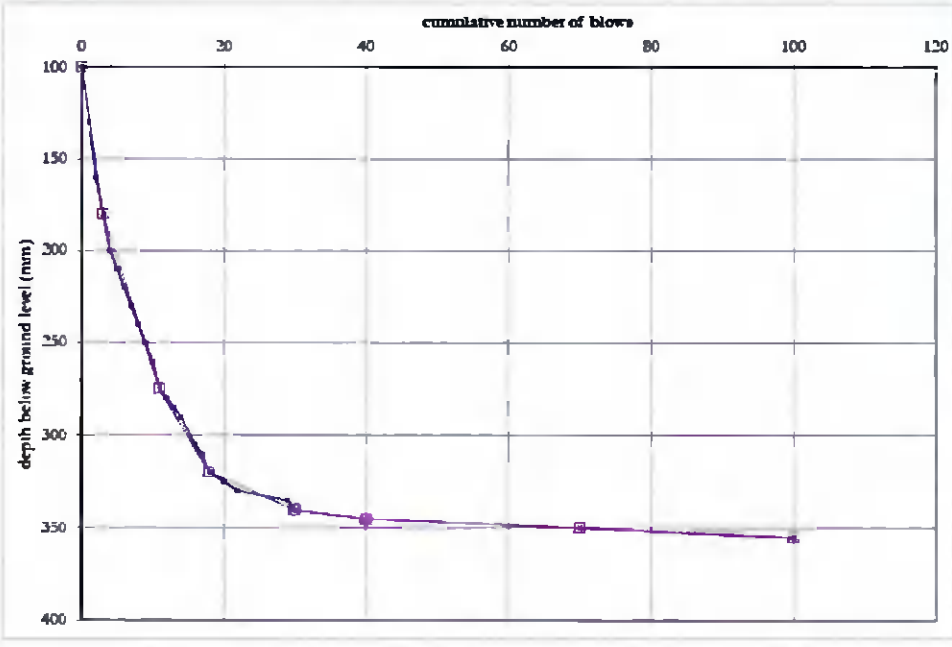
Test Number: TP09

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.057 Log (mm/blow)

Project No: 18-0827

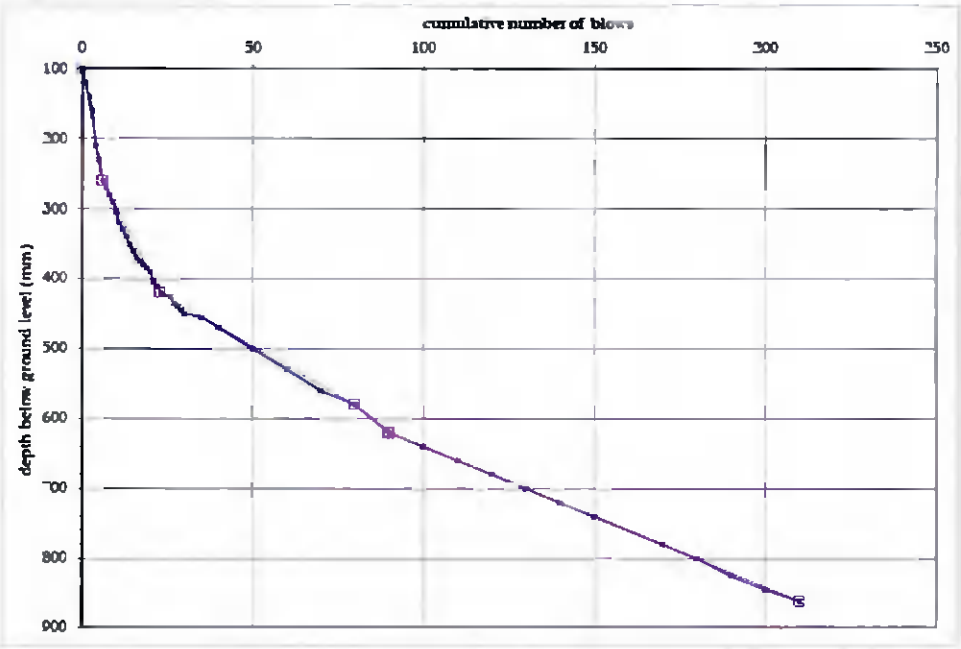
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	27	9.4
180		
180	12	22
275		
275	6.4	42
320		
320	1.7	>100
340		
340	0.5	>100
345		
345	0.2	>100
350		
350	0.2	>100
355		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP10

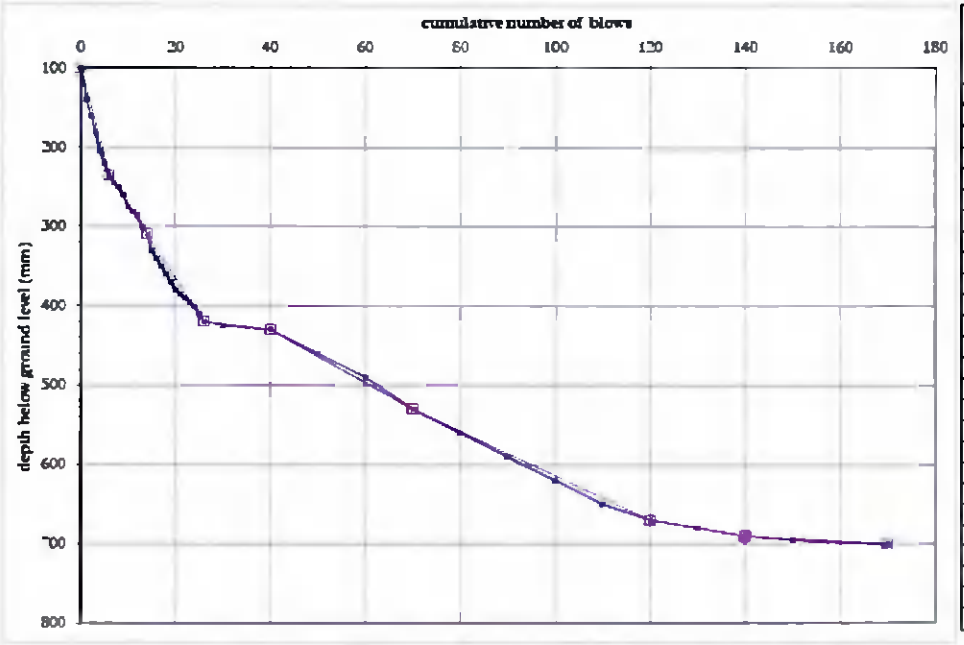
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100		
260	27	9.4
260		
420	9.4	28
420		
580	2.8	>100
580		
620	4	70
620		
861	2	>100

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP11

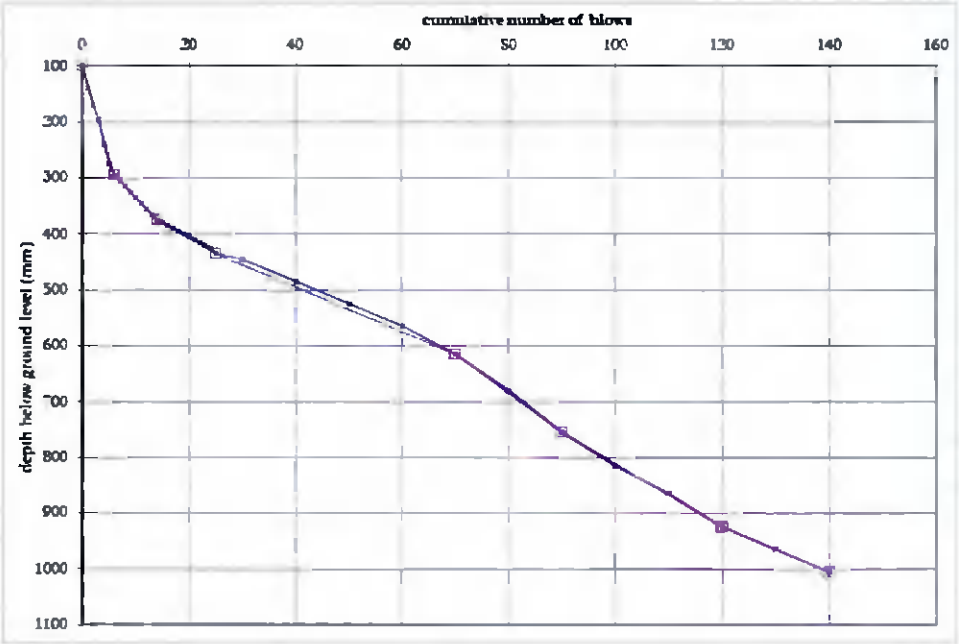
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100		
235	23	11
235		
310	9.4	28
310		
420	9.2	29
420		
430	0.7	>100
430		
530	3.3	85
530		
670	2.8	>100
670		
690	1	>100
690		
700	0.3	>100

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP12

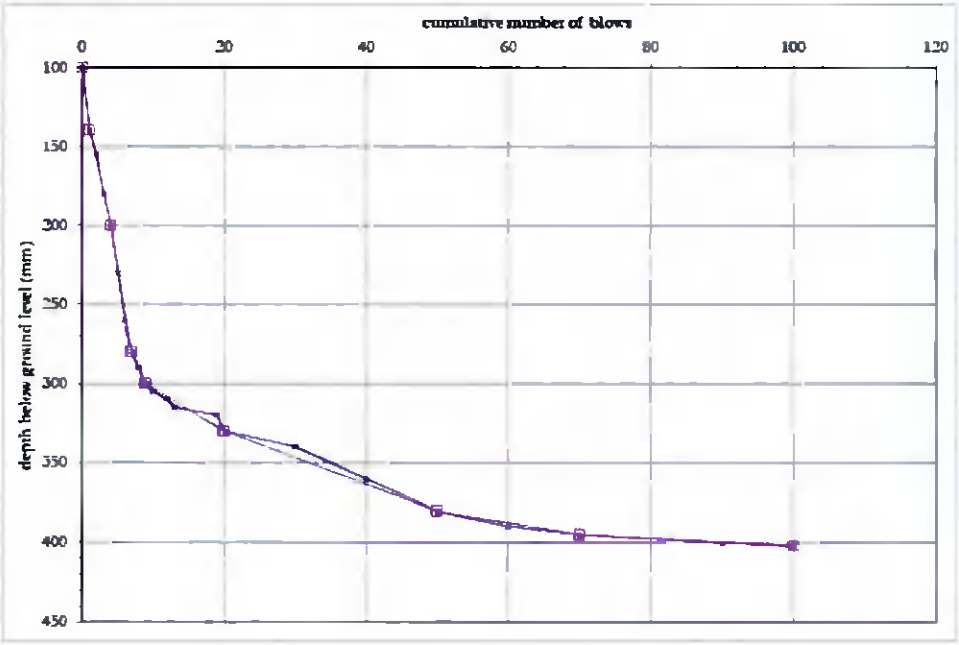
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	33	7.6
295		
295	10	26
375		
375	5.5	50
435		
435	4	70
615		
615	[illegible]	39
755		
755	5.7	48
925		
925	4	70
1005		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP13

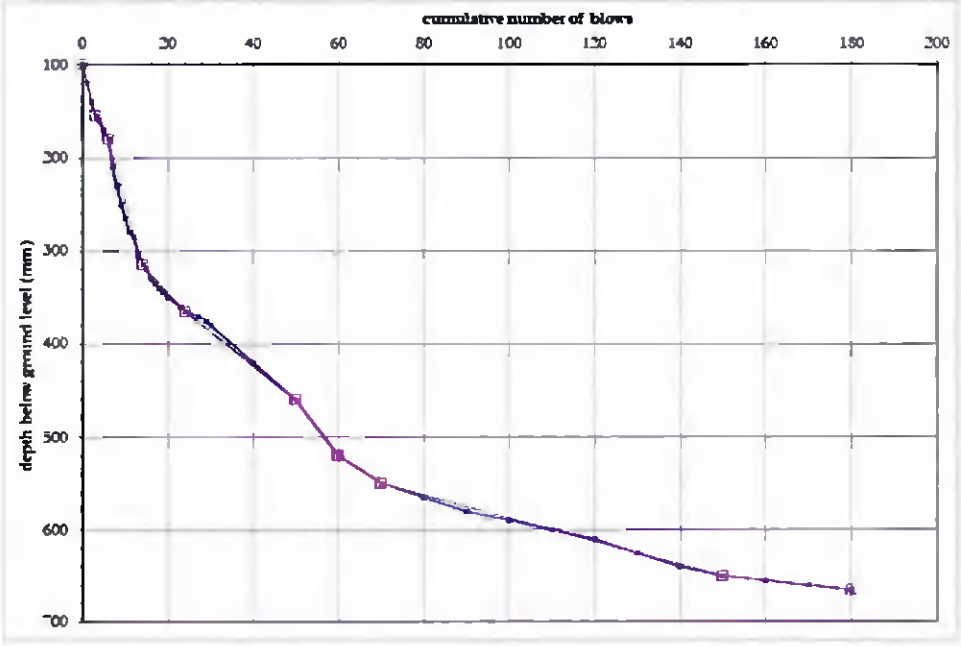
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	40	6.1
140		
140	20	13
200		
200	27	9.4
280		
280	10	26
300		
300	2.7	>100
350		
350	1.7	>100
380		
380	0.8	>100
395		
395	0.2	>100
402		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP14

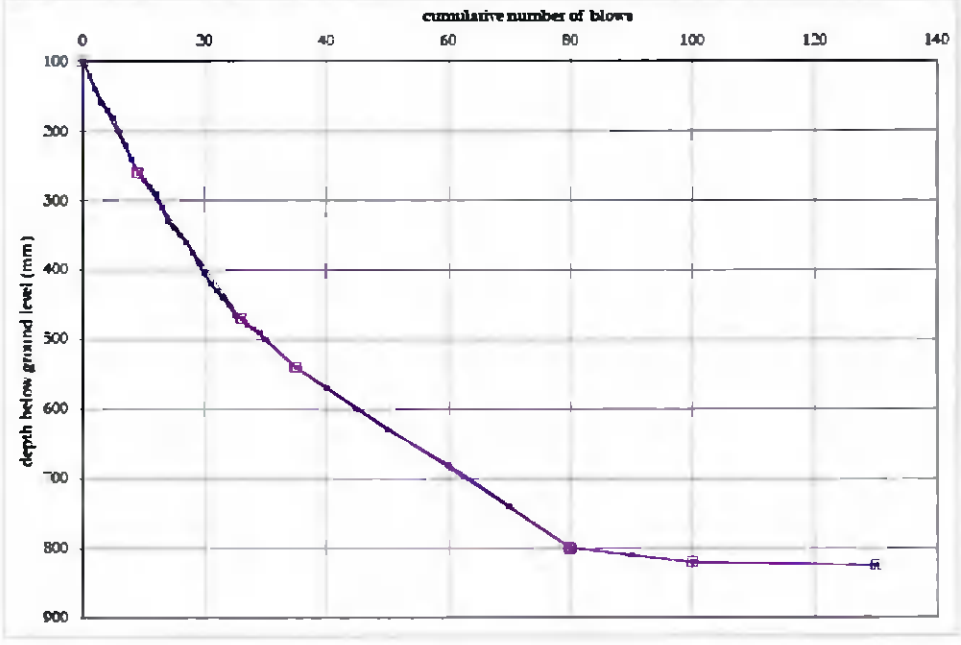
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.05* Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	18	14
155		
155	8.3	32
180		
180	17	15
315		
315	5	55
365		
365	3.7	—
460		
460	6	45
520		
520	3	95
550		
550	1.7	>100
650		
650	0.3	>100
665		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP15

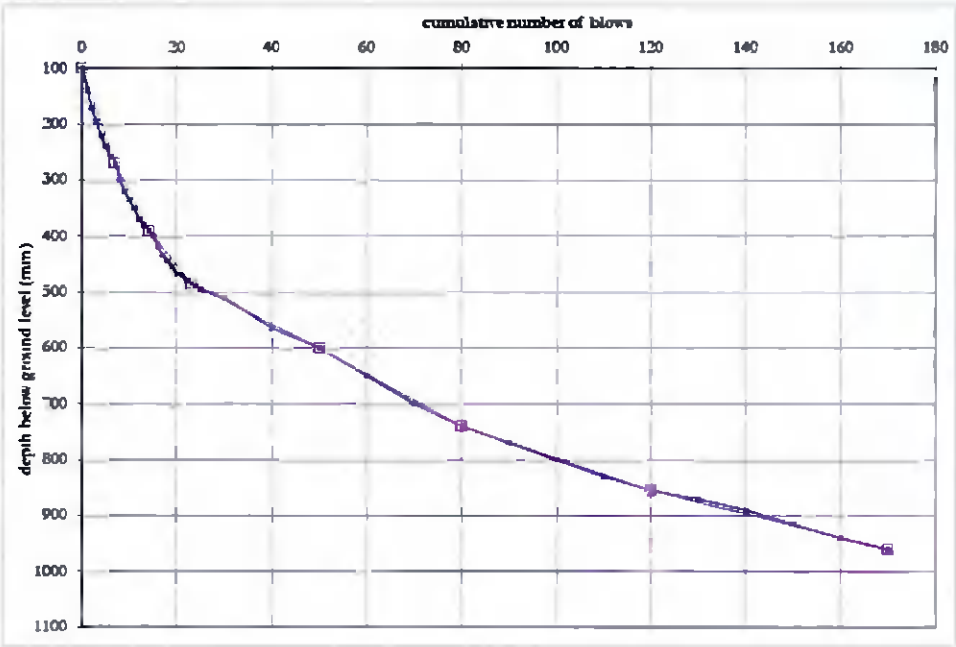
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.05* Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	18	14
260		
260	12	21
470		
470	7.8	35
540		
540	5.8	47
800		
800	1	>100
820		
820	0.2	>100
825		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP16

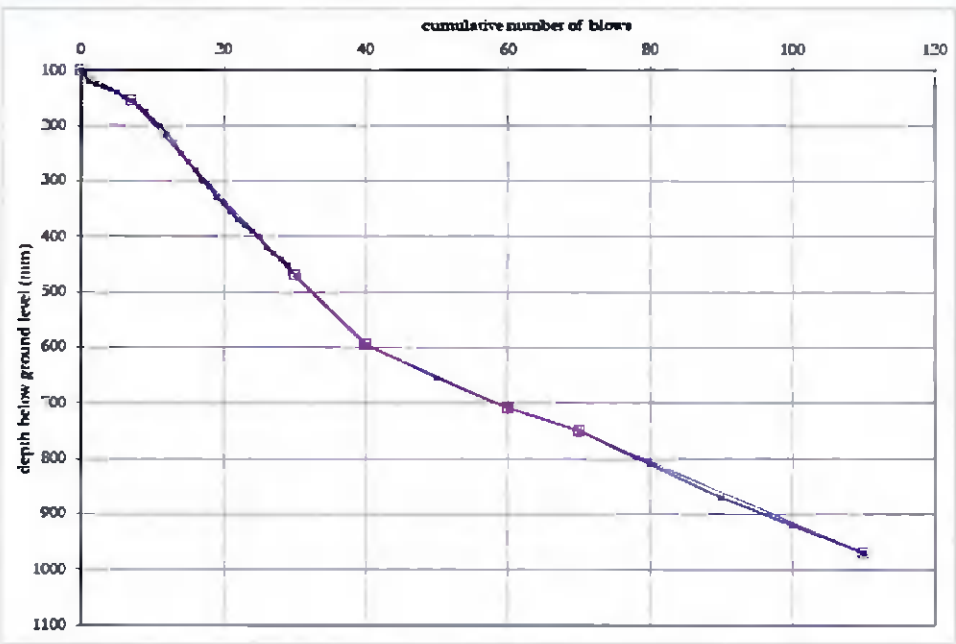
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	24	10
270		
270	17	15
390		
390	11	25
485		
485	4.3	65
600		
600	4.7	59
740		
740	2.9	99
855		
855	2.8	>100
960		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP17

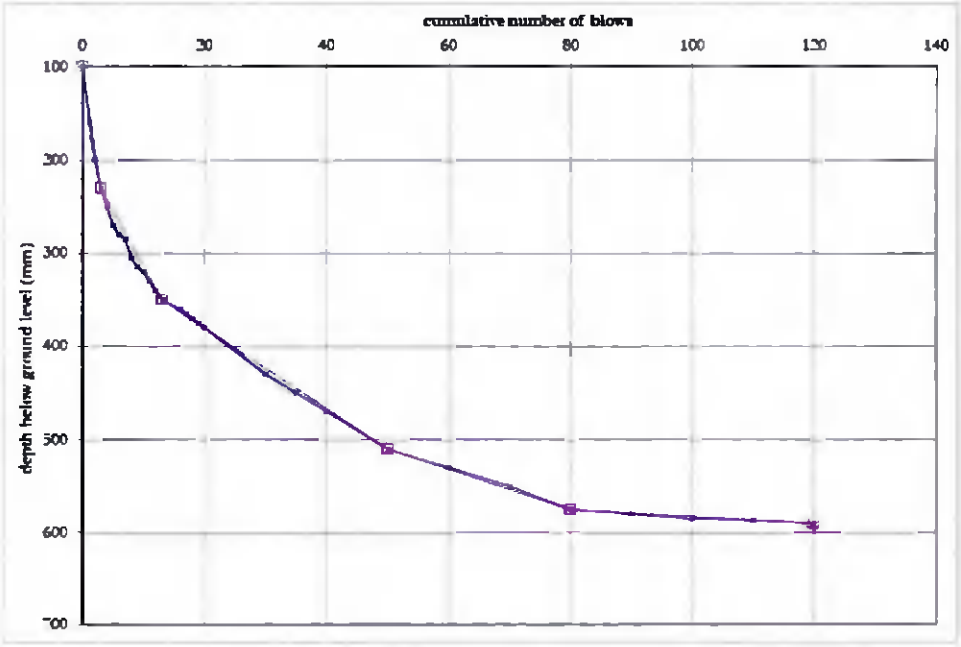
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	7.9	34
155		
155	14	19
470		
470	13	21
595		
595	5.8	48
710		
710	4	70
750		
750	5.5	50
970		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP18

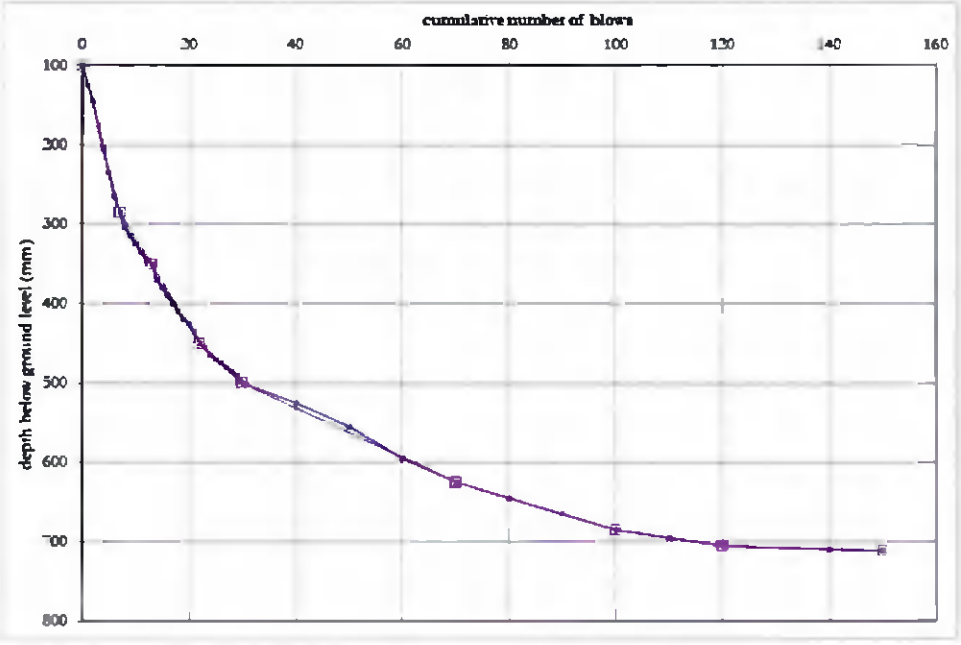
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	43	5.6
230		
230	12	22
350		
350	4.3	64
510		
510	2.2	>100
575		
575	0.4	>100
590		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP19

CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	26	9.5
285		
285	11	24
350		
350	11	24
450		
450	6.3	44
500		
500	3.1	91
625		
625	2	>100
685		
685	1	>100
705		
705	0.2	>100
711		

CAUSEWAY GEOTECH

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SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

Project Name:	Lands at Ballymakealy
Project No.:	18-0827
Client:	BCEI
Engineer:	BCEI
Date:	15/08/18

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Comment page(s).

The attached results completes the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days from the above date after which they will be appropriately disposed of unless we receive written instructions to the contrary prior to that date.

We trust our report meets with your approval but if you have any queries or require additional information, please do not hesitate to contact the undersigned.

Approved Signatory

Stephen Watson
Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

Causeway Geotech Ltd
8 Drumahiskey Road, Ballymoney
Co Antrim, N Ireland, BT53 7QL

CAUSEWAY GEOTECH

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Project Name: Lands at Ballymakealy

Report Reference: 18-0827 – Soils Schedule 1

The table below details the tests carried out, the specifications used, and the number of tests included in this report.

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	16
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	16
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	16
SOIL	Particle size distribution - sedimentation: hydrometer method	BS 1377-2: 1990: Cl 9.5	16

SUB-CONTRACTED TESTS

In agreement with Client, the following tests were conducted by an approved sub-contractor. All sub-contracting laboratories used are UKAS accredited.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	pH Value of Soil		16
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	Sulphate Content water extract		16

Causeway Geotech Ltd
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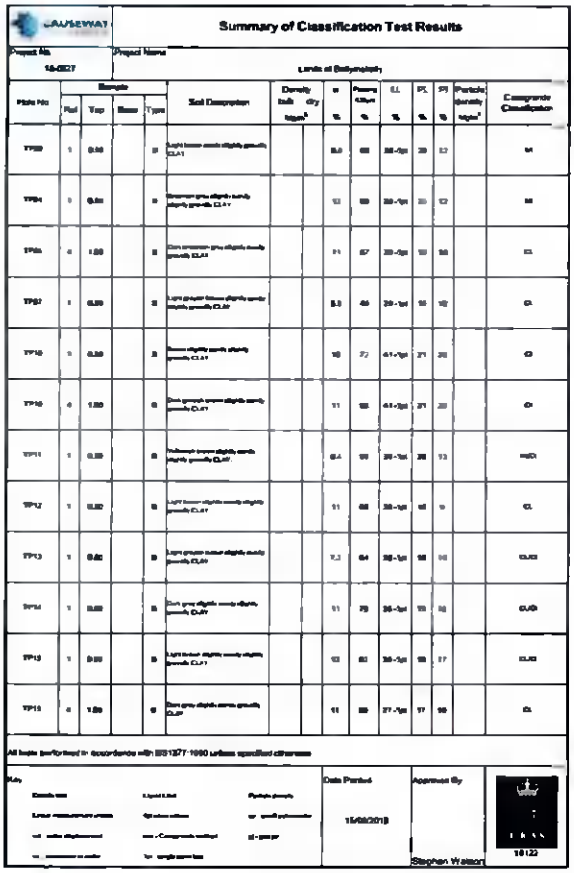
Co Antrim, N Ireland, BT53 7QL



CAUSEWAY

Summary of Classification Test Results

Project No.: 18-0827

Project Name: Lands at Ballymakeady

Hole No.	Sample Ref	Sample Top	Sample Base	Sample Type	Soil Description	Density bulk / dry kg/m³	w %	Passing 425µm %	LL %	PL %	PI %	Particle density kg/m³	Casagrande Classification
TP09	1	0.50		B	Light brown sandy slightly gravelly CLAY			80	39	22	17		MI
TP04	1	0.50		B	Brownish grey slightly sandy slightly gravelly CLAY			89	39	20	19		MI
TP05	4	1.80		B	Dark brownish grey slightly sandy gravelly CLAY			87	39	19	20		CI
TP07	1	0.50		B	Light greyish brown slightly sandy slightly gravelly CLAY			46	29	15	15		CI
TP10	1	0.50		B	Brown slightly sandy slightly gravelly CLAY			72	41	21	20		CI
TP10	4	1.80		B	Dark greyish brown slightly sandy gravelly CLAY			68	41	21	20		CI
TP11	1	0.50		B	Reddish brown slightly sandy slightly gravelly CLAY			89	39	26	13		MI/CI
TP12	1	0.50		B	Light brown slightly sandy slightly gravelly CLAY			68	38	29	9		CL
TP13	1	0.50		B	Light greyish brown slightly sandy gravelly CLAY			84	38	25	13		CI/CL
TP14	1	0.50		B	Dark grey slightly sandy slightly gravelly CLAY			79	38	19	19		CI/CL
TP15	1	0.50		B	Light brown slightly sandy slightly gravelly CLAY			82	38	25	17		CI/CL
TP15	4	1.80		B	Dark grey slightly sandy gravelly CLAY			69	37	17	20		CI

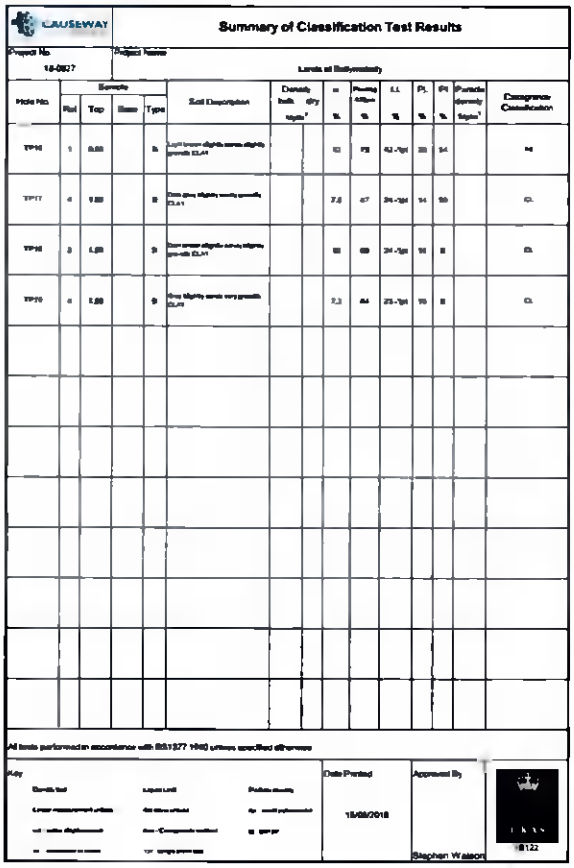
All tests performed in accordance with BS1377:1990 unless specified otherwise

Key

Date Printed: 15/08/2018

Approved By: Stephen Watson

18122



CAUSEWAY

Summary of Classification Test Results

Project No.: 18-0827

Project Name: Lands at Ballymakeady

Hole No.	Sample Ref	Sample Top	Sample Base	Sample Type	Soil Description	Density bulk / dry kg/m³	w %	Passing 425µm %	LL %	PL %	PI %	Particle density kg/m³	Casagrande Classification
TP16	1	0.50		B	Light brown slightly sandy slightly gravelly CLAY			72	42	20	24		MI
TP17	4	1.80		B	Dark grey slightly sandy gravelly CLAY			67	34	14	20		CI
TP18	3	1.20		B	Dark brown slightly sandy slightly gravelly CLAY			69	34	16	8		CL
TP20	4	1.80		B	Grey slightly sandy very gravelly CLAY			64	25	16	9		CL

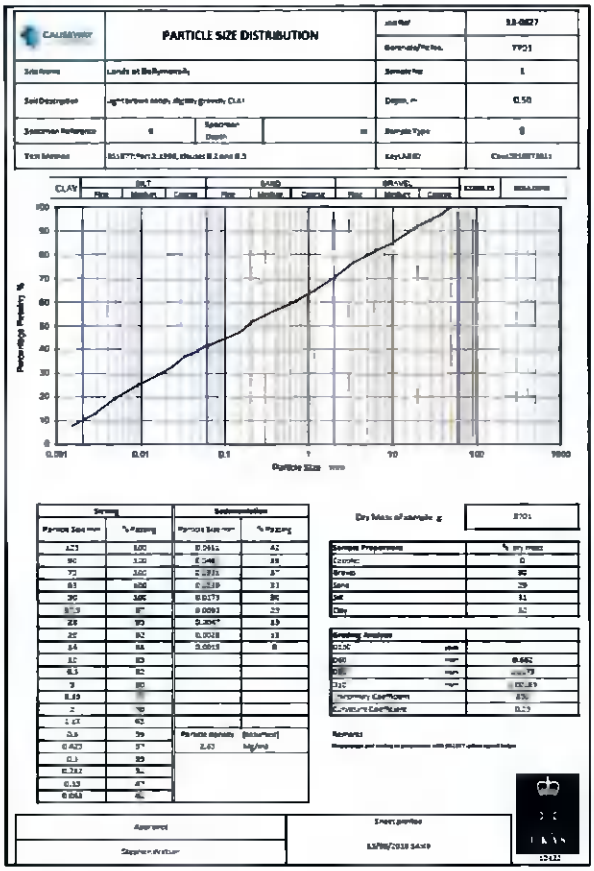
All tests performed in accordance with BS1377:1990 unless specified otherwise

Key

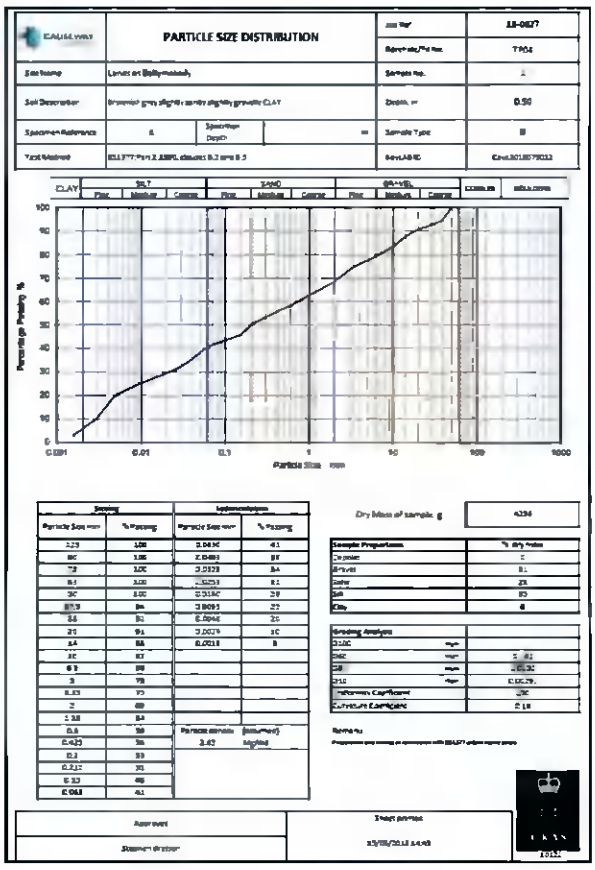
Date Printed: 15/08/2018

Approved By: Stephen Watson

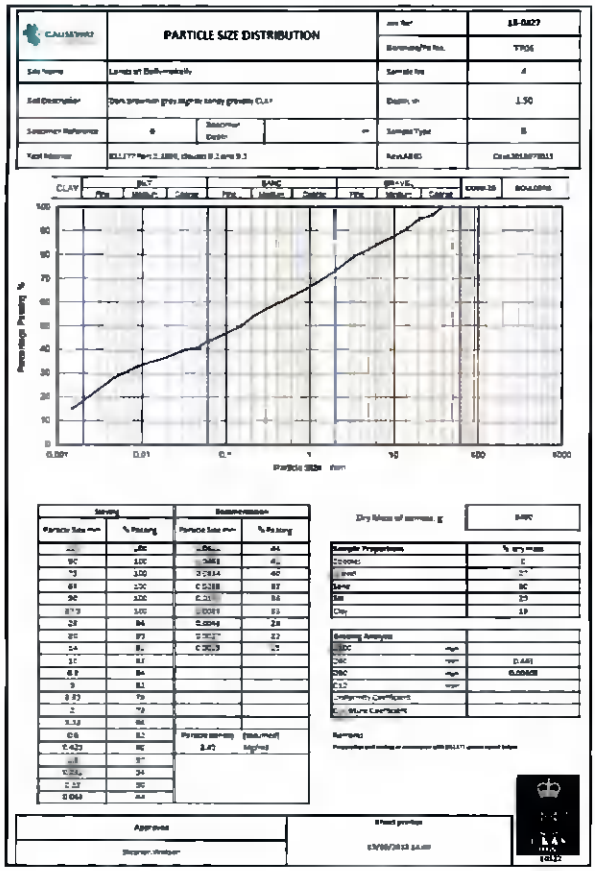
18122

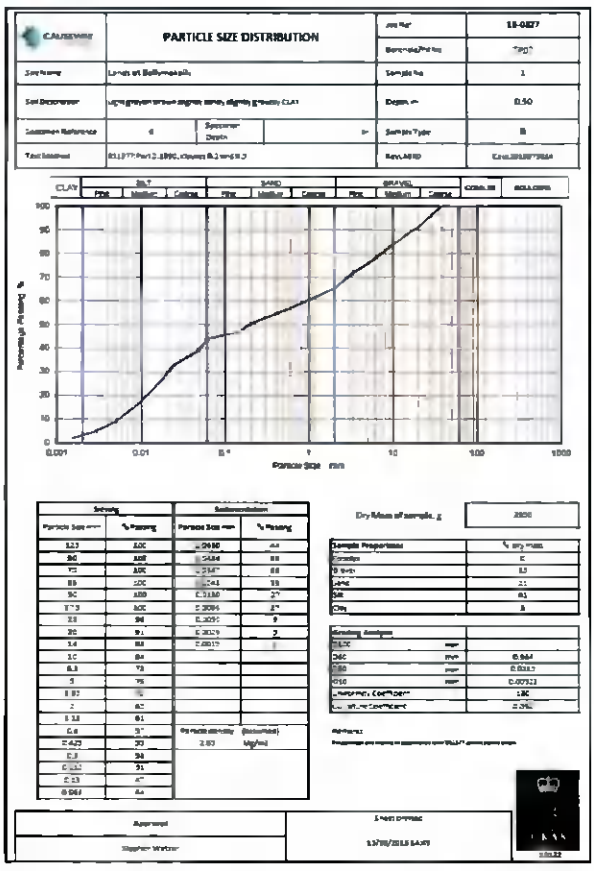


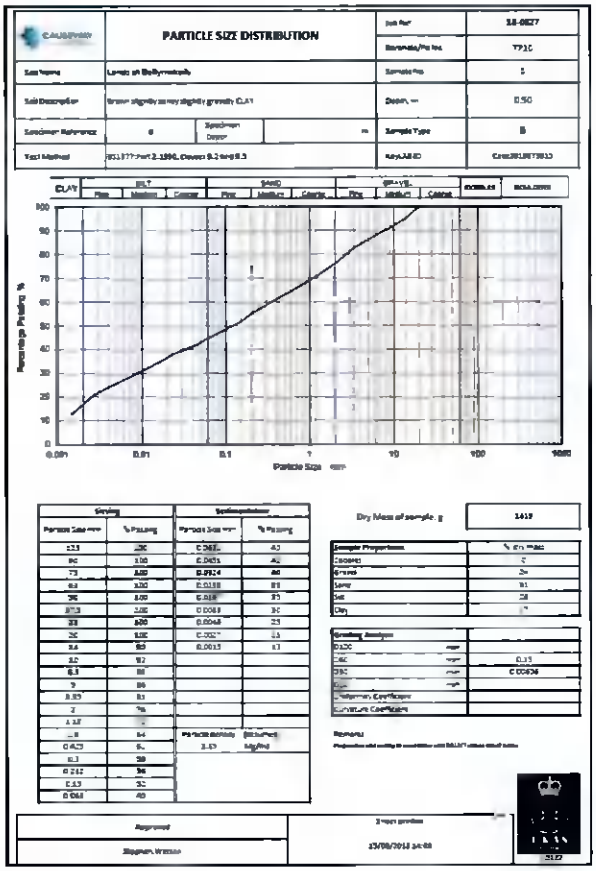
PARTICLE SIZE DISTRIBUTION

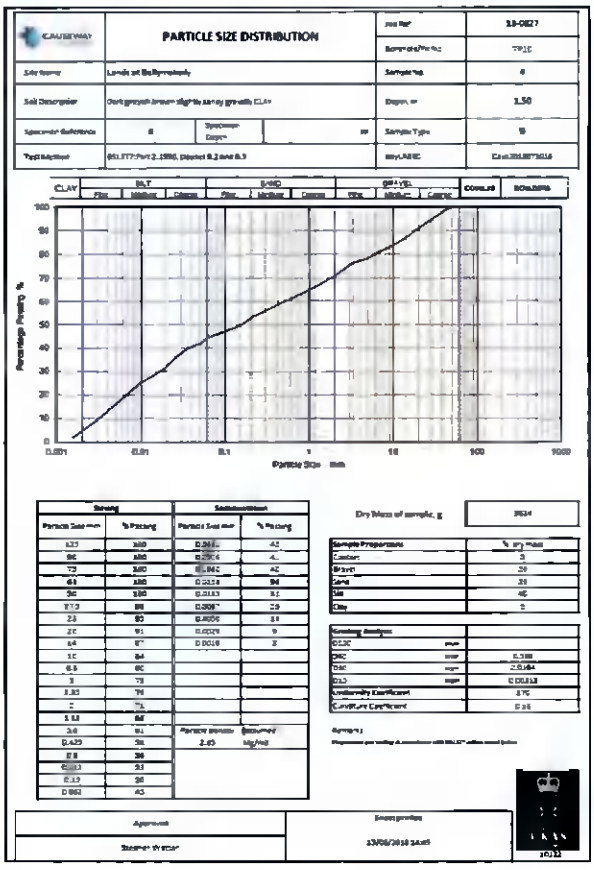


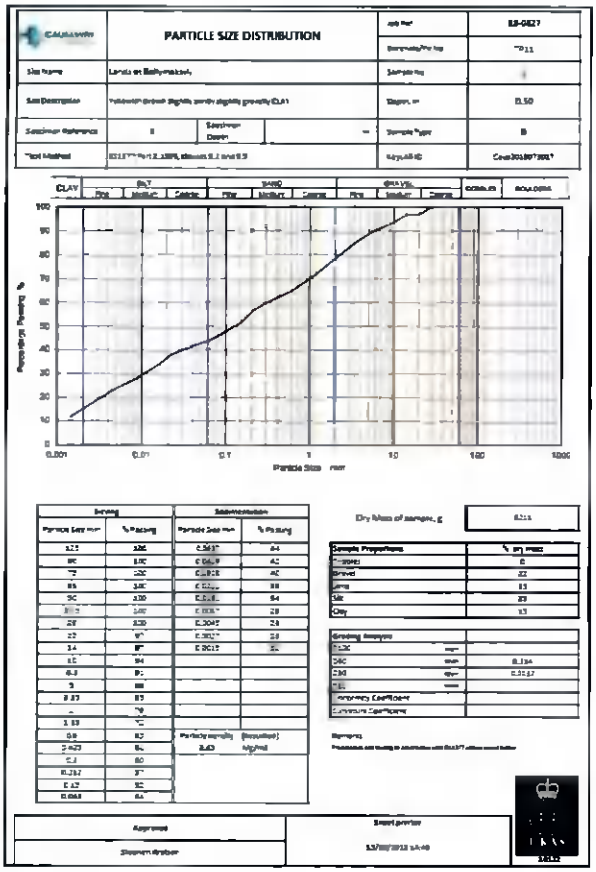
PARTICLE SIZE DISTRIBUTION


PARTICLE SIZE DISTRIBUTION
CLAY
SAND
GRAVEL
Particle Size mm
Percentage Passing %


PARTICLE SIZE DISTRIBUTION
CLAY
SAND
GRAVEL
Particle Size mm
Percentage Passing %


PARTICLE SIZE DISTRIBUTION
CLAY
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
CLAY
Percentage Passing %
Particle Size mm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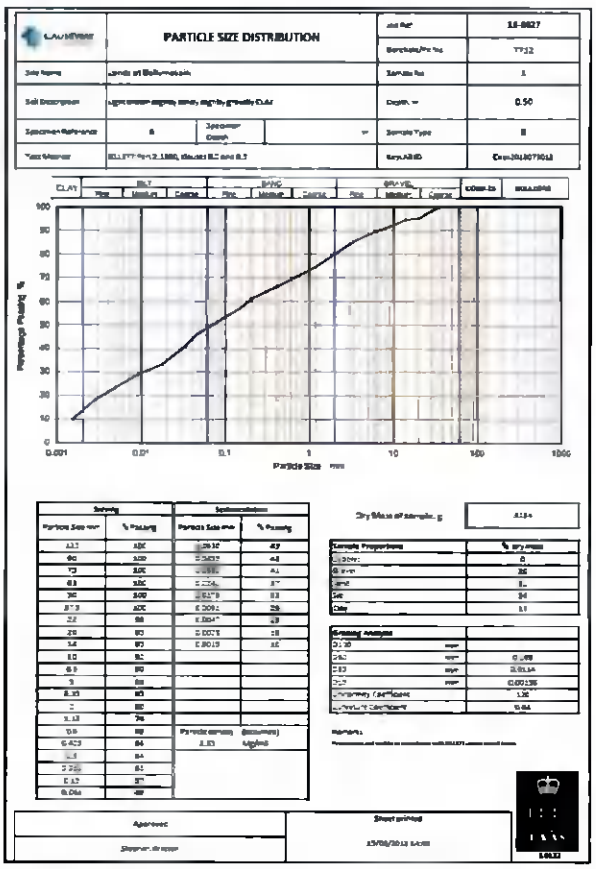
Percentage Passing %
Particle Size mm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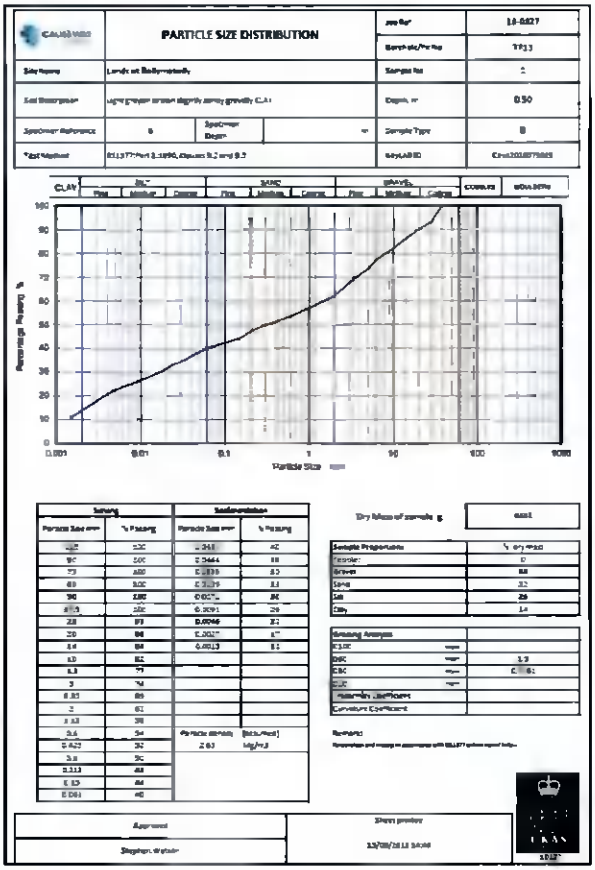
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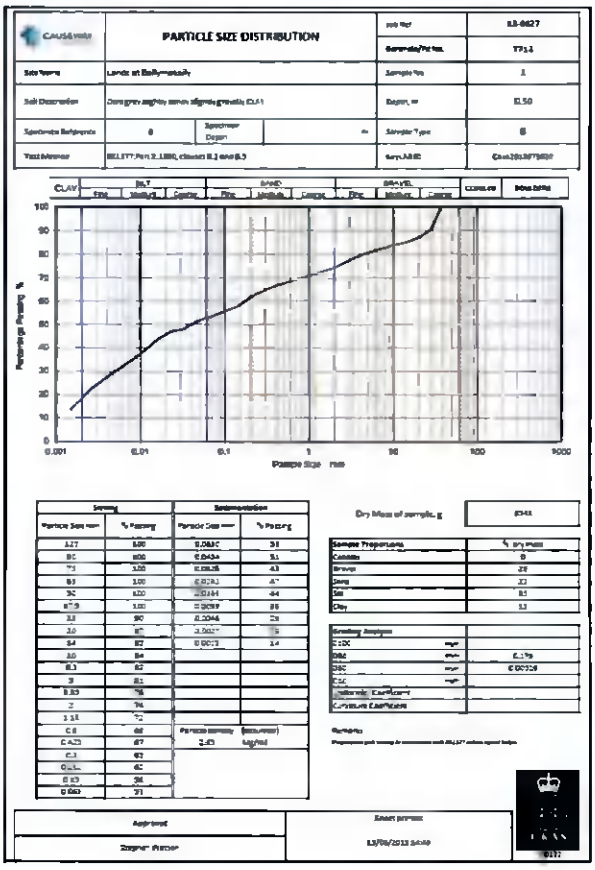
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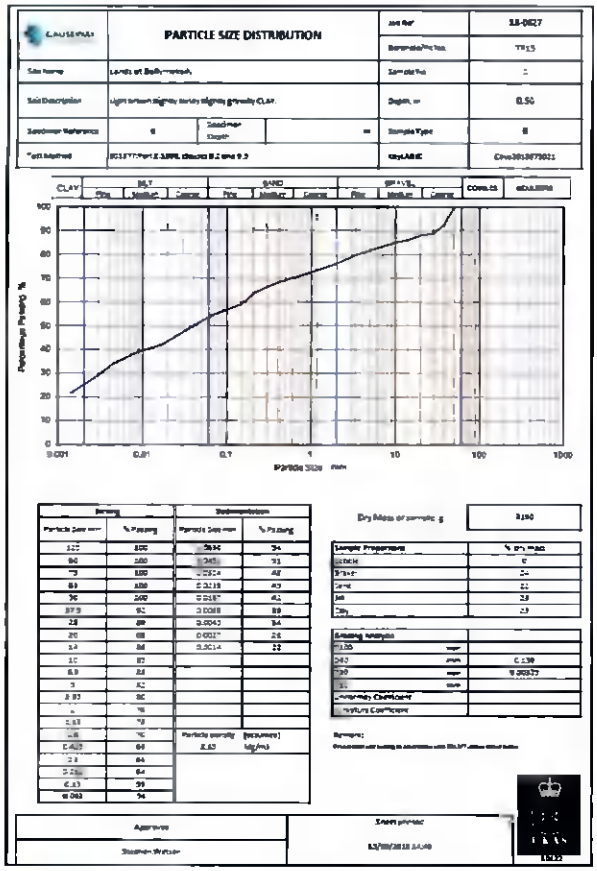
Percentage Passing %
Particle Size mm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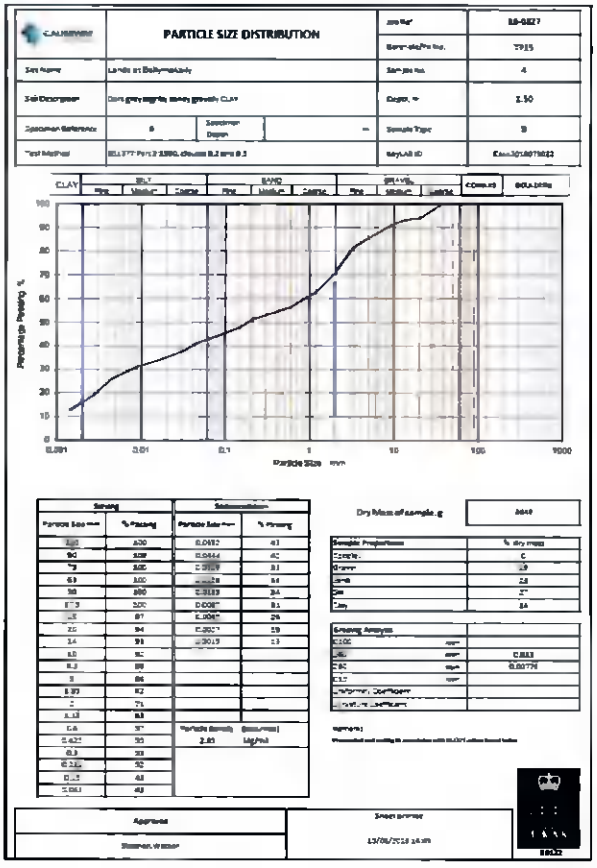
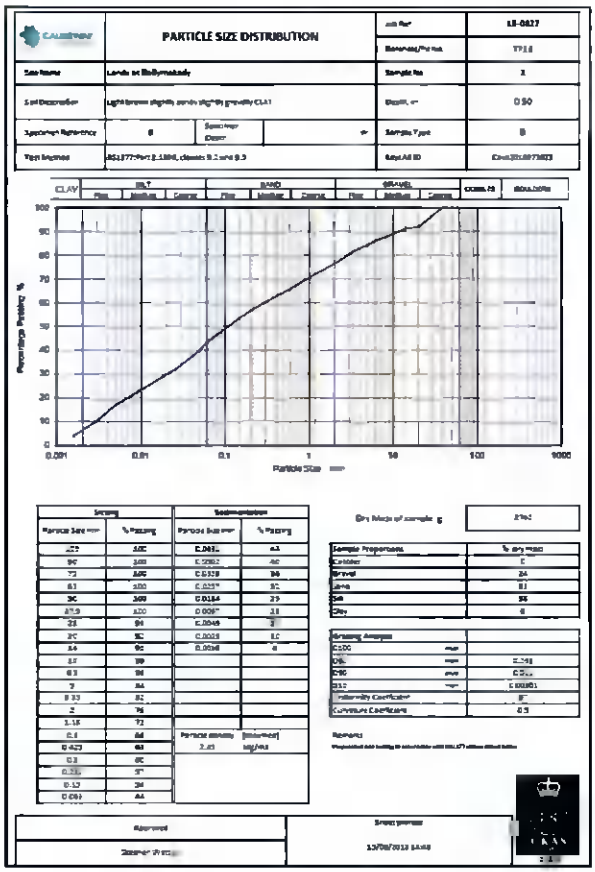
CLAY
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
CLAY
Percentage Passing %
Particle Size mm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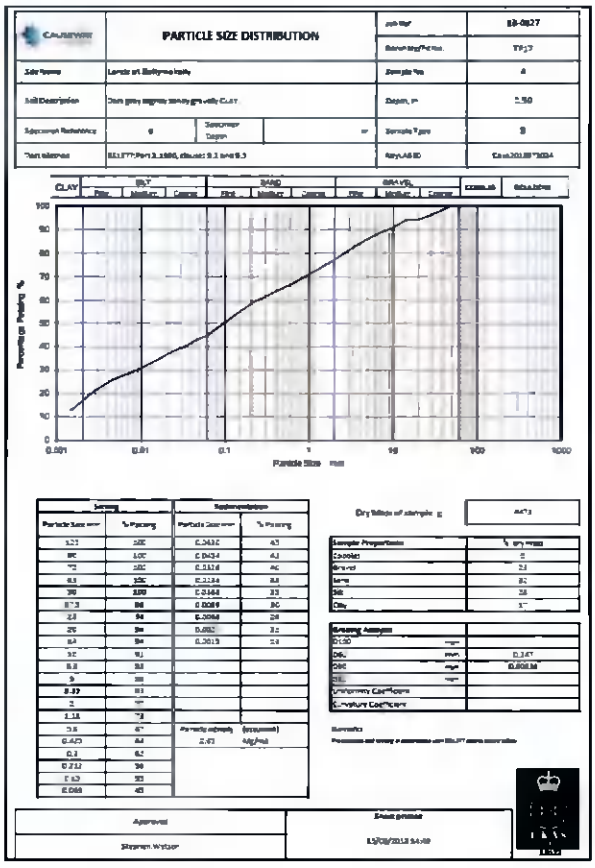
CLAY
SILT
SAND
GRAVEL
Percentage Passing %
Particle Size mm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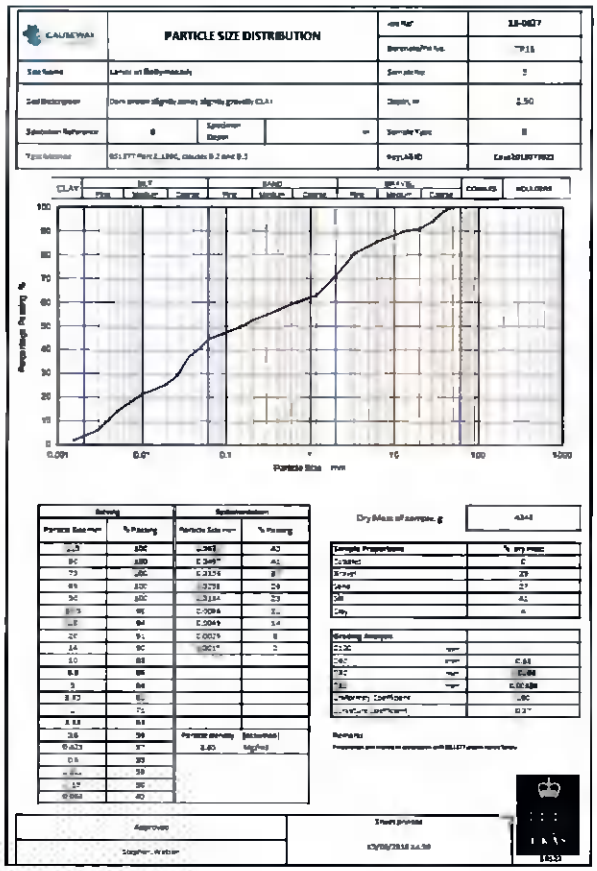
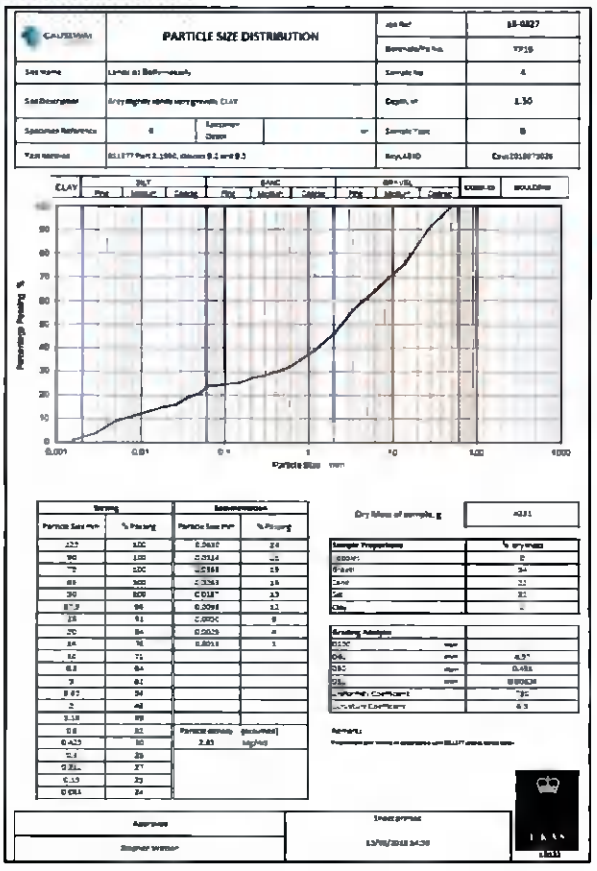
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
CLAY
SILT
SAND
GRAVEL
COBBLES
BOULDERS
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
CLAY
SILT
SAND
GRAVEL
COBBLES
BOULDERS
Percentage Passing %
Particle Size mm

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Depot Road
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2183

Final Report

Report No.:	18-23652-1
Initial Date of Issue:	10-Aug-2018
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Cann Cornwall Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Lucy Newland Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Sean Ross Stephen Franey Stephen Watson Stuart Abraham
Project	18-0827 Lands at Ballymakelly
Quotation No.:	
Order No.:	
No. of Samples:	16
Turnaround (Wkdays):	3
Date Approved:	10-Aug-2018
Approved By:	
Details:	Martin Dyer Laboratory Manager

Date Received:	08-Aug-2018
Date Instructed:	08-Aug-2018
Results Due:	10-Aug-2018

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Results - Soil

Project: 18-0827 Lands at Ballymakelly

Client: Causeway Geotech Ltd	Chemtest Job No.:	18-23652	18-23652	18-23652	18-23652	18-23652	18-23652	18-23652	18-23652
Quotation No.	Chemtest Sample ID:	667501	667902	667903	667904	667905	667906	667907	667908
Order No.	Client Location ID:	TP01	TP01	TP02	TP02	TP03	TP03	TP04	TP04
	Client Sample No.:	1	2	3	4	5	6	7	8
	Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):	0.50	0.50	1.50	0.50	0.50	1.50	0.50	0.50
	Date Sampled:	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018

Determinand	Accred.	SOP	Units	LOD							
Moisture	N	2030	%	0.020	7.8	11	9.2	4.4	7.8	9.6	7.7	8.3
pH	U	2011		N/A	8.4	8.6	8.5	8.5	8.5	8.6	8.3	8.4
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010

Chemtest

Project: 18-0827 Lands at Ballymakaily

Results - Soil

Client: Causeway Geotech Ltd		Chemtest Job No.:	18-23652	18-23652	18-23652	18-23652	18-23652	18-23652	18-23652	18-23652
Quotation No.:		Chemtest Sample ID:	667914	667915	667911	667912	667913	667914	667915	667916
Order No.:		Client Location ID:	TP13	TP14	TP15	TP15	TP16	TP17	TP18	TP19
		Client Sample Ref.:	2	4	2	4	2	5	4	5
		Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):	0.50	0.50	0.50	1.50	0.50	1.50	1.50	1.50
		Date Sampled:	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	5.7	6.7	8.0	11	10	8.5	10	5.9
pH	U	2010		N/A	8.5	8.5	8.4	8.7	8.2	8.8	8.5	8.7
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010

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Report Information

Key

U UKAS accredited
M MCERTS and UKAS accredited
N Unaccredited
S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis.
SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis.
T This analysis has been subcontracted to an unaccredited laboratory.
MS Insufficient Sample
UNS Unsuitable Sample
NFE not evaluated
< "less than"
> "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

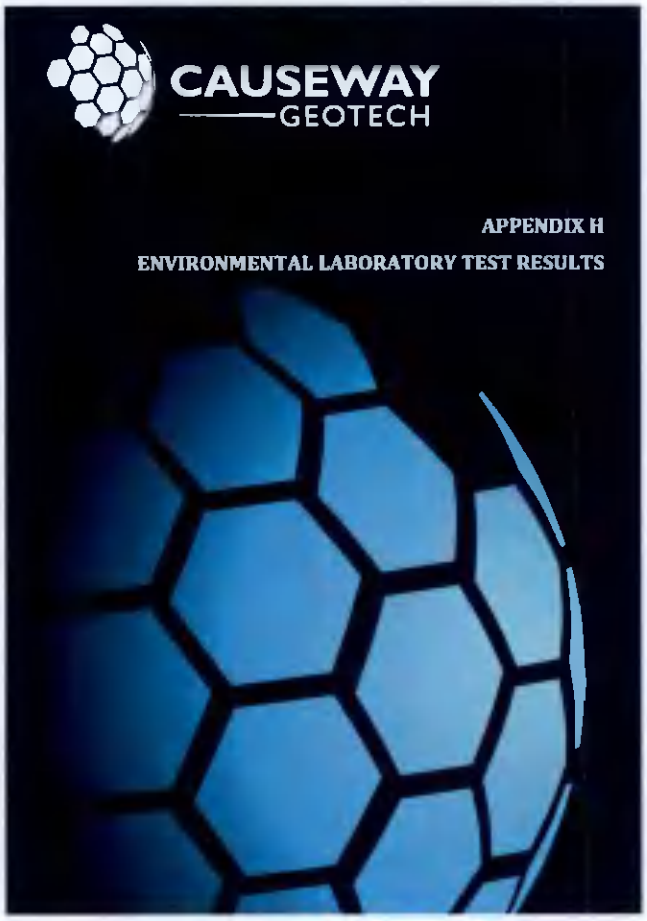
Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to customerservices@chemtest.co.uk



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UKAS TESTING 2183

Final Report

Report No.:	18-22446-1
Initial Date of Issue:	03-Aug-2018
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Aisling O'Kane Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Lucy Newland Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Stephen Franey Stephen Watson Sean Ross
Project	18-0827 Ballymaraddy
Quotation No.:	
Order No.:	
No. of Samples:	14
Turnaround (Wkdays):	3
Date Approved:	03-Aug-2018
Approved By:	
Details:	Robert Monk, Technical Manager

Date Received:	30-Jul-2018
Date Instructed:	30-Jul-2018
Results Due:	01-Aug-2018

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Results - Soil

Project: 18-0827 Ballymakally

Client: Causeway Geotech Ltd				Chemtest Job No.	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446
Quotation No				Chemtest Sample ID	661593	661595	661597	661599	661601	661602	661603	661604	661606
Order No				Client Location ID	[illegible]	TP6	TP10	TP11	[illegible]	TP22	[illegible]	[illegible]	TP12
				Client Sample Ref	1	2	1	1	2	1	1	1	2
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m)	1.50	1.50	0.50	0.50	1.50	0.30	0.50	0.50	1.50
				Date Sampled	[illegible]	23-Jul-2018	23-Jul-2018	23-Jul-2018	25-Jul-2018	[illegible]	[illegible]	[illegible]	25-Jul-2018
				Asbestos Lab	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	12	9.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.3	7.8
pH	U	2010		N/A	8.4	[illegible]	8.4	8.4	8.5	[illegible]	8.5	[illegible]	8.5
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.52	< 0.40	< 0.40	< 0.40	0.55	0.74	< 0.40	< 0.40	< 0.40
Sulfate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.095	< 0.010	< 0.010	< 0.010
Cyanide (Free)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Cyanide (Total)	U	2300	mg/kg	0.50	[illegible]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Thiocyanate	U	2300	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	15	35	6.3	12	12	6.2	8.1	22	16
Sulphate (Total)	U	2430	%	0.010	[illegible]	0.094	0.042	0.029	0.16	0.23	0.047	0.059	0.23
Arsenic	U	2450	mg/kg	1.0	26	[illegible]	33	[illegible]	31	31	21	[illegible]	31
Cadmium	U	2450	mg/kg	0.10	1.5	[illegible]	[illegible]	0.53	[illegible]	1.6	[illegible]	0.54	1.2
Chromium	U	2450	mg/kg	1.0	19	12	16	21	14	16	19	11	14
Copper	U	2450	mg/kg	0.50	25	22	32	17	30	38	16	[illegible]	26
Mercury	U	2450	mg/kg	0.10	0.11	< 0.10	< 0.10	< 0.10	< 0.10	0.11	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	49	42	53	37	55	31	37	59	47
Lead	U	2450	mg/kg	0.50	26	14	20	16	38	42	18	[illegible]	16
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20	[illegible]	[illegible]	< 0.20	< 0.20	0.56
Zinc	U	2450	mg/kg	0.50	80	58	74	56	72	110	60	37	72
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	1.5	0.52	3.8	0.84	1.9	5.2	0.88	[illegible]	1.0
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Page 2 of 8

Chemtest

Results - Soil

Project: 18-0827 Ballymakally

Client: Causeway Geotech Ltd				Chemtest Job No.	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446
Quotation No				Chemtest Sample ID	661593	661595	661597	661599	661601	661602	661603	661604	661606
Order No				Client Location ID	[illegible]	TP6	TP10	TP11	TP21	TP22	TP24	TP29	TP12
				Client Sample Ref	1	2	1	1	2	1	1	1	2
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m)	1.50	1.50	0.50	0.50	1.50	0.30	0.50	0.50	1.50
				Date Sampled	23-Jul-2018	23-Jul-2018	23-Jul-2018	23-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018
				Asbestos Lab	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Resorcinol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Cresols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Xylenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1-Naphthol	N	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Trimethylphenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

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Chemtest

Results - Soil

Project: 18-0627 Ballymakelly

Client: Causeway Geotech Ltd					Chemtest Job No.:	18-22446	18-22446	18-22446	18-22446	18-22446
Location No:					Chemtest Sample ID:	661618	661619	661611	661614	661615
Order No:					Client Location ID:	TP13	TP15	TP16	TP17	TP19
					Client Sample Ref:	2	1	1	2	2
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	1.50	0.50	0.50	1.50	1.50
					Date Sampled:	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018
					Asbestos Lab:	SOLENTPY	SOLENTPY	SOLENTPY	SOLENTPY	SOLENTPY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type	U	2192		N/A	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	
Moisture	N	2030	%	0.020	11	5	9.4	9.4	6.5	
pH	U	2010	pH Units	N/A	8.5	8.2	8.3	8.5	8.5	
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	0.54	0.49	< 0.40	< 0.40	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	
Cyanide (Free)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	
Cyanide (Total)	U	2300	mg/kg	5	< 5	< 5	< 5	< 5	< 5	
Thiocyanate	U	2300	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	12	6.3	8.0	8.9	11	
Sulphate (Total)	U	2430	%	0.010	0.063	0.063	0.071	0.14	0.057	
Arsenic	U	2450	mg/kg	1.0	21	21	21	40	14	
Cadmium	U	2450	mg/kg	0.15	1.7	1.4	1.2	2.6	1.6	
Chromium	U	2450	mg/kg	1.0	14	24	19	12	15	
Copper	U	2450	mg/kg	0.50	34	34	45	20	22	
Mercury	U	2450	mg/kg	0.10	< 0.10	0.11	< 0.10	< 0.10	< 0.10	
Nickel	U	2450	mg/kg	0.50	49	44	36	36	38	
Lead	U	2450	mg/kg	0.50	20	27	22	20	13	
Selenium	U	2450	mg/kg	0.20	0.73	0.48	< 0.20	0.76	< 0.20	
Zinc	U	2450	mg/kg	0.50	87	63	61	73	63	
Chromium (Hexavalent)	N	2490	mg/kg	0.5	< 0.50	< 0.50	< 0.5	< 0.50	< 0.5	
Organic Matter	U	2625	%	0.40	2.1	2.1	1.7	1.9	1.66	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	

Chemtest

Results - Soil

Project: 18-0627 Ballymakelly

Client: Causeway Geotech Ltd					Chemtest Job No.:	18-22446	18-22446	18-22446	18-22446	18-22446
Location No:					Chemtest Sample ID:	661618	661619	661611	661614	661615
Order No:					Client Location ID:	TP13	TP15	TP16	TP17	TP19
					Client Sample Ref:	2	1	1	2	2
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	1.50	0.50	0.50	1.50	1.50
					Date Sampled:	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018
					Asbestos Lab:	SOLENTPY	SOLENTPY	SOLENTPY	SOLENTPY	SOLENTPY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10	
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(a)anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(b)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(k)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(a)pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Indeno(1,2,3-cd)pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Dibenz(a,h)anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(g,h,i)perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Total Of 16 PAHs	U	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Resorcinol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Phenol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Cresols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Xylenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
1-Naphthol	N	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Trimethylphenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	

Chemtest

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to
customerservices@chemtest.co.uk

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UKAS TESTING 2183

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report No.:	18-24061-1		
Initial Date of Issue:	16-Aug-2018		
Client	Causeway Geotech Ltd		
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL		
Contact(s):	Carin Cornwall Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Lucy Newland Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Sean Ross Stephen Franey Stephen Watson Stuart Abraham		
Project	18-0827 Lands at Ballymakelly		
Quotation No.:		**Date Received:**	10-Aug-2018
Order No.:		**Date Instructed:**	13-Aug-2018
No. of Samples:	10		
Turnaround (Wkdays):	3	**Results Due:**	15-Aug-2018
Date Approved:	16-Aug-2018		
Approved By:			
Details:	Robert Monk, Technical Manager		

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Chemtest

Results - Soil

Project: 18-0827 Lands at Ballymakelly

Client: Causeway Geotech Ltd				Chemtest Job No.:	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061
Quotation No.:				Chemtest Sample ID:	669833	669834	669835	669836	669837	669838	669839	669840
Order No.:				Client Location ID:	BH05	BH05	BH11	BH11	BH12	BH13	BH14	BH14
				Client Sample Ref:	ES1	ES2	ES2	ES1	ES1	ES2	ES1	ES2
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.5	1.5	1.50	0.50	0.5	1.5	0.5	1.5
				Date Sampled:	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018	[illegible]	09-Aug-2018	[illegible]	[illegible]
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	7.6	[illegible]	13	12	[illegible]	[illegible]	14	[illegible]
pH	U	2010		N/A	5.6	8.6	8.4	[illegible]	8.6	8.6	[illegible]	8.5
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40	0.61	< 0.40	< 0.40	< 0.40	[illegible]	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Cyanide (Free)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Thiocyanate	U	2300	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	7.9	24	17	5.1	4.3	21	1.6	6.2
Sulphate (Total)	U	2430	%	0.010	[illegible]	[illegible]	[illegible]	0.021	0.041	[illegible]	0.077	0.084
Arsenic	U	2450	mg/kg	1.0	[illegible]	22	[illegible]	[illegible]	[illegible]	[illegible]	23	26
Cadmium	U	2450	mg/kg	0.10	[illegible]	1.6	1.3	[illegible]	[illegible]	1.4	2.6	2.6
Chromium	U	2450	mg/kg	1.0	18	12	18	24	14	12	25	17
Copper	U	2450	mg/kg	0.50	11	25	25	13	[illegible]	22	23	38
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	30	45	41	48	51	48	50	60
Lead	U	2450	mg/kg	0.50	14	11	31	18	15	11	24	20
Selenium	U	2450	mg/kg	0.20	< 0.20	0.83	2.0	0.30	< 0.20	0.60	0.84	2.6
Zinc	U	2450	mg/kg	0.50	49	53	69	73	54	[illegible]	96	90
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	1.1	1.2	2.9	0.72	0.78	1.5	[illegible]	1.6
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	16	65	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	16	65	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

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Chemtest

Results - Soil

Project: 18-0827 Lands at Ballymakelly

Client: Causeway Geotech Ltd				Chemtest Job No.:	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061
Quotation No.:				Chemtest Sample ID:	669833	669834	669835	669836	669837	669838	669839	669840
Order No.:				Client Location ID:	BH05	BH05	BH11	BH11	BH12	BH13	BH14	BH14
				Client Sample Ref:	ES1	ES2	ES2	ES1	ES1	ES2	ES1	ES2
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.5	1.5	1.50	0.50	0.5	1.5	0.5	1.5
				Date Sampled:	[illegible]	09-Aug-2018	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	25	97	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	[illegible]	97	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	41	160	< 10	< 10	< 10	< 10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.32	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.66	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Resorcinol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Cresols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Xylenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1-Naphthol	N	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Trimethylphenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

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Chemtest

Results - Soil

Project: 18-0627 Lands at Ballymakeily

Client: Causeway Geotech Ltd		Chemtest Job No.:	18-24061	18-24061
Quotation No.		Chemtest Sample ID:	669841	669842
Order No.		Client Location ID:	BH15	BH15
		Client Sample Ref.:	ES1	ES2
		Sample Type:	SOIL	SOIL
		Top Depth (m):	0.5	1.5
		Date Sampled:	05-Aug-2018	05-Aug-2018
		Asbestos Lab:	COVENTRY	COVENTRY

Determinand	Accred.	SOP	Units	LOD		
Asbestos Type	U	2192		N/A	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	9.5	7.6
pH	U	2010		N/A	8.4	8.6
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010
Cyanide (Free)	U	2300	mg/kg	0.50	< 0.50	< 0.50
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50
Thiocyanate	U	2325	mg/kg	5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)	N	2325	mg/kg	1.50	2.1	10
Sulphate (Total)	U	2430	%	0.010	0.084	0.18
Arsenic	U	2450	mg/kg	1.0	44	36
Cadmium	U	2450	mg/kg	0.10	1.2	2.0
Chromium	U	2450	mg/kg	1.0	22	18
Copper	U	2450	mg/kg	0.50	28	38
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	54	56
Lead	U	2450	mg/kg	0.50	16	16
Selenium	U	2450	mg/kg	0.20	0.73	0.5
Zinc	U	2450	mg/kg	0.50	58	78
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	0.86	1.6
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0

Chemtest

Results - Soil

Project: 18-0627 Lands at Ballymakeily

Client: Causeway Geotech Ltd		Chemtest Job No.:	18-24061	18-24061
Quotation No.		Chemtest Sample ID:	669841	669842
Order No.		Client Location ID:	BH15	BH15
		Client Sample Ref.:	ES1	ES2
		Sample Type:	SOIL	SOIL
		Top Depth (m):	0.5	1.5
		Date Sampled:	05-Aug-2018	05-Aug-2018
		Asbestos Lab:	COVENTRY	COVENTRY

Determinand	Accred.	SOP	Units	LOD		
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo(a)anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo(b)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo(k)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo(a)pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo(g,h,i)perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Resorcinol	U	2920	mg/kg	0.050	< 0.050	< 0.050
Phenol	U	2920	mg/kg	0.050	< 0.050	< 0.050
Cresols	U	2920	mg/kg	0.050	< 0.050	< 0.050
Xylenols	U	2920	mg/kg	0.050	< 0.050	< 0.050
1-Naphthol	N	2920	mg/kg	0.050	< 0.050	< 0.050
Trimethylphenols	U	2920	mg/kg	0.050	< 0.050	< 0.050
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30

Chemtest

Report Information

Key

U UKAS accredited
M MCERTS and UKAS accredited
N Unaccredited
S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T This analysis has been subcontracted to an unaccredited laboratory
IS Insufficient Sample
US Unsuitable Sample
NE not evaluated
< "less than"
> "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to
[redacted]

Page 6 of 6

CAUSEWAY GEOTECH

APPENDIX H

SPT HAMMER ENERGY MEASUREMENT REPORT

Southern Testing

SPT Hammer Energy Test Report

In accordance with BSEN ISO 22476-3:2005

Neil Burrows
Southern Testing Laboratories
Unit 11
Charlwoods Road
East Grinstead
RH19 2HU

SPT Hammer Ref:	T10267
Test Date:	14/04/2018
Report Date:	15/04/2018
File Name:	T10267.spt
Test Operator:	CAUSEWAY

Instrumented Rod Data

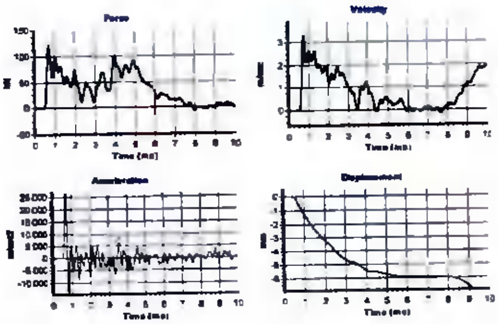
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

SPT Hammer Information

Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.5

Comments / Location

Causeway Yard



Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	351
Energy Ratio E_r (%):	**74**

Signed: N P Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months

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Appendix 7.3 Soil chemical test analysis results

element

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

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F +44 (0) 1244 833781
W: www.element.com

AWN Consulting
Tecpro Building
Clonshaugh Business & Technology Park
Dublin
Dublin 17
Ireland

Attention :	Colm Dwyer
Date :	4th December, 2020
Your reference :	
Our reference :	Test Report 20/16584 Batch 1
Location :	Edgeconnex, Grangecastle
Date samples received :	26th November 2020
Status :	Final report
Issue :	1

Four samples were received for analysis on 26th November 2020 of which four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Phil Sommerton BSc
Senior Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology Environmental UK Limited
Registered in England and Wales
Registered Office: 10 Lower Grosvenor Place, London SW1W 0EN
Company Registration No. 11371415

Element Materials Technology

Client Name: AWN Consulting
Reference:
Location: Edgeconnex Grangecastle
Contact: Colm Driver
EMT Job No. 20/16584

Report : Liquid

Liquids/products: V=40ml vial G=glass bottle P=plastic bottle
H=H_2SO_4 Z=ZnAc N=NaOH HN=HNO_3

EMT Sample No.	1-6	7-12	13-18	19-24							LOD/LOR	Units	Method No
Sample ID	BH08	BH10	BH11	BH15									
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G									
Sample Date	[illegible]	[illegible]	[illegible]	[illegible]									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	26/11/2020	26/11/2020	26/11/2020	26/11/2020									
Dissolved Arsenic*	<2.5	<2.5	<2.5	<2.5							<2.5	ug/l	TM30/PM14
Dissolved Boron	13	<12	13	14							<12	ug/l	TM30/PM14
Dissolved Cadmium*	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM30/PM14
Total Dissolved Chromium*	<1.5	<1.5	<1.5	<1.5							<1.5	ug/l	TM30/PM14
Dissolved Copper*	<7	<7	<7	<7							<7	ug/l	TM30/PM14
Dissolved Lead*	<5	<5	<5	<5							<5	ug/l	TM30/PM14
Dissolved Mercury*	<1	<1	<1	<1							<1	ug/l	TM30/PM14
Dissolved Nickel*	4	<2	3	4							<2	ug/l	TM30/PM14
Dissolved Selenium*	<3	<3	<3	<3							<3	ug/l	TM30/PM14
Dissolved Zinc*	<3	<3	<3	7							<3	ug/l	TM30/PM14
PAH MS													
Naphthalene*	<0.1	<0.1	<0.1	<0.1							<0.1	ug/l	TM4/PM30
Acenaphthylene*	<0.013	<0.013	<0.013	<0.013							<0.013	ug/l	TM4/PM30
Acenaphthene*	<0.013	<0.013	<0.013	<0.013							<0.013	ug/l	TM4/PM30
Fluorene*	<0.014	<0.014	<0.014	<0.014							<0.014	ug/l	TM4/PM30
Phenanthrene*	<0.011	<0.011	<0.011	<0.011							<0.011	ug/l	TM4/PM30
Anthracene*	<0.013	<0.013	<0.013	<0.013							<0.013	ug/l	TM4/PM30
Fluoranthene*	<0.012	<0.012	<0.012	<0.012							<0.012	ug/l	TM4/PM30
Pyrene*	<0.013	<0.013	<0.013	<0.013							<0.013	ug/l	TM4/PM30
Benzo(a)anthracene*	<0.015	<0.015	<0.015	<0.015							<0.015	ug/l	TM4/PM30
Chrysene*	<0.011	<0.011	<0.011	<0.011							<0.011	ug/l	TM4/PM30
Benzo(bk)fluoranthene*	<0.018	<0.018	<0.018	<0.018							<0.018	ug/l	TM4/PM30
Benzo(a)pyrene*	<0.016	<0.016	<0.016	<0.016							<0.016	ug/l	TM4/PM30
Indeno(123cd)pyrene*	<0.011	<0.011	<0.011	<0.011							<0.011	ug/l	TM4/PM30
Dibenzo(ah)anthracene*	<0.01	<0.01	<0.01	<0.01							<0.01	ug/l	TM4/PM30
Benzo(ghi)perylene*	<0.011	<0.011	<0.011	<0.011							<0.011	ug/l	TM4/PM30
PAH 16 Total*	<0.195	<0.195	<0.195	<0.195							<0.195	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01							<0.01	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01							<0.01	ug/l	TM4/PM30
PAH Surrogate % Recovery	86	85	88	77							<0	%	TM4/PM30
Methyl Tertiary Butyl Ether*	<0.1	<0.1	<0.1	<0.1							<0.1	ug/l	TM15/PM10
Benzene*	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM15/PM10
Toluene*	<5	<5	<5	<5							<5	ug/l	TM15/PM10
Ethylbenzene*	<1	<1	<1	<1							<1	ug/l	TM15/PM10
m/p-Xylene*	<2	<2	<2	<2							<2	ug/l	TM15/PM10
o-Xylene*	<1	<1	<1	<1							<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	97	96	96	96							<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	94	96	95	95							<0	%	TM15/PM10

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: AWN Consulting
Reference:
Location: Edgeconnex Grangecastle
Contact Colm Driver
EMT Job No: 20/16584

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=HNO_3

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24							LOD/LOR	Units	Method No
Sample ID	BH05	BH10	BH11	BH15									
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G									
Sample Date	[redacted]	[redacted]	[redacted]	[redacted]									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	26/11/2020	26/11/2020	26/11/2020	26/11/2020									
TPH CWG													
Aliphatics													
>C5-C6 [#]	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>C6-C8 [#]	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>C8-C10 [#]	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>C10-C12 [#]	<5	<5	<5	<5							<5	ug/l	[redacted]
>C12-C16 [#]	<10	<10	<10	<10							<10	ug/l	[redacted]
>C16-C21 [#]	<10	<10	<10	<10							<10	ug/l	[redacted]
>C21-C35 [#]	<10	<10	<10	<10							<10	ug/l	[redacted]
Total aliphatics C5-35 [#]	<10	<10	<10	<10							<10	ug/l	[redacted]
Aromatics													
>C5-EC7 [#]	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>EC7-EC8 [#]	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>EC8-EC10 [#]	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>EC10-EC12 [#]	<5	<5	<5	<5							<5	ug/l	[redacted]
>EC12-EC16 [#]	<10	<10	<10	<10							<10	ug/l	[redacted]
>EC16-EC21 [#]	<10	<10	<10	<10							<10	ug/l	[redacted]
>EC21-EC35 [#]	<10	<10	<10	<10							<10	ug/l	[redacted]
Total aromatics C5-35 [#]	<10	<10	<10	<10							<10	ug/l	[redacted]
Total aliphatics and aromatics(C5-35) [#]	<10	<10	<10	<10							<10	ug/l	[redacted]
PCBs (Total vs Aroclor 1254)	<0.2	<0.2	<0.2	<0.2							<0.2	ug/l	TM17/PM30
Chloride [#]	60.6	2.5	14.9	15.0							<0.3	mg/l	TM38/PM0
Ortho Phosphate as PO4 [#]	<0.06	<0.06	<0.06	<0.06							<0.06	mg/l	TM38/PM0
Total Oxidised Nitrogen as N [#]	<0.2	0.6	0.4	0.2							<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N [#]	0.10	0.03	0.05	0.04							<0.03	mg/l	TM38/PM0
Electrical Conductivity @25C [#]	541	339	422	356							<2	uS/cm	TM76/PM0
pH [#]	7.60	7.66	7.66	7.75							<0.01	pH units	TM73/PM0
Total Nitrogen	5.4	5.6	5.0	3.2							<0.5	mg/l	[redacted]

Element Materials Technology

Client Name: AWN Consulting **SVOC Report :** Liquid
Reference:
Location: Edgeconnex Grangecastle
Contact: Colm Dwyer
EMT Job No: 20/16584

EMT Sample No.	1-6	7-12	13-18	19-24							Please see attached notes for all abbreviations and acronyms		
Sample ID	BH05	BH10	BH11	BH15									
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G									
Sample Date	25/11/2020	25/11/2020 19:20	25/11/2020 10:30	26/11/2020 11:00									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	26/11/2020	26/11/2020	26/11/2020	26/11/2020							LOD/LOR	Units	Method No
SVOC MS													
Phenols													
2-Chlorophenol [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2-Methylphenol [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2-Nitrophenol	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2,4-Dichlorophenol [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2,4-Dimethylphenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2,4,5-Trichlorophenol [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Chloro-3-methylphenol [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
4-Methylphenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Nitrophenol	<10	<10	<10	<10							<10	ug/l	TM16/PM30
Pentachlorophenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Phenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
PAHs													
2-Chloronaphthalene [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2-Methylnaphthalene [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Phthalates													
Bis(2-ethylhexyl) phthalate	<5	<5	<5	<5							<5	ug/l	TM16/PM30
Butylbenzyl phthalate	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Di-n-butyl phthalate [#]	<1.5	<1.5	<1.5	<1.5							<1.5	ug/l	TM16/PM30
Di-n-Octyl phthalate	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Diethyl phthalate [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Dimethyl phthalate	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Other SVOCs													
1,2-Dichlorobenzene [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
1,2,4-Trichlorobenzene [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
1,3-Dichlorobenzene [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
1,4-Dichlorobenzene [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2-Nitroaniline	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2,4-Dinitrotoluene [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2,6-Dinitrotoluene	<1	<1	<1	<1							<1	ug/l	TM16/PM30
3-Nitroaniline	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Bromophenylphenylether [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Chloroaniline	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Chlorophenylphenylether [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Nitroaniline	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Azobenzene [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Bis(2-chloroethyl)ether [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Carbazole [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Dibenzofuran [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Hexachlorobenzene [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Hexachlorobutadiene [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Hexachlorocyclopentadiene	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Hexachloroethane [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Isophorone [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
N-nitrosodi-n-propylamine [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Nitrobenzene [#]	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Surrogate Recovery 2-Fluorobiphenyl	76	63 [SV]	70	118							<0	%	TM16/PM30
Surrogate Recovery p-Terphenyl-d14	72	62 [SV]	68	114							<0	%	TM16/PM30

Element Materials Technology

Client Name: AWN Consulting **VOC Report :** **Liquid**
Reference:
Location: Edgeconnex Grangecastle
Contact: Colm Driver
EMT Job No: 20/16584

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	LOD/LOR	Units	Method No.
Sample ID	BH06	BH10	BH11	BH15			
Depth							
COC No / misc							
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G			
Sample Date	[illegible]	[illegible]	[illegible]	[illegible]			
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water			
Batch Number	1	1	1	1			
Date of Receipt	26/11/2020	26/11/2020	26/11/2020	26/11/2020			
VOC MS							
Dichlorodifluoromethane	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether*	<0.1	<0.1	<0.1	<0.1	<0.1	ug/l	TM15/PM10
Chloromethane*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Vinyl Chloride*	<0.1	<0.1	<0.1	<0.1	<0.1	ug/l	TM15/PM10
Bromomethane	<1	<1	<1	<1	<1	ug/l	TM15/PM10
Chloroethane*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Trichlorofluoromethane*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE)*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Dichloromethane (DCM)*	<5	<5	<5	<5	<5	ug/l	TM15/PM10
trans-1-2-Dichloroethene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,1-Dichloroethane*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1	<1	<1	<1	<1	ug/l	TM15/PM10
Bromochloromethane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Chloroform*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,1,1-Trichloroethane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,1-Dichloropropene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Carbon tetrachloride*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2-Dichloroethane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Benzene*	<0.5	<0.5	<0.5	<0.5	<0.5	ug/l	TM15/PM10
Trichloroethene (TCE)*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,2-Dichloropropane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Dibromomethane*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Bromodichloromethane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Toluene*	<5	<5	<5	<5	<5	ug/l	TM15/PM10
trans-1-3-Dichloropropene	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,1,2-Trichloroethane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Tetrachloroethene (PCE)*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,3-Dichloropropane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Dibromochloromethane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2-Dibromoethane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Chlorobenzene*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Ethylbenzene*	<1	<1	<1	<1	<1	ug/l	TM15/PM10
m/p-Xylene*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
o-Xylene*	<1	<1	<1	<1	<1	ug/l	TM15/PM10
Styrene	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Bromoform*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
Isopropylbenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4	<4	<4	<4	<4	ug/l	TM15/PM10
Bromobenzene*	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2,3-Trichloropropane*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Propylbenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
2-Chlorotoluene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
4-Chlorotoluene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
tert-Butylbenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
sec-Butylbenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
4-Isopropyltoluene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,3-Dichlorobenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,4-Dichlorobenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
n-Butylbenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,2-Dichlorobenzene*	<3	<3	<3	<3	<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Naphthalene	<2	<2	<2	<2	<2	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3	<3	<3	<3	<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	97	96	96	96	<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	94	96	95	95	<0	%	TM15/PM10

QF-PM 3.1.4 v11

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Element Materials Technology **Notification of Deviating Samples**

Client Name: AWN Consulting
Reference:
Location: Edgeconnex, Grangecastle
Contact: Colm Driver

EMT Job No	Batch	Sample ID	Depth	EMT Sample No	Analysis	Reason
No deviating sample report results for job 20/16584						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating
Only analyses which are accredited are recorded as deviating if set criteria are not met

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 20/16584

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

EMT Job No.: 20/16584

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
^	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

Element Materials Technology **Method Code Appendix**

EMT Job No: 20/16584

Test Method No	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM4	Modified USEPA 8270D v5 2014 method for the solvent extraction and determination of PAHs by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex				
TM4	Modified USEPA 8270D v5 2014 method for the solvent extraction and determination of PAHs by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex	Yes			
TM5	Modified 8015B v2 1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPHE within the range C8-C40 by GCFID For waters the solvent extracts dissolved phase plus a sheen if present	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex	Yes			
TM5/TM36	please refer to TM5 and TM36 for method details	PM12/PM16/PM30	please refer to PM16/PM30 and PM12 for method details	Yes			
TM15	Modified USEPA 8260B v2 1996 Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS	PM10	Modified US EPA method 5021A v2 2014 Preparation of solid and liquid samples for GC headspace analysis				
TM15	Modified USEPA 8260B v2 1996 Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS	PM10	Modified US EPA method 5021A v2 2014 Preparation of solid and liquid samples for GC headspace analysis	Yes			
TM16	Modified USEPA 8270D v5 2014 Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex				
TM16	Modified USEPA 8270D v5 2014 Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex	Yes			
TM17	Modified US EPA method 8270D v5 2014 Determination of specific Polychlorinated Biphenyl congeners by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry) WATERS by Modified USEPA Method 200 7 Rev 4 4 1994 Modified EPA Method 6010B Rev 2 Dec 1996 Modified BS EN ISO 11885:2009 SOILS by Modified USEP	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS Samples are filtered for Dissolved metals and remain unfiltered for Total metals then acidified				

Element Materials Technology **Method Code Appendix**

EMT Job No: 20/16584

Test Method No	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry) WATERS by Modified USEPA Method 200 7 Rev 4 4 1994 Modified EPA Method 6010B Rev 2 Dec 1996 Modified BS EN ISO 11885:2009 SOILS by Modified USEP	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS Samples are filtered for Dissolved metals and remain unfiltered for Total metals then acidified	Yes			
TM38	Modified US EPA method 8015B v2 1996 Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4 - 12 by headspace GC-FID MTBE by GCFID co elutes with 3-methylpentane if present and therefore can give a false positive Positive MTBE results will be re-run using GC-MS to double check when requested	PM12	Modified US EPA method 5021A v2 2014 Preparation of solid and liquid samples for GC headspace analysis	Yes			
TM38	Soluble ion analysis using Discrete Analyser Modified US EPA methods Chloride 325 2 1978), Sulphate 375 4 (Rev 2 1993) o-Phosphate 365 2 (Rev 2 1993) TON 353 2 (Rev 2 1993) Nitrite 354 1 (1971) Rev C 7196A (1992), NH4+ 350 1 (Rev 2 1993 (comparab	PM0	No preparation is required	Yes			
TM38/TM125	Total Nitrogen/Organic Nitrogen by calculation	PM6	No preparation is required				
TM73	Modified US EPA methods 150 1 (1982) and 9045D Rev 4 2004) and BS1377 3 1990 Determination of pH by Metrohm automated probe analyser	PM0	No preparation is required	Yes			
TM76	Modified US EPA method 120 1 (1982) Determination of Specific Conductance by Metrohm automated probe analyser	PM6	No preparation is required	Yes			

CHAPTER 8 - HYDROLOGY

Appendix 8.1 Criteria for rating Site Attributes - Estimation of Importance of Hydrology Attributes (NRA)

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2- 3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Estimation of magnitude of impact on hydrology attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss or extensive change to a waterbody or water dependent habitat. Increase in predicted peak flood level >100mm. Extensive loss of fishery. Calculated risk of serious pollution incident >2% annually. Extensive reduction in amenity value.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50mm. Partial loss of fishery. Calculated risk of serious pollution incident >1% annually. Partial reduction in amenity value.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10mm. Minor loss of fishery. Calculated risk of serious pollution incident >0.5% annually. Slight reduction in amenity value.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level. Calculated risk of serious pollution incident <0.5% annually.
Minor Beneficial	Results in minor improvement of attribute quality	Reduction in predicted peak flood level >10mm. Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually.
Moderate Beneficial	Results in moderate improvement of attribute quality	Reduction in predicted peak flood level >50mm. Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually.
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm

Rating of Significant Environmental Impacts at EIS Stage (NRA)

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

CHAPTER 9 - NOISE AND VIBRATION

Appendix 9.1 Glossary of acoustic terminology (prepared by AWN Consulting Ltd.)

ambient noise	The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.
background noise	The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).
broadband	Sounds that contain energy distributed across a wide range of frequencies.
dB	Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 µPa).
dB L_{pA}	An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'–weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Hertz (Hz)	The unit of sound frequency in cycles per second.
impulsive noise	A noise that is of short duration (typically less than one second), the sound pressure level of which is significantly higher than the background.
$L_{Aeq,T}$	This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.
L_{AFN}	The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.
L_{AFmax}	is the instantaneous slow time weighted maximum sound level measured during the sample period (usually referred to in relation to construction noise levels).
$L_{Ar,T}$	The Rated Noise Level, equal to the L_{Aeq} during a specified time interval (T). plus specified adjustments for tonal character and impulsiveness of the sound.
L_{AF90}	Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval: it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.
L_{AT}(DW)	equivalent continuous downwind sound pressure level.
L_{fT}(DW)	equivalent continuous downwind octave-band sound pressure level.
L_{day}	L_{day} is the average noise level during the daytime period of 07:00hrs to 19:00hrs
L_{night}	L_{night} is the average noise level during the night-time period of 23:00hrs to 07:00hrs.
low frequency noise	LFN - noise which is dominated by frequency components towards the lower end of the frequency spectrum.
noise	Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause

actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.

noise sensitive location NSL – Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.

octave band A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.

rating level See $L_{Ar,T}$.

sound power level The logarithmic measure of sound power in comparison to a referenced sound intensity level of one picowatt (1pW) per m^2 where:

$$Lw = 10Log\frac{P}{P_0}\ \text{dB}$$

Where: p is the rms value of sound power in pascals; and
P_0 is 1 pW.

sound pressure level The sound pressure level at a point is defined as:

$$Lp = 20Log\frac{P}{P_0}\ \text{dB}$$

specific noise level A component of the ambient noise which can be specifically identified by acoustical means and may be associated with a specific source. In BS 4142, there is a more precise definition as follows: 'the equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval ($L_{Aeq,T}$)'.

tonal Sounds which cover a range of only a few Hz which contains a clearly audible tone i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'.

$^1/_3$ octave analysis Frequency analysis of sound such that the frequency spectrum is subdivided into bands of one–third of an octave each.

Appendix 9.2 Noise monitoring details (AWN Consulting Ltd.)

A series of environmental noise surveys were conducted in order to quantify the existing noise environment. The survey was conducted in accordance with *ISO/DIS 1996-2 Acoustics - Description, measurement and assessment of environmental noise -- Part 2: Determination of sound pressure levels (2015)*. Specific details are set out below.

Choice of noise monitoring locations

Noise measurements were conducted at three positions on the site boundary that are reflective of noise levels at the nearest noise sensitive locations and the common boundary with the Cuisine de France facility to the west. Details for the particular locations are outlined below:

Location S01 Located in the north western corner of the site in line with the common boundary of the nearest noise sensitive locations at the junction of the R102 and the Grand Canal.

Location S02 Located on the south western corner of the site along with the common boundary of a nearby noise sensitive location. The location is representative of the row of noise sensitive locations that along the R102 beyond the western boundary of the proposed development.

Location S03 Located in the vicinity of the nearest residential location to the north east of the proposed development site. The property is located on the boundary of the Grangecastle Business Park and is immediately adjacent a number of commercial activities.

Location S04 Located in the north eastern concern of the development lands. This location is considered to be representative of noise levels currently experienced in the vicinity of the residential properties on the Royal Canal to the north.

Location S05 Located in the south western concern of the development lands. The location is considered to be representative of noise levels currently experienced in the vicinity of the halting site located to the south west at some 200 m distance.

Figure A Noise monitoring locations (Source: Bing Maps)

Survey periods
Measurements were conducted over the course of the following survey periods:

Table A Noise monitoring periods

Locations	Period	Start Time/Date	End Time/Date
S01, S02, S03	Day	09:50hrs 9 April 2016	12:40hrs 9 April 2016
	Evening	21:40hrs 9 April 2016	22:50hrs 9 April 2016
	Night	23:00hrs 9 April 2016	01:40hrs 10 April 2016
S04, S05	Unattended	15:00hrs 4 November 2020	11:45hrs 10 November 2020

Personnel & Instrumentation
Leo Williams (AWN) conducted the noise level measurements during the various survey periods. The measurements were performed using Brüel & Kjær Type 2260 Modular Precision Sound Analysers. Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator. Donogh Casey installed and removed the noise meters on site in the 2020 unattended survey.

Table B Instrumentation details

Meter	Serial Number
Brüel & Kjær 2260	2248262
Rion NL-42	575802
Rion NL-52	186670

Procedure
During each of the daytime, evening and night-time periods, measurements were conducted on a continuous basis over the stated time periods. Sample periods were 15 minutes during all surveys. The results were saved to the instrument memory for later analysis where appropriate. Survey personnel noted all primary noise sources contributing to noise build-up. In terms of the various locations the following significant noise sources (in subjective order of influence) were noted:

Table C Significant noise sources

Location	
S01	S02
• R120 road traffic noise. • Water running in a nearby canal in absence of traffic. • Site work and plant noise associated with existing sites. • During evening period noise dominated by traffic and water noise associated with the canal. • During night time plant noise from existing facilities (to the East and South) is the dominant background source.	• Plant noise from facility to the south. • Noise from existing site including impulsive noise (bangs) and reverse alarms. • Dogs barking and birdsong. • During the evening distant traffic noise and plant noise noted. • During night time existing plant noise from southern existing facilities is the dominant source. Distant traffic also noted.
Location	
S03	S04
• Noise dominated by existing plant noise from adjacent facility. • Occasional bus passing by. • Water flow from nearby watercourse. • Reverse alarms and construction noise from nearby site. • As above for evening period with the exception of construction noise. • During night time plant noise from the adjacent facility and water flow from nearby watercourse.	• R120 road traffic noise. • Water flow from nearby watercourse. • During night time plant noise from the adjacent facility and water flow from nearby watercourse noted.
Location	
S05	
• R120 road traffic noise. • Water flow from nearby watercourse. • During night time plant noise from the adjacent facility and water flow from nearby watercourse noted.	

Noise Monitoring Results

The noise data collated during the current noise survey is extensive in nature. It is not produced in full here however is available on request.

Table D presents average daytime and night time noise levels measured at the monitoring location over the period of the noise monitoring programme.

Table D Noise monitoring results

Location	Date	Period	Start Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
				$L_{Aeq,15min}$	L_{AFMax}	$L_{A90,15min}$
S01	9 April	Day	09:51	58	71	44
	9 April	Day	11:15	61	76	47
	9 April	Evening	21:46	53	63	45
	10 April	Night	00:01	48	61	42
	10 April	Night	00:58	49	67	43
S02	9 April	Day	10:23	48	65	42
	9 April	Day	11:37	48	73	41
	9 April	Day	12:47	49	65	43
	9 April	Evening	22:04	44	61	41
	9 April	Night	23:38	41	63	39
	10 April	Night	01:20	40	61	38
S03	9 April	Day	10:50	53	76	47
	9 April	Day	12:05	53	73	48
	9 April	Day	12:21	52	72	48
	9 April	Evening	22:35	51	68	49
	9 April	Night	23:00	51	70	48
	9 April	Night	23:16	49	54	48

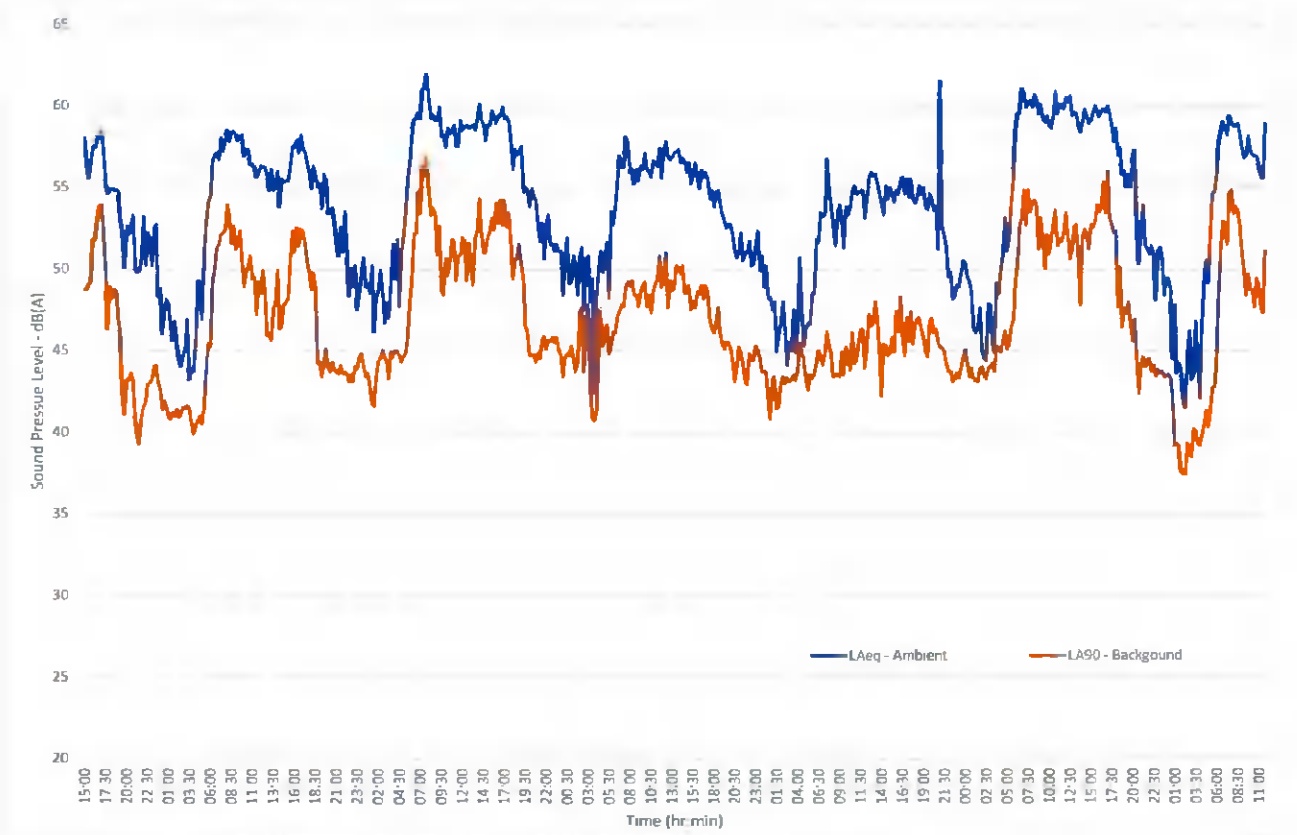

Figure B Unattended Noise Monitoring – Location S04

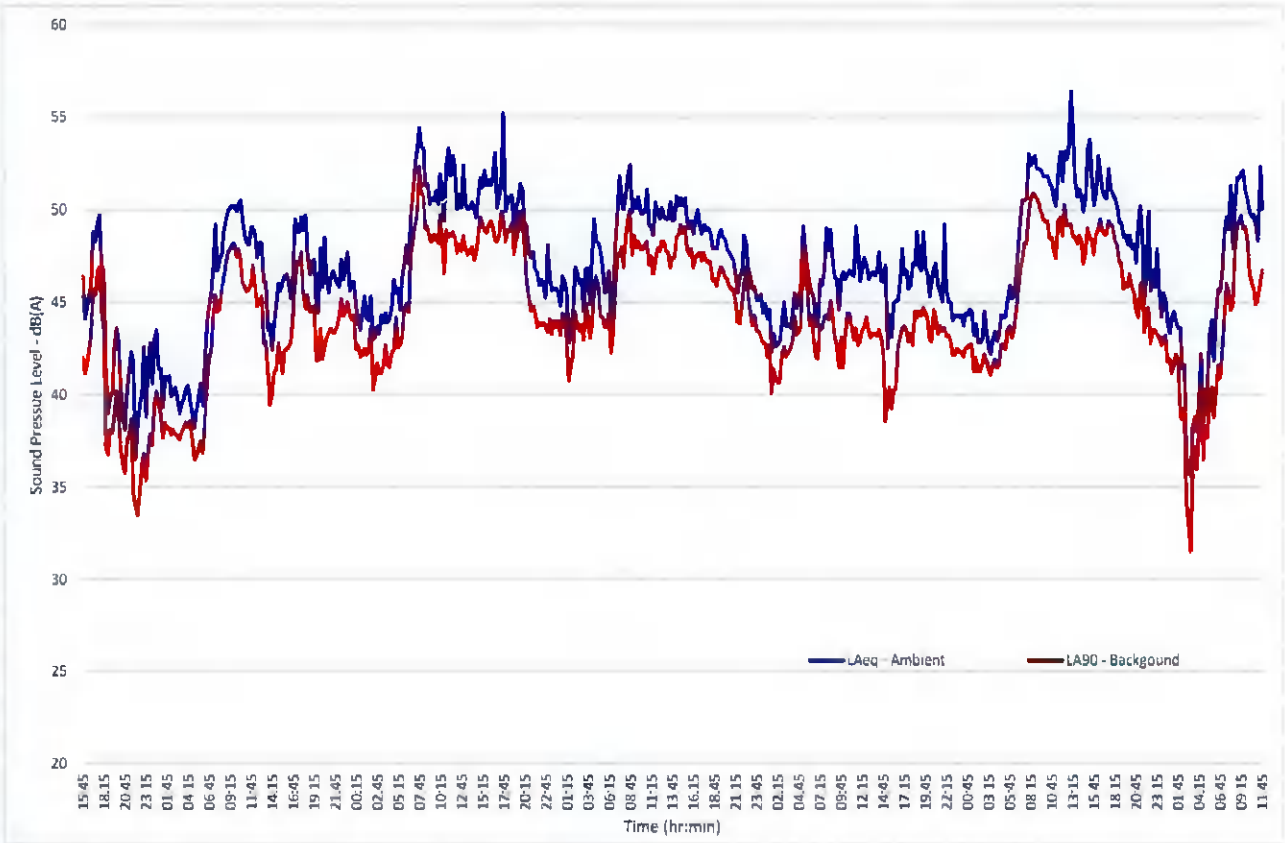

Figure C Unattended Noise Monitoring – Location S05

Appendix 9.3 Indicative construction noise & vibration management plan

This Noise and Vibration Management Plan (NVMP) details a *'Best Practice'* approach to dealing with potential noise and vibration emissions during the construction phase of the development. The Plan should be adopted by all contractors and sub-contractors involved in construction activities on the site. The Site Manager should ensure that adequate instruction is provided to contractors regarding the noise and vibration control measures contained within this document.

The environmental impact assessment report conducted for the construction activity has highlighted that the construction noise and vibration levels can be controlled to within the adopted criteria. However, mitigation measures should be implemented, where necessary, in order to control impacts to nearby sensitive areas within acceptable levels.

Nearby sensitive properties in the vicinity of the proposed development are summarised in Figure A overleaf:

Figure A Sensitive receptors

Construction Noise Criteria

As referenced in the EIS prepared for the site, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the National Roads Authority (NRA) publication *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*[1] which indicates the following criteria and hours of operation.

Table A Construction noise limit values

Days and Times	Noise Levels (dB re. 2x10-5 Pa)	
	$L_{Aeq(1hr)}$	L_{Amax}
Monday to Friday 07:00hrs to 19:00hrs	70	80
Monday to Friday 19:00 to 22:00hrs	60*	65*
Saturdays 08:00hrs to 14:00hrs	65	75

Note * Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority.

[1] *Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1, 25 October 2004* , National Roads Authority.

Construction Vibration Criteria

It is recommended in the EIS that vibration from construction activities to off-site residences be limited to the values set out in Table B. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage these limits may need to be reduced by up to 50%.

Table B Construction vibration limit values

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10 Hz	10 to 50 Hz	50 to 100 Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

Hours of Work

The proposed general construction hours are 07:00 to 19:00hrs, Monday to Friday and 08:00 to 13:00 on Saturdays. However, there are also weekday evening works proposed (19:00 to 23:00hrs).

Weekday evening activities should be significantly reduced and generally only involve internal activities and concrete pouring which will be required during certain phases of the development. As a result, noise emissions from evening activities are expected to be significantly lower than for other general daytime activities.

Best Practice Guidelines for the Control of Noise & Vibration

BS5228 includes guidance on several aspects of construction site mitigation measures, including, but not limited to:

- selection of quiet plant;
- control of noise sources;
- screening;
- hours of work;
- liaison with the public, and;
- monitoring.

Detailed comment is offered on these items in the following paragraphs. Noise and vibration control measures that will be considered include the selection of suitable plant, enclosures and screens around noise sources, limiting the hours of work and monitoring.

Selection of Quiet Plant

This practice is recommended in relation to sites with static plant such as compressors and generators. It is recommended that these units be supplied with manufacturers' proprietary acoustic enclosures where possible. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected wherever possible. Should a particular item of plant already on the site be found to generate high noise levels, the first action should be to identify whether or not said item can be replaced with a quieter alternative.

General Comments on Noise Control at Source

If replacing a noisy item of plant is not a viable or practical option, consideration should be given to noise control "at source". This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier. For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

BS5228 states that *"as far as reasonably practicable sources of significant noise should be enclosed"*. In applying this guidance, constraints such as mobility, ventilation, access and safety must be taken into account. Items suitable for enclosure include pumps and generators. Demountable enclosures will also be used to screen operatives using hand tools and will be moved around site as necessary.

In practice, a balance may need to be struck between the use of all available techniques and the resulting costs of doing so. As with Ireland's Environmental Protection Act legislation, we propose that the concept of

"best available techniques not entailing excessive cost" (BATNEEC) be adopted. Furthermore, proposed noise control techniques should be evaluated in light of their potential effect on occupational safety etc. BS5228 makes a number of recommendations in relation to "use and siting of equipment". These are all directly relevant and hence are reproduced in full. These recommendations will be adopted on site.

"Plant should always be used in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading should also be carried out away from such areas. Special care will be necessary when work has to be carried out at night.

Circumstances can arise when night-time working is unavoidable. Bearing in mind the special constraints under which such work has to be carried out, steps should be taken to minimise disturbance to occupants of nearby premises.

Machines such as cranes that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum. Machines should not be left running unnecessarily, as this can be noisy and waste energy.

Plant known to emit noise strongly in one direction should, when possible, be orientated so that the noise is directed away from noise-sensitive areas. Attendant operators of the plant can also benefit from this acoustical phenomenon by sheltering, when possible, in the area with reduced noise levels.

Acoustic covers to engines should be kept closed when the engines are in use and idling. The use of compressors that have effective acoustic enclosures and are designed to operate when their access panels are closed is recommended.

Materials should be lowered whenever practicable and should not be dropped. The surfaces on to which the materials are being moved could be covered by resilient material."

All items of plant should be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

Screening

Typically screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to all other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen and its position relative to both the source and receiver.

The length of the screen should in practice be at least five times the height, however, if shorter sections are necessary then the ends of the screen should be bent around the source. The height of any screen should be such that there is no direct line of sight between the source and the receiver.

BS5228 states that on level sites the screen should be placed as close as possible to either the source or the receiver. The construction of the barrier should be such that there are no gaps or openings at joints in the screen material. In most practical situations the effectiveness of the screen is limited by the sound transmission over the top of the barrier rather than the transmission through the barrier itself. In practice screens constructed of materials with a mass per unit of surface area greater than 7 kg/m^2 will give adequate sound insulation performance.

In addition, careful planning of the site layout should also be considered. The placement of site buildings such as offices and stores and in some instances materials such as topsoil or aggregate can provide a degree of noise screening if placed between the source and the receiver.

Vibration

The vibration from construction activities will be limited to the values set out in Table 2. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage, these limits may need to be reduced by up to 50%.

Liaison with the Public

The Contractor will provide proactive community relations and will notify the public and sensitive premises before the commencement of any works forecast to generate appreciable levels of noise or vibration, explaining the nature and duration of the works. The Contractor will distribute information circulars informing people of the progress of works and any likely periods of significant noise and vibration.

A designated noise liaison should be appointed to site during construction works. Any complaints should be logged and followed up in a prompt fashion. In addition, prior to particularly noisy construction activity, e.g. rock breaking, piling, etc., the site contact should inform the nearest noise sensitive locations of the time and expected duration of the works.

Noise Monitoring

During the construction phase consideration should be given to noise monitoring at the nearest sensitive locations.

Noise monitoring should be conducted in accordance with the International Standard ISO 1996: 2007: *Acoustics – Description, measurement and assessment of environmental noise* and be located a distance of greater than 3.5m away from any reflective surfaces, e.g. walls, in order to ensure a free-field measurement without any influence from reflected noise sources.

Vibration Monitoring

During the construction phase consideration should be given to vibration monitoring at the nearest sensitive locations.

Vibration monitoring should be conducted in accordance with BS7385-1 (1990) *Evaluation and measurement for vibration in buildings — Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings* or BS6841 (1987) *Guide to measurement and evaluation of human exposure to whole-body mechanical vibration and repeated shock.*

The mounting of the transducer to the vibrating structure should comply with BS ISO 5348:1998 *Mechanical vibration and shock – Mechanical mounting of accelerometers.* In summary, the following ideal mounting conditions apply:

- the transducer and its mountings are as rigid as possible;
- the mounting surfaces should be as clean and flat as possible;
- simple symmetric mountings are best, and;
- the mass of the mounting should be small in comparison to that of the structure under test.

In general the transducer will be fixed to the floor of a building or concrete base on the ground using expansion bolts. In instances where the vibration monitor will be placed outside of a building a flat and level concrete base with dimensions of approximately 1m x 1m x 0.1m will be required.

Appendix 9.4 Noise modelling details

Noise model

A 3D computer-based prediction model has been prepared in order to quantify the noise level associated with the operation of the proposed building. This section discusses the methodology behind the noise modelling process.

Brüel & Kjær Type 7810 Predictor

Proprietary noise calculation software has been used for the purposes of this modelling exercise. The selected software, DGMR iNoise, calculates noise levels in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996.*

DGMR iNoise is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. Predictor calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

Brief description of ISO9613-2: 1996

ISO9613-2:1996 calculates the noise level based on each of the factors discussed previously. However, the effect of meteorological conditions is significantly simplified by calculating the average downwind sound pressure level, $L_{AT}(DW)$, for the following conditions:

- wind direction at an angle of ±45° to the direction connecting the centre of the dominant sound source and the centre of the specified receiver region with the wind blowing from source to receiver, and;
- wind speed between approximately 1 ms^{-1} and 5 ms^{-1}, measured at a height of 3 m to 11 m above the ground.

The equations and calculations also hold for average propagation under a well-developed moderate ground based temperature inversion, such as commonly occurs on clear calm nights.

The basic formula for calculating $L_{AT}(DW)$ from any point source at any receiver location is given by:

$$L_{fT}(DW) = L_W + D_C - A \qquad \textbf{Eqn. A}$$

Where:

$L_{fT}(DW)$ is an octave band centre frequency component of $L_{AT}(DW)$ in dB relative to $2x10^{-5}$Pa:
L_W is the octave band sound power of the point source;
D_C is the directivity correction for the point source;
A is the octave band attenuation that occurs during propagation, namely attenuation due to geometric divergence, atmospheric absorption, ground effect, barriers and miscellaneous other effects.

The estimated accuracy associated with this methodology is shown in Table A below:

Table A Estimated accuracy for broadband noise of $L_{AT}(DW)$

Height, h*	Distance, d†	
	0 < d < 100 m	100 m < d < 1,000 m
0<h<5m	±3dB	±3dB
5m<h<30m	±1dB	±3dB

* h is the mean height of the source and receiver. † d is the mean distance between the source and receiver.
N.B. These estimates have been made from situations where there are no effects due to reflections or attenuation due to screening.

Input data and assumptions

The noise model has been constructed using data from various source as follows:

Site Layout The general site layout has been obtained from the drawings forwarded by Henry J Lyons Architects.

Local Area The location of noise sensitive locations has been obtained from a combination of site drawings provided by Henry J Lyons Architects and others obtained from Ordinance Survey Ireland (OSI).

Heights The heights of buildings on site have been obtained from site drawings forwarded by Henry J Lyons Architects. Off-site buildings have been assumed to be 6m high with the exception of industrial buildings where a default height of 15 m has been assumed.

Contours Site ground contours/heights have been obtained from site drawings forwarded by Henry J Lyons Architects where available.

The final critical aspect of the noise model development is the inclusion of the various plant noise sources. Details are presented in the following section.

Source sound power data

BCEI Engineering has provided noise emission data for the significant external mechanical plant and emergency generators. The information provided is review in Table B below.

Table B Source noise data assumed for assessment (DUB05)

Item	Sound Power Levels dB								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Condenser Left Side	86	83	74	70	64	62	61	55	73
Condenser Right Side	86	83	74	70	64	62	61	55	73
Condenser Front (Evaporator)	84	81	72	68	62	60	59	53	71
Condenser Rear (Condenser)	86	83	74	70	65	62	61	55	73
Condenser Top	90	87	78	74	69	66	65	59	77
Gen. Front Note B	100.8	108.7	92.4	90.2	78.9	73	73.7	67.8	64
Gen. Rear Note B	99	107	90.7	88.5	77.2	71.3	72	66.1	62.3
Gen. Sides Note B	102.5	105.3	89	86.8	75.5	69.6	70.3	64.4	60.6
Gen. Exhaust Note B	86	103	86.7	84.5	73.2	67.3	68	62.1	58.3
Transformer Note C	72	40	70	63	66	50	39	36	36

Note A Maximum permissible Sound Power Level Per unit.
Note B Dub 05 generators are assumed to be attenuated to achieve max. 75dB(A) at 1m.
Note C Transformer noise level advised by Ethos Engineering and typical transformer spectrum from AWN database has been assumed for assessment purposes.

It has been advised that significant noise emissions are not associated with the proposed substations related to the development.

Figure A presents a 3D render of the developed site noise model.

Figure A Images of Developed Noise Model – View of Site

Note in relation to the emergency diesel generators screening to these elements of plant are to be formed from an acoustic louvre which offers the following sound insertion loss. The height of the screen is at least 0.5m above the top of the generator installations.

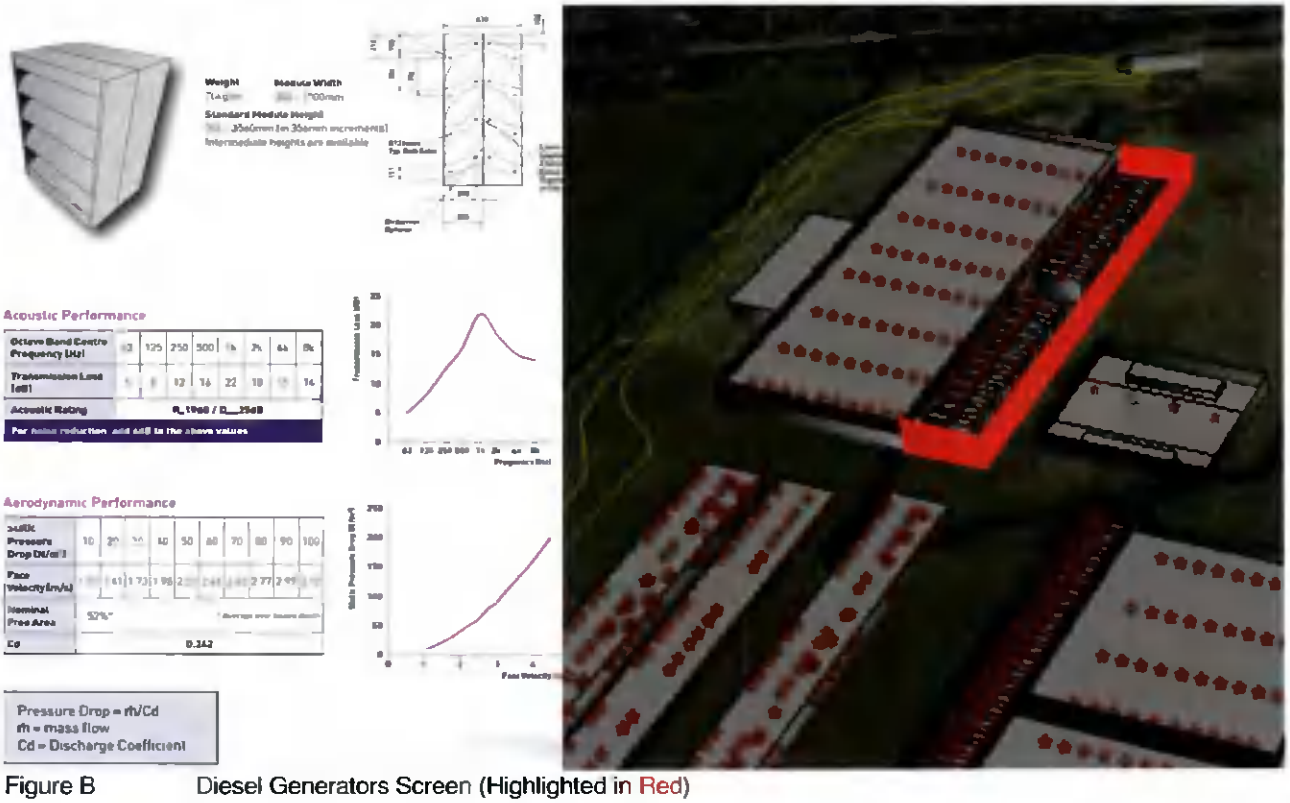

Figure B Diesel Generators Screen (Highlighted in Red)

In terms of the gas generator buildings that are proposed the following assumptions have been made:

A 75dB(A) at 1m containerised gas generator unit is proposed. We have assumed the following sound power level associated with an individual unit.

Table C Sound Power Levels assumed for DUB05 Internal Gas Generator Units

Item	Sound Power Levels dB								dB(A)
	63	125	250	500	1000	2000	4000	8000	
75dB(A) at 1m Gen Set	108	105	98	94	90	86	81	79	97

Based on the generator hall volumes obtained from drawings, considering the number of units in a typical hall, assuming a reverberation time of ≤1.5s in the spaces the predicted reverberant noise levels within the buildings has been calculated and assumed not to exceed the following:

Table D Reverberant Sound Pressure Levels assumed for DUB05 Generator Halls

Item	Sound Pressure Levels dB								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Sound Pressure Level in Hall	101	98	91	86	82	79	73	71	89

It has been advised that intake and exhaust louvres to the building will be some 3.5m wide and 5m high (i.e. some 15m^2).

The following insertion loss has been assumed for acoustic attenuation applied to these louvered sections:

Table E Sound Insulation Performance Requirements Walls, SRI (dB) – Louvres

Source	L_w - Octave Band Centre Frequency							
	63	125	250	500	1k	2k	4k	8k
Intake / Exhaust per Louvre	8	11	21	30	28	25	15	10

Based on this knowledge and the extent of the buildings shown on masterplan drawings developed to date the following maximum sound power levels for the louvres opens have been estimated:

Table F Assumed Louvre Sound Power Level – Reverse Engineered

Source	L_w - Octave Band Centre Frequency								dB (A)
	63	125	250	500	1k	2k	4k	8k	
Intake / Exhaust per Louvre	71	76	66	58	59	60	64	65	78

The above noise level equates to a level of some **50dB(A) at a distance of 10m**.

We have assumed that walls and roof of the generator rooms offer the following minimum sound insulation performance:

Table G Sound Insulation Performance Requirements Walls, SRI (dB) – Walls

Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
38	43	45	55	60	70	70	70

A typical construction that can achieve this performance is a 200mm RC wall with insulated cladding or 2 layers of 100mm dense concrete blocks with a 50mm cavity between them.

Table H Sound Insulation Performance Requirements Walls, SRI (dB) – Roof

Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
41	39	43	51	57	62	62	67

A typical roof construction capable of achieve this performance is a 250mm thick hollowcore concrete plank.

In terms of the walls and roof of the generator halls is assumed detailed design will result in sound power levels per m^2 of the element as detailed in Table I.

Table I Assumed Louvre Sound Power Level – Walls & Roof per m^2

Source	L_w - Octave Band Centre Frequency								dB (A)
	63	125	250	500	1k	2k	4k	8k	
Wall / Roof per m^2	50	50	50	40	30	20	20	20	45

A radiator is located 1.5m above the roof of the building with the following noise rating associated with it as extracted from the supplied data sheet[2]:

Table J Assumed Radiator L_{WA} Level – Gas Generation (Cummings Data)

Source	L_{WA} - Octave Band Centre Frequency								dB (A)
	63	125	250	500	1k	2k	4k	8k	
Radiators	62	69	72	78	80	76	70	61	83

It is advised generator exhaust stacks will need to be attenuated to achieve a sound pressure level of no more than 65 dB(A) at 1 m. Based on this we have assumed a sound power level of some 76 dB(A) in relation to these sources. Solid screens to the radiator units are assumed. These screens will be are assumed to be at least 1m above the top of the radiator plant. Figure 2 illustrates the principle and location of the screening assumed here.

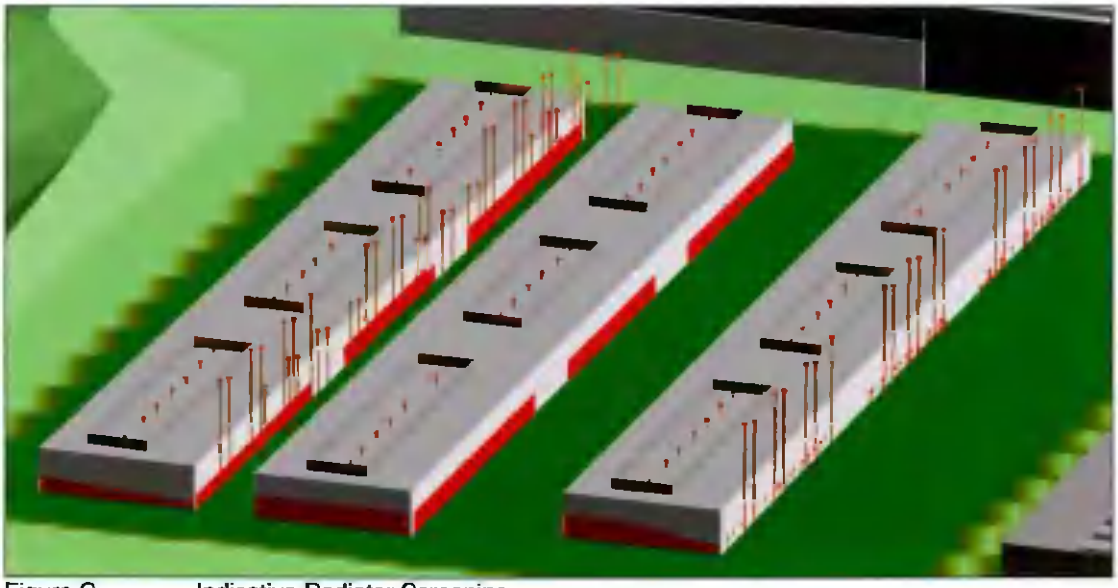

Figure C Indicative Radiator Screening

Note that as part of detailed design the above assumptions will be given due consideration and any alternate proposals would be designed such that the relevant noise conditions are satisfied.

Modelling calculation parameters

Prediction calculations for plant noise have been conducted in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996.* Ground attenuation factors of 0.8 have been assumed. No metrological corrections were assumed for the calculations. The atmospheric attenuation outlined in Table K has been assumed for all calculations.

Table K Atmospheric attenuation assumed for noise calculations (dB per km)

Temp (ºC)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

[2] Radiator Technical Information – Finning/CAT – 25ºC ambient level

Appendix 9.5 – Modelling calculation parameters

Prediction calculations for noise emissions have been conducted in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996.* The following are the main aspects that have been considered in terms of the noise predictions presented in this instance.

Directivity Factor: The directivity factor (D) allows for an adjustment to be made where the sound radiated in the direction of interest is higher than that for which the sound power level is specified. In this case the sound power level is measures in a down wind direction, corresponding to the worst case propagation conditions and needs no further adjustment.

Ground Effect: Ground effect is the result of sound reflected by the ground interfering with the sound propagating directly from source to receiver. The prediction of ground effects is inherently complex and depend on source height receiver height propagation height between the source and receiver and the ground conditions. The ground conditions are described according to a variable defined as G, which varies between 0.0 for hard ground (including paving, ice concrete) and 1.0 for soft ground (includes ground covered by grass trees or other vegetation) Our predictions have been carried out using various source height specific to each plant item, a receiver heights of 1.6m for single storey properties and 4m for double. An assumed ground factor of G = 0.8 has been applied off site. Noise contours presented in the assessment have been predicted to a height of 4m in all instances.

Geometrical Divergence This term relates to the spherical spreading in the free-field from a point sound source resulting in attenuation depending on distance according to the following equation:

$$A_{geo} = 20 \times \log(\text{distance from source in meters}) + 11$$

Atmospheric Absorption Sound propagation through the atmosphere is attenuated by the conversion of the sound energy into heat. This attenuation is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies. In these predictions a temperature of 10°C and a relative humidity of 70% have been used, which give relativity low levels of atmosphere attenuation and corresponding worst case noise predictions.

Table A Atmospheric Attenuation Assumed for Noise Calculations (dB per km)

Temp (°C)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

Barrier Attenuation The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise.

CHAPTER 10 – AIR QUALITY AND CLIMATE

Appendix 10.1 Description of the AERMOD model

The AERMOD dispersion model has been developed in part by the U.S. Environmental Protection Agency (USEPA, 2004a). The model is a steady-state Gaussian model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement on the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources.

Improvements over the ISCST3 model include the treatment of the vertical distribution of concentration within the plume. ISCST3 assumes a Gaussian distribution in both the horizontal and vertical direction under all weather conditions. AERMOD with PRIME, however, treats the vertical distribution as non-Gaussian under convective (unstable) conditions while maintaining a Gaussian distribution in both the horizontal and vertical direction during stable conditions. This treatment reflects the fact that the plume is skewed upwards under convective conditions due to the greater intensity of turbulence above the plume than below. The result is a more accurate portrayal of actual conditions using the AERMOD model. AERMOD also enhances the turbulence of night-time urban boundary layers thus simulating the influence of the urban heat island.

In contrast to ISCST3, AERMOD is widely applicable in all types of terrain. Differentiation of the simple versus complex terrain is unnecessary with AERMOD. In complex terrain, AERMOD employs the dividing-streamline concept in a simplified simulation of the effects of plume-terrain interactions. In the dividing-streamline concept, flow below this height remains horizontal, and flow above this height tends to rise up and over terrain. Extensive validation studies have found that AERMOD (precursor to AERMOD with PRIME) performs better than ISCST3 for many applications and as well or better than CTDMPLUS for several complex terrain data sets (USEPA, 1999).

Due to the proximity to surrounding buildings, the PRIME (Plume Rise Model Enhancements) building downwash algorithm has been incorporated into the model to determine the influence (wake effects) of these buildings on dispersion in each direction considered. The PRIME algorithm takes into account the position of the stack relative to the building in calculating building downwash. In the absence of the building, the plume from the stack will rise due to momentum and/or buoyancy forces. Wind streamlines act on the plume leads to the bending over of the plume as it disperses. However, due to the presence of the building, wind streamlines are disrupted leading to a lowering of the plume centreline.

When there are multiple buildings, the building tier leading to the largest cavity height is used to determine building downwash. The cavity height calculation is an empirical formula based on building height, the length scale (which is a factor of building height & width) and the cavity length (which is based on building width, length and height). As the direction of the wind will lead to the identification of differing dominant tiers, calculations are carried out in intervals of 10 degrees.

In PRIME, the nature of the wind streamline disruption as it passes over the dominant building tier is a function of the exact dimensions of the building and the angle at which the wind approaches the building. Once the streamline encounters the zone of influence of the building, two forces act on the plume. Firstly, the disruption caused by the building leads to increased turbulence and enhances horizontal and vertical dispersion. Secondly, the streamline descends in the lee of the building due to the reduced pressure and drags the plume (or part of) nearer to the ground, leading to higher ground level concentrations. The model calculates the descent of the plume as a function of the building shape and, using a numerical plume rise model, calculates the change in the plume centreline location with distance downwind.

The immediate zone in the lee of the building is termed the cavity or near wake and is characterised by high intensity turbulence and an area of uniform low pressure. Plume mass captured by the cavity region is re-emitted to the far wake as a ground-level volume source. The volume source is located at the base of the lee wall of the building, but is only evaluated near the end of the near wake and beyond. In this region, the disruption caused by the building downwash gradually fades with distance to ambient values downwind of the building.

AERMOD has made substantial improvements in the area of plume growth rates in comparison to ISCST3 (USEPA, 2004a, 2009). ISCST3 approximates turbulence using six Pasquill-Gifford-Turner Stability Classes and bases the resulting dispersion curves upon surface release experiments. This treatment, however, cannot explicitly account for turbulence in the formulation. AERMOD is based on the more realistic modern planetary boundary layer (PBL) theory which allows turbulence to vary with height. This use of turbulence-based plume growth with height leads to a substantial advancement over the ISCST3 treatment.

Improvements have also been made in relation to mixing height (USEPA, 2004a, 2009). The treatment of mixing height by ISCST3 is based on a single morning upper air sounding each day. AERMOD, however, calculates mixing height on an hourly basis based on the morning upper air sounding and the surface energy balance, accounting for the solar radiation, cloud cover, reflectivity of the ground and the latent heat due to evaporation from the ground cover. This more advanced formulation provides a more realistic sequence of the diurnal mixing height changes.

AERMOD also has the capability of modelling both unstable (convective) conditions and stable (inversion) conditions. The stability of the atmosphere is defined by the sign of the sensible heat flux. Where the sensible heat flux is positive, the atmosphere is unstable whereas when the sensible heat flux is negative the atmosphere is defined as stable. The sensible heat flux is dependent on the net radiation and the available surface moisture (Bowen Ratio). Under stable (inversion) conditions, AERMOD has specific algorithms to account for plume rise under stable conditions, mechanical mixing heights under stable conditions and vertical and lateral dispersion in the stable boundary layer.

AERMOD also contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed may be less than 1 m/s, but still greater than the instrument threshold.

Appendix 10.2 Description of AERMET

AERMOD incorporates a meteorological pre-processor AERMET PRO (USEPA 2004b). AERMET PRO allows AERMOD to account for changes in the plume behaviour with height. AERMET PRO calculates hourly boundary layer parameters for use by AERMOD, including friction velocity, Monin-Obukhov length, convective velocity scale, convective (CBL) and stable boundary layer (SBL) height and surface heat flux. AERMOD uses this information to calculate concentrations in a manner that accounts for changes in dispersion rate with height, allows for a non-Gaussian plume in convective conditions, and accounts for a dispersion rate that is a continuous function of meteorology.

The AERMET PRO meteorological pre-processor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. A morning sounding from a representative upper air station, latitude, longitude, time zone, and wind speed threshold are also required.

Two files are produced by AERMET PRO for input to the AERMOD dispersion model. The surface file contains observed and calculated surface variables, one record per hour. The profile file contains the observations made at each level of a meteorological tower, if available, or the one-level observations taken from other representative data, one record level per hour.

From the surface characteristics (i.e. surface roughness, albedo and amount of moisture available (Bowen Ratio)) AERMET PRO calculates several boundary layer parameters that are important in the evolution of the boundary layer, which, in turn, influences the dispersion of pollutants. These parameters include the surface friction velocity, which is a measure of the vertical transport of horizontal momentum; the sensible heat flux, which is the vertical transport of heat to/from the surface; the Monin-Obukhov length which is a stability parameter relating the surface friction velocity to the sensible heat flux; the daytime mixed layer height; the nocturnal surface layer height and the convective velocity scale which combines the daytime mixed layer height and the sensible heat flux. These parameters all depend on the underlying surface.

The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, water, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the location of the meteorological station in line with USEPA recommendations (USEPA 2005) for albedo and Bowen ratio with a 1km geometric determination undertaken for the surface roughness. In relation to wind direction, a minimum sector arc of 30 degrees is recommended.

Surface roughness

Surface roughness length is the height above the ground at which the wind speed goes to zero. Surface roughness length is defined by the individual elements on the landscape such as trees and buildings. In order to determine surface roughness length, the USEPA recommends that a representative length be defined for each sector, based on geometric mean of the inverse distance area-weighted land use within the sector. by using the eight land use categories outlined by the USEPA. The area-weighted surface roughness length derived from the land use classification within a radius of 1km from Casement Aerodrome is shown in Table A.10.1.

Table A.10.1 Surface Roughness based on an inverse distance area-weighted average of the land use within a 1km radius of Casement Aerodrome.

Sector	Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter[Note 1]
0-360	100% Grassland	0.050	0.100	0.010	0.010

Note 1: Winter defined as periods when surfaces covered permanently by snow whereas autumn is defined as periods when freezing conditions are common, deciduous trees are leafless and no snow is present (Iqbal (1983)). Thus for the current location autumn more accurately defines "winter" conditions at the proposed facility.

Albedo

Noon-time Albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Albedo is used in calculating the hourly net heat balance at the surface for calculating hourly values of Monin-Obuklov length. The area-weighted arithmetic mean albedo derived from the land use classification over a 10km x 10km area centred on Casement Aerodrome is shown in Table A.10.2.