10 GROUNDWATER / HYDROGEOLOGY

This chapter evaluates the impacts, if any, which the development will have on Groundwater as defined in the Environmental Protection Agency (EPA) 'Advice Notes on Current Practice (in the preparation of Environmental Impact Statements'), 2003 and the Institute of Geologists of Ireland (IGI) Geology in Environmental Impact Statements – A Guide (2002).

This chapter has been prepared based on a number of previous assessments of the site, the most recent of which was completed as part of an EIS and planning application submitted in 2009. It is considered that the primary assessment undertaken at the site in 2005 addressed the primary impacts potentially affecting the Groundwater aspect. This chapter will assess the impact of proposed amendments to the existing planning permission as described in Chapter 1, on the groundwater of the site and environs. The only significant changes with respect to potential impact on groundwater is the installation of an additional domestic effluent treatment system to serve the new office block. Minor construction works will also be required for hardstanding and parking associated with the new buildings. New legislative standards for groundwater quality (SI 9 of 2010) have been considered in determining the impact on the environment.

As the primary facility has now been constructed and is operational, a number of mitigation measures recommended in previous EIS's have now been implemented. This chapter therefore represents an update of the 2009 assessment to include the results of mitigation measures as implemented and any further mitigation measures now required.

10.1 INTRODUCTION

The information regarding the existing hydrogeological environment is based on investigations completed at the site in 2000 and 2001, geotechnical reports based on assessments completed in 2007 and 2008, borehole installation completed in 2011, a desk study and information from the Geological Survey of Ireland database.

10.2 OVERBURDEN HYDROGEOLOGY

The development site is underlain by a thick deposit of low permeability brown silty clays. Some discontinuous lenses of sandy horizons and gravels were also recorded. The vulnerability of the immediate area has been classified by the Geological Survey of Ireland (GSI) as Moderate (Figure 10.1).

The boulder clay varies in thickness across the site, ranging from approximately four metres towards the west of the site, to in excess of 10 metres towards the centre underneath the main building.

With the construction of the main facility now complete, the amendments proposed by this application entail the following

- conversion from temporary to permanent of the office and spare parts facilities
- additional car parking spaces associated with the offices
- paved roadway to the offices
- additional puraflo treatment plant and percolation area for sanitary effluent from the modular office.
- Additional hardstanding areas for shutdowns and maintenance periods

For these works it is anticipated that, only shallow excavations of overburden will be required. The vulnerability in these areas is likely to be of moderate to high rating.

As described further below, the waste bunker has been designed for full containment. The bunker floor has a basal thickness of 1.1m and a wall thickness underground of 800mm. The bunker has a secondary containment system with fully sealed membrane and leak detection system to ensure that the bunker remains water tight all times. Though site conditions required the base of the bunker to be constructed below the surface of bedrock at the site, the protective design measures outlined above ensure the risk of contaminating the aquifer is very low. No changes are proposed to the bunker construction on site.

10.3 BEDROCK AQUIFER

As detailed in Section 9, the limestones found beneath the development site are part of the Platin Formation. The grey limestone which was weathered at the surface was proven by borehole drilling at the site. The limestone is typical of the Lower Carboniferous shallow water limestones. These are typically pale thick-bedded with minor shales, possible dolomitised, with palaeokarstic features (GSI Sheet 16 and Meath Groundwater Protection Scheme). The Platin Formation has been classified by the GSI as; *regionally important, diffuse karst aquifer, good development potential (Rkd)* (Figure 10.2). This classification was determined by the GSI in 2004. This regionally important aquifer displays both karst and fracture flow features.

Since the implementation of the Water Framework Directive (WFD –Directive 2000/60/EC) various initiatives have been underway to lead to its implementation in Ireland. Characterisation of aquifers is one of the first key deliverables in the implementation of the WFD. Eight River Basin districts have been established in Ireland. The development is located in the Eastern River Basin District. The karstified aquifer upon which the site is located has been classified as Rkd, described as a Regionally Important Aquifer Karstified (diffuse). The site is located within the Bettystown Groundwater Body (GWB), coded IE_EA_G_016. The EPA publication *Water Framework Status Update based on Monitoring Results 2007-2009* indicate an overall chemical status of 'Poor Status' and an overall quantitative status of 'Good Status' for the GWB. However, the final classification for the GWB is one of 'Poor Status.'

The karstic nature and productivity of the Platin Formation are demonstrated at the nearby Platin Quarry where a significant dewatering operation is required to maintain dry working conditions at the quarry floor. The development site is located within the local groundwater regime which is now largely determined by the Platin Quarry dewatering programme.

10.4 Aquifer Vulnerability and Resource Protection

On the basis of site specific data, the GSI/EPA/DoEHLG Groundwater Protection Scheme Classification (see table below) ranks the site as having a high (H) to moderate (M) vulnerability due to the thickness and type of overburden cover present at the site. Percolation testing undertaken at the site determined extremely low percolation rates due to the presence of these clays.

Table 10.1 GSI Vulnerability Mapping Guidelines.

Vulnerability Rating	Hydrogeological Requirements (below the point of release of contaminants)				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Recharge Type
	high permeability (sand/gravel)	Moderate permeability (sandy till)	Low permeability (clayey till, clay, peat)	(sand & gravel aquifers only)	
Extreme	0-3.0m	0-3.0 m	0-3.0m	0-3.0m	point (<30 m radius)
High	>3.0	3.0-10.0m	3.0-5.0m	>3.0m	N/A
Moderate	N/A	>10m	5.0-10.0m	N/A	N/A
Low	N/A	N/A	>10.0m	N/A	N/A

Notes: i)N/A =not applicable

ii) Precise permeability values cannot be given at present

iii) Release point of contaminants is assumed to be 1-2 m below ground surface

(from Daly & Warren 1997)

10.4.1 Assessment of Resource Protection Zonation

As the bedrock aquifer is considered Regionally Important, and the soil cover varies in thickness from zero at the base of the waste bunker (post construction) to in excess of 10 metres in thickness in places, the site is assigned a rating of Regionally Important-Extreme to Regionally Important-Moderate (Rk/E to Rk/M) under the GSI classification system for designating resource protection zones. The proposed amendments to the facility will not affect the rating of the site under the GSI classification system.

Response levels have been developed for three polluting activities (septic tanks, landspreading and landfills) using this matrix of resource protection zones. Based on the risk involved in each of these potentially polluting activities, they are either acceptable, acceptable subject to conditions, not acceptable with some exemptions or not acceptable. There is no response level developed for waste-to-energy facilities, however stringent mitigation measures have been incorporated into the facility design and in particular the bunker design to ensure adequate resource protection.

10.5 GROUNDWATER CHARACTERISTICS

10.5.1 Groundwater Flow

Groundwater flow beneath the development site is determined by a cone of depression centred on the Platin excavation. Prior to the quarry development, the groundwater flow beneath the development site would have been towards the River Nanny and in a general south easterly direction.

Today, the groundwater flow beneath the development site has been reversed and is now in a general northwards direction towards the nearby Platin quarry due to the lowering of the water table within the excavation. Current water levels in excess of 30m below ground level (as presented in Appendix 10.1) are well below the level of any excavations completed for the development or required by the proposed amendments.

The groundwater abstracted from the excavation at Platin Quarry is piped directly to the River Nanny and so there is no loss of groundwater to this river. In fact there is a small increase due to the Platin excavation drawing some groundwater from the Boyne River catchment.

10.5.2 Groundwater Quality

Following an assessment of the groundwater monitoring wells present at the site in June 2008, the existing monitoring wells (MW1-MW4) were found to be no longer functioning. All wells were dry. Replacement deeper monitoring boreholes (AGW1-1, AGW1-2 and AGW1-3) were installed in June 2011 at locations as shown on Figure 10.3. As part of the EPA licence for the facility regular groundwater monitoring is required and recent monitoring results are presented in Appendix 10.1

Results have been compared to Groundwater Quality Threshold Values of SI No 9 of 2010 (European Communities Environmental Objectives Groundwater Regulations 2010. Also presented are site specific warning and action trigger levels agreed with the Agency in July 2011. The development of trigger levels for the facility is ongoing. In summary, results indicate groundwater quality is moderate to good at the site. Some breaches of warning trigger (conductivity and Total Organic Carbon (TOC)) levels in both background and downgradient monitoring well have been recorded during late 2011. However, the monitoring record for these wells is not long enough to determine any trends that would indicate any impact from construction/operation. Records for the installation of these monitoring wells (and the installation of the production well) are provided in Appendix 10.2

10.6 GROUNDWATER ABSTRACTIONS

Groundwater is extensively used by the local community as a source of water supply. A GSI well search in 2005 revealed 22 recorded wells within 3km of the site. A table of the available data is presented in Appendix 10.3 It should be noted that the GSI database is not a complete data source for all private water wells.

10.6.1 On Site Groundwater Abstraction

A production well was installed at the site in June 2011 from which the water requirements of the site are supplied. A yield in excess of 600m^3/d was identified during installation which comfortably meets the water requirements for the site. The location of the production well is presented on the drawings accompanying the application. The proposed development and increase in capacity will entail only a very minor increase in abstraction requirement (c.300 litres an hour) and will therefore not alter the existing groundwater regime.

10.7 POTENTIAL IMPACTS

The main potential impacts relate to

- Groundwater contamination relating to the storage of chemicals on the site and
- Percolation of treated waste water.

10.7.1 Construction Phase

Potential impacts during the construction phase would be associated with accidental spillage of potentially polluting substances including oils, paints and liquid wastes and any additional substances associated with the construction activities.

All potentially polluting chemicals will be securely stored during the construction phase and refuelling of earth moving machinery will be carried out according to an appropriate Method Statement. Waste water generated during the construction phase will be managed via the existing foul water management network.

10.7.2 Operational Phase

The potential impacts during the operation phase would include;

- Impact on groundwater quality
- Impact due to abstraction on site.

The development site lies within the groundwater regime now established by the Platin dewatering programme. The quarry abstracts sufficient groundwater to maintain the water table just below the working quarry floor. This operation has resulted in a cone of depression in the water table that is centred on the deep excavation. The groundwater abstraction at the site is located within the Platin cone of depression.

Drawdown from this single borehole is minimal when compared to the extent of the Platin cone of depression. Also, as the volume Platin abstracts is varied to maintain the water table level at or just below the quarry floor the small additional abstraction at Indaver does not materially add to the total amount of groundwater abstracted from the aquifer. Rather, the planned abstraction at the development site results in a small net reduction in the amount of groundwater abstracted from

beneath the nearby quarry excavation with the total being abstracted from the aquifer remaining largely unchanged.

In the unlikely event that the facility abstraction is found to impact on groundwater levels in nearby private wells, the Company would remedy the situation by deepening the impacted well(s). No evidence of this has been recorded to date.

In the event that Platin Quarry should cease dewatering, it will take a considerable amount of time for the water table to recover to their pre-quarrying levels. When the water levels have recovered, it is acknowledged that the groundwater flow direction beneath the site will revert to flow in the direction of the River Nanny.

Given the stringent containment measures incorporated into the design of the facility and the bunker, the risk of leakage from the proposed development entering the groundwater system is virtually nil. Therefore even in the event of the dewatering operation ceasing at Platin, there will be no impact on the groundwater quality regime as a result of the groundwater flow direction reverting to its pre dewatering orientation.

The planned disposal of additional treated waste water from the sanitary facility in the modular office block to the ground has the potential to impact on groundwater quality immediately below the percolation area. However in order to ensure adequate protection of the aquifer, the proposed treatment plant and secondary/tertiary treatment system will be designed and constructed in accordance with the EPAs requirements as per the EPA Waste Water Treatment Manual for Small Communities, Business, Leisure Centres and Hotels (1999) and recently published EPA Guidance on the Authorisation of Discharge to Ground (2011). Two other similar treatment plants are already operational on the site at the main process building and security gate house. Both treatment systems have been designed and constructed in compliance with the relevant guidance documents.

In the event of an unmitigated accidental discharge any resulting plume would move in the direction of the Platin excavation and potentially result in the deterioration of the groundwater being pumped from the quarry. Mitigation measures to prevent such an eventuality are described under 10.8 mitigation measures below.

10.8 MITIGATION MEASURES

10.8.1 Construction Phase

Construction works will be completed in accordance with the principles of CIRIA Environmental good practice on site (C692) and the Environmental Management Plan for the site.

All oils, chemicals, paints or other potentially polluting substances used during construction will be stored in designated storage areas which will be bunded to a volume of 110% capacity of the largest tank/container within the bunded area(s). The existing designated storage areas at the site will be used to minimise risks during the construction period.

Filling and draw-off points will be fully located within the bunded area(s).

Drainage for the bunded area(s) will be diverted for collection and safe disposal.

All domestic effluent generated on site during construction works will be discharged via the existing effluent treatment plant systems. It is not proposed to provide portaloos or any other temporary sanitary facilities during construction.

10.8.2 Operational Phase

There are no additional measures/monitoring requirements as a result of the proposed amendments.

The storm water attenuation pond has been constructed with a sealing membrane commonly used for forming secondary containment liners in effluent tanks. The attenuation pond has been tested and demonstrated to be watertight to the satisfaction of the local Authority and EPA as required under the facility licence. The tank is approximately 2.6m deep and surrounded by a 2.4m high chainlink fence. A minimum permanent water level of approximately 300mm is maintained in the tank at all times. A minimum freeboard of 300mm is maintained for any storm occurrence less than 1:100 years.

The only discharge from the site is from the treatment of foul effluent in Puraflo systems and disposal via appropriately sized engineered percolation areas. The system will be designed and constructed in accordance with the EPA requirements and current best practice. All domestic effluent will be treated by an appropriate system prior to its discharge to the percolation area. The Puraflo system proposed will achieve a minimum effluent treatment standard of B.O.D. (Biochemical Oxygen Demand) 20 mg/l and T.S.S. (Total Suspended Solids) 30 mg/l.

All underground piping will be maintained and regularly inspected for integrity.

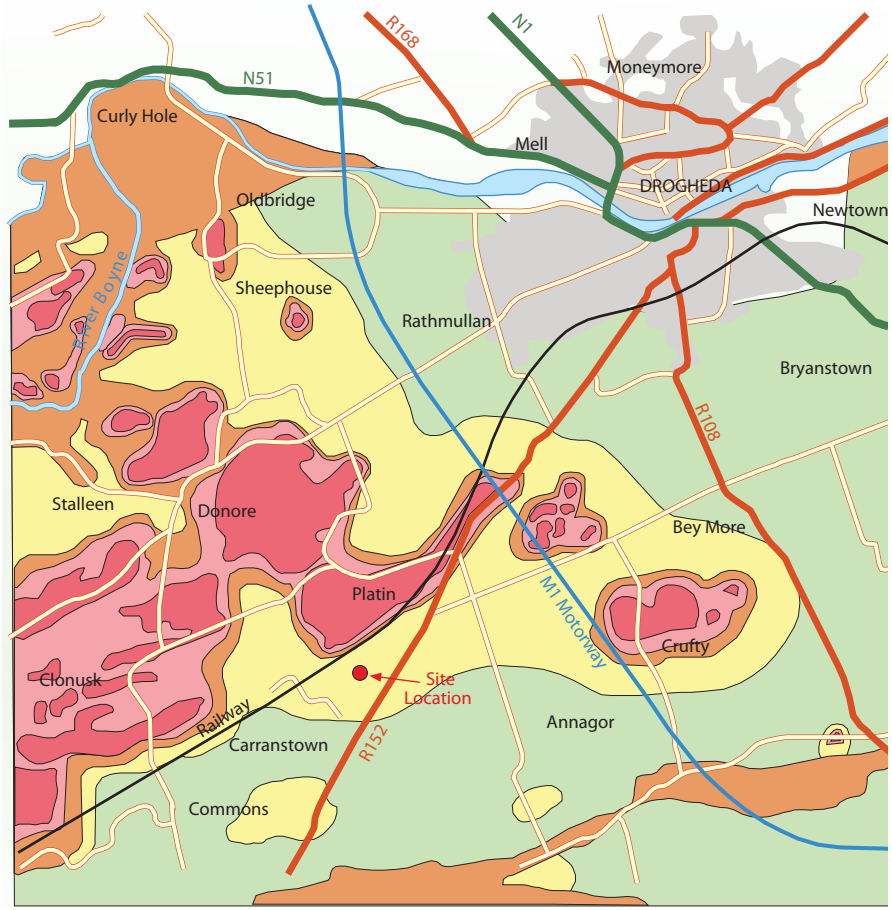
A petrol interceptor is in place on the surface water drainage outfall line from hardstanding areas to contain any leakages from vehicles on site. Full details of the proposed on site drainage network are presented in Section 11.

In the event that Platin might cease dewatering or pumping in the future, it is acknowledged that the groundwater flow direction beneath the site will revert to towards the River Nanny. This would take a considerable amount of time to recover. Given the containment measures incorporated into the design

of the facility (and in particular the waste bunker) the risk of leakage to groundwater is virtually nil. The facility will be operated in accordance with an EPA waste licence which will require regular monitoring to detect any potential contamination issues.

10.9 RESIDUAL IMPACTS

The facility as amended will not have a significant impact on the hydrogeology of the development site or beneath the surrounding lands. The proposed development will have no impact on the groundwater regime within this water body. The potential for accidental discharge during construction or operation is low and mitigation measures are in place to minimise any risk to the underlying aquifer.



Source: www.gsi.ie

0 1.6
KILOMETRES

LEGEND

- E (Rock near Surface or Karst)
- E - Extreme
- H - High
- M - Moderate
- L - Low

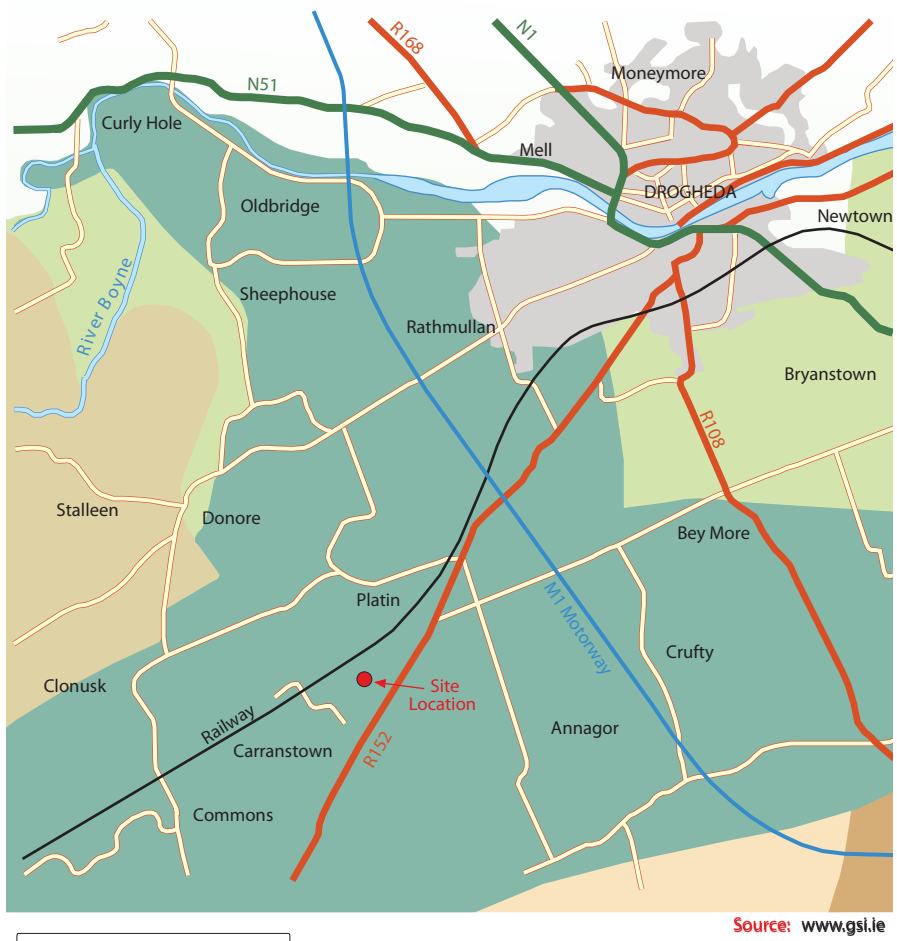
NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

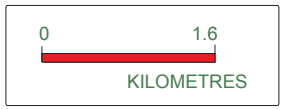
Indaver
Regional Vulnerability

Figure No. 10.1

Job No. CE07624	**Date.** Aug. 2009
Finalised By - DMcD	**Office** - 1404
Drawn By: J Farrar - CS2,Illustrator	

WYG Ireland





LEGEND

- Rkd - Regionally important, diffuse karst aquifer, good development potential
- Lm - Locally important, generally moderately productive
- Ll - Locally important , generally moderate productive in local zones
- Lg - Locally important, sand/gravel aquifers
- Pl - Poor aquifer, generally unproductive except in local zones
- Pu - Poor aquifer, bedrock which is generally unproductive

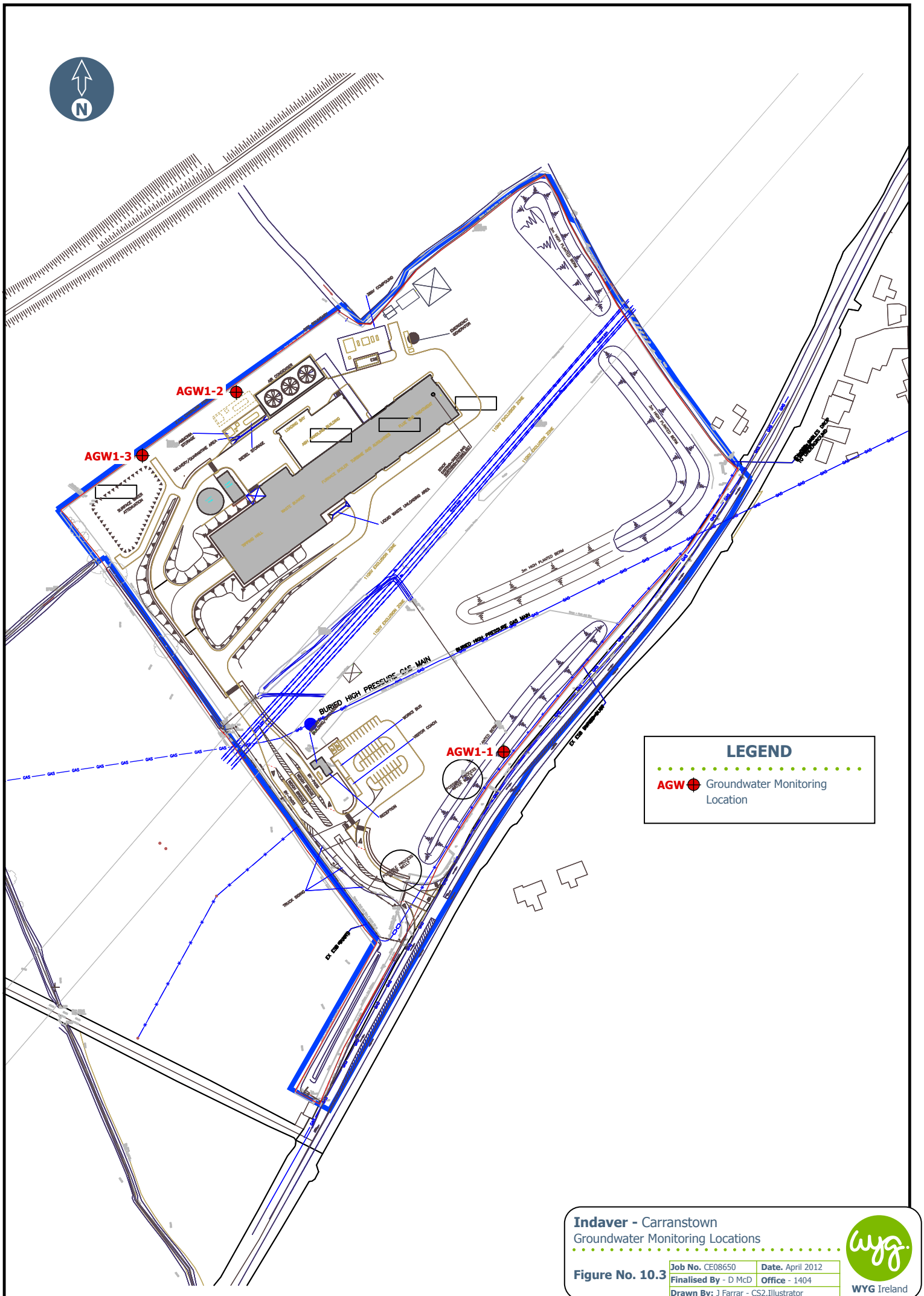
NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

Indaver
Regional Aquifers

Figure No. 10.2

Job No. CE07624	**Date.** Aug. 2009
Finalised By - DMcD	**Office** - 1404
Drawn By: J Farrar - CS2,Illustrator	

WYG Ireland



Indaver - Carranstown
Groundwater Monitoring Locations

Figure No. 10.3

Job No. CE08650	**Date.** April 2012
Finalised By - D McD	**Office** - 1404
Drawn By: J Farrar - CS2,Illustrator	

WYG Ireland

Appendix 10.1

Groundwater Monitoring Results 2011

Monitoring Location	AGW1-1	AGW1-2	AGW1-3	AGW1-1	AGW1-2	AGW1-3	AGW1-1	AGW1-2	AGW1-3	AGW1-1	AGW1-2	AGW1-3	SI 9 of 2010 Threshold Value	Trigger Level (Warning)	Trigger Level (Action)
Date of Sampling	Sep-11	Sep-11	Sep-11	Oct-11	Oct-11	Oct-11	Nov-11	Nov-11	Nov-11	Dec-11	Dec-11	Dec-11			
Field Data															
Depth of Well	62.7	49	60	62.7	49	60	62.7	49	60	62.7	49	60	-	-	-
Static Water Level	36.1	32.4	41.5	37	32.8	41.2	37.1	33.1	40.8	36.5	32.7	39.8	-	-	-
Monthly Groundwater Monitoring Suite Laboratory Parameters															
TOC (mg/l)	0.94	2.78	2.75	6.89	2.97	2.74	2.7	2.56	1.73	6.16	9.49	5.2	-	5	10
Ammonia (NH4) as N mg/l	0.01	0.01	0.023	0.044	0.021	0.01	0.01	0.01	0.01	0.01	0.022	0.01	0.175	0.125	0.175
Conductivity (uS/cm @25 degC)	780	657	643	729	650	642	**911**	667	669	**921**	667	697	1875	650	800
Biannual Monitoring Suite Laboratory Parameters															
pH	-	-	-	-	-	-	7.1	7.4	7.2	-	-	-	-	-	-
Nitrate (mg/l as N)	-	-	-	-	-	-	3.97	10.02	12.61	-	-	-	37.5	-	-
Nitrite (mg/l as N)	-	-	-	-	-	-	<0.002	<0.002	<0.002	-	-	-	0.375	-	-
Chloride (mg/l)	-	-	-	-	-	-	83.52	30.9	31.56	-	-	-	187.5	-	-
Fluoride (mg/l)	-	-	-	-	-	-	0.14	0.12	0.14	-	-	-	-	-	-
Metals _Cd (ug/l)	-	-	-	-	-	-	<0.09	<0.09	<0.09	-	-	-	0.00375	-	-
Metals_Tl (ug/l)	-	-	-	-	-	-	<0.06	<0.06	<0.06	-	-	-	-	-	-
Metals_Hg (ug/l)	-	-	-	-	-	-	<0.04	<0.04	<0.04	-	-	-	0.00075	-	-
Metals_Pb (ug/l)	-	-	-	-	-	-	<0.02	<0.02	<0.02	-	-	-	0.01875	-	-
Metals _Cr (ug/l)	-	-	-	-	-	-	<2.14	<2.14	<2.14	-	-	-	0.0375	-	-
Metals_Cu (ug/l)	-	-	-	-	-	-	<0.11	<0.11	<0.11	-	-	-	1.5	-	-
Metals_Mn (ug/l)	-	-	-	-	-	-	<0.04	<0.04	<0.04	-	-	-	-	-	-
Metals_Ni (ug/l)	-	-	-	-	-	-	<0.14	<0.14	<0.14	-	-	-	0.015	-	-
Metals_As (ug/l)	-	-	-	-	-	-	<0.1	<0.1	<0.1	-	-	-	0.0075	-	-
Metals_Co (ug/l)	-	-	-	-	-	-	<0.02	<0.02	<0.02	-	-	-	-	-	-
Metals_V (ug/l)	-	-	-	-	-	-	<0.16	<0.16	<0.16	-	-	-	-	-	-
Metals_Sn (ug/l)	-	-	-	-	-	-	<2.8	<2.8	<2.8	-	-	-	-	-	-
Organo Halogens	-	-	-	-	-	-	<1	<1	<1	-	-	-	Note 1	-	-
Total Coliforms (cfu/100ml)	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-
Faecal Coliforms (cfu/100ml)	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-

Notes:
SI 9 of 2010 Threshold Values are limit values setout in SI No 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations, 201
Trigger Level Warning and Action Values - as agreed with the Agency during 2011
Note 1- There is no standard under SI 9 of 2010 for general organo halogens though a number of compounds including TCD, VC and others have specific standards which should be compared
6.89= Shaded values exceed relevant trigger level warning limit value
911= Bold, Underlined and Shaded values exceed relevant trigger level action limit value
Note Trigger levels are presently under review with the Agency.

Appendix 10.2

Well Installation Records 2011

TOM BRIODY & SON

Well drilling specialists since 1960

Winner of Service to Business 2010

STANDARD

Ref: AQ/CBC/EPS/INDAVER/2 No Mon Well/Monitoring Well Report

MONITORING WELL REPORT

Client: Indaver Ireland
Duleek
Drogheda
Co Louth

Date: 20 June 2011.

Drillers: Stephen Harte
Stefan Grosko

Drilling commenced on the 16th June and work was completed on 18th June 2011. We used our T4 Ingersoll Rand Drill Rig to construct 2 No Monitoring Wells as per the following Method Statement.

ESTABLISH ALL PLANT & EQUIPMENT AT DRILLING LOCATION

Transport of drilling equipment onto site. Liaise with Indaver personnel and mark location of well. Fence off area and erect safety signs as required. Spoil and water will flow into sediment pit and excess water will be pumped to a safe area.

DRILLING OF 2 NO GROUND WATER MONITORING WELLS

Air hammer drill at open hole diameter 200mm to a depth of 2 metres into bedrock to accommodate 150mm diameter steel casing. Airlift well and check yield of water. Supply and install 150mm diameter steel casing. Airlift well and check yield of water. Drill 150mm diameter through bedrock to target depth. Airlift well and check yield of water every 5 metres. Supply and install 50mm diameter uPVC screen and riser. Supply local pea gravel from bottom of well to above screen section and install 0.5 metres of sand, 2 metre of bentonite and 0.5 metres of sand. Back fill with pea gravel to within 2 mts below ground level. Supply and install 0.5 mts of sand and 1 mtr of bentonite and 0.5 mts of concrete to ground level. Supply and Install lockable cap.

REINSTATEMENT OF SITE

Remove Drill rig from well location. Reports will be completed and sent to you once work is fully completed.

Tom Briody & Son Limited, Shanco, Crossakiel, Kells, Co. Meath
Tel: +353 (0) 46 9243614 Fax: +353 (0) 46 9243610
Email: info@briodydrilling.ie Web: www.briodydrilling.ie

Company Registration No: 294399
Directors: Hugh Briody, Emer Briody
VAT Number: 8294399B

Supplied and installed the following:

Monitoring Well No 1

Total Depth: 50 mts

Materials	Diameter	From	To
Steel Casing	150mm	0 mts	17 mts
Bottom Cap on uPVC Riser	50mm		
uPVC Riser	50mm	50 mts	49 mts
uPVC Screen	50mm	49 mts	34 mts
uPVC Riser	50mm	34 mts	00.0 mts
Top Cap on uPVC Riser	50mm		
Pea gravel		50 mts	33 mts
Sand		33 mts	32.5 mts
Bentonite		32.5 mts	30.5 mts
Sand		30.5 mts	30 mts
Pea Gravel		30 mts	3 mts
Sand		3 mts	2.5 mts
Bentonite		2.5 mts	0.5 mts
Sand		0.5 mts	0.0 mts
Lockable Cap		Yes	

Monitoring Well No 2

Total Depth: 60 mts

Materials	Diameter	From	To
Steel Casing	150mm	0 mts	46.7 mts
Bottom Cap on uPVC Riser	50mm		
uPVC Riser	50mm	60 mts	59 mts
uPVC Screen	50mm	59 mts	50 mts
uPVC Riser	50mm	50 mts	00.0 mts
Top Cap on uPVC Riser	50mm		
Pea gravel		60 mts	49 mts
Sand		49 mts	48.5 mts
Bentonite		48.5 mts	46.5 mts
Sand		46.5 mts	46 mts
Pea Gravel		46 mts	3 mts
Sand		3 mts	2.5 mts
Bentonite		2.5 mts	0.5 mts
Sand		0.5 mts	0.0 mts
Lockable cap		Yes	

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Directors: Hugh Briody, Emer Briody
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Well drilling specialists since 1960

Winner of Service to Business 2010

EXCELLENCE THROUGH PEOPLE STANDARD

Monitoring Well of R 152 Road

Ref: AQ/CBC/EPS/BOQ11.02.11

Customer Name: EPS
Site Address: Indaver
Duleek,
Co. Louth

DESCRIPTION	DIAMETER	DEPTH
Drill	200mm	0 – 13.1Mts
Supply & Install Steel Casing	150mm	13.1Mts
Drill	150mm	13.1 – 62.8Mts
Supply and install uPVC screen	50mm	Bottom Cap
And Riser from bottom up		62.8 – 59.8Mts Riser
		59.8 – 38.8Mts Screen
		38.8 – 00.0Mts Riser
		Top Cap
Supply and install Pea gravel		62.8 – 37.8Mts
Supply and install Sand		37.8 - 37.3Mts
Supply and install Bentonite		37.3 – 35.3Mts
Supply and install Sand		35.3 – 34.8Mts
Supply and install Pea Gravel		34.8 – 2.5Mts
Supply and install Sand		2.5 - 2.0Mts
Supply and install Bentonite		2.0 - 1.0Mts
Supply and install Sand		1.0 - 0.5Mts
Supply and install Cement		0.5 - 0.0Mts

Type of Subsoil: 0 – 10.6Mts Boulder Clay
Depth to Bedrock: 10.6Mts
Type of Bedrock: 10.6 – 62.8Mts Limestone
Well Development: 2Hrs
Water Entry: 61Mts – 11m3/Day

Remarks:
No Water in Overburden
Supply and Install Cast Iron Manhole Cover

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EXCELLENCE THROUGH PEOPLE STANDARD

Monitoring Well No 1

Ref: AQ/CBC/EPS/Indaverl/MW l

Customer Name: EPS
Site Address: Indaver,
Duleek,
Co.Louth.

DESCRIPTION	DIAMETER	DEPTH
Drill	200mm	0 – 17 Mts
Supply and install Steel Casing	150mm	17 Mts
Drill	150mm	17 - 50 Mts
Supply and install uPVC screen and Riser from bottom up	50mm	Bottom Cap
		50 – 49Mts Riser
		49 – 34Mts Screen
		34 - 0Mts Riser
		Top Cap
Supply and install Pea gravel		50 – 33 Mts
Supply and install Sand		33 – 32.5Mts
Supply and install Bentonite		32.5 – 30.5Mts
Supply and install Sand		30.5 – 30 Mts
Supply and install Pea Gravel		30 – 3 Mts
Supply and install Sand		3 – 2.5Mts
Supply and install Bentonite		2.5 – 0.5Mts
Supply and install Sand		0.5 – 0 Mts
Supply and install lockable Lid		Yes

Type of Subsoil:	0 – 3.1Mts	Boulder Clay
	3.1 - 7.6Mts	Sand and Gravel
	7.6 - 13.7Mts	Boulder Clay
Depth to Bedrock:	13.7Mts	
Type of Bedrock:	13.7 – 30.5Mts	Sandstone
	30.5 – 50 Mts	Limestone with clay Crevices
Well Development:	2Hr	
Water Entry:	40.0Mts – 4.4m3/hr	50Mts – 10.9m3/hr.

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EXCELLENCE THROUGH PEOPLE STANDARD

Monitoring Well No 2

Ref: AQ/CBC/EPS/Indaverl/MW 2

Customer Name: EPS
Site Address: Indaver,
Duleek,
Co.Louth.

DESCRIPTION	DIAMETER	DEPTH
Drill	200mm	0 – 46.7 Mts
Supply and install Steel Casing	150mm	46.7 Mts
Drill	150mm	46.7 - 60 Mts
Supply and install uPVC screen and Riser from bottom up	50mm	Bottom Cap 60 – 59Mts Riser 59 – 50Mts Screen 50 - 0Mts Riser Top Cap
Supply and install Pea gravel		60 – 49 Mts
Supply and install Sand		49 – 48.5Mts
Supply and install Bentonite		48.5 – 46.5Mts
Supply and install Sand		46.5 – 46 Mts
Supply and install Pea Gravel		46 – 3 Mts
Supply and install Sand		3 – 2.5Mts
Supply and install Bentonite		2.5 – 0.5Mts
Supply and install Sand		0.5 – 0 Mts
Supply and install lockable Lid		Yes

Type of Subsoil:	0 – 4.6 Mts	Boulder Clay
	4.6 - 46.7Mts	Sand
Depth to Bedrock:	46.7Mts	
Type of Bedrock:	46.7 – 49.7 Mts	White Limestone
	49.7 – 53.4 Mts	Weathered Sandstone
	53.4 – 57.9 Mts	Limestone
	57.9 – 60 Mts	Weathered sandstone
Well Development:	3Hr	
Water Entry:	48.8Mts – 43.6m3/hr	60Mts – 65.5m3/hr.

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EXCELLENCE THROUGH PEOPLE STANDARD

PRODUCTION WELL NO 2

WELL LOG

Ref:AQ/CBC/EPS/Indaver/BOQ11.02.11

Customer Name: EPS
Site Address: Indaver
Duleek,
Co. Louth

DEPTH OF WELL: 91.5Mts

DESCRIPTION	DIAMETER	DEPTH
Drill	375mm	0 – 15.6Mts
Supply & Install Steel Casing	300mm	15.6Mts
Drill	300mm	15.6 – 64Mts
Back Fill Well with Pea Gravel		64-58Mts
Supply & Install uPVC Casing	200 x 184.6mm	58Mts
Grout annulus of well with use of Tremmie pipe and Grout Plant		3.30 Tonne
Airlift Pea gravel		58- 64Mts
Drill	150mm	64 – 91.5Mts

Type of Subsoil:	0 – 13.7Mts	Boulder Clay
Depth to Bedrock:	13.7Mts	
Type of Bedrock:	13.7 – 61.0Mts	Limestone
	61.0 – 62.5Mts	Crevice in Bedrock
	62.5 – 68.6Mts	Limestone
	68.6 – 83.8Mts	Limestone with Crevices
	83.8 – 91.5Mts	Weathered Limestone
Water Entry Levels:	62.0Mts, 76.2Mts, 83.8Mts Onwards	
Supply at time of testing	330m3/Day @ 62.0Mts	
with drilling rig:	500m3/Day @ 76.2Mts	
	600m3/Day @ 83.8Mts	

Remarks:
Cap Well on Completion.
Developed Well for 2.75Hr

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Appendix 10.3

GSI Well Survey Data 2005

Appendix 10.3 GSI Well search Results (3km radius around 306300, 270900)

DTB	DEPTH	GSI HOLENAME	TYPE	EASTING	NORTHING	TOWNLAND	USAGE	YIELD	YIELD CLASS	AVE DAILY ABSTRACT	WATER STRIKE	MAIN AQUIFER	ABSTR-ACTION
8.2	22.9	2925NWW070	Bored Well	30460	26835	DULEEK		109	Good			Limestone	
7.6	48.2	2925NWW071	Bored Well	30460	26830	DULEEK	Agri/ domestic use	101	Good			Limestone & Drift	
31.5	63.1	2925NWW072	Unknown well	30460	26825	DULEEK		12.5	Poor			Boulder Clay, Sand & Gravel, Limestone	
	18.9	2925NEW070	Bored Well	30855	26910	BEAUMONT		49	Moderate				
0	61	2927SEW047	Bored Well	30605	27150	PLATIN	Industrial	3600	Excellent	3600	41	Limestone with fissures.	137.5
	30	2927SEW048	Bored Well	30590	27135	PLATIN	Industrial	3600	Excellent	3600		Limestone	
	24.4	2925NWW060	Bored Well	30359	26852	DOWNESTOWN	Public supply		Poor	10			
	4.6	2925NEW058	Dug Well	30551	26899	BELLEWSTOWN	Public supply	3.3	Poor				
9.1	42.7	2927SEW036	Bored Well	30665	27210	PLATIN	Public supply	54.5	Moderate				
0	61	2927SEW037	Bored Well	30600	27150	PLATIN, DULEEK	Industrial		Unknown		2.5		
15.2	47.2	2927SEW038	Bored Well	30665	27190	PLATIN	Industrial	872.7	Excellent		28.9		51.12
11.3	34.1	2927SEW039	Bored Well	30665	27185	PLATIN	Industrial	164	Good		14.6		
	21.9	2927SEW041	Bored Well	30630	27335	DROGHEDA		28	Poor				
		2927SEW035	Bored Well	30665	27205	PLATIN			Unknown				
	6.7	2927SEW001	Dug Well	30745	27211	BEYMORE			Unknown				
		2927SEW003	Dug Well	30500	27200	DONORE			Unknown				
	6.1	2927SEW106	Dug Well	30387	27362	OLDBRIDGE							
9.8	10.3	2927SEW107	Dug Well	30380	27363	OLDBRIDGE							

Appendix 10.3 GSI Well search Results (3km radius around 306300, 270900) Contd

DTB	DEPTH	GSI HOLENAME	TYPE	EASTING	NORTHING	TOWNLAND	USAGE	YIELD	YIELD CLASS	AVE DAILY ABSTRACT	WATER STRIKE	MAIN AQUIFER	ABSTR-ACTION
5.1	5.1	2927SEW108	Dug Well	30372	27364	DOWTH							
1.8	1.8	2927SEW109	Dug Well	30367	27365	DOWTH							
0	76.2	2927SEW110	Bored Well	30601	27258	DONORE	Agri/ domestic use	21.8	Poor				
0	42.7	2827SEW111	Bored Well	30602	27251	DONORE	Agri/ domestic use	1091	Excellent		36.5		