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INTRODUCTION

Background

7.1 This Chapter of the Environmental Impact Assessment (EIA) Report addresses the potential impacts on surface water and groundwater of soil and stone waste recovery activities on the western side of Huntstown South Quarry. These activities will facilitate backfilling of the South Quarry and its ultimate long-term restoration to grassland.

7.2 In order to facilitate the transfer and re-location of soil waste recovery activities from the North Quarry (where they are currently ongoing) to the South Quarry, a waste licence review application is to be submitted to the EPA to provide for the following:

- importation of soil and stone waste to the western side of Huntstown South Quarry at a maximum rate of 750,000 tonnes per annum (as permitted by Planning Ref. FW12A/0012);
- extension of the licensed site boundary to incorporate the proposed waste recovery area on the western side of the South Quarry and the haul roads leading to / from it;
- an increase in the total permitted (lifetime) soil and stone waste intake to the (extended) waste facility to 18.76 million tonnes;
- continued use of pre-existing site infrastructure to support recovery activities; and
- re-routing of traffic flows via existing internal haul roads (i.e. within the quarry complex) to access the backfilling / recovery area at the South Quarry.

7.3 No new infrastructure is required to facilitate transfer and re-location of established soil waste recovery operations from Huntstown North Quarry across to the western side of the South Quarry and the extension of the waste licence boundary to include this area.

7.4 It is currently envisaged that backfilling of the South Quarry will commence in early 2023, at which time it is expected that the ongoing backfilling of the North Quarry to surrounding ground level will be largely complete and the importation, backfilling and recovery of soil and stone waste at that location will cease.

7.5 Further details of planned backfilling and soil recovery activities at the South Quarry (site infrastructure, operations, environmental management systems, and controls, etc.) are provided in Chapter 2 of this EIAR. Details of the proposed site layout, configuration of site infrastructure and internal haul routes are shown in Figure 2-2.

7.6 Details of the overall restoration scheme for Huntstown, previously approved under the 2014 quarry permission, are provided in Figure 2-3. Proposed final, restoration contours at the South Quarry are shown separately in Figure 2-4 and cross-sections through the backfilled quarry are provided in Figure 2-5.

7.7 For the purposes of this EIAR Chapter, the study area comprises the proposed waste licence extension area and the surrounding local area extending up to a 5km radius around it. Unmitigated potential impacts on hydrology and hydrogeology are considered for the initial impact assessment, before appropriate mitigation measures for the potential impacts identified are discussed, and the identified potential impacts reassessed, assuming the identified mitigation measures in place.

Scope of Work

7.8 This Chapter describes the local hydrological and hydrogeological environment at and around the Huntstown Quarry Complex based on available information from the area.

7.9 The assessment presented herein considers the existing water management at Huntstown South

Quarry and the potential impact of the soil waste intake, backfilling and recovery activities on the local water environment.

7.10 The scope of this Chapter includes:

- an assessment of the existing surface water and groundwater conditions associated with the South Quarry;
- an assessment of the potential impact of soil waste intake, backfilling and recovery activities at the South Quarry on surface water and groundwater; and
- a recommendation of remedial measures to reduce or eliminate any significant potential impacts (where necessary).

Consultations / Consultees

7.11 Following a review of the proposed activities, existing consents and site mapping / surveys, it was considered that there was no requirement for any formal external consultations to be carried out in respect of surface water or groundwater impacts for the purposes of this assessment. There was, however, significant consultation with other specialist EIA contributors.

Contributors / Author(s)

7.12 This EIAR Chapter was prepared by SLR Consulting Ireland. The project team consists of:

- Dominica Baird, Principal Hydrogeologist, BSc., MSc. (Hydrogeology), CGeol, EurGeol; and
- Dr Peter Glanville, Principal Hydrologist, PGeo, EurGeol.

Limitations / Difficulties Encountered

7.13 The assessment of the hydrological and hydrogeological environment presented herein is based on visual observations from site visits, available monitoring records, published information and discussions with personnel employed on site. It should be viewed as a largely qualitative assessment. No limitations or difficulties were encountered in the preparation of this Chapter of the EIAR.

REGULATORY BACKGROUND

Legislation

7.14 The key European Directives / European Union Legislation which apply to this Chapter of the EIAR and the hydrology and hydrogeology assessment presented herein are:

- Environmental Impact Assessment Directive (2011/92/EU); and
- Directive of the European Parliament and of the Council amending Directive 2011/92/EU on assessment of effects of certain public and private projects on the environment (2014/52/EU).

7.15 Other European Directives to which this EIAR makes reference, or has had regard, are listed in Appendix 7-A.

7.16 Irish Government Acts, National Legislation and Regulations which apply to this Chapter of the EIAR and the hydrology and hydrogeology assessment presented herein are also listed in Appendix 7-A.

7.17 Most notably, under Regulation 4 of the Groundwater Regulations 2010, a duty is placed on public authorities to promote compliance with the requirements of the regulations and to take all reasonable steps including, where necessary, the implementation of programmes of measures, to:

"(a) prevent or limit, as appropriate, the input of pollutants into groundwater and prevent the

deterioration of the status of all bodies of groundwater;

(b) protect, enhance and restore all bodies of groundwater and ensure a balance between abstraction and recharge of groundwater with the aim of achieving good groundwater quantitative status and good groundwater chemical status by 2015 or, at the latest, by 2027;

(c) reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce pollution of groundwater;

(d) achieve compliance with any standards and objectives established for a groundwater dependent protected area included in the register of protected areas established under Regulation 8 of the 2003 Regulations [S.I. No. 722 of 2003] by not later than 2015, unless otherwise specified in the Community legislation under which the individual protected areas have been established."

Planning Policy and Development Control

7.18 There are no planning policy and development control regulations that specifically apply to this hydrology and hydrogeology assessment.

Guidelines and Technical Standards

7.19 The following key guidelines apply to this hydrology and hydrogeology assessment:

- Institute of Geologists of Ireland (IGI) (April 2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements; and
- National Roads Authority (NRA) (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

7.20 Additional guidelines and technical standards which apply to this Chapter of the EIAR and the hydrology and hydrogeology assessment presented herein are listed in Appendix 7-A.

RECEIVING ENVIRONMENT

Study Area

7.21 For the purposes of this assessment, the study area comprises the proposed waste licence extension area and the surrounding area extending up to a 5km radius around the site boundary. Unmitigated potential impacts on hydrology and hydrogeology are considered for the initial assessment, before appropriate mitigation measures for the potential impacts identified are discussed, and the identified potential impacts are then re-assessed assuming the identified mitigation measures are in place.

Baseline Study Methodology

7.22 The methodology used in the investigation follows the guidelines and advice notes provided by the Environmental Protection Agency (EPA) on environmental impact assessments and the IGI's guidance on Geology in Environmental Impact Statements.

7.23 Existing information on the geology, hydrogeology and hydrological features of the Huntstown area and its surrounds was collated and evaluated. Monitoring data, including discharge quality data, discharge quantity data, groundwater quality results and groundwater level monitoring was assessed.

7.24 The methodology involved in the assessment of the hydrology and hydrogeology in the area around Huntstown South Quarry can be summarised as follows:

- a desk study, in which existing data and relevant regional data sources for the area were

examined;

- a field visit, in which key aspects of the local hydrology and hydrogeology at the quarry and surrounding area were identified and assessed;
- a review of monitoring data provided by Roadstone, including groundwater quality, groundwater levels, discharge quality and discharge flow volumes; and
- analysis of the information gathered.

Sources of Information

7.25 The following sources of information have been consulted in order to investigate and define the hydrogeology and hydrology of lands surrounding the proposed recovery area at the South Quarry:

- The EPA website (www.epa.ie);
- The Geological Survey Ireland (GSI) website (www.gsi.ie);
- Details of Groundwater Protection Schemes (at www.gsi.ie); and
- Water Maps and Water Framework Directive online mapping (www.catchments.ie).

Soils and Geology

7.26 A detailed description of the local and regional soil, subsoil and bedrock geology at and around the proposed waste licence extension area is provided in Chapter 6 of this EIAR. A summary is provided below:

Soils and Subsoils

7.27 The EPA website publishes soils and subsoils maps created by the Spatial Analysis Unit, Teagasc in collaboration with the Geological Survey of Ireland. These maps indicate that the proposed licence extension area at Huntstown and the surrounding area is / was typically underlain by deep basic mineral soils with variable drainage characteristics – from poorly drained to well drained. The parent material for these soils is the underlying glacial till derived from limestone which extends across much of the North Dublin region, refer to Figure 6-2 in Chapter 6 of this EIAR.

7.28 Much of the soil cover across this area was previously removed to facilitate the extraction of rock at the South Quarry and was placed in perimeter screening berms around the Roadstone property boundary.

Solid Geology

7.29 The soil and subsoil deposits at the proposed licence extension area and in the area immediately surrounding it are underlain by bedrock of several lower Carboniferous Formations. Regional geological maps indicate that four bedrock formations occur across the Huntstown Quarry complex, and that those across the South Quarry footprint comprise the Malahide (Boston Hill) Formation, as well as Waulsortian Formation, refer to Figures 6-3 and 6-4 in Chapter 6 of this EIAR.

7.30 The bedrock formations are typically described as follows:

- Malahide (Boston Hill) Formation: rather uniform, thick successions of nodular diffusely bedded, argillaceous fossiliferous limestones (and their dolomitised equivalents) and subordinate thin shales (improved understanding means that the Boston Hill formation is now recognised to be part of the Malahide Formation);
- Waulsortian Limestone: a mainly pale grey biomicrite;
- The Tober Colleen Formation: a very gradationally interbedded calcareous mudstone and very argillaceous micrite. It overlies, and fills in the gaps between depressions of the

Waulsortian Limestones;

- The Malahide Formation: at its top, is described as a fossiliferous limestone and shale with some oolites and sandstone, biomicrites and biosparites.

Hydrogeology

Aquifer Characteristics

7.31 The overall quarry complex at Huntstown straddles the Dublin Groundwater Body (GWB) and the Swords GWB. The boundary between the two groundwater bodies is inferred to run through the middle of the quarry complex, as indicated in Figure 7-1. As can be seen, the southern part of the quarry complex and the entirety of the proposed waste licence extension area are located within the Dublin GWB.

7.32 The quarries at Huntstown provide for significant groundwater abstraction from both the Swords and Dublin GWBs. Notwithstanding this, there are no major abstractions for groundwater supply from the Dublin GWB (www.gsi.ie). Although the source protection area for a wellfield at Dunboyne extends marginally into the Dublin GWB, this protection zone is 8.5 km west of the Huntstown Quarry complex. There are no groundwater supply source protection areas identified within the Swords GWB.

7.33 The predominant bedrock at Huntstown is limestone. As is typical of Irish bedrock, groundwater flow through the limestone formations is controlled by secondary fissure permeability. The bulk permeability of the limestone formations is relatively high, with groundwater storage and movement mainly constrained to the upper, weathered horizons of each unit and to discontinuities (such as joints, fractures and faults).

7.34 Bedrock aquifer maps published on the GSI website indicate that the South Quarry area comprises the Malahide (Boston Hill) Formation, as well as Waulsortian Formation. Both the Waulsortian and Malahide (Boston Hill) Formations are classified as Locally Important Aquifers (Ll), i.e., Bedrock which is Moderately Productive only in Local Zones. An extract of the bedrock aquifer map is presented as Figure 7-2.

Groundwater Vulnerability

7.35 The subsoil deposits that overlie the bedrock at Huntstown tend to be relatively thin but play an important role in groundwater recharge. Where there are glacial till subsoils present there will be reduced groundwater recharge to the underlying bedrock due to the lower permeability of the till. Where glacial till subsoils are absent around the South Quarry, recharge will be directly to the underlying bedrock.

7.36 Groundwater vulnerability maps published on the GSI website indicate that the South Quarry is located within an area indicated to be of medium to extreme groundwater vulnerability status, refer to extract of the vulnerability map presented in Figure 7-3. The groundwater vulnerability reflects the exposed nature of the quarry area as a result of thin subsoil cover and/or absence thereof.

7.37 Future backfilling of the existing quarry will provide an enhanced degree of groundwater protection, as the backfilled soils can be expected to have a relatively low permeability and will be of significant thickness (>3m) upon completion of backfilling to original ground level.

7.38 The Department of the Environment and Local Government (DoELG) / EPA / GSI has developed a scheme (Groundwater Protection Response Matrix for Landfills) to assess potential landfill sites on the basis of groundwater vulnerability and aquifer status. It should be noted however that this scheme has largely been developed for new non-hazardous landfills (i.e., receiving a waste stream of municipal solid wastes, and commercial and industrial wastes). It is therefore not a directly applicable tool for assessment of inert soil and stone recovery facilities such as that at Huntstown.

7.39 Nevertheless, these classifications have been compared against the matrix for non-hazardous landfills which indicates that the site setting falls within a response category of R2[2], which is described as being '*acceptable subject to guidance outlined in the EPA Landfill Design Manual or conditions of a waste licence*'.

Water Management

7.40 The quarry excavations at Huntstown have intersected the groundwater table and have lowered it around the periphery with excavation of each bench. Minor groundwater inflows to each of the quarries drain to the quarry floor, where they are contained.

7.41 Surface water run-off and dewatered groundwater currently collects in a sump at a low point on the floor of the South Quarry. It is pumped from the sump to the top of the quarry and falls under gravity thereafter to a number of existing settlement ponds in series. The treated surface water run-off then flows north-east along a pipe and is discharged to a drainage channel which runs eastwards through the Roadstone landholding for approximately 500m. Thereafter it passes through a hydrocarbon interceptor and is discharged off-site to the headwaters of the Finglas Stream (in accordance with the discharge permit issued by Fingal County Council, Ref. WPW/F/075). The pump on the quarry floor is floating in a collection sump and any pumping / discharge from it is automated via a float level switch. Discharge volumes from the South Quarry are discussed in later sections of this Chapter.

Karst Features

7.42 A review of the GSI karst database (www.gsi.ie) indicates that there are no karst landforms or features within 5 km of the Huntstown Quarry complex.

Rainfall and Climate

7.43 The Average Annual Rainfall (AAR) in the area around Huntstown is c. 773 mm/yr for the 30-year period 1991-2020 (Met Eireann, 2021). Mmonthly average rainfall values for 1991-2020 are shown in Table 7-1 below.

Table 7-1
Monthly Rainfall Averages (mm) 1991-2020 for Huntstown

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	AAR
62	52	52	55	57	64	62	74	62	79	83	72	773

7.44 Rainfall values for one-hour and two-day storm events of 5-year return period intensity are 16mm and 59.6mm respectively, refer to the Met Éireann Depth Duration Frequency (DDF) rainfall return table reproduced in Appendix 7-B.

Groundwater Recharge

7.45 Local groundwater recharge potential has been modelled by the Geological Survey of Ireland (GSI) based on subsoil characteristics, aquifer type, soil drainage and bedrock geology.

7.46 Groundwater recharge around the Huntstown quarries has been assessed by the GSI in accordance with guidelines published by the Irish Working Group on Groundwater (WGGW, 2005). The effective rainfall in this area is assessed as 380 mm/yr and the maximum groundwater recharge capacity is indicated to be 200mm/yr (www.gsi.ie).

The Water Framework Directive's Working Group on Groundwater (2005) has suggested that a reasonable 'cap' on recharge to locally important aquifers would be between 150 mm/year and 200mm/year and that any incident rainfall in excess of this will be rejected as run-off. The bulk of this groundwater recharge would be likely to occur between late October and early March.

Groundwater Monitoring

7.47 At the present time, there are 11 No. groundwater monitoring wells installed around the Huntstown Quarry complex. Of these 3 No., designated GW6A, GW8 and GW9, are located in the vicinity of the South Quarry, as shown in Figure 7-4. Borehole GW6A is located in the South Quarry itself, borehole GW8 is located above and behind the western quarry face, and borehole GW9 is located above and behind the north-eastern face. Borehole GW6A had to be re-drilled recently (in March 2021, as GW06B), after the groundwater monitoring borehole had become inaccessible. Details of the groundwater monitoring well construction are presented in Table 7-2 below. Relevant borehole logs are presented in Appendix 7-C.

Table 7-2
South Quarry Groundwater Monitoring Wells

Date	GW06A	GW06B	GW08	GW09
GL Elevation (mOD) (during drilling)	31.02	81.62	90.68	78.64
Depth (m bgl)	40	100	120	120
Toe Level (mOD)	-8.98	-18.38	-29.32	-41.35

7.48 The groundwater level elevation recorded at the three boreholes around the South Quarry are quite different. The ground and aquifer conditions at each borehole are described in brief below.

7.49 Borehole GW06A is developed entirely in limestone. Water strikes were encountered at 29.5mOD (1.50 m bgl) and 8.0mOD (23 m bgl).

7.50 The recent drilling of the replacement well for GW06A (identified as GW06B) encountered Made (Filled) Ground and boulder clay to approximately 74.8mOD (6.8m bgl). Weathered limestone is recorded to approximately 73.1mOD (8.5mbgl) and strong limestone bedrock is recorded thereafter to 45.1mOD (36.5m bgl). The competent limestone rock was underlain by a zone of more weathered limestone with clay infill to 20.6mOD (61m bgl). Competent limestone bedrock was again encountered beneath this zone to -18.4mOD (100m bgl). There were no water strikes reported during well drilling / installation.

7.51 Borehole GW08 is mainly developed in limestone. Overburden is present in the form of boulder clay to 84.6mOD (6.1m bgl), with gravel and muck thereafter to 81.6mOD (9.1m bgl). Weathered rock is encountered from 81.6mOD (9.1m bgl) to 75.5mOD (15.2m bgl), and some 'brown weathered rock' from 41.9mOD (48.8m bgl) to 29.8mOD (60.9m bgl). Water strikes were encountered at 37.7mOD (53m bgl) and 32.7mOD (58m bgl), within the section identified as 'brown weathered rock'.

7.52 Borehole GW09 is mainly developed in limestone. Overburden is present in the form of clay and broken rock to 73.15mOD (5.5m bgl). A 'broken brown crevice' is encountered from 41.45mOD (37.2m bgl) to 40.85mOD (37.8m bgl), and 'brown rock with crevices' from 10.05 mOD (68.7m bgl) to -28.05mOD (106.7m bgl). No water strikes were reported during drilling of borehole GW09.

Groundwater Levels and Flow

7.53 Except for a short period in April and May 2020 (when stringent Covid restriction were in place), water levels have been monitored on a monthly basis at the South Quarry by SLR Consulting since January 2019. Detailed results are presented in Table 7-3 below with a summary of the data obtained provided in Table 7-4 below. Results are plotted as a function of time in Graph 7-1.

7.54 The recorded variation in groundwater levels over the two-year monitoring period between January 2019 and December 2020 ranges from 14.8m at GW06A to 20.5m at GW09. Groundwater elevations are observed to be highly variable around the South Quarry, ranging from an upper limit of 75.2mOD at GW08 to 16.45mOD at GW06A. The groundwater level at the recent redrill of GW06A (i.e. GW06B) was recorded at approximately 80m bgl directly following drilling (at approximately 1.6mOD).

Table 7-3
Groundwater Levels

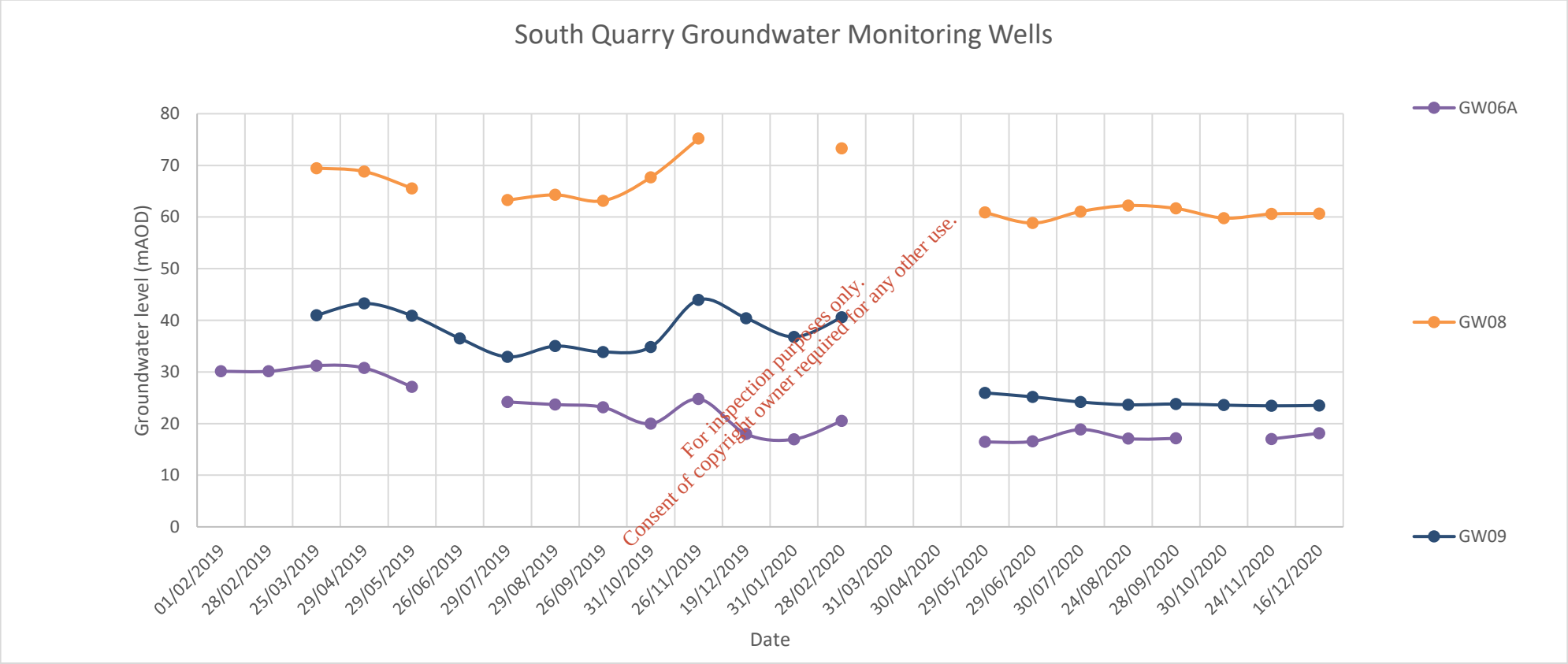
Date	GW06A	GW08	GW09	GW06A	GW08	GW09
	m bgl			mOD		
01/02/2019	0.9	Not yet drilled		30.12	Not yet drilled	
28/02/2019	0.9			30.12		
25/03/2019	-0.21	21.24	37.69	31.23	69.44	40.96
29/04/2019	0.25	21.86	35.37	30.77	68.82	43.28
29/05/2019	3.93	25.14	37.76	27.09	65.54	40.89
26/06/2019	Dry	Pumping	42.15	Dry	Pumping	
29/07/2019	6.83	27.42	45.73	24.19	63.26	32.92
29/08/2019	7.35	26.39	43.64	23.67	64.29	35.01
26/09/2019	7.86	27.54	44.78	23.16	63.14	33.87
31/10/2019	11.05	23	43.81	19.97	67.68	34.84
26/11/2019	6.27	15.5	34.69	24.75	75.18	43.96
19/12/2019	13.06	Pumping	38.24	17.96	Pumping	40.41
31/01/2020	14.06	Inaccessible	41.86	16.96	Inaccessible	36.79
28/02/2020	10.5	17.39	38.07	20.52	73.29	40.58
31/03/2020	Covid Restrictions					
30/04/2020	Covid Restrictions					
29/05/2020	14.57	29.79	52.71	16.45	60.89	25.94
29/06/2020	14.48	31.86	53.47	16.54	58.82	25.18

Date	GW06A	GW08	GW09	GW06A	GW08	GW09
		m bgl			mOD	
30/07/2020	12.17	29.62	54.47	18.85	61.06	24.18
24/08/2020	13.93	28.47	55.01	17.09	62.21	23.64
28/09/2020	13.89	29.03	54.85	17.13	61.65	23.80
30/10/2020	Inaccessible	30.89	55.07	Inaccessible	59.79	23.58
24/11/2020	14	30.1	55.21	17.02	60.58	23.44
16/12/2020	12.89	30.01	55.13	18.13	60.67	23.52

Table 7-4
Summary Groundwater Levels (January 2019 to December 2020)

	GW06A	GW08	GW09
Maximum (mOD)	31.23	75.18	43.96
Average (mOD)	22.09	64.49	32.66
Minimum (mOD)	16.45	58.82	23.44
Variation (m)	14.78	16.36	20.52

Graph 7-1
South Quarry Groundwater Levels



7.55 Inferred groundwater contours across the Huntstown quarry complex are presented in Figure 7-4. The contour drawing shows the location and water depth of the pumps in the South Quarry and North Quarry. The quarry floor is assumed to represent groundwater lows at each of the two quarries.

7.56 As the South Quarry is located within the Tolka River Catchment and Dublin Groundwater Body, whilst the North Quarry is located within the Ward River Catchment and the Swords Groundwater Body, a groundwater divide is shown across the quarry complex.

7.57 Over the two-year monitoring period, the pump at the South Quarry was located at approximately 16mOD. The average groundwater level at GW06A which is located nearby along a quarry bench is 22.1mOD. It should be noted that the quarry floor has been deepened below this level in recent months (since early 2021), to approximately -10mOD. It is inferred that the groundwater in the vicinity of GW06A is/was controlled by a water bearing fracture at approximately 16mOD which was dewatered by the pump. No groundwater strike was encountered during the recent drilling of the replacement well for GW06A (GW06B), which indicates that the water bearing fracture in this area is localised.

7.58 Groundwater levels around the quarry complex are influenced by their proximity to dewatered quarry voids which lowers the groundwater level in the immediate vicinity, as can be seen in Figure 7-4. As indicated in Table 7-3 and Table 7-4, groundwater levels around the South Quarry vary within a range of 14.8m to 20.5m at the existing monitoring wells. Groundwater levels are most likely controlled by both distance from quarry voids, the presence of water bearing fractures and variations in bedrock geology.

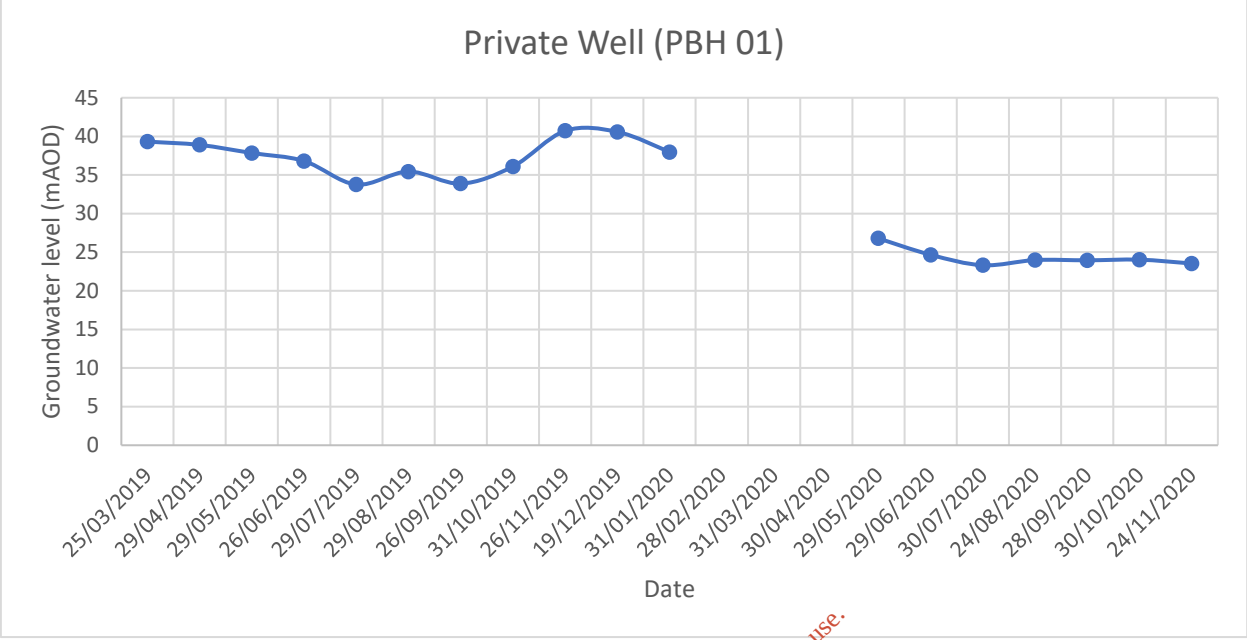
7.59 Groundwater contours plotted in Figure 7-4 indicate that the existing dewatering operations at Huntstown have lowered groundwater levels around the quarry complex and have locally altered the regional groundwater flow regime in the aquifers, diverting groundwater toward sumps on quarry floors.

Surrounding Groundwater Levels

7.60 There is one private well (PBH-01) located in the area immediately adjoining the South Quarry, less than 250m from the eastern property boundary, as indicated on Figure 7-4. Monthly groundwater level monitoring has been undertaken at this location by SLR Consulting Ireland since 2019.

7.61 This private well supplies water to the neighbouring property for domestic and agricultural purposes. The groundwater level at the well is plotted as a function of time in Graph 7-2 below. In February 2020 the borehole could not be accessed due to the presence of livestock. Due to Covid-19 restrictions, groundwater levels were not recorded during the following months of March and April 2020.

Graph 7-2
Private Well PBH1 Groundwater Levels



Discharge Volumes

7.62 Surface water at the Huntstown Quarry is discharged from pumps located on the quarry floor at the South Quarry and the North Quarry and verified discharge data is available for both quarries for the calendar year 2020. Full details of recorded discharge volumes from the South Quarry are presented in Appendix 7-D, while a summary is presented in Table 7-5 below. As can be seen, the maximum recorded discharge volume from the South Quarry in 2020 was 9,740m^3/day.

7.63 The discharge rate in the South Quarry typically ranged between 4,000m^3/d and 6,000m^3/d over the course of 2020. Notably, the discharge rate range after August 2020 was reasonably consistent between 4,900m^3/d and 5,300m^3/d. The discharge licence limit is for 7,300m^3/d, and the majority of daily discharge rates are below this limit. Historical discharge records show that discharge volumes prior to 2020 were more variable, but these are now actively attenuated and limited to 7,300m^3/day.

Table 7-5
Summary Groundwater Discharge Volumes (2018 and 2020)

Date	Maximum (m^3/d)	Minimum (m^3/d)	Average (m^3/d)
South Quarry 2020	9,740	0	5,194
South Quarry 2018	9,770	156	4,660

Groundwater Quality

7.64 Groundwater monitoring boreholes GW6A, GW8, and GW9 around the South Quarry were monitored for baseline groundwater quality on 26th June 2020 and 28th September 2020. The baseline groundwater quality testing is based on an extensive suite of quarterly parameters, with additional parameters tested for annually (A):

- physical parameters (pH and conductivity);
- dissolved organic carbon;

- anions (chloride, fluoride, sulphate, sulphide);
- nutrients (ammoniacal nitrogen as N and NH_3, nitrate as NO_3, orthophosphate as PO_4,
- cyanide free and total (A);
- metals (antimony, arsenic, barium, boron, cadmium, chromium, chromium hexavalent, copper, iron, lead, mercury, nickel, selenium, vanadium, zinc);
- phenols (A);
- speciated Total Petroleum Hydrocarbons (TPHs);
- Polyaromatic Hydrocarbons (PAHs);
- Polychlorinated Biphenol (PCBs);
- Semi-Volatile Organic Compounds (SVOCs) (A);
- Volatile Organic Compounds (VOCs) (A); and
- pesticides/herbicides (A).

7.65 The results are compared against several assessment criteria: specifically, those set out in S.I. No 366 of 2016 (Groundwater Regulations), S.I. No 122 of 2014 (Drinking Water Regulations) and EPA's Interim Guideline Values (IGVs). The results are summarised in Table 7-6 below and presented in detailed in spreadsheet format in Appendix 7-E.

Table 7-6
Baseline Groundwater Quality (June and September 2020)

Parameter	Units	GW6A		GW8		GW9	
		June 2020	Sept 2020	June 2020	Sept 2020	June 2020	Sept 2020
Physical Properties							
Conductivity @ 20 °C	mS/cm	1.09	1.08	0.627	0.652	0.879	0.946
pH	pH Units	7.21	7.3	7.46	7.35	7.46	7.57
Carbon							
Carbon, Organic (diss.filt)	mg/l	<3	<3	5.67	5.55	<3	<3
Ions							
Ammoniacal Nitrogen as N	mg/l	0.0853	0.108	**0.527**	**0.662**	0.0788	0.0495
Chloride	mg/l	27.9	29.4	31.1	30.2	30.9	30.7
Cyanide, Free (low level)	µg/l	<2.5	-	<2.5	-	<2.5	-
Cyanide, Total (low level)	µg/l	<5	-	<5	-	<5	-
Fluoride	mg/l	0.548	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrate as NO3	mg/l	2.6	<0.3	0.752	<0.3	<0.3	1.17
Phosphate (Ortho as PO4)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate	mg/l	**370**	**370**	46.7	53.1	**222**	**221**

Parameter	Units	GW6A		GW8		GW9	
		June 2020	Sept 2020	June 2020	Sept 2020	June 2020	Sept 2020
Sulphide	mg/l	0.0451	<0.01	0.0238	<0.01	<0.01	<0.01
Filtered (Dissolved) Metals							
Antimony (diss.filt)	µg/l	**18.5**	2.1	<1	<1	1.55	1.35
Arsenic (diss.filt)	µg/l	3.33	6.65	1.27	0.55	1.33	1.3
Barium (diss.filt)	µg/l	17.3	14.5	**144**	**130**	55.9	91.2
Boron (diss.filt)	µg/l	27.6	28.8	27.1	28.7	19.2	23.1
Cadmium (diss.filt)	µg/l	<0.08	<0.08	<0.08	<0.08	0.0941	<0.08
Chromium (diss.filt)	µg/l	<1	<1	<1	<1	<1	<1
Chromium, Hexavalent	mg/l	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Copper (diss.filt)	µg/l	0.381	<0.3	1.35	0.928	1.82	1.35
Iron (diss.filt)	mg/l	0.0248	**0.377**	**0.389**	<0.019	<0.019	0.0427
Lead (diss.filt)	µg/l	0.786	0.539	0.756	<0.2	0.264	0.523
Mercury (diss.filt)	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (diss.filt)	µg/l	9.91	5.93	6.21	6.33	5.02	3.19
Selenium (diss.filt)	µg/l	<1	<1	<1	<1	1.26	2.54
Vanadium (diss.filt)	µg/l	<1	<1	<1	<1	<1	<1
Zinc (diss.filt)	µg/l	73.2	43.7	49.3	10.4	**132**	**137**
Total Petroleum Hydrocarbons (TPH CWG)							
Total EPH (C6-C40) (aq)	µg/l	**104**	<100	<100	<100	**160**	**237**
Polyaromatic Hydrocarbons (PAHs)							
Fluoranthene (aq)	µg/l	<0.005	<0.0009	<0.005	<0.0009	0.00591	<0.0009
Naphthalene (aq)	µg/l	<0.01	<0.01	0.0146	<0.01	0.0283	0.0325
Phenanthrene (aq)	µg/l	<0.005	<0.005	<0.005	<0.005	0.0149	0.0176
Pyrene (aq)	µg/l	<0.005	<0.005	<0.005	<0.005	0.00872	<0.01
Bold: concentration in excess of assessment criteria							

7.66 All phenols, PCBs, SVOCs, VOCs, and pesticides / herbicides were below detection limit. Most parameters reported concentrations at less than the assessment criteria. Nitrate concentrations are low and conductivity is below the threshold value of 1875µs/cm. Although hydrocarbons are recorded in samples, they are only present at relatively low concentrations above detection limit. PAHs were also detected at low concentrations above detection limit on occasion (for fluoranthene, naphthalene, phenanthrene and pyrene).

7.67 Borehole GW6A exceeded assessment criteria for sulphate, antimony, iron and total EPH (C6-C40). Borehole GW8 exceeded assessment criteria for ammoniacal nitrogen, barium, and iron. Borehole GW9 exceeded assessment criteria for sulphate, zinc and total EPH (C6-C40) and exceeded the detection limit for phenanthrene and pyrene (PAHs).

7.68 Ongoing groundwater monitoring is being carried and will confirm any trends in groundwater quality at and around the South Quarry.

7.69 Separately, monthly groundwater monitoring undertaken by Roadstone for ongoing extractive operations at the South Quarry indicates that ammoniacal nitrogen was elevated on a number of occasions in 2020, particularly at borehole GW08. Coliforms were also elevated, which is indicative of likely agricultural impact on groundwater. Sulphate was elevated, and conductivity occasionally elevated. While TPH was recorded above detection limits on occasion, it was not persistent and was present at only relatively low concentration.

Groundwater Abstractions: Use and Quality

7.70 The GSI national well database records indicate that there are 12 wells or drill holes within 1 km of the Huntstown Quarry complex. Of these, only 2 wells appear to be used for groundwater abstraction: one is developed in the Waulsortian Limestone Formation at a location approximately 1km to the south of the South Quarry while the other, also developed in Waulsortian Formation, is located approximately 1.8km to the west.

7.71 Much of the potable water demand in Huntstown and the surrounding area is satisfied by a Local Authority mains supply.

7.72 Under Ireland's obligations for the Water Framework Directive, the status of groundwater bodies nationally has been assessed (www.wfdireland.ie), on the basis of both their quality and availability. The Dublin GWB is classified as being of Good overall status, however it is classified as being 'at risk' of losing its current 'Good' status as a result of urban development pressures. The Swords GWB is also classified as being of 'Good' overall status and is identified as being 'probably not at risk' of losing its current 'Good' status.

7.73 At the quarry itself, water for the concrete plant, aggregate washing and processing is sourced from the sump located on the South Quarry floor which collects groundwater ingress and surface water run-off. The sump is continually pumped to maintain dry conditions on the quarry floor.

Hydrology

Local Hydrology: Surface Water Bodies

7.74 Huntstown South Quarry is located immediately inside the Tolka River catchment, as shown in Figure 7-5. The Ward River catchment is located a short distance (<600m) to the north of the quarry.

Local Hydrology: Quality

7.75 The closest surface water body to the South Quarry is the Finglas Stream, which runs along the eastern boundary of the South Quarry and the Roadstone landholding. The Finglas Stream is a tributary of the River Tolka. The closest surface water quality monitoring point along the River Tolka is located at Glasnevin, approximately 4.5km south-east of the quarry and results indicate that at this location the river has a Q-value rating of Q3, indicating it to be of poor status.

Local Hydrology: Flow

7.76 Treated discharge from the South Quarry is discharged off-site to the headwaters of the Finglas Stream immediately east of the quarry and Roadstone property holding, at the discharge point shown in Figure 7-5 (designated 'W3' by existing Local Authority discharge licence). At the discharge point, almost the entire flow in the stream comprises discharge from the South Quarry. With no other significant inputs of flow, the Finglas Stream is reliant on discharge of water from the quarry to provide baseflow at the top of its catchment. In the absence of any discharge, it is likely that this watercourse would periodically run dry, except during periods of heavy or prolonged rainfall. There are no hydrometric stations along the stream in the vicinity of, or immediately downstream of, the South Quarry.

Surface Water Quality

7.77 Surface water quality has been monitored in compliance with the requirements of the existing discharge licence for the South Quarry (Ref. No. WPW/F/075), reproduced in Appendix 7-F. The results of water quality monitoring required by the existing discharge licence at the discharge point (designated 'W3') for the calendar years 2019 and 2020 are presented in Table 7-7. More detailed surface water quality test results are presented in Appendix 7-G.

7.78 The water quality results are generally within the licence limit warning value for the discharge. Very occasional exceedances of ammoniacal nitrogen and suspended solids were reported. None of the exceedances were persistent, and where exceedances did occur the parameter was within the licence limit during the next monitoring round.

Table 7-7
Water Quality Results for Discharge to Finglas Stream (W3)

Parameter	Ammoniacal Nitrogen	BOD5	COD	Detergents	Mineral Oil	Phosphate (as PO_4-P)	pH	Sulphate	Total Suspended Solids	Temperature
Unit	mg/L as N	mg/L O2	mg/L O2	mg/L MBAS	mg/L	mg/L as P	pH Unit	mg/L	mg/L	°C
Maximum Permitted	**1**	**5**	**50**	**10**	**10**	**0.1**	**6. - 9**	**300**	**30**	**25**
30/01/2019	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19/02/2020	0.62	< 2	< 4	< 0.05	< 0.010	0.07	7.8	168	4	8
26/03/2019	< 0.08	< 2	< 4	< 0.05	< 0.010	0.1	8	155	4	12
23/04/2019	0.27	< 2	< 4	0.09	< 0.010	0.02	8	142	< 2	15
29/05/2019	0.16	< 4	27	< 0.05	< 0.010	0.01	7.7	159	11	15
26/06/2019	**2**	< 2	< 4	0.76	< 0.010	0.01	7.8	227	7	16
24/07/2019	0.11	< 2	< 4	0.28	< 0.010	0.03	7.9	159	< 2	20
27/08/2019	0.18	< 2	< 4	< 0.05	< 0.010	0.01	7.9	172	2	18
24/09/2019	**1.8**	< 2	< 4	0.38	< 0.010	0.01	7.9	160	7	16
23/10/2019	0.26	< 2	< 4	< 0.05	< 0.010	< 0.01	7.7	205	< 2	10
20/11/2019	0.15	< 2	< 4	1.3	< 0.010	0.01	7.8	216	12	9

Parameter	Ammoniacal Nitrogen	BOD5	COD	Detergents	Mineral Oil	Phosphate (as PO_4-P)	pH	Sulphate	Total Suspended Solids	Temperature
Unit	mg/L as N	mg/L O2	mg/L O2	mg/L MBAS	mg/L	mg/L as P	pH Unit	mg/L	mg/L	°C
19/12/2019	< 0.08	< 2	< 4	< 0.05	< 0.010	< 0.01	7.6	176	6	9
20/01/2020	< 0.08	< 2	< 4	< 0.05	< 0.010	0.02	8	195	3	7
24/02/2020	0.29	3	< 4	0.09	< 0.010	< 0.01	7.9	223	**37**	10
25/03/2020	< 0.08	2	< 4	0.09	< 0.010	0.01	7.9	114	28	11
26/05/2020	< 0.08	< 5	22	< 0.05	< 0.010	< 0.01	7.9	126	3	18
25/06/2020	< 0.08	< 2	< 4	< 0.05	< 0.010	0.01	7.8	164	3	18
27/07/2020	0.11	< 2	< 4	< 0.05	0.054	0.04	7.7	154	9	17
17/08/2020	0.12	< 2	< 4	< 0.05	< 10	0.01	7.7	139	7	No record
21/09/2020	< 0.08	< 2	< 4	0.3	< 0.010	0.02	7.9	164	4	17
27/10/2020	< 0.08	< 2	4	1	< 0.010	< 0.01	7.9	51	3	11
16/11/2020	0.21	< 2	16	0.73	< 0.010	0.05	7.9	185	14	10
14/12/2020	0.08	< 2	< 4	0.61	< 0.010	0.01	7.8	209	13	9

Flooding

7.79 The Office of Public Works (OPW) website (www.floodmaps.ie) indicates that there is a record of one historic flood event in the vicinity of Huntstown, at Kilshane Cross in November 2002. This flood was attributed to '*run-off from adjacent grasslands*' and was not attributable to quarrying or production activities at Huntstown Quarry.

7.80 Surface water run-off and discharges from the Huntstown Quarry complex are managed on a continual basis so as not to increase the risk of flooding in the surrounding area. An assessment was previously undertaken to assess the channel carrying capacity of the Finglas Stream at the time of the discharge licence application and demonstrated that the existing channel had sufficient capacity to transmit the off-site discharge.

Sensitive Receptors

7.81 Arising from the foregoing baseline study, the following sensitive receptors have been identified in the receiving environment around Huntstown South Quarry:

- Locally important bedrock aquifer;
- Nearby domestic groundwater supply well, and;
- Finglas Stream, which flows into the Tolka River.

IMPACT ASSESSMENT

Evaluation Methodology

7.82 The impacts of the proposed soil waste importation, backfilling and recovery at Huntstown South Quarry on the local surface water and groundwater environment are assessed in the following sections of this EIAR Chapter.

7.83 The methodology applied here is a qualitative risk assessment methodology in which the nature of the potential impacts is described in terms of the character, magnitude, duration, probability and consequence of the impact and whether they are direct or indirect impacts. The terms used to describe potential hydrological and hydrogeological impacts or effects are explained in tables reproduced in Appendix 7-H and Appendix 7-I. The cumulative impact of any potential impacts is also assessed.

7.84 The description of the potential impact is then screened against the significance and sensitivity of the receiving environment to establish the overall significance of the potential impact (without mitigation). The classification of the impact significance is determined using the matrix from the EPA Guidelines (2017) which is reproduced in Appendix 7-J.

7.85 This approach provides a mechanism for identifying the key areas where mitigation measures are required, and for identifying mitigation measures appropriate to the risk presented by future backfilling and recovery activities. Following consideration of mitigation measures (pre-existing and proposed) an assessment is provided of residual impacts associated with planned future operations.

7.86 The following sections identify the potential impacts on the hydrogeological and hydrological environments arising from the soil waste backfilling and recovery at the South Quarry. It also assesses the likelihood of occurrence of each identified impact. It should be noted that the impacts are initially assessed with no mitigation or design measures incorporated to reduce the risk.

7.87 The potential direct and indirect impacts to surface waters and groundwater during the Construction Stage (site preparation), the Operation Stage (importation and placement of soil and stone waste) and Post Operational Stage (site restoration) are discussed below.

Future Development

Surface Water Management during Quarry Backfilling

7.88 In the course of future backfilling and recovery operations at the South Quarry, the upper surface of the backfilled soil will be graded so as to ensure that surface water run-off falling over the quarry footprint falls to sumps at temporary low points within the quarry floor or backfilled material. These temporary sumps will effectively function as primary settlement ponds.

7.89 During quarry backfilling and recovery activities, any dewatered groundwater and surface water run-off which collects at sumps or at low points will be pumped (causing minimum agitation to ponded water) directly to existing settlement ponds which run in series and are located beyond the north-western corner of the quarry.

7.90 With the elapse of the required retention time in settlement ponds, the treated surface water run-off then flows north-east along a pipe and is discharged to a drainage channel which runs eastwards through the Roadstone landholding for approximately 500m. Thereafter it passes through additional treatment infrastructure (a hydrocarbon interceptor) and is discharged off-site to the Finglas Stream as it flows along Roadstone's eastern property boundary. The configuration of the existing / proposed surface water management system at the South Quarry is indicated on the site infrastructure layout in Figure 2-6 (refer to Chapter 2 of this EIAR).

7.91 Off-site discharges from the South Quarry are currently regulated by a discharge licence issued by Fingal County Council (Ref. WPW/F/075). Prior to commencing soil and stone waste backfill and recovery activities at the South Quarry, it is necessary to review the existing waste licence (Ref. W0277-03) and extend the waste licence area to also include the South Quarry. The review of the waste licence will be carried out by the EPA and, if approved, will result in all off-site discharges from quarry backfilling and recovery activities at the South Quarry being regulated by way of the updated EPA licence in the future.

Surface Water Monitoring

7.92 At the present time, surface water run-off and dewatered groundwater from the South Quarry is monitored at monitoring location W3, downstream of the settlement ponds which treat water pumped from the floor of the South Quarry and immediately upstream of discharge into the Finglas Stream. Sampling and testing are undertaken by Roadstone on a monthly basis, as required by the existing Local Authority discharge licence.

7.93 It is envisaged that an additional monitoring location, designated DP2, will be established downstream of the existing hydrocarbon interceptor, adjacent to the existing monitoring location at W3, refer to Figure 7-5. This monitoring point will be adopted as the compliance point for future off-site discharge of treated water associated with backfilling and recovery activities at the South Quarry.

7.94 In addition to the off-site discharge, occasional sampling and testing is / will also be undertaken on samples taken from any temporary surface water features which may either be created or form naturally at low points within the South Quarry as it is backfilled.

Existing Environment Significance and Sensitivity

7.95 The impact assessment undertaken for the proposed backfilling and recovery activities is focussed on the sensitive receptors identified by the baseline study above.

7.96 The importance and sensitivity of the identified existing environment water receptors are described in Table 7-8 below.

Table 7-8
Existing Environment – Importance and Sensitivity of Identified Receptors

No.	Existing Environment	Importance	Sensitivity	Existing Significance / Sensitivity Rating (H/M/L/N)
1	Underlying locally important limestone bedrock aquifer	The bedrock aquifer is classified by the GSI as being a locally important aquifer which is moderately productive in local zones.	The bedrock aquifer can be used for water supply. Reduction in groundwater volumes and quality.	**Medium - Attribute has a medium quality or value on a local scale**
2	Private water supply	Domestic well supply in locally important bedrock aquifer which is moderately productive in local zones.	Reduction in groundwater volumes and quality.	**Medium - Attribute has a medium quality or value on a local scale**
3	Finglas Stream	Tributary of the Tolka River	Increase in surface water flows and reduction in surface water quality.	**Medium - Attribute has a medium quality or value on a local scale**

Construction Stage Impacts (No Mitigation)

7.97 No site infrastructure construction and/or preparatory site works will be required prior to commencement of the backfilling and recovery activities at the South Quarry.

Operation Stage Impacts (No Mitigation)

7.98 The operation stage is taken to comprise the importation, backfilling and recovery of inert soil and stone waste at Huntstown South Quarry at a rate of 750,000 tonnes per annum. These activities are required to progress the infilling of the quarry void to former ground levels and its restoration to agricultural use / grassland.

7.99 Some minor works will be undertaken at the outset of the operational phase to facilitate soil waste intake and recovery activities. These will principally comprise:

- Upgrading and/or maintenance of existing haul roads and hardstanding areas as required to facilitate routing of HGV / trucks across the quarry complex;
- Construction of temporary access ramps (if required) to access initial backfill areas on the western side of the South Quarry; and
- Establishment of any additional environmental control and monitoring infrastructure required by the EPA waste licence in respect of backfilling / recovery activities.

Direct Impacts

7.100 During the operational stage, the direct impacts identified below will apply :

- accidental spillage of fuels and lubricants by construction plant during the restoration, backfilling and soil recovery activities, with the potential for contaminated runoff entering surface water and groundwater, and;
- increase in suspended solids and potential for runoff with suspended solids entering surface water and groundwater during the restoration, backfilling and soil recovery activities.

It is noted that the effects of any accidental spillage will be impeded by the placement of inert soil and stone backfill on the floor of the existing quarry and as such, risks to groundwater quality will reduce following the initial backfilling stages:

7.101 In addition, the following potential impacts, relating specifically to ongoing soil recovery activities over the course of the operation stage, could also arise in the absence of any mitigation:

- the unintended importation of non-inert material or a rogue load with contaminated soils has the potential to adversely impact on groundwater quality of the locally important bedrock aquifer and nearby private water supply;
- dewatering of the South Quarry will continue for much of the backfilling stage. The reduction in, and ultimate cessation, of dewatering around the South Quarry as backfilling works progress will result in a local rise in groundwater level and contribute to increased flow around or beneath the quarry, as well as a likely reduction in the discharge to surface waters;
- infilling of the site with low permeability inert fill material has the potential to create a low permeability zone which could reduce recharge to the underlying bedrock aquifer over the excavated quarry footprint; and
- the restoration of the site with inert material will increase the thickness of unsaturated material above the groundwater table. This measure will afford additional protection to groundwater from potential pollutants, thus reducing the groundwater vulnerability across the backfilled area to impact from human activities.

7.102 The significance of the identified potential impacts is presented in Table 7-9, based on the matrix presented in Appendix 7-J. Impact significance is assessed having regard to the importance / sensitivity assessment presented in Table 7-8 and the likely magnitude of potential impacts described in Table 7-9.

Indirect Impacts

7.103 No indirect impacts are anticipated for surface water and groundwater over the operational stage.

Post - Operational Stage Impacts (No Mitigation)

Direct Impacts

7.104 During the post-operational stage, all plant and equipment at the quarry / recovery facility will be decommissioned and removed and the former quarry restored to agricultural after-use.

7.105 Following the completion of restoration works at the quarry, some rainfall will infiltrate naturally to the ground through near-surface soil while the bulk of it will likely be rejected and flow overground, as surface water run-off, northwards over the final restored landform toward the watercourse which flows off-site to the headwaters of the Finglas Stream. Drains or channels will be provided as required to intercept runoff and channel it toward the watercourse running off-site.

7.106 It is not considered that there are any direct impacts on groundwater associated with the post operational restoration of the site.

Indirect Impacts

7.107 There are no indirect impacts anticipated with this stage.

Summary of Potential Impacts

7.108 A summary of potential impacts without mitigation is presented in Table 7-9 below. As outlined in Table 7-8, the identified existing environment water receptors (bedrock groundwater / Finglas Stream / private water supplies) have an importance and sensitivity rated as "**medium**".

Table 7-9
Classification of Significance of Impacts (No Mitigation)

No.	Identified Potential Impact	Magnitude of Impact (with Description) (No Mitigation)	Significance of Impact (No Mitigation)
Operation Stage – Direct - Groundwater			
1	Impact on groundwater quality in bedrock aquifer due to unintentional import of non-inert material	**Low** - Potential to affect groundwater quality in underlying aquifer through vertical migration. Impact is unlikely as the intent is to use only inert, uncontaminated soil for backfilling purposes. The risk to groundwater will be reduced following the initial backfilling stage due to the placement of inert, low permeability (clay-bound) soil and stone across the floor of the existing quarry.	**Slight**
2	Impact on groundwater quality in private water supplies due to unintentional import of non-inert material	**Low** - Potential to affect groundwater quality in underlying aquifer through lateral migration. Impact is unlikely as the intent is to use only inert, uncontaminated soil for backfilling purposes. The risk to groundwater will be reduced following the initial backfilling stage due to the placement of inert, low permeability (clay-bound) soil and stone across the floor of the existing quarry	**Slight**
3	Reduction in dewatering and resultant increase in groundwater levels	**Low** - The potential impact from the reduction in, and ultimate cessation of, quarry dewatering will result in localised groundwater level rise and increased groundwater flow around the backfilled quarry.	**Slight**
4	Impact on groundwater recharge to bedrock aquifer due to low permeability zone	**Low** - Recharge over the quarry footprint is currently limited by dewatering and rainfall is diverted to surface water. The potential impact from backfilling will be minimal. While some recharge may occur as dewatering is scaled back, it will be limited by low permeability backfill material. The area to be backfilled with low permeability soil is also limited within the overall aquifer catchment area.	**Not Significant**
5	Impact on groundwater quality in bedrock aquifer from accidental fuel leakage/ spillage	**Low - Medium** - Potential to affect groundwater quality in underlying aquifer through vertical migration. Any leakage / spillage would be accidental only and of limited volume only. The risk to groundwater will be reduced following initial backfilling stage due to the placement of inert low permeability (clay-bound) soil and stone across the floor of the existing quarry.	**Slight - Moderate**

No.	Identified Potential Impact	Magnitude of Impact (with Description) (No Mitigation)	Significance of Impact (No Mitigation)
6	Impact on groundwater quality in bedrock aquifer from increased suspended solids	**Low** - Potential to affect groundwater quality in underlying aquifer through vertical migration. The risk to groundwater will be reduced following the initial backfilling stage due to the placement of inert low permeability (clay-bound) soil and stone across the floor of the existing quarry.	**Slight**
7	Impact on groundwater quality in private water supplies from accidental fuel leakage/ spillage	**Low - Medium** - Potential to affect groundwater quality in underlying aquifer through lateral migration. Any leakage / spillage would be accidental only. The risk to groundwater will be reduced following the initial backfilling stage due to the placement of inert low permeability (clay-bound) soil and stone across the floor of the existing quarry	**Slight - Moderate**
8	Impact on groundwater quality in private water supplies from increased suspended solids	**Low** - Potential to affect groundwater quality in underlying aquifer through lateral migration. The risk to groundwater will be reduced following the initial backfilling stage due to the placement of inert low permeability (clay-bound) soil and stone across the floor of the existing quarry	**Slight**
Operation Stage – Direct – Surface Water			
9	Impact on surface water quality in Finglas Stream from accidental fuel leakage/ spillage	**Low - Medium** - Potential to affect surface water quality in Finglas Stream, and in turn Tolka River, through contaminated runoff. Any leakage / spillage would be accidental only and of limited volume.	**Slight - Moderate**
10	Impact on surface water quality in Finglas Stream from increased suspended solids	**Low - Medium** - Potential to affect surface water quality in Finglas Stream, and in turn Tolka River, through increased sediment in run-off.	**Slight - Moderate**
11	Reduction in dewatering and resultant decrease in discharge volumes	**Low** - The potential impact from the gradual scaling back of and ultimate cessation of dewatering will result in a decrease in discharge volumes from the quarry void to the Finglas Stream. This will be compensated by long-term increase in run-off from the restored landform at the South Quarry to the existing drainage channel to the north and to the Finglas Stream thereafter.	**Slight**

7.109 Table 7-9 indicates that if no mitigation measures are applied to take account of the quarry backfilling and recovery operations, there is potential for these activities to increase the risk of pollution to groundwater.

7.110 Similarly, in the absence of an effective surface water management system, the backfilling and recovery operations have the potential to increase the risk of pollution to the Finglas Stream, and in turn the Tolka River further downstream.

Do-Nothing Scenario

7.111 The South Quarry is currently an active quarry and continues to be dewatered to facilitate local excavation to -18mOD in places. Planning permission has already been secured for the recovery of inert soil and stone at a rate of 750,000 tonnes per annum.

7.112 If the proposed waste licence review application is not approved, alternative strategies would have to be developed to progress the restoration of the South Quarry to agricultural land use in line with the planning conditions attached to the current extractive permission, most likely using materials classified as non-waste by-product.

7.113 Although the end result would be the same as that provided for in the licence review application, it could ultimately take longer to complete given the limited number of decisions made by the Agency confirming by-product status for soil and stone to date.

Interactions

7.114 It is considered that the groundwater and surface water at Huntstown South Quarry are not in hydraulic continuity at the present time. This will continue to be the case over the operational life of the soil recovery facility and for a period thereafter, following completion of the restoration works.

7.115 The backfilling and soil recovery operations have the potential to impact water quality and this also has implications for human health, biodiversity (habitats and species) and material assets (aquifers / wells) which are addressed in the respective Chapters of this EIAR.

MITIGATION MEASURES

7.116 Mitigation measures are required to reduce the assessed significance of potential impacts associated with the placement of imported soil waste materials to “slight” (or lower) for water environment receptors. The required measures are identified in the following sections of this EIAR Chapter.

Existing and Proposed Mitigation Measures

7.117 In order to mitigate against the risk of pollution to groundwater and surface water occurring arising during the backfilling and recovery of Huntstown South Quarry, the following water / environmental control measures will be implemented:

Existing Mitigation Measures

- Any dewatered groundwater and surface water will continue to be collected in sumps (and/or at low points) and pumped to existing settlement / attenuation ponds. The treated surface water is then passed through a silt trap and hydrocarbon interceptor prior to its discharge off-site. The water treatment system reduces the concentration of suspended solids and removes any hydrocarbon contamination in water discharged off-site;
- The existing traffic management system will continue to evolve and will be further developed to reduce potential conflicts between vehicles travelling to and from the South Quarry and those travelling to other areas within the quarry complex. By minimising / avoiding

interaction between vehicles transiting to different areas, the risk of accidental vehicle collisions and associated fuel spills or oil leaks will be reduced;

- All plant is regularly maintained and inspected daily for leaks of fuels, lubricating oil or other contaminating liquids / liquors;.
- Fuel for plant and equipment used for quarry backfilling and recovery operations will continue to be stored in existing fuel storage tanks at the central infrastructure and production area within the Huntstown quarry complex;
- These tanks are constructed on sealed concrete surfaces and bunded to provide a storage volume equivalent to 110% of the tank storage volume;
- The plant and equipment undertaking the backfilling works at the South Quarry will be refuelled over concrete surfaced areas around existing bunded fuel storage tanks, from mobile, double skin fuel bowsers or fuel lorries on the quarry floor or hardstanding areas. Any refuelling of mobile plant undertaken within the quarry void is only to be undertaken using drip trays to contain any spillages. When refuelling directly from fuel trucks, drivers will be required to carry spill kits, to cut off delivery when fuel tanks are full and limit deliveries to a maximum of 200 litres;
- Oil and lubricant changes and servicing of wheeled or tracked plant employed at the South Quarry will continue to be undertaken at the existing maintenance sheds;
- A small bunded area for waste oils is provided within the maintenance shed. Oil collected in tanks is emptied at intervals by a licensed waste contractor and disposed off-site at an authorised waste facility;
- Numerous spill kits are available and plant operators are briefed during 'toolbox' talks and site induction on where the spill kits are kept and how and when they are deployed; and
- Regular visual inspection and testing is undertaken of the integrity of tanks, drums, bunded pallets and double skinned containers.

Proposed Additional Mitigation Measures

- Only soil and stone waste and C&D material carried by authorised waste collectors will be accepted at the waste recovery facility at Huntstown South Quarry. All waste intake and acceptance will be subject to regulation and control by way of the amended EPA Waste Licence;
- Any waste consignment observed to have other non-approved wastes intermixed with it on the basis of a CCTV / visual inspection at the weighbridge will not be accepted for intake and will be immediately rejected and re-directed off-site;
- As with the existing / established soil recovery operations at the North Quarry, a comprehensive system of in-situ compliance monitoring and testing of imported waste materials will be implemented, and detailed records will be kept of all testing;
- All soil and stone unloaded (end-tipped) from trucks at the backfill areas will be further inspected by site-based personnel to ensure that there is no non-hazardous or hazardous waste intermixed with it. Should any intermixed, non-inert waste be identified at this point, the entire consignment will be rejected, reloaded back onto the HGV and the haulier directed to remove it off-site to another authorised facility;
- Any soil and stone waste which is accepted for intake to the facility but is subsequently suspected to be non-compliant with agreed waste acceptance criteria will be transferred to the waste inspection and quarantine facility for closer examination and/or testing. The shed is roofed, closed on three sides and has a concrete floor, protecting quarantine material from

rainfall and avoiding potential to generate (suspect) contaminated surface water run-off;

- All surface water discharges will comply with the emission limits set by the discharge licence (or those which may supersede them in any amended waste licence issued by the EPA); and
- The upper surface of the backfilled soil will be graded so as to ensure that surface water run-off falling over the quarry footprint falls to sumps at temporary low points within the quarry floor or within the backfilled materials. These temporary sumps will effectively function as primary settlement ponds.

Assessment of Impacts with Mitigation Measures in Place

7.118 With the above mitigation measures in place at the proposed recovery facility, it is projected that the following reduction in the assessed significance of impacts will result:

- Reduction of the potential impact on groundwater quality in bedrock aquifer from accidental fuel leakage/ spillage during the operational stage from "slight – moderate" to "slight" (No. 5 in Table 7-9).
- Reduction of the potential impact on groundwater quality in private water supplies from accidental fuel leakage/ spillage during the operation stage from "slight – moderate" to "slight" (No. 7 in Table 7-9).
- Reduction of the potential impact on surface water quality in Finglas Stream from accidental fuel leakage/ spillage from "slight – moderate" to "slight" (No. 9 in Table 7-9).
- Reduction of the potential impact on surface water quality in Finglas Stream from suspended solids from "slight – moderate" to "slight" (No. 10 in Table 7-9).

RESIDUAL IMPACT ASSESSMENT

7.119 Examination of the identified potential impacts on the receiving environment show that with the mitigation measures in place, there are no significant residual impacts with respect to groundwater and surface water during the construction / operational / post operational stages of the soil waste recovery and backfilling activities. Following mitigation, the significance of all potential impacts identified will be reduced to "**slight**" or lower.

MONITORING

7.120 Existing monitoring measures being implemented at and around the South Quarry will continue in service to monitor any potential impact arising from the backfilling and recovery operations on groundwater or surface water.

Groundwater Monitoring

7.121 The extensive suite of parameters (outlined previously for the quarterly monitoring being undertaken at the South Quarry) will continue to be tested annually (i.e., inorganics, metals, TPHs, PAHs, PCBs and pesticides/herbicides with cyanide, phenols, VOCs and SVOCs), in line with the existing waste licence requirements (or any amendment thereto).

7.122 The groundwater parameters that are currently being tested by Roadstone on a monthly basis include pH, conductivity, ammonia, nitrite, nitrate, orthophosphate, sulphate, TDS, TPHs (i.e. DRO and PRO) and coliforms. The scope and extent of future monthly groundwater monitoring to be undertaken at and around the South Quarry will be in accordance with the existing waste licence (or any amendment thereto).

7.123 The groundwater monitoring regime will remain in place for the duration of the quarry backfilling / recovery activities and final restoration works, until such time as the (amended) waste licence is ultimately surrendered.

Surface Water Monitoring

7.124 Surface water discharge from the South Quarry (W3) is currently tested for a range of physical and chemical parameters, in line with the existing discharge licence requirements. It is envisaged that an additional monitoring location, designated DP2, will be established at a location adjoining W3 downstream of the hydrocarbon interceptor and that this will be adopted as the compliance point for off-site discharges of treated water associated with future backfilling and recovery activities at the South Quarry.

7.125 Future surface water sampling and chemical testing at the South Quarry will be undertaken as per the parameters and monitoring frequency set out in the existing waste licence (for backfilling and recovery activities at the North Quarry), reproduced in Table 7-10 below.

Table 7-10
Surface Water Monitoring Schedule from Waste Licence

Parameter	Monitoring Frequency	Analysis Method / Technique
Visual Inspection	Daily	Examine colour and odour
Flow	Daily	Flow meter
Temperature	Weekly	Temperature probe
pH	Weekly	pH Electrode/meter
BOD	Weekly	Standard Method
Suspended solids (mg/l)	Weekly	Standard Method
Ammonia as N	Weekly	Standard Method
Orthophosphate as P	Weekly	Standard Method
Dissolved Metals (Cd, Cu, Fe, Pb, Mg, Mn, Ni and Zn)	Quarterly	Standard Method
Total Dissolved Solids	Quarterly	Standard Method
Total Petroleum Hydrocarbons	Biannually	Standard Method
Diesel Range Organics	Biannually	Standard Method
Petrol Range Organics	Biannually	Standard Method

7.126 The emission limit values for the discharge to surface water are set out in Schedule B of the current waste licence (covering operations at the North Quarry) and are reproduced in Table 7-11 below. It is proposed that these limits will also apply to future backfilling at the South Quarry.

Table 7-11
Surface Water Emission Limit Values

Parameter	Unit	Emission Limit Value
Temperature	°C	25
pH	pH units	6 - 9
BOD	mg/l	5
Suspended Solids	mg/l	15
Ammonia as N	mg/l	0.5
Orthophosphate as P	mg/l	0.5

7.127 The surface water monitoring regime will remain in place for the duration of the quarry backfilling / recovery activities and final restoration works, until such time as the (amended) waste licence is ultimately surrendered.

FIGURES

N

NORTH QUARRY

WEST QUARRY

CENTRAL QUARRY (W)

CENTRAL QUARRY (E)

SOUTH QUARRY

Waste Inspection Shed

Asphalt Plant

Water Settlement Ponds

Weighbridges

Concrete Batching Plant

Workshop

Concrete Block Plant

Block Yard

Security Hut

VIRIDIAN POWER STATION
(NOT OWNED BY ROADSTONE LIMITED)

ENERGIA AD PLANT
(NOT OWNED BY ROADSTONE LIMITED)

High Voltage Powerlines

0 100 200 300 400m 600 800 1000

Metres 1:10,000

NOTES

1. EXTRACT FROM 1:2,500 ORDNANCE SURVEY DIGITAL SHEET **NO'S. 3062-A, 3062-B, 3062-C, 3062-D, 3063-A, 3063-C, 3130-A & 3130-B**.

2. **CYAL50167032** (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND

LEGEND

- ROADSTONE LIMITED LAND INTEREST **(C. 171.8 HA)**
- AMENDED WASTE LICENCE AREA (COMPRISING EXISTING LICENCE AREA AND PROPOSED EXTENSION) **(C. 77.5 HA)**
- PROPOSED EXTENSION TO CURRENT WASTE LICENCE AREA
- N2 DUAL CARRIAGEWAY
- R135 REGIONAL ROAD (NORTH ROAD)
- LOCAL ROAD
- M50 MOTORWAY
- SWORDS GROUNDWATER BODY
- DUBLIN GROUNDWATER BODY

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ENVIRONMENTAL IMPACT ASSESSMENT REPORT

WASTE LICENCE REVIEW APPLICATION
NORTH ROAD, FINGLAS, DUBLIN 11

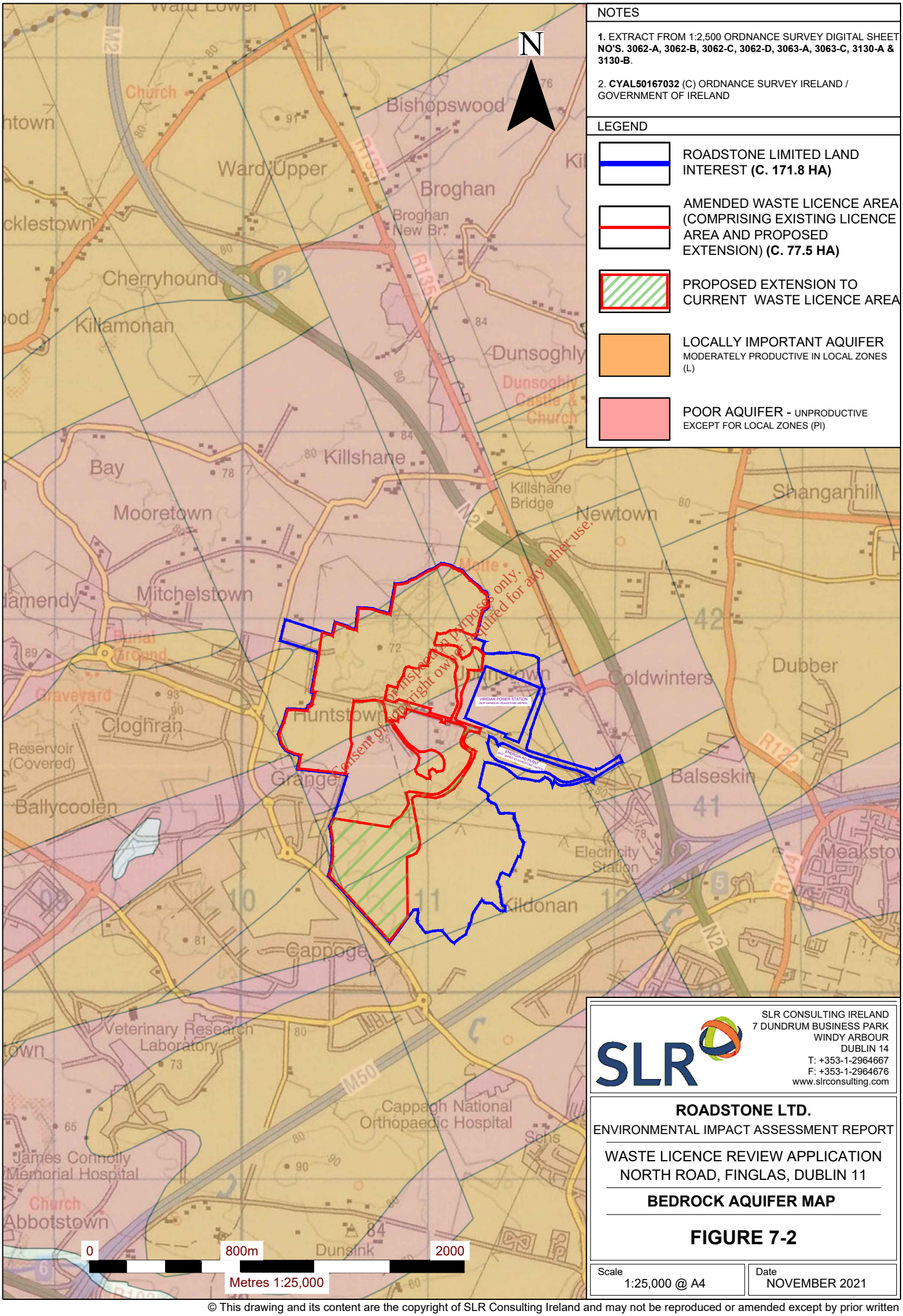
GROUNDWATER BODIES MAP

FIGURE 7-1

Scale: 1:10,000 @ A3

Date: NOVEMBER 2021

0180.00313.0.Fig 7-1.WLR RevA.Groundwater Bodies Map.dwg



NOTES

1. EXTRACT FROM 1:2,500 ORDNANCE SURVEY DIGITAL SHEET **NO'S. 3062-A, 3062-B, 3062-C, 3062-D, 3063-A, 3063-C, 3130-A & 3130-B**.

2. **CYAL50167032** (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND

LEGEND

- ROADSTONE LIMITED LAND INTEREST **(C. 171.8 HA)**
- AMENDED WASTE LICENCE AREA (COMPRISING EXISTING LICENCE AREA AND PROPOSED EXTENSION) **(C. 77.5 HA)**
- PROPOSED EXTENSION TO CURRENT WASTE LICENCE AREA
- LOCALLY IMPORTANT AQUIFER MODERATELY PRODUCTIVE IN LOCAL ZONES (L)
- POOR AQUIFER - UNPRODUCTIVE EXCEPT FOR LOCAL ZONES (Pl)

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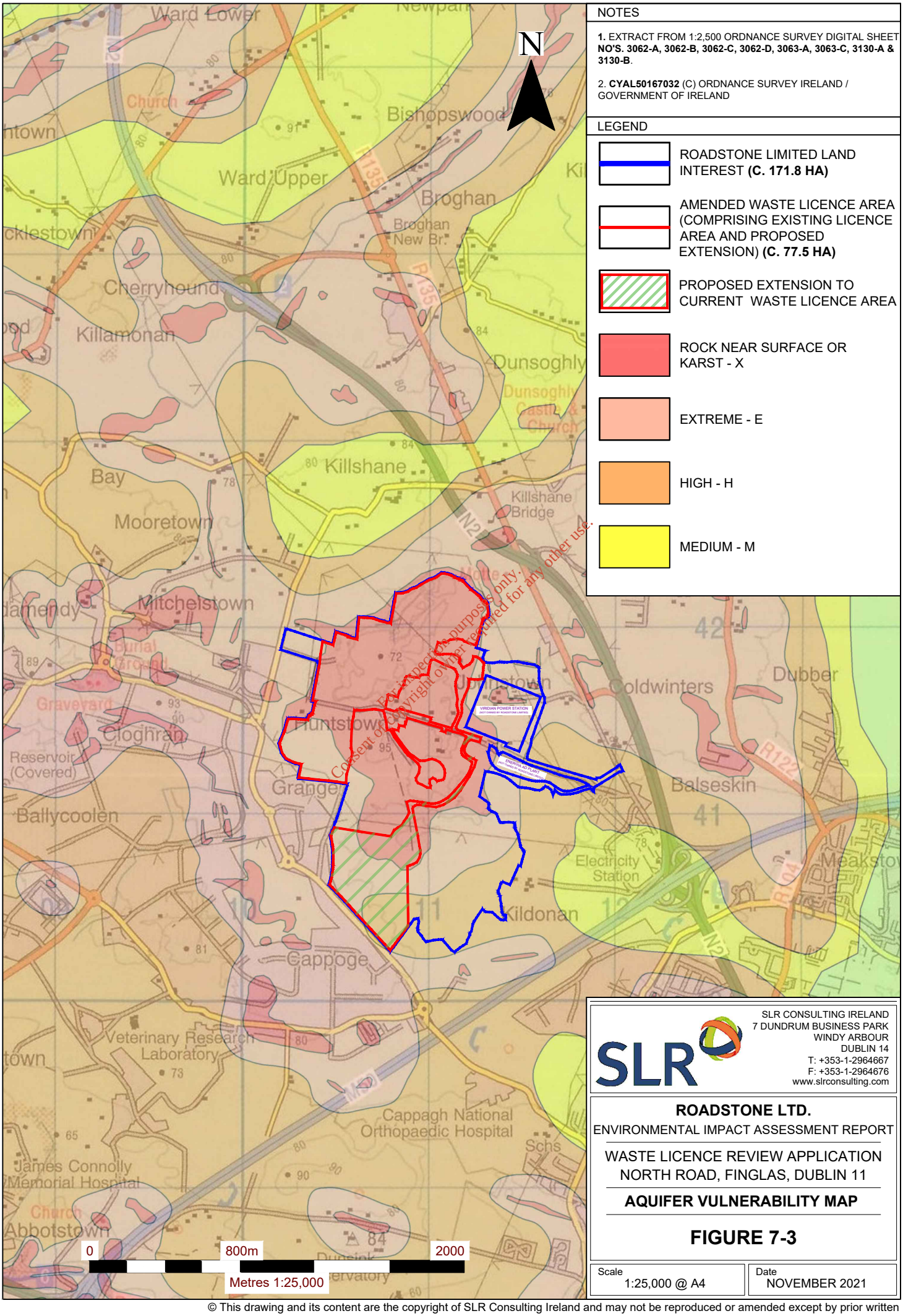
NORTH ROAD, FINGLAS, DUBLIN 11

BEDROCK AQUIFER MAP

FIGURE 7-2

Scale	Date
1:25,000 @ A4	NOVEMBER 2021

0180.00313.0.Fig 7-2.WLR RevA.Bedrock Aquifer Map.dwg



NOTES

1. EXTRACT FROM 1:2,500 ORDNANCE SURVEY DIGITAL SHEET **NO'S. 3062-A, 3062-B, 3062-C, 3062-D, 3063-A, 3063-C, 3130-A & 3130-B**.

2. **CYAL50167032** (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND

LEGEND

- ROADSTONE LIMITED LAND INTEREST **(C. 171.8 HA)**
- AMENDED WASTE LICENCE AREA (COMPRISING EXISTING LICENCE AREA AND PROPOSED EXTENSION) **(C. 77.5 HA)**
- PROPOSED EXTENSION TO CURRENT WASTE LICENCE AREA
- ROCK NEAR SURFACE OR KARST - X
- EXTREME - E
- HIGH - H
- MEDIUM - M

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WASTE LICENCE REVIEW APPLICATION
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AQUIFER VULNERABILITY MAP

FIGURE 7-3

Scale	Date
1:25,000 @ A4	NOVEMBER 2021

0180.00313.0.Fig 7-3.WLR RevA.Aquifer Vulnerability Map.dwg

N

GW07

GW04
55.07mOD

GW03
34.42mOD

GW05
74.77mOD

GW02A
44.74mOD

GW01A
21.04mOD

GW09
23.44mOD

PBH-1
23.54mOD

GW08
60.58mOD

GW06A
17.02mOD

GW06B

42mOD

16mOD

50
40
45
70
60
30
20
10
0
-10

0 100 200 300 400m 600 800 1000
Metres 1:10,000

NOTES

1. EXTRACT FROM 1:2,500 ORDNANCE SURVEY DIGITAL SHEET **NO'S. 3062-A, 3062-B, 3062-C, 3062-D, 3063-A, 3063-C, 3130-A & 3130-B**.

2. **CYAL50167032** (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND

LEGEND

- ROADSTONE LIMITED LAND INTEREST **(C. 171.8 HA)**
- AMENDED WASTE LICENCE AREA (COMPRISING EXISTING LICENCE AREA AND PROPOSED EXTENSION) **(C. 77.5 HA)**
- PROPOSED EXTENSION TO CURRENT WASTE LICENCE AREA
- WEST QUARRY INFILLED
- NORTH QUARRY INFILLED
- ON-SITE GROUNDWATER WELL LOCATIONS
- PRIVATE WELLS
- PUMP LOCATION (ELEVATION mAOD)
- GROUNDWATER LEVEL CONTOURS mOD
- WARD RIVER CATCHMENT (NORTH)
- TOLKA RIVER CATCHMENT (SOUTH)

GROUNDWATER LEVELS BASED ON MEASUREMENTS TAKEN BY SLR ON THE 24/11/2020

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WASTE LICENCE REVIEW APPLICATION
NORTH ROAD, FINGLAS, DUBLIN 11

GROUNDWATER CONTOUR MAP

FIGURE 7-4

Scale: 1:10,000 @ A3
Date: NOVEMBER 2021

0180.00313.0.Fig 7-4.WLR RevA.Groundwater Contours Map.dwg

N

NORTH QUARRY

WEST QUARRY

CENTRAL QUARRY (W)

CENTRAL QUARRY (E)

SOUTH QUARRY

Waste Inspection Shed

Asphalt Plant

Water Settlement Ponds

Weighbridges

Concrete Batching Plant

Maintenance Workshop

Concrete Block Plant

Block Yard

Wheelwash

Security Hut

DP

W4

VIRIDIAN POWER STATION
(NOT OWNED BY ROADSTONE LIMITED)

ENERGIA AD PLANT
(NOT OWNED BY ROADSTONE LIMITED)

DP2

W3

DISCHARGE POINT (W3) TO FINGLAS STREAM

FINGLAS STREAM

High Voltage Powerlines

Water Settlement Ponds

0 100 200 300 400m 600 800 1000

Metres 1:8,000

NOTES

1. EXTRACT FROM 1:2,500 ORDNANCE SURVEY DIGITAL SHEET **NO'S. 3062-A, 3062-B, 3062-C, 3062-D, 3063-A, 3063-C, 3130-A & 3130-B**.

2. **CYAL50167032** (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND

LEGEND

- ROADSTONE LIMITED LAND INTEREST **(C. 171.8 HA)**
- AMENDED WASTE LICENCE AREA (COMPRISING EXISTING LICENCE AREA AND PROPOSED EXTENSION) **(C. 77.5 HA)**
- PROPOSED EXTENSION TO CURRENT WASTE LICENCE AREA
- N2 DUAL CARRIAGEWAY
- R135 REGIONAL ROAD (NORTH ROAD)
- LOCAL ROAD
- M50 MOTORWAY
- WARD RIVER CATCHMENT
- TOLKA RIVER CATCHMENT
- DRAINAGE ROUTE FROM SETTLEMENT PONDS
- FINGLAS STREAM
- DISCHARGE POINT

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RIVER CATCHMENT MAP

FIGURE 7-5

Scale: 1:8,000 @ A3

Date: NOVEMBER 2021

0180.00313.0.Fig 7-5.WLR RevA.River Catchments Map.dwg

APPENDIX 7-A

EU Directives / National Legislation and Regulations / Guidelines / Technical Standards

APPENDIX 7-A

EU Directives / National Legislation and Regulations

Guidelines / Technical Standards

European Directives

- Environmental Impact Assessment. Directive (2011/92/EU) on the assessment of the effects of certain public and private projects on the environment;
- Environmental Impact Assessment Directive (2014/52/EU) on the assessment of the effects of certain public and private projects on the environment;
- Water Framework Directive (2000/60/EC);
- Groundwater Directive (2006/118/EC);
- Flooding Directive (2007/60/EC);
- Integrated Pollution and Prevention Control Directive (2008/1/EC); and
- The Management of Waste from Extractive Industries (2006/21/EC).

Irish Government Acts, National Legislation and Regulations

- S.I. No. 349 of 1989, European Communities (Environmental Impact Assessment) Regulations, and subsequent amendments (including S.I. No. 84 of 1994, S.I. No. 352 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001);
- The Planning and Development Acts, 2000 to 2009, The Planning and Development (Amendment) Act 2010, S.I. 600 of 2001 Planning and Development Regulations and subsequent amendments (including S.I. No. 364 of 2005 and S.I. 685 of 2006).

National Legislation on the Protection of the Water Environment.

Since 2000 water management in EU member states has primarily been directed by the Water Framework Directive (2000/60/EC) and the associate daughter' Groundwater Directive (2006/118/EC).

Irish legislation implementing these, and other relevant directives currently includes:

- S.I. No. 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations 2010 and amendments (S.I. No. 389 of 2011 and S.I. No. 149 of 2012);
- European Union (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014);
- S.I. No. 278 of 2007 European Communities (Drinking Water) (No. 2) Regulations;
- S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations 2009 and amendment (S.I. No. 327 of 2012);
- S.I. No. 684 of 2007 Waste Water Discharge (Authorisation) Regulations, 2007, as amended (including S.I. No. 231 of 2010 and S.I. No. 652 of 2016);
- S.I. No. 122 of 2010 European Communities (Assessment and Management of Flood Risks) Regulations 2010;
- S.I. No. 457 of 2008 European Communities (Environmental Liability) Regulations which bring into force the European Liability Directive (2004/35/EC);
- European Union (Planning and Development) (Environmental Impact Assessment) (No. 2) Regulations 2018 (S.I. No. 404 of 2018);
- Local Government (Water Pollution) Acts 1977 to 1990 and associated regulations;

- European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988);
- European Communities (Quality of Shellfish Waters) Regulations, 2006 (S.I. No. 268 of 2006) and amendments (S.I No. 55 and 464 of 2009), and;
- Bathing Water Quality Regulations, 2008 (S.I. No. 79 of 2008) and amendments (S.I No. 351 of 2011 and S.I. No. 163 of 2016).

Guidelines

- CIS (2007). Common Implementation Strategy (CIS) for the Water Framework Directive (2000/60/EC) Guidance on preventing or limiting direct and indirect inputs in the context of the Groundwater Directive 2006/118/EC. Guidance Document No. 17.
- CIS (2010). Common Implementation Strategy (CIS) for the Water Framework Directive (2000/60/EC). Guidance on risk assessment and the use of conceptual models for groundwater. Guidance document No. 26.
- DEHLG (2004). National Urban Waste Water Study. National Report.
- DEHLG (2009). Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities.
- DELG/EPA/GSI (1999). Groundwater Protection Schemes. Document prepared jointly by the Geological Survey of Ireland (GSI), the Environmental Protection Agency, and the Department of Environment, Heritage and Local Government.
- EPA (Draft May 2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- EPA (2010). Methodology for Establishing Groundwater Threshold Values and the Assessment of Chemical and Quantitative Status of Groundwater, Including and Assessment of Pollution Trends and Trend Reversal.
- EPA (2011). Guidance on the Authorisation of Discharges to Groundwater. Version 1, December 2011.
- EPA (2003). Towards Setting Guideline Values for the Protection of groundwater in Ireland. Interim Report.
- EPA (2006). Ireland Water Framework Directive Monitoring Programme.
- Fitzsimons, V., Daly, D. and Deakin, J. (2003). Draft GSI guidelines for assessment and mapping of groundwater vulnerability to contamination. Groundwater Chapter, Geological Survey of Ireland.
- GSI (2006). Criteria used in aquifer classification. Available from http://www.gsi.ie/Programmes/Groundwater/Aquifer+Classification.htm
- IGI (2007). Guidelines on Water Well Construction. Available from http://www.igi.ie/assets/files/Water%20Well%20Guidelines/Guidelines.pdf
- IGI (2007) Recommended collection, presentation and interpretation of geological and hydrogeological information for quarry developments; and
- Kilroy, G., Dunne, F., Ryan, J., O'Connor, A., Daly, D., Craig, M., Coxon, C., Johnston, P. and Moe, H. (2008). A Framework for the Assessment of Groundwater – Dependent Terrestrial Ecosystems under the Water Framework Directive. Environmental Research Centre Report Series No. 12.

Technical Standards

- British Standards (2015). Code of Practice for Ground Investigations BS5930:2015; and
- CIRIA (2007). The SuDS Manual. (C697). CIRIA publication, February 2007.

APPENDIX 7-B

Met Éireann Depth Duration Frequency (DDF) Rainfall Return Periods

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 311201, Northing: 241045,

	Interval		Years											
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.6,	3.6,	4.2,	5.1,	5.6,	6.1,	7.6,	9.3,	10.4,	12.0,	13.4,	14.5,	16.2,	17.5,	18.6,	N/A ,
10 mins	3.6,	5.0,	5.8,	7.0,	7.9,	8.5,	10.6,	13.0,	14.5,	16.7,	18.7,	20.2,	22.6,	24.4,	26.0,	N/A ,
15 mins	4.2,	5.9,	6.9,	8.3,	9.3,	10.0,	12.5,	15.2,	17.1,	19.7,	22.0,	23.8,	26.6,	28.8,	30.6,	N/A ,
30 mins	5.5,	7.7,	8.9,	10.7,	11.9,	12.8,	15.8,	19.2,	21.4,	24.5,	27.3,	29.4,	32.7,	35.3,	37.4,	N/A ,
1 hours	7.3,	10.1,	11.6,	13.7,	15.2,	16.3,	20.0,	24.1,	26.8,	30.5,	33.8,	36.4,	40.3,	43.3,	45.8,	N/A ,
2 hours	9.7,	13.2,	15.0,	17.7,	19.5,	20.9,	25.4,	30.3,	33.6,	38.0,	42.0,	45.0,	49.6,	53.2,	56.1,	N/A ,
3 hours	11.4,	15.4,	17.5,	20.5,	22.6,	24.1,	29.1,	34.7,	38.3,	43.2,	47.6,	50.9,	56.0,	60.0,	63.2,	N/A ,
4 hours	12.8,	17.2,	19.5,	22.8,	25.0,	26.7,	32.2,	38.1,	42.0,	47.4,	52.1,	55.6,	61.1,	65.3,	68.7,	N/A ,
6 hours	15.1,	20.1,	22.6,	26.4,	28.9,	30.8,	36.9,	43.6,	47.9,	53.9,	59.0,	63.0,	69.0,	73.6,	77.3,	N/A ,
9 hours	17.7,	23.4,	26.4,	30.6,	33.4,	35.6,	42.4,	49.9,	54.7,	61.2,	67.0,	71.3,	77.9,	83.0,	87.1,	N/A ,
12 hours	19.9,	26.2,	29.4,	34.0,	37.1,	39.4,	46.8,	54.9,	60.0,	67.1,	73.2,	77.9,	84.9,	90.3,	94.7,	N/A ,
18 hours	23.4,	30.6,	34.2,	39.4,	42.9,	45.5,	53.8,	62.7,	68.4,	76.3,	83.0,	88.2,	95.9,	101.8,	106.6,	N/A ,
24 hours	26.3,	34.1,	38.1,	43.8,	47.5,	50.4,	59.3,	69.0,	75.1,	83.5,	90.8,	96.3,	104.6,	110.9,	116.0,	133.5,
2 days	32.6,	41.5,	46.0,	52.3,	56.5,	59.6,	69.3,	79.8,	86.3,	95.3,	102.9,	108.7,	117.3,	123.8,	129.2,	147.1,
3 days	37.7,	47.5,	52.3,	59.2,	63.7,	67.0,	77.5,	88.5,	95.5,	104.9,	112.9,	118.9,	128.0,	134.8,	140.3,	158.8,
4 days	42.1,	52.6,	57.8,	65.2,	69.9,	73.5,	84.5,	96.2,	103.5,	113.3,	121.7,	127.9,	137.3,	144.3,	150.0,	169.2,
6 days	49.9,	61.7,	67.5,	75.6,	80.8,	84.7,	96.8,	109.5,	117.3,	127.9,	136.8,	143.5,	153.5,	161.0,	167.0,	187.2,
8 days	56.8,	69.7,	76.0,	84.8,	90.4,	94.6,	107.5,	121.0,	129.4,	140.6,	150.1,	157.1,	167.6,	175.5,	181.8,	203.0,
10 days	63.1,	77.0,	83.7,	93.1,	99.0,	103.5,	117.2,	131.5,	140.3,	152.1,	162.0,	169.4,	180.4,	188.6,	195.2,	217.1,
12 days	69.0,	83.7,	90.8,	100.8,	107.1,	111.8,	126.2,	141.2,	150.4,	162.7,	173.0,	180.7,	192.1,	200.6,	207.5,	230.2,
16 days	80.0,	96.2,	104.0,	114.9,	121.8,	127.0,	142.7,	158.8,	168.8,	182.0,	193.1,	201.3,	213.5,	222.6,	229.8,	254.0,
20 days	90.1,	107.7,	116.2,	127.9,	135.3,	140.9,	157.7,	174.9,	185.5,	199.5,	211.3,	220.0,	232.9,	242.4,	250.1,	275.5,
25 days	101.9,	121.1,	130.3,	143.0,	151.0,	157.0,	175.0,	193.5,	204.8,	219.7,	232.2,	241.5,	255.1,	265.2,	273.3,	300.1,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation_of-Point-Rainfall-Frequencies_TN61.pdf

APPENDIX 7-C

Groundwater Monitoring Well Construction Records

BOREHOLE LOG

BOREHOLE No **GW06A**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	16/05/2017		

Project: **Huntstown GW Monitoring**

Sheet 1 of 4

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
1				▼				LIMESTONE	
2									
3									
4									
5									
6									
7									
8									
9									

Borehole Continued on Next Page

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 3m for at 20 gallons per hour, tested at 23m at 40 g/h, tested at 40m at 40 g/h. Good rock all the way. Shut out water at 1.5m with screen & bentonite seal.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Leonard Grogan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW06A**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	16/05/2017		

Project: **Huntstown GW Monitoring**

Sheet 2 of 4

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
11								LIMESTONE	
12									
13									
14									
15									
16									
17									
18									
19									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 3m for at 20 gallons per hour, tested at 23m at 40 g/h, tested at 40m at 40 g/h. Good rock all the way. Shut out water at 1.5m with screen & bentonite seal.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Leonard Grogan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW06A**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	16/05/2017		

Project: **Huntstown GW Monitoring**

Sheet 3 of 4

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
21								LIMESTONE	
22									
23				▼					
24									
25							(40.00)		
26									
27									
28									
29									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 3m for at 20 gallons per hour, tested at 23m at 40 g/h, tested at 40m at 40 g/h. Good rock all the way. Shut out water at 1.5m with screen & bentonite seal.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Leonard Grogan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW06A**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	16/05/2017		

Project: **Huntstown GW Monitoring**

Sheet 4 of 4

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
31								LIMESTONE	
32									
33									
34									
35									
36									
37									
38									
39							40.00	Borehole Complete at 40.00m	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 3m for at 20 gallons per hour, tested at 23m at 40 g/h, tested at 40m at 40 g/h. Good rock all the way. Shut out water at 1.5m with screen & bentonite seal.

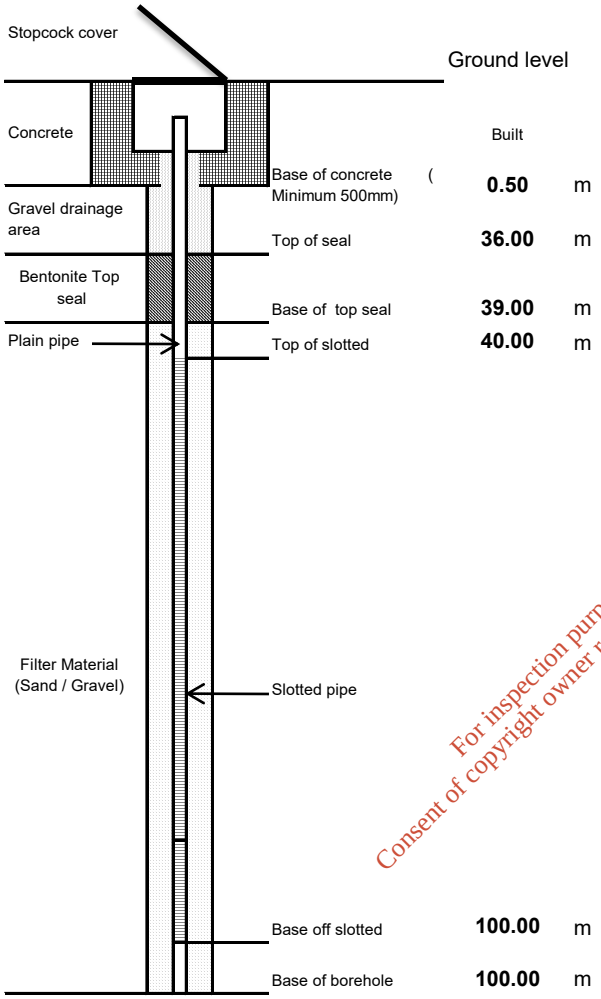
All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, ~~Leonard Grogan~~

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

Petersen Drilling Services Ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	Dry	m
Time of Initial reading	1355	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	36.00	0.50
Borehole seal top	39.00	36.00
Filter zone	100.00	39.00
Plain pipe	40.00	GL
Slotted zone	100.00	40.00
Base of borehole	100.00	

Remarks

2nd bentonite seal 8 to 6m

Rig type	Knebel HY79	**Project Title**			
Drilling Crew Details		Huntstown Pit			
Support Operative	John Whyte				
Lead Driller	Stephan Petersen	**Project No**		21-Jun	
Site category	Green	**Day**	Tuesday	**Date**	March 16, 2021
Engineer	D Baird			**Borehole Number**	
Lead Driller's signature				**GW 6B**	

AGS

Produced by KeyLogbook

Petersen Drilling Services Ltd. on behalf of Roadstone — Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description
0.00	dark grey rock fill Made Ground
3.50	soft clay fill dark grey [MADE GROUND]
5.60	Firm dark grey brownish gravelly CLAY
6.80	Weak to Medium strong interbedded weathered grey LIMESTONE
8.50	Strong dark grey blackish LIMESTONE with frequent fractures
36.50	Very weak fractured grey brownish LIMESTONE with frequent clay infill

Sample / Hole / Test Details

No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)

Drilling Details

Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour

Standard Penetration Test

Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0845			
Finish time (hhmm)	**Hole (m)**	**Water (m)**	**Casing (m)**
1635	78.00	Dry	8.00

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	8.00					Sim. Casing			
RO	154.00	0.00	8.00				DTH Button Bit		115	Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
0845		CAT Scanned: Yes
0845		Permit Completed: Yes
		DREM (36.50m - 61.00m): Highly fractured limestone with clay infill at 36.5-37; 40-40.5; 48.5-51; 59.5-61

SPT I.D. Number	PD1	**Calibration Date**	01/02/2021
SPT Rod Type	2 3/8 Regular	**SPT Energy Ratio**	0.00
Drilling Crew Details			**CSCS No**
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer	D Baird		
Lead Driller's signature			

Project Title

Huntstown Pit

Weather	Fine	**Project No**	21-Jun
Date	15/03/2021	**Day**	Monday
Rig type	**Knebel HY79**	**Borehole Number**	
Inclination	**Orientation**		GW 6B
Sheet	1 of 3	**Completed**	Y

AGS

Produced by KeyLogbook

Petersen Drilling Services Ltd. on behalf of Roadstone — Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
61.00	Very strong dark grey LIMESTONE																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0845			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1635	78.00	Dry	8.00

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer	D Baird		
Lead Driller's signature			

Project Title

Huntstown Pit

Weather	Fine	Project No	21-Jun
Date	15/03/2021	Day	Monday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	GW 6B
Sheet	2 of 3	Completed	Y

AGS

Produced by KeyLogbook

Petersen Drilling Services Ltd. on behalf of Roadstone — Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
			RO		0.00	100.00		0000		100	grey											0.00	Dry

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0810	78.00	Dry	8.00
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1520			

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
RO	120.00	8.00	100.00				DTH			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer	D Baird		
Lead Driller's signature			

Project Title

Huntstown Pit

Weather	Fine	Project No	21-Jun
Date	16/03/2021	Day	Tuesday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	GW 6B
Sheet	3 of 3	Completed	Y

AGS

Produced by KeyLogbook

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 1 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
							(6.10)	Boulder CLAY	
					84.58		6.10		
							(3.00)	GRAVEL and muck	
					81.58		9.10		
								Weathered rock	
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres
Scale 1:66

Contractor: Tom Briody & Son
Plant: T4

Method: Rotary open hole
Hole Size (mm): 50

Logged By: Drillers

Approved By: John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 2 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
11								Weathered rock	
12							(6.10)		
13									
14									
15					75.48		15.20		
16								LIMESTONE	
17									
18									
19								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 3 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
21								LIMESTONE	
22									
23									
24									
25									
26									
27									
28									
29									

Borehole Continued on Next Page

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 4 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
31								LIMESTONE	
32									
33									
34									
35							(33.60)		
36									
37									
38									
39								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 5 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
41								LIMESTONE	
42									
43									
44									
45									
46									
47									
48									
					41.88		48.80		
49								Brown weathered rock	
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 6 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
51								Brown weathered rock	
52									
53				▼					
54									
55							(12.10)		
56									
57									
58				▼					
59									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 7 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
								Brown weathered rock	
					29.78		60.90		
61								LIMESTONE	
62									
63									
64									
65									
66									
67									
68									
69									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 8 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
71								LIMESTONE	
72									
73									
74									
75									
76									
77									
78									
79									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 9 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
81								LIMESTONE	
82									
83									
84									
85									
86									
87									
88									
89									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 10 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
91								LIMESTONE	
92									
93									
94									
95							(50.10)		
96									
97									
98									
99								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 11 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
101								LIMESTONE	
102									
103									
104									
105									
106									
107									
108									
109									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 12 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
111								LIMESTONE	
112									
113									
114									
115									
116									
117									
118									
119									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW08**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	01/02/2019	90.68m aOD	E710435 N740657

Project: **Huntstown GW Monitoring**

Sheet 13 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
					-30.32		121.00	LIMESTONE	
121								Borehole Complete at 121.00m	
122									
123									
124									
125									
126									
127									
128									
129									

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Drilled in February 2019 - exact date unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 53m for 15 mins at 360 gallons per hour, tested at 58m for 15 mins at 500 g/h, tested at 122m for 15 mins at 500 g/h. Shut out water at 7.5m

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By: Drillers	Approved By: John Fennell, Mark Nolan
Scale 1:66	Plant: T4	Hole Size (mm): 50		

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 1 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
							(5.50)	CLAY and broken rock	
					73.15		5.50	LIMESTONE	
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 2 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
11								LIMESTONE	
12									
13									
14									
15									
16									
17									
18									
19								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 3 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
21								LIMESTONE	
22									
23									
24									
25							(31.70)		
26									
27									
28									
29									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 4 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
31								LIMESTONE	
32									
33									
34									
35									
36									
37					41.45		37.20		
					40.85		(0.60) 37.80	Broken brown crevis	
38								LIMESTONE	
39								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 5 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
41								LIMESTONE	
42									
43									
44									
45									
46									
47									
48									
49								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 6 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
51								LIMESTONE	
52									
53									
54									
55							(30.80)		
56									
57									
58									
59									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 7 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
61								LIMESTONE	
62									
63									
64									
65									
66									
67									
68					10.05		68.60		
69								Brown rock with crevises	
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 8 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
								Brown rock with crevises	
71									
72									
73									
74									
75									
76									
77									
78									
79									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 9 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
81								Brown rock with crevises	
82									
83									
84									
85							(38.10)		
86									
87									
88									
89								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 10 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
91								Brown rock with crevises	
92									
93									
94									
95									
96									
97									
98									
99								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 11 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
101								Brown rock with crevises	
102									
103									
104									
105									
106									
					-28.05		106.70		
107								Black LIMESTONE	
108									
109									
								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 12 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
111								Black LIMESTONE	
112									
113									
114									
115							(14.30)		
116									
117									
118									
119								Borehole Continued on Next Page	

Boring Progress and Water Observations						Chiselling			Water Added		General Remarks
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To	Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

BOREHOLE LOG

BOREHOLE No **GW09**

Client: **Roadstone Ltd**

Project No:	Date:	Ground Level:	Co-ordinates:
501.00180.00257	25/02/2019	78.65m aOD	E711303 N740969

Project: **Huntstown GW Monitoring**

Sheet 13 of 13

SAMPLES & TESTS				Water	STRATA				
Depth	Sample No	Test Type	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument Backfill
								Black LIMESTONE	
								Borehole Complete at 120.00m	
					-42.35		121.00		
121									
122									
123									
124									
125									
126									
127									
128									
129									

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Dpt	Casing Dia	Water Dpt	From	To	Hours	From	To

General Remarks

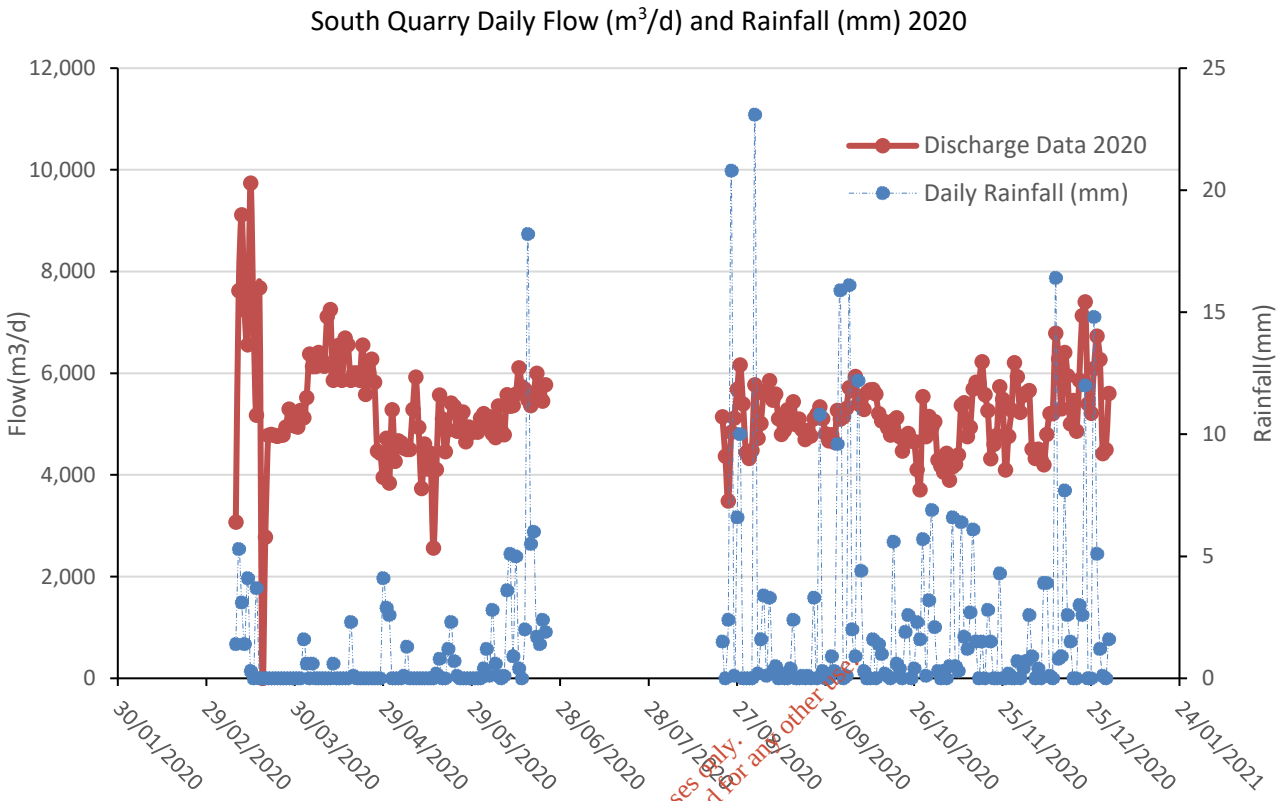
Drilling method unknown. Elevation is ground level elevation. Well diameter 150mm, PVC pipe 50mm. Well development: tested at 38m for 30s at 100 gallons per hour, tested at 91m for 15 mins at 100 g/h, tested at 122m for 15 mins at 100 g/h. Drillers installation details do not add up properly.

All dimensions in metres	Contractor: Tom Briody & Son	Method: Rotary open hole	Logged By:	Approved By:
Scale 1:66	Plant: T4	Hole Size (mm): 50	Drillers	John Fennell, Mark Nolan

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930:2015

APPENDIX 7-D

Discharge Volumes



APPENDIX 7-E

Groundwater Quality Monitoring

		SI No 366 of 2016 (GW Regs)	SI No 122 of 2014 (DW Regs)	EPA IGVs	26/06/2020			28/09/2020		
					GW6A	GW8	GW9	GW6A	GW8	GW9
Carbon										
Carbon, Organic (diss.filt)	mg/l				<3	5.67	<3	<3	5.55	<3
Inorganics										
Ammoniacal Nitrogen as N (low level)	mg/l	0.065-0.175		0.15	0.0853	0.527	0.0788	0.108	0.662	0.0495
Ammoniacal Nitrogen Low as NH3	mg/l	0.07891-0.21245		0.1821	0.104	0.64	0.0957	0.131	0.804	0.0601
Chloride	mg/l	24-187.5	250	30	27.9	31.1	30.9	29.4	30.2	30.7
Conductivity @ 20 deg.C	mS/cm	0.8 - 1.875*	2.5	1	1.09	0.627	0.879	1.08	0.652	0.946
Cyanide, Free (low level)	µg/l	37.5	50	10	<2.5	<2.5	<2.5	-	-	-
Cyanide, Total (low level)	µg/l	37.5	50	10	<5	<5	<5	-	-	-
Fluoride	mg/l		0.8	1	0.548	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrate as NO3	mg/l	37.5	50	25	2.6	0.752	<0.3	<0.3	<0.3	1.17
pH	pH Units		6.5 - 9.5	6.5 - 9.5	7.21	7.46	7.46	7.3	7.35	7.57
Phosphate (Ortho as PO4)	mg/l			0.03	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate	mg/l	187.5	250	200	370	46.7	222	370	53.1	221
Sulphide	mg/l				0.0451	0.0238	<0.01	<0.01	<0.01	<0.01
Filtered (Dissolved) Metals										
Antimony (diss.filt)	µg/l		5		18.5	<1	1.55	2.1	<1	1.35
Arsenic (diss.filt)	µg/l	7.5	10	10	3.33	1.27	1.33	6.65	0.55	1.3
Barium (diss.filt)	µg/l			100	17.3	144	55.9	14.5	130	91.2
Boron (diss.filt)	µg/l				27.6	27.1	19.2	28.8	28.7	23.1
Cadmium (diss.filt)	µg/l	3.75	5	5	<0.08	<0.08	0.0941	<0.08	<0.08	<0.08
Chromium (diss.filt)	µg/l	37.5	50	30	<1	<1	<1	<1	<1	<1
Chromium, Hexavalent	mg/l	0.0075		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Copper (diss.filt)	µg/l	1500	2000	30	0.381	1.35	1.82	<0.3	0.928	1.35
Iron (diss.filt)	mg/l		0.2	0.2	0.0248	0.389	<0.019	0.377	<0.019	0.0427
Lead (diss.filt)	µg/l	7.5	10	10	0.786	0.756	0.264	0.539	<0.2	0.523
Mercury (diss.filt)	µg/l	0.75	1	1	<0.01	<0.01	<0.01			
Nickel (diss.filt)	µg/l	15	20	20	9.91	6.21	5.02	5.93	6.33	3.19
Selenium (diss.filt)	µg/l		10		<1	<1	1.26	<1	<1	2.54
Vanadium (diss.filt)	µg/l				<1	<1	<1	<1	<1	<1
Zinc (diss.filt)	µg/l	75		100	73.2	49.3	132	43.7	10.4	137
Phenols										
Cresols	mg/l				<0.006	<0.006	<0.006	-	-	-
Phenol	mg/l			0.5	<0.002	<0.002	<0.002	-	-	-
Phenols, Total Detected monohydric	mg/l				<0.016	<0.016	<0.016	-	-	-
Xylenols	mg/l				<0.008	<0.008	<0.008	-	-	-
Gasoline Range Organics (GRO)										
GRO >C10-C12	µg/l				<10	<10	<10	<10	<10	<10
GRO >C5-C6	µg/l				<10	<10	<10	<10	<10	<10
GRO >C6-C7	µg/l				<10	<10	<10	<10	<10	<10
GRO >C7-C8	µg/l				<10	<10	<10	<10	<10	<10
GRO >C8-C10	µg/l				<10	<10	<10	<10	<10	<10
EPH (Extractable Petroleum Hydrocarbons)										
EPH Band >C10-C12 (aq)	µg/l				<100	<100	<100	<100	<100	<200
EPH Band >C12-C16 (aq)	µg/l				<100	<100	<100	<100	<100	<200
EPH Band >C16-C21 (aq)	µg/l				<100	<100	<100	<100	<100	<200
EPH Band >C21-C28 (aq)	µg/l				<100	<100	<100	<100	<100	<200
EPH Band >C28-C35 (aq)	µg/l				<100	<100	<100	<100	<100	<200
EPH Band >C35-C40 (aq)	µg/l				<100	<100	<100	<100	<100	<200
EPH Range >C10 - C40 (aq)	µg/l			10	104	<100	160	<100	<100	237
TPH Criteria Working Group (TPH CWG)										
Benzene	µg/l	0.75	1	1	<7	<7	<7	<7	<7	<7
Ethylbenzene	µg/l			10	<5	<5	<5	<5	<5	<5
GRO >C5-C12	µg/l				<50	<50	<50	<50	<50	<50
m,p-Xylene	µg/l				<8	<8	<8	<8	<8	<8
Methyl tertiary butyl ether (MTBE)	µg/l			30	<3	<3	<3	<3	<3	<3
o-Xylene	µg/l				<3	<3	<3	<3	<3	<3
Sum of detected BTEX	µg/l				<28	<28	<28	<28	<28	<28
Sum of detected Xylenes	µg/l				<11	<11	<11	<11	<11	<11
Toluene	µg/l	525		10	<4	<4	<4	<4	<4	<4
Total EPH (C6-C40) (aq)	µg/l			10	104	<100	160	<100	<100	237
Polyaromatic Hydrocarbons (PAHs)										
Acenaphthene (aq)	µg/l				<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Acenaphthylene (aq)	µg/l				<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Anthracene (aq)	µg/l			10000	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Benzo(a)anthracene (aq)	µg/l				<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Benzo(a)pyrene (aq)	µg/l	0.0075	0.01	0.01	<0.002	<0.002	<0.002	<0.00017	<0.00017	<0.00017
Benzo(b)fluoranthene (aq)	µg/l			0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Benzo(g,h,i)perylene (aq)	µg/l			0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Benzo(k)fluoranthene (aq)	µg/l			0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Chrysene (aq)	µg/l				<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Dibenzo(a,h)anthracene (aq)	µg/l				<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Fluoranthene (aq)	µg/l			1	<0.005	<0.005	0.00591	<0.0009	<0.0009	<0.0009
Fluorene (aq)	µg/l				<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Indeno(1,2,3-cd)pyrene (aq)	µg/l			0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01
Naphthalene (aq)	µg/l			1	<0.01	0.0146	0.0283	<0.01	<0.01	0.0325
PAH, Total Detected USEPA 16 (aq)	µg/l	0.075		0.1	<0.082	<0.082	<0.082	<0.082	<0.082	<0.164
Phenanthrene (aq)	µg/l				<0.005	<0.005	0.0149	<0.005	<0.005	0.0176

	SI No 366 of 2016 (GW Regs)	SI No 122 of 2014 (DW Regs)	EPA IGVs	26/06/2020			28/09/2020		
				GW6A	GW8	GW9	GW6A	GW8	GW9
Pyrene (aq) µg/l				<0.005	<0.005	0.00872	<0.005	<0.005	<0.01
PCB's - (Solids)									
PCB congener 101 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 105 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 114 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 118 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 123 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 126 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 138 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 153 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 156 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 157 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 167 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 169 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 180 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 189 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 28 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 52 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 77 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
PCB congener 81 µg/l				<0.015	<0.015	<0.015	<0.015	<0.015	<0.03
Sum of detected EC7 PCB's µg/l			0.01	<0.105	<0.105	<0.105	<0.105	<0.105	<0.21
Semi-Volatile Organic Compounds (SVOCs)									
1,2,4-Trichlorobenzene (aq) µg/l				<8	<1	<100	-	-	-
1,2-Dichlorobenzene (aq) µg/l			10	<8	<1	<100	-	-	-
1,3-Dichlorobenzene (aq) µg/l				<8	<1	<100	-	-	-
1,4-Dichlorobenzene (aq) µg/l				<8	<1	<100	-	-	-
2,4,5-Trichlorophenol (aq) µg/l				<8	<1	<100	-	-	-
2,4,6-Trichlorophenol (aq) µg/l			200	<8	<1	<100	-	-	-
2,4-Dichlorophenol (aq) µg/l				<8	<1	<100	-	-	-
2,4-Dimethylphenol (aq) µg/l				<8	<1	<100	-	-	-
2,4-Dinitrotoluene (aq) µg/l				<8	<1	<100	-	-	-
2,6-Dinitrotoluene (aq) µg/l				<8	<1	<100	-	-	-
2-Chloronaphthalene (aq) µg/l				<8	<1	<100	-	-	-
2-Chlorophenol (aq) µg/l				<8	<1	<100	-	-	-
2-Methylnaphthalene (aq) µg/l				<8	<1	<100	-	-	-
2-Methylphenol (aq) µg/l				<8	<1	<100	-	-	-
2-Nitroaniline (aq) µg/l				<8	<1	<100	-	-	-
2-Nitrophenol (aq) µg/l				<8	<1	<100	-	-	-
3-Nitroaniline (aq) µg/l				<8	<1	<100	-	-	-
4-Bromophenylphenylether (aq) µg/l				<8	<1	<100	-	-	-
4-Chloro-3-methylphenol (aq) µg/l				<8	<1	<100	-	-	-
4-Chloroaniline (aq) µg/l				<8	<1	<100	-	-	-
4-Chlorophenylphenylether (aq) µg/l				<8	<1	<100	-	-	-
4-Methylphenol (aq) µg/l				<8	<1	<100	-	-	-
4-Nitroaniline (aq) µg/l				<8	<1	<100	-	-	-
4-Nitrophenol (aq) µg/l				<8	<1	<100	-	-	-
Acenaphthene (aq) µg/l				<8	<1	<100	-	-	-
Acenaphthylene (aq) µg/l				<8	<1	<100	-	-	-
Anthracene (aq) µg/l				<8	<1	<100	-	-	-
Azobenzene (aq) µg/l				<8	<1	<100	-	-	-
Benzo(a)anthracene (aq) µg/l				<8	<1	<100	-	-	-
Benzo(a)pyrene (aq) µg/l	0.0075		0.01	<8	<1	<100	-	-	-
Benzo(b)fluoranthene (aq) µg/l			0.5	<8	<1	<100	-	-	-
Benzo(g,h,i)perylene (aq) µg/l			0.05	<8	<1	<100	-	-	-
Benzo(k)fluoranthene (aq) µg/l			0.05	<8	<1	<100	-	-	-
bis(2-Chloroethoxy)methane (aq) µg/l				<8	<1	<100	-	-	-
bis(2-Chloroethyl)ether (aq) µg/l				<8	<1	<100	-	-	-
bis(2-Ethylhexyl) phthalate (aq) µg/l				<16	<2	<200	-	-	-
Butylbenzyl phthalate (aq) µg/l				<8	<1	<100	-	-	-
Carbazole (aq) µg/l				<8	<1	<100	-	-	-
Chrysene (aq) µg/l				<8	<1	<100	-	-	-
Dibenzo(a,h)anthracene (aq) µg/l				<8	<1	<100	-	-	-
Dibenzofuran (aq) µg/l				<8	<1	<100	-	-	-
Diethyl phthalate (aq) µg/l				<8	<1	<100	-	-	-
Dimethyl phthalate (aq) µg/l				<8	<1	<100	-	-	-
Fluoranthene (aq) µg/l				<8	<1	<100	-	-	-
Fluorene (aq) µg/l				<8	<1	<100	-	-	-
Hexachlorobenzene (aq) µg/l			0.03	<8	<1	<100	-	-	-
Hexachlorobutadiene (aq) µg/l			0.1	<8	<1	<100	-	-	-
Hexachlorocyclopentadiene (aq) µg/l				<8	<1	<100	-	-	-
Hexachloroethane (aq) µg/l				<8	<1	<100	-	-	-
Indeno(1,2,3-cd)pyrene (aq) µg/l			0.05	<8	<1	<100	-	-	-
Isophorone (aq) µg/l				<8	<1	<100	-	-	-
Naphthalene (aq) µg/l				<8	<1	<100	-	-	-
n-Dibutyl phthalate (aq) µg/l				<8	<1	<100	-	-	-
n-Dioctyl phthalate (aq) µg/l				<40	<5	<500	-	-	-
Nitrobenzene (aq) µg/l			10	<8	<1	<100	-	-	-
n-Nitroso-n-dipropylamine (aq) µg/l				<8	<1	<100	-	-	-

	SI No 366 of 2016 (GW Regs)	SI No 122 of 2014 (DW Regs)	EPA IGVs	26/06/2020			28/09/2020		
				GW6A	GW8	GW9	GW6A	GW8	GW9
Pentachlorophenol (aq) µg/l			2	<8	<1	<100	-	-	-
Phenanthrene (aq) µg/l				<8	<1	<100	-	-	-
Phenol (aq) µg/l			0.5	<8	<1	<100	-	-	-
Pyrene (aq) µg/l				<8	<1	<100	-	-	-
Volatile Organic Compounds (VOCs)									
1,1,1,2-Tetrachloroethane µg/l				<0.1	<0.1	<0.1	-	-	-
1,1,1-Trichloroethane µg/l			500	<0.1	<0.1	<0.1	-	-	-
1,1,2,2-Tetrachloroethane µg/l				<0.1	<0.1	<0.1	-	-	-
1,1,2-Trichloroethane µg/l				<0.1	<0.1	<0.1	-	-	-
1,1-Dichloroethane µg/l				<0.1	<0.1	<0.1	-	-	-
1,1-Dichloroethene µg/l				<0.1	<0.1	<0.1	-	-	-
1,1-Dichloropropene µg/l				<0.1	<0.1	<0.1	-	-	-
1,2,3-Trichlorobenzene µg/l				<0.1	<0.1	<0.1	-	-	-
1,2,3-Trichloropropane µg/l				<0.3	<0.3	<0.3	-	-	-
1,2,4-Trichlorobenzene µg/l				<0.1	<0.1	<0.1	-	-	-
1,2,4-Trimethylbenzene µg/l				<0.1	<0.1	<0.1	-	-	-
1,2-Dibromo-3-chloropropane µg/l				<0.2	<0.2	<0.2	-	-	-
1,2-Dibromoethane µg/l				<0.1	<0.1	<0.1	-	-	-
1,2-Dichlorobenzene µg/l			10	<0.1	<0.1	<0.1	-	-	-
1,2-Dichloroethane µg/l	2.25	3	10	<0.2	<0.2	<0.2	-	-	-
1,2-Dichloropropane µg/l				<0.2	<0.2	<0.2	-	-	-
1,3,5-Trimethylbenzene µg/l				<0.1	<0.1	<0.1	-	-	-
1,3-Dichlorobenzene µg/l				<0.1	<0.1	<0.1	-	-	-
1,3-Dichloropropane µg/l				<0.1	<0.1	<0.1	-	-	-
1,4-Dichlorobenzene µg/l				<0.1	<0.1	<0.1	-	-	-
2-Chlorotoluene µg/l				<0.1	<0.1	<0.1	-	-	-
4-Chlorotoluene µg/l				<0.1	<0.1	<0.1	-	-	-
4-iso-Propyltoluene µg/l				<0.1	<0.1	<0.1	-	-	-
Benzene µg/l	0.75	1	1	<0.2	<0.2	<0.2	-	-	-
Bromobenzene µg/l				<0.1	<0.1	<0.1	-	-	-
Bromochloromethane µg/l				<0.2	<0.2	<0.2	-	-	-
Bromodichloromethane µg/l				<0.1	<0.1	<0.1	-	-	-
Bromoform µg/l				<0.1	<0.1	<0.1	-	-	-
Carbontetrachloride µg/l				<0.1	<0.1	<0.1	-	-	-
Chlorobenzene µg/l			1	<0.6	<0.6	<0.6	-	-	-
Chloroethane µg/l				<0.2	<0.2	<0.2	-	-	-
Chloroform µg/l			12	<0.1	<0.1	<0.1	-	-	-
Cis-1,2-Dichloroethene µg/l				<0.1	<0.1	<0.1	-	-	-
cis-1,3-Dichloropropene µg/l				<0.1	<0.1	<0.1	-	-	-
Dibromochloromethane µg/l				<0.1	<0.1	<0.1	-	-	-
Dibromomethane µg/l				<0.1	<0.1	<0.1	-	-	-
Ethylbenzene µg/l			10	<0.1	<0.1	<0.1	-	-	-
Hexachlorobutadiene µg/l				<0.1	<0.1	<0.1	-	-	-
Isopropylbenzene µg/l				<0.1	<0.1	<0.1	-	-	-
m,p-Xylene µg/l				<0.2	<0.2	<0.2	-	-	-
Naphthalene µg/l				<0.1	<0.1	<0.1	-	-	-
n-Butylbenzene µg/l				<0.1	<0.1	<0.1	-	-	-
o-Xylene µg/l				<0.2	<0.2	<0.2	-	-	-
Propylbenzene µg/l				<0.1	<0.1	<0.1	-	-	-
sec-Butylbenzene µg/l				<0.1	<0.1	<0.1	-	-	-
Styrene µg/l				<0.1	<0.1	<0.1	-	-	-
tert-Butylbenzene µg/l				<0.1	<0.1	<0.1	-	-	-
Tetrachloroethene µg/l	7.5	10*		<0.1	<0.1	<0.1	-	-	-
Toluene µg/l			10	<0.2	<0.2	<0.2	-	-	-
Trans-1,2-Dichloroethene µg/l				<0.1	<0.1	<0.1	-	-	-
trans-1,3-Dichloropropene µg/l				<0.2	<0.2	<0.2	-	-	-
Trichloroethene µg/l	7.5	10*	70	<0.1	<0.1	<0.1	-	-	-
Trichlorofluoromethane µg/l				<0.1	<0.1	<0.1	-	-	-
Vinyl chloride µg/l	0.375	0.5		<0.1	<0.1	<0.1	-	-	-
Combined Pesticides / Herbicides									
1,2,3-Trichlorobenzene µg/l				<0.01	<0.01	<0.1	-	-	-
1,2,4-Trichlorobenzene µg/l				<0.01	<0.01	<0.1	-	-	-
1,3,5-Trichlorobenzene µg/l				<0.01	<0.01	<0.1	-	-	-
Aldrin µg/l				<0.01	<0.01	<0.01	-	-	-
alpha-HCH µg/l				<0.01	<0.01	<0.01	-	-	-
Atrazine µg/l	0.075		1	<0.01	<0.01	<0.1	-	-	-
Azinphos ethyl µg/l				<0.04	<0.04	<0.4	-	-	-
Azinphos methyl µg/l				<0.04	<0.04	<0.4	-	-	-
beta-HCH µg/l				<0.01	<0.01	<0.01	-	-	-
Carbophenothion µg/l				<0.01	<0.01	<0.1	-	-	-
Chlorfenvinphos µg/l			5	<0.01	<0.01	<0.1	-	-	-
Chlorpyriphos µg/l			90000	<0.01	<0.01	<0.1	-	-	-
Chlorpyriphos-methyl µg/l				<0.01	<0.01	<0.1	-	-	-
cis-Chlordane µg/l				<0.01	<0.01	<0.01	-	-	-
cis-Chlordane µg/l				<0.01	<0.01	<0.1	-	-	-
delta-HCH µg/l				<0.01	<0.01	<0.01	-	-	-
Demeton-S-methyl µg/l				<0.01	<0.01	<0.1	-	-	-
Diazinon µg/l				<0.01	<0.01	<0.1	-	-	-

	SI No 366 of 2016 (GW Regs)	SI No 122 of 2014 (DW Regs)	EPA IGVs	26/06/2020			28/09/2020		
				GW6A	GW8	GW9	GW6A	GW8	GW9
Dichlobenil µg/l				<0.01	<0.01	<0.1	-	-	-
Dichlorvos µg/l			0.001	<0.01	<0.01	<0.1	-	-	-
Dieldrin µg/l				<0.01	<0.01	<0.01	-	-	-
Dimethoate µg/l				<0.01	<0.01	<0.1	-	-	-
Disulfoton µg/l				<0.01	<0.01	<0.1	-	-	-
Endosulphan I µg/l				<0.01	<0.01	<0.01	-	-	-
Endosulphan II µg/l				<0.02	<0.02	<0.02	-	-	-
Endosulphan Sulphate µg/l				<0.02	<0.02	<0.02	-	-	-
Endrin µg/l				<0.01	<0.01	<0.01	-	-	-
Ethion µg/l				<0.01	<0.01	<0.1	-	-	-
Fenitrothion µg/l				<0.01	<0.01	<0.1	-	-	-
Fenthion µg/l				<0.01	<0.01	<0.1	-	-	-
gamma-HCH (Lindane) µg/l				<0.01	<0.01	<0.01	-	-	-
Heptachlor µg/l				<0.01	<0.01	<0.01	-	-	-
Heptachlor epoxide µg/l				<0.01	<0.01	<0.01	-	-	-
Hexachlorobenzene µg/l			0.03	<0.01	<0.01	<0.1	-	-	-
Hexachlorobutadiene µg/l			0.1	<0.01	<0.01	<0.1	-	-	-
Isodrin µg/l				<0.01	<0.01	<0.01	-	-	-
Malathion µg/l			0.01	<0.01	<0.01	<0.1	-	-	-
Methyl Parathion µg/l				<0.01	<0.01	<0.1	-	-	-
Mevinphos µg/l				<0.01	<0.01	<0.1	-	-	-
o,p'-DDD (TDE) µg/l				<0.01	<0.01	<0.01	-	-	-
o,p'-DDE µg/l				<0.01	<0.01	<0.01	-	-	-
o,p'-DDT µg/l				<0.01	<0.01	<0.01	-	-	-
o,p'-Methoxychlor µg/l				<0.01	<0.01	<0.01	-	-	-
p,p'-DDD (TDE) µg/l				<0.01	<0.01	<0.01	-	-	-
p,p'-DDE µg/l				<0.01	<0.01	<0.01	-	-	-
p,p'-DDT µg/l				<0.01	<0.01	<0.01	-	-	-
p,p'-Methoxychlor µg/l				<0.01	<0.01	<0.01	-	-	-
Parathion µg/l				<0.01	<0.01	<0.1	-	-	-
Pendimethalin µg/l				<0.01	<0.01	<0.1	-	-	-
Permethrin I µg/l				<0.01	<0.01	<0.01	-	-	-
Permethrin II µg/l				<0.01	<0.01	<0.01	-	-	-
Phorate µg/l				<0.01	<0.01	<0.1	-	-	-
Phosalone µg/l				<0.02	<0.02	<0.2	-	-	-
Pirimiphos-methyl µg/l				<0.01	<0.01	<0.1	-	-	-
Propetamphos µg/l				<0.01	<0.01	<0.1	-	-	-
Simazine µg/l	0.075		1	<0.01	<0.01	<0.1	-	-	-
Tecnazene µg/l				<0.01	<0.01	<0.1	-	-	-
trans-Chlordane µg/l				<0.01	<0.01	<0.01	-	-	-
trans-Chlordane µg/l				<0.01	<0.01	<0.1	-	-	-
Triadimefon µg/l				<0.01	<0.01	<0.1	-	-	-
Triallate µg/l				<0.01	<0.01	<0.1	-	-	-
Triazophos µg/l				<0.01	<0.01	<0.1	-	-	-
Trifluralin µg/l			0.1	<0.01	<0.01	<0.01	-	-	-

Exceeds limit of detection

APPENDIX 7-F

Discharge Licence WPW/F/075

COMHAIRLE CONTAE FHINE GALL

FINGAL COUNTY COUNCIL

LICENCE TO DISCHARGE TRADE EFFLUENT TO WATERS

To: Roadstone Wood Ltd.,
Fortunestown,
Tallaght,
Dublin 24.

Ref. Number in Register: **WPW/F/075**

Fingal County Council (hereinafter referred to as "the Council") in exercise of the powers conferred on it by the Local Government (Water Pollution) Acts 1977 and 1990, hereby grants a Licence, Reference Number WPW/F/075 to Roadstone Wood Ltd., Fortunestown, Tallaght, Dublin 24 (hereinafter referred to as "Licensee") to discharge trade effluent to waters from their premises at Huntstown South Quarry, Ashbourne Road, Finglas, Dublin 11, subject to the following conditions:-

1. The temperature of the treated effluent shall not exceed **25 degrees Centigrade**, or **ambient temperature** if it exceeds **25 degrees Centigrade.**

2. The **pH** of the treated effluent shall lie in the range **6.0 to 9.0.**
The **pH** of the receiving waters shall not be altered by more than **+/- 0.5 pH** units by the effluent discharge.

3. Over any 24 hour period, the mean concentration of **biochemical oxygen demand (B.O.D.)** in the effluent shall not exceed **3 mg/litre 0_2** and the maximum concentration of **B.O.D.** shall not exceed **5 mg/litre 0_2.** The total quantity of biochemical oxygen demand discharged in this period shall not exceed **21.9 Kgs. (P.E. = 365)**

4. Over any 24 hour period, the mean concentration of **chemical oxygen demand (C.O.D.)** in the effluent shall not exceed **30 mg/litre** and the maximum concentration of **C.O.D.** shall not exceed **50 mg/litre**. The total quantity of chemical oxygen demand discharged in this period shall not exceed **219 Kgs.**

5. Over any 24 hour period, the mean concentration of suspended solids in the effluent shall not exceed **20 mg/litre** and the maximum concentration of **suspended solids** shall not exceed **30 mg/litre**. The total quantity of suspended solids discharged in this period shall not exceed **146 Kgs.**

6. The concentration of mineral oils in the effluent shall not exceed **10.0** mg/l.
The total quantity of mineral oils discharged per day shall not exceed **73 Kgs.**

Petroleum hydrocarbons shall not be present in the effluent which would:
(a) Form a visible film on the receiving water surface or form coatings on the sub-stratum.
(b) Impart a detectable hydrocarbon taste to edible finfish and/or shellfish.
(c) Cause deleterious effects on aquatic life.

7. The concentration of detergents in the effluent shall not exceed **10.0 mg/l.**
The total quantity of detergents discharged per day shall not exceed **73 Kgs.**

8. The concentration of **Ammonium (as N)** in the effluent shall not exceed **1 mg/l as N.**
The total quantity of **Ammonium** discharged per day shall not exceed **7.3 Kg as N.**

9. The concentration of **Phosphates (as PO_4-P)** in the effluent shall not exceed **0.1 mg/l as P.**
The total quantity of **Phosphates** discharged per day shall not exceed **0.73 Kg as P.**

10. The concentration of **Sulphates (as SO_4)** in the effluent shall not exceed **300 mg/l.**
The total quantity of **Sulphates** discharged per day shall not exceed **2190 Kgs as SO_4.**

11. Over any 24 period, the maximum volume of effluent discharged shall not exceed **7300 cubic metres.**

12. Materials classifiable as Hazardous Waste under the Waste Management Acts, shall not be discharged to waters.

13. Other wastewaters (including firewater, accidental spillages etc.) arising on the site shall not be discharged to waters without prior authorisation of Fingal County Council.

14. The effluent discharged shall be of the same nature and composition as described and conditioned in this licence. The effluent shall contain no other substances in such a concentration, nor to be discharged in such a manner as to be harmful or detrimental to public health or to domestic, commercial, industrial agricultural or recreational uses of the receiving waters.

15. All storage tanks for fuel and or chemicals shall be surrounded by a bund capable of retaining 110% of the volume of the largest single tank within the bunded area. The intake and outlet for the tanks shall be positioned inside the bund. Provision shall be made to remove and dispose of the rainwater so as to ensure the specified volume is always available within the bund. The bund shall be constructed and maintained by the Licensee to specifications agreed with Fingal County Council.

16. The Licensee shall keep records, in such form as required, of volume, rate of discharge, nature and composition of the trade effluent discharged and these shall be available at all reasonable times for inspection by duly authorised persons as defined in Section 28(9) of the Local Government (Water Pollution) Acts 1977 & 1990. Copies of such records shall be sent to the Council on demand.

17. A record or log-book of cleaning, maintenance and performance of each settling pond shall be kept and made available for inspection at all times by duly authorised persons as defined in Section 28(9) of the Local Government (Water Pollution) Acts 1977 & 1990.

18. The Licensee shall display in a prominent position a notice to the effect that in the event of an accidental discharge, spillage or deposit of any polluting matter which enters or is likely to enter any waters or a sewer, the person responsible shall notify the Council as soon as practicable after the occurrence and the and that failure to do so is an offence under Section 14, Local Government (Water Pollution) Acts 1977 & 1990.

19. The Licensee shall monitor the discharge of treated effluent to ensure compliance with the conditions of this licence. Representative samples of the treated final effluent shall be taken by the Licensee and tested for the chemical and physical characteristics conditioned in this licence using standard methods. The frequency of sampling shall be as necessary but shall not be less than **12 times per year (monthly).**

    The costs of all such tests shall be borne by the Licensee.

20. A fee of **€205.00** per sample collected by the Fingal County Council representative for compliance monitoring is payable to Fingal County Council, to cover the cost of sample collection and chemical analysis and is payable on demand. This charge will be reviewed annually by Fingal County Council.

21. The Licensee shall permit authorised persons as defined in Section 28(9) of the Local Government (Water Pollution) Acts 1977 & 1990 as Amended, to inspect, examine and test, at all reasonable times, any works and apparatus installed in connection with the trade effluent and to take samples of the trade effluent.

22. The Licensee shall submit monitoring results to Fingal County Council on an annual basis, but not later than **January 15th** for the previous year.

23. The Licensee shall comply with all of the conditions of this Licence.

    (Note: Failure to comply with any of these conditions will result in prosecution under section 16(9) of the Local Government (Water Pollution) Acts 1977 & 1990. A conviction could result in substantial fines (up to €5,000) and/or imprisonment).

Brendan Fleming
Authorised Officer

Dated this 7th day of December 2012

APPENDIX 7-G

Surface Water Quality Results

Surface Water Chemical Test Results

Quarry Name: Huntstown South
Monitoring Location: W3

Date	Ammonia	Ammoniacal Nitrogen	BOD_5	COD	Detergents	Mineral Oil	Phosphate (as PO_4-P)	pH	Sulphate	Total Suspended Solids	Temperature
Unit	mg/L as NH_4	mg/L as N	mg/L O_2	mg/L O_2	mg/L MBAS	mg/L	mg/L as P	pH Unit	mg/L	mg/L	°C
30/01/2019	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19/02/2020	0.79	0.62	< 2	< 4	< 0.05	< 0.010	0.07	7.8	168	4	8
26/03/2019	< 1.0	< 0.08	< 2	< 4	< 0.05	< 0.010	0.1	8	155	4	12
23/04/2019	0.35	0.27	< 2	< 4	0.09	< 0.010	0.02	8	142	< 2	15
29/05/2019	0.21	0.16	< 4	27	< 0.05	< 0.010	0.01	7.7	159	11	15
26/06/2019	2.6	2	< 2	< 4	0.76	< 0.010	0.01	7.8	227	7	16
24/07/2019	0.14	0.11	< 2	< 4	0.28	< 0.010	0.03	7.9	159	< 2	20
27/08/2019	0.23	0.18	< 2	< 4	< 0.05	< 0.010	0.01	7.9	172	2	18
24/09/2019	2.3	1.8	< 2	< 4	0.38	< 0.010	0.01	7.9	160	7	16
23/10/2019	0.33	0.26	< 2	< 4	< 0.05	< 0.010	< 0.01	7.7	205	< 2	10
20/11/2019	0.2	0.15	< 2	< 4	1.3	< 0.010	0.01	7.8	216	12	9
19/12/2019	< 0.10	< 0.08	< 2	< 4	< 0.05	< 0.010	< 0.01	7.6	176	6	9
20/01/2020	< 0.10	< 0.08	< 2	< 4	< 0.05	< 0.010	0.02	8	195	3	7
24/02/2020	0.37	0.29	3	< 4	0.09	< 0.010	< 0.01	7.9	223	37	10
25/03/2020	< 0.10	< 0.08	2	< 4	0.09	< 0.010	< 0.01	7.9	114	28	11
26/05/2020	< 0.10	< 0.08	< 5	22	< 0.05	< 0.010	< 0.01	7.9	126	3	18
25/06/2020	0.1	< 0.08	< 2	< 4	< 0.05	< 0.010	0.01	7.8	164	3	18
27/07/2020	0.15	0.11	< 2	< 4	< 0.05	0.054	0.04	7.7	154	9	17
17/08/2020	0.16	0.12	< 2	< 4	< 0.05	< 10	0.01	7.7	139	7	Not recorded
21/09/2020	< 0.10	< 0.08	< 2	< 4	0.3	< 0.010	0.02	7.9	164	4	17
27/10/2020	< 0.10	< 0.08	< 2	4	1	< 0.010	< 0.01	7.9	51	3	11
16/11/2020	0.27	0.21	< 2	16	0.73	< 0.010	0.05	7.9	185	14	10
14/12/2020	0.1	0.08	< 2	< 4	0.61	< 0.010	0.01	7.8	209	13	9

APPENDIX 7-H

Rating of Existing Environment Significance / Sensitivity

APPENDIX 7-H

Rating of Existing Environment Significance / Sensitivity

(IGI, 2013 Guidelines)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	Groundwater/ Surface Water 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 wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation, e.g. NHA status. Regionally important potable water source supplying >2,500 homes. Inner source protection area for regionally important water source. Drinking water supply from river. Amenity use of waterbody.
High	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. No specific recreational use of waterbody.
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer. Potable water source supplying <50 homes. No water supply from surface water, no abstraction designation for watercourse. No amenity value of waterbody
Negligible	Attribute has negligible quality or value on a local site scale	No groundwater supply from a bedrock aquifer in vicinity of site. Surface water not used for any specific purpose.

APPENDIX 7-I

Descriptions of Effects (EPA, 2017)

APPENDIX 7-I

Descriptions of Effects (EPA, 2017)

Impact Characteristic	Term	Description
Quality of Effects	Positive Effects	A change which improves the quality of the environment.
	Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative / Adverse Effects	A change which reduces the quality of the environment.
Describing the Significance of Effects	Imperceptible	An effect capable of measurement but without significant consequences.
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound Effects	An effect which obliterates sensitive characteristics.
Describing the Extent and Context of Effects	Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?).
Describing the Probability of Effects	Likely Effects	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Unlikely Effects	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?).

Impact Characteristic	Term	Description
Describing the Duration and Frequency of Effects	Momentary Effects	Effects lasting from seconds to minutes.
	Brief Effects	Effects lasting less than a day.
	Temporary Effects	Effects lasting less than a year.
	Short-term Effects	Effects lasting one to seven years.
	Medium-term Effects	Effects lasting seven to fifteen years.
	Long-term Effects	Effects lasting fifteen to sixty years.
	Permanent Effects	Effects lasting over sixty years.
	Reversible Effects	Effects that can be undone, for example through remediation or restoration.
	Frequency of Effects	Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).
Describing the Types of Effects	Indirect / Secondary Effects	Likely, significant effects on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative Effects	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	Do-Nothing Effects	The environment as it would be in the future should the subject project not be carried out.
	Worst Case Effects	The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable Effects	When the full consequences of a change in the environment cannot be described.
	Irreversible Effects	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
	Residual Effects	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic Effects	Where the resultant effect is of greater significance than the sum of its constituents (e.g. combination of SOx and NOx to produce smog).

APPENDIX 7-J

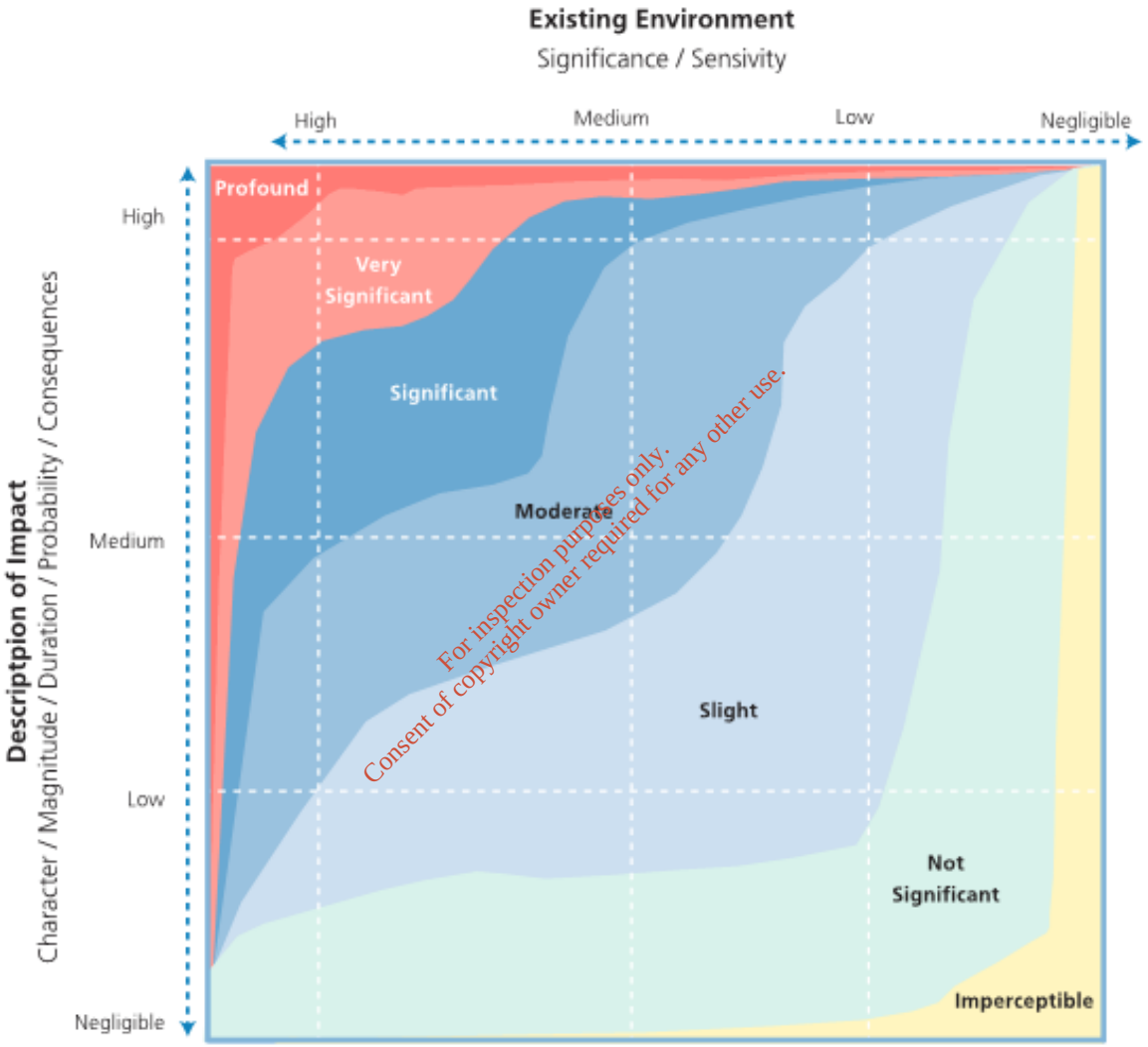
Classification of the Significance of Impacts

APPENDIX 7-J

Classification of the Significance of Impacts

Determining Significance

The diagram below shows how comparison of the character of the predicted impact to the sensitivity of the receiving environment can determine the significance of the impact.



(Source: Environmental Protection Agency (Draft - August 2017), 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports')