HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Date: 28th February 2018
Our Ref: P1164-4-0010

Kilsaran Group
Piercetown
Dunboyne
Co. Meath

Attn: Mr Fergus Gallagher

Dear Fergus,

Re: Kilmessan Quarry Waste Licence Application, Co. Meath – Response to certain Article 14 Items – (EPA Reg No. W0296-01)

1.0 Introduction

Hydro-Environmental Services (HES) were requested by Kilsaran Group to respond to certain hydrological items from an Article 14 request from the EPA in respect of Waste Licence Application W0296-01.

This letter provides a response to the following:

> Item 2 "*Given that waste has been deposited in the quarry void, provide evidence in the form of groundwater sampling and analysis that no groundwater pollution has been caused*".
>
> Item 7 "*State the direction of groundwater flow and which of the existing or proposed new groundwater monitoring wells can or will be used to represent the up-gradient and down-gradient groundwater quality*".
>
> Item 10 "*Provide a hydraulic model of the volumetric discharge from the pumping of the quarry so that there is sufficient evidence to demonstrate that the pumping will not cause flooding in the ephemeral stream (EPA Name: Balreask Stream) or Skane River downstream. Proposed volumetric pumping limit values, seasonally varied if necessary, that are not disruptive to the natural environment regarding protection of species and habitats and contribution to flood risk*".
>
> Item 11 "*Provide an analysis that demonstrates that the low temperature of the pumped water will not have an impact on species and habitats in the Balreask Stream and Skane River*".
>
> Item 12 "proposed limit values for parameters in the discharge from the quarry and demonstrate that there are protective of water quality in the receiving waters".

2.0 Response to Item 2

Sampling of both up-gradient and down-gradient wells at the quarry was undertaken in 2011 and 2018. The complied results are shown in **Table 1** attached below. The location of each of the wells with respect to the quarry site (*i.e.* up-gradient or down-gradient) is indicated in the table. Monitoring well locations are shown on **Figure RFI-1** attached below.

There were a number of exceedances recorded with respect to the groundwater regulation values (S.I. No. 9 2010) and the drinking water regulations (S.I. 122 of 2014), but they occur randomly in both up-gradient and down-gradient wells and are reflective of the baseline groundwater quality of the area and not due the quarry site workings.

The exceedances in down-gradient well MW10-02 relate to manganese, ortho-phosphate and coliforms. The elevated manganese is most likely related to the natural geology of the site while the elevated ortho-phosphate is likely due a variation in groundwater quality locally. Importantly, elevated levels of manganese and ortho-phosphate (or any other chemical parameter) were not reported in PW10-01 which is located in the centre of the quarry void. If there was any groundwater contamination at the quarry, it would likely be detected at this well first.

There were minor microbial detections in all wells but this is likely as a result of the wells not been sealed (i.e. not grouted).

The observed groundwater quality is similar to that determined in 2011, and based on these overall sample results, the screening berm creation and material management at the quarry is having no apparent impact on groundwater quality.

3.0 Response Item 7

Based on the local topography and local drainage features (*i.e.* Skane River), the natural groundwater gradient/flow direction in the area of the quarry (in the absence of quarry pumping) is expected to be to the west/ southwest towards the Skane River.

Therefore, the proposed up-gradient wells are MW10-04 (located to the north of quarry) and MW10-06 (located on east of quarry). The proposed down-gradient wells are MW10-02 (on west of quarry) and M1 (on southwest of quarry). Monitoring well locations are shown on **Figure RFI-1**.

Presently, the quarry is being dewatering on an on-going basis (to maintain the quarry floor in dry condition) and therefore as a result of this pumping there is a local groundwater gradient towards (into) the quarry void. This situation will continue to be the case until such time as pumping, for dewatering of the quarry void, ceases.

4.0 Response Item 10

This section looks at the estimated peak flood flows in the Balreask Stream and Skane River, and then an assessment of the hydraulic capacity of the river channels of both watercourses in terms of accepting the proposed discharge from the quarry is undertaken.

The average daily discharge rate from the quarry is 1,000m^{3}day with a range of between 0 – 5,500m^3/day (max = 0.064m^3/s). The higher discharge volumes occur very infrequently (<4% of time) and relate to very heavy rainfall events. It should be noted that the quarry is pumping at this rate for the last 8 – 10 years and there have been no reported issues from landowners with regard to fluvial flooding downstream of the quarry.

There are no long-term flow records available for the Balreask Stream and Skane River at the proposed site location. The Balreask Stream is ungauged, and there are no available flow records.

Design flood flows for the Balreask Stream and Skane River are estimated using the Institute of Hydrology IH124 method (attached as **Appendix I**) and also the OPW Flood Studies Update (FSU) web portal (**www.opw.hydronet.com**) for estimation of Q_{med} in ungauged catchments. These estimated flows are shown in **Table A** below.

The design flood flows estimated by the IH124 method are slightly larger than the FSU method and are therefore used below in the hydraulic assessment.

Table A: Design Floods for the Balreask Stream and Skane River

Watercourse	Catchment Area (km²)	Q_{med}		100-Year		1000-Year	
		IH124	FSU	IH124	FSU	IH124	FSU
Balreask	2.7	0.68	0.63	1.55	1.43	2.12	1.96
Skane	49.4	9.41	6.49	21.4	14.8	29.3	20.24

Note 1: *Design flood = Qmed x Growth Factor x 20% (for climate change)*
Note 2: *100 – year Growth factor = 1.9*
Note 3: *1000 - year Growth Factor = 2.6*

For the purpose of the channel capacity assessment, the dimensions of the Balreask Stream were surveyed at 8 no. locations along the lower section of the stream (*i.e.* the section of the Balreask Stream downstream of the public road crossing northeast of Kilmessan village). Access to the lands adjacent to the Balreask Stream upstream of the road crossing was not possible.

However, a visual assessment of the upstream section of the stream was carried out from the road crossing and also from where the stream leaves the quarry site. The section upstream of the road crossing is similar in size and dimension to the lower section which was surveyed.

The survey was targeted at "pinch areas" and the narrowest section of the stream channel. The locations of the cross-sections are shown on **Figure A** below, and full details of the survey are included in **Appendix II**.

The channel cross-sections were modelled in Flowmaster (proprietary hydraulic modelling analysis software) to determine the maximum channel capacity at each of the channel survey locations.

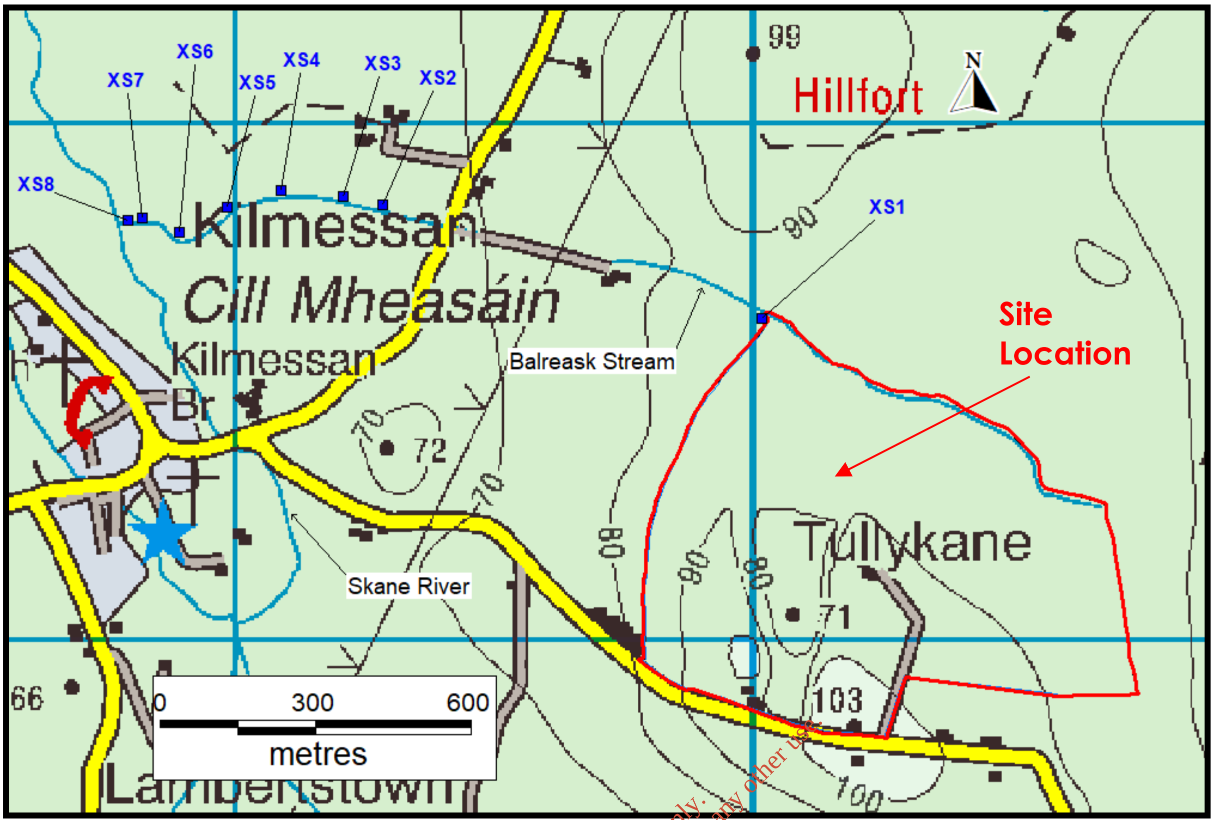


Figure A: Locations of Balreask Stream Survey Cross-sections

The estimated peak flood flows were then compared with maximum channel capacities at each cross-section location to determine where the flood flows could potentially exceed the channel/culvert capacity.

Channel capacity acceptance in terms of increasing possible natural flood flows (*i.e.* Median of the Annual Maximum - Q_{med} and a modelled 100-year Flood) using the more conservative IH124 method are shown in **Table B** below.

These are bank full capacities, and no freeboard is applied, and no flow from the quarry is included (these are natural river flows). Green shading denotes where there is surplus channel capacity during natural flood flows.

There was no exceedance of channel capacity during the Q_{med} or 100-year peak flow at any of the cross-section locations.

Most importantly, the surplus channel capacity (as shown in **Table B** below) is well in excess of the peak quarry discharge (5,500m^3/day or 0.064m^3/s), and all sections are capable of transmitting this additional flow.

Based on the outcome of the Balreask Stream assessment, which shows the channel has more than enough capacity to accommodate the quarry discharge, no channel surveys were deemed necessary in the downstream Skane River. The Skane River is significantly larger in capacity than the Balreask Stream, and therefore the hydraulic capacity of the Skane River will not be an issue with regard quarry discharge. The maximum quarry discharge rate of 0.064m^3/s only accounts for 0.28% of the IH124 100-year flood flow of 21.4m^3/s which is negligible.

Table B: Channel Capacity Assessment for the Balreask Stream

Section Name	Channel Capacity (m^3/s)	Q_{med} flow (m^3/s)	100-year flow (m^3/s)	Able to Accept Max Quarry Discharge (m^3/sec)
		0.68*	1.55*	0.064
		Channel Capacity Surplus		
Section 1	11.95	11.27	10.4	Yes
Section 2	8.75	8.07	7.2	Yes
Section 3	7.31	6.63	5.76	Yes
Section 4	17.16	16.48	15.61	Yes
Section 5	38.48	37.8	36.93	Yes
Section 6	18.37	17.69	16.82	Yes
Section 7	16.06	15.38	14.51	Yes
Section 8	18.01	17.33	16.46	Yes

Note: ** flows rates used defined in Table A*
*** Green = surplus capacity during flood flow (m^3/s), Red = exceedance of the culvert/channel capacity during natural flood flow (m^3/s) (Does not apply for this assessment as all sections have adequate capacity).*

The above assessment demonstrates the downstream capacity of the Baleask Stream and larger downstream Skane River is capable of receiving and transmitting the predicted flows from the catchment and the quarry during future operations without increasing flow risk or altering the hydromorpholoy of the stream (or the River Skane).

The hydraulic modelling of the Balreask Stream demonstrates that quarry pumping will not cause flooding in the ephemeral stream (Balreask Stream) or the downstream Skane River.

The maximum quarry discharge rate of 5,500m^3/day (0.064m^3/s) only accounts for between 0.15% and 0.8% of the channel capacity of the Balreask Stream channel capacity and therefore impacts on the natural environment (hydromorpholoy or water quality) of the stream (or downstream Skane River) in terms of species and habitats is not anticipated. No seasonal limits on quarry discharge are proposed. Please also refer to the water quality assessment as outlined in Section 5 (Response to Item 12) below.

5.0 Response Item 11

The natural variation in temperature found in Irish surface waters is of the order of 25°C - from freezing point to a summer maximum of around 25°C in occasional years. All rivers and streams can tolerate seasonal, temporal, and diurnal temperature variations.

However, the water being discharged from the site is of relatively stable temperature (the water being mainly groundwater), and it also has little impact on temperature in the receiving water.

There is a water level data logger located at the settlement pond outfall v – notch weir for continuous measurement of quarry discharge. This data logger is also capable of recording quarry discharge water temperature. Based on the data logger records, the average temperature of quarry discharge during winter (Nov – Feb) is approximately 6.9˚C (min: 4.0 ˚C, max 10.4 ˚C). These data are plotted on **Figure B** below.

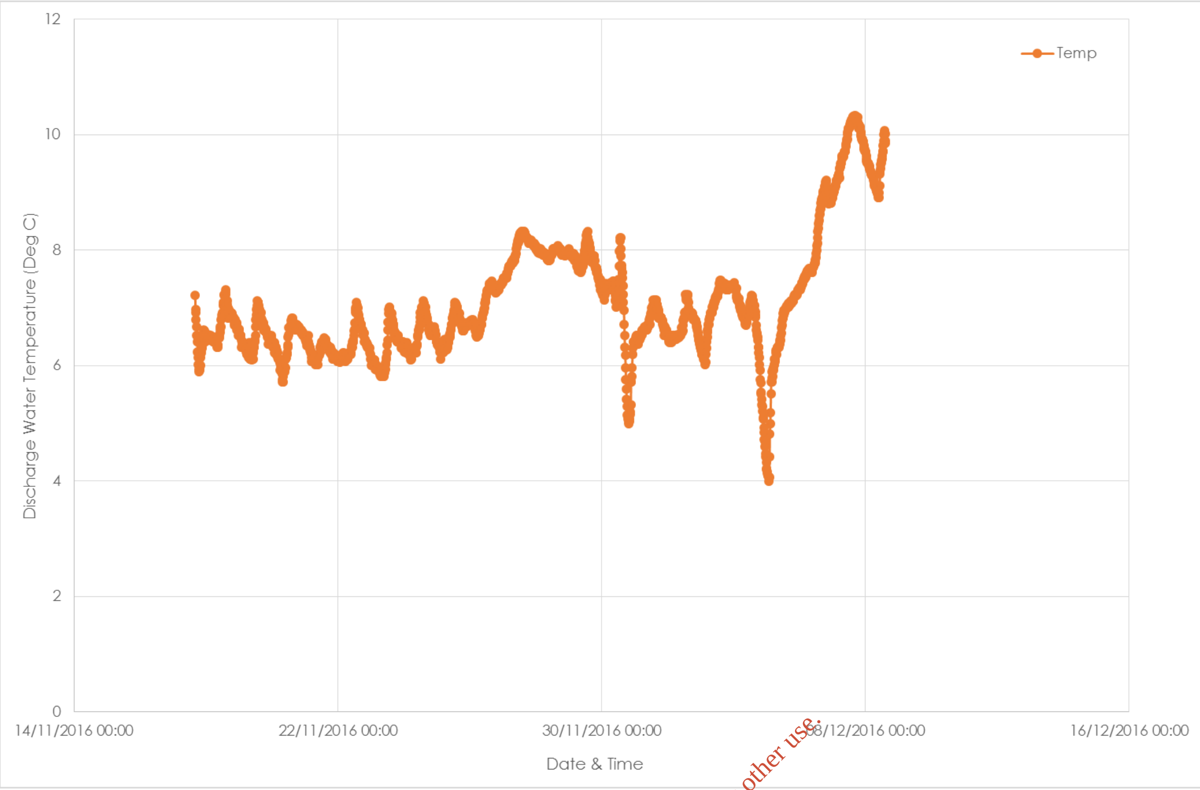


Figure B: Temperature of Quarry Discharge

Duration curve analysis of temperature of upstream and downstream water samples indicates that the quarry discharge has little or no impact on stream temperature, irrespective of the season. This is shown on **Figure C** below.

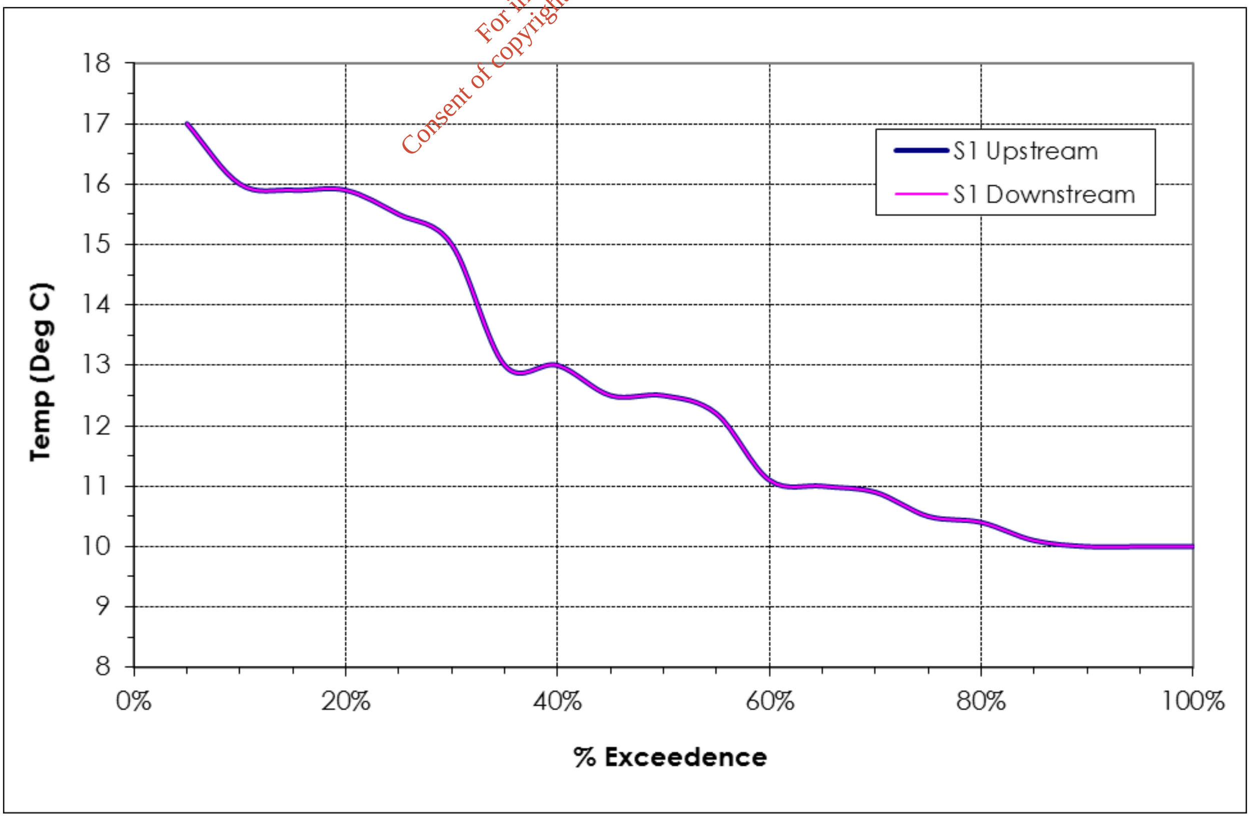


Figure C: Temperature Duration Curve for Upstream and Downstream sampling locations at Kilmessan Quarry (upstream and downstream of the existing discharge).

Therefore, as a result of the above data plots and assessment, there will be no significant effects on species and habitats in the Balreask Stream and Skane River relating to temperature of the proposed existing quarry discharge.

6.0 Response Item 12

There is an existing discharge licence in place for the quarry since 25th November 2013. The applicant suggests that the limits set out in the existing licence be maintained. These are included here for clarity:

Parameter	Unit	Maximum Limit Value
BOD_5	mg/L	2.0
COD	mg/L	50
Suspended Solids	mg/L	20
pH	pH units	6.0 – 9.0
Ortho-phosphate, as P	mg/L	0.06
Nitrate, as N	mg/L	8.0
Ammonium, as N	mg/L	0.1
Total Petroleum Hydrocarbons	µg/L	50
BTEX compounds	µg/L	10
Parameter	**Unit**	**Minimum Limit Value**
Dissolved Oxygen	mg/L	7.0

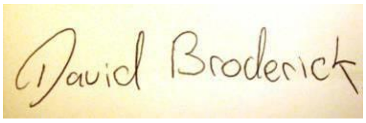
The existing discharge licence is attached as **Appendix III**.

An assessment of the assimilative capacity of the receiving water and downstream rivers was completed at Section 6 of a Hydrogeological Assessment Report completed by HES in 2011 relating to the quarry. The quarry and the discharge have not changed since that time. That assessment is attached here as **Appendix IV**. That assessment demonstrates that the proposed discharge water is suitable for discharge and is protective of water quality in the receiving waters.

7.0 Closure

We trust the above response meets your requirements. Please contact the undersigned if you have any questions regarding the above.

Yours sincerely,



David Broderick
Hydrogeologist - (BSc, H. Dip Env Eng, MSc)

FIGURE

TABLE

APPENDIX I
IH 124 FLOW CALCULATIONS

APPENDIX II
CHANNEL SURVEY

APPENDIX III
EXISTING DISCHARGE LICENCE D/L 13/07

APPENDIX IV
2011 SURFACE WATER ASSESSMENT COMPLETED BY HES

Appendix I
Project: Kilmessan Quarry Waste Licence Application
Greenfield Runoff Rates

Using Institute of Hydrology Report 124:

Qbar = $0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$

where for site:

SAAR	817	mm	From Met Eireann
AREA	2.7	km^2	Balreask Stream Catchment
SOIL	0.35	(NERC, 1975)	Soil Index weighted mean

Qbar = 0.68 m^3/s or 684.33 L/s
= 0.00253 m^3/s per Ha or 2.53 L/s per Ha

Return Period	Growth Factor	Culvert Qbar (m3/sec)
Mean Annual	0	0.68

Bankfull Capacity - XS1

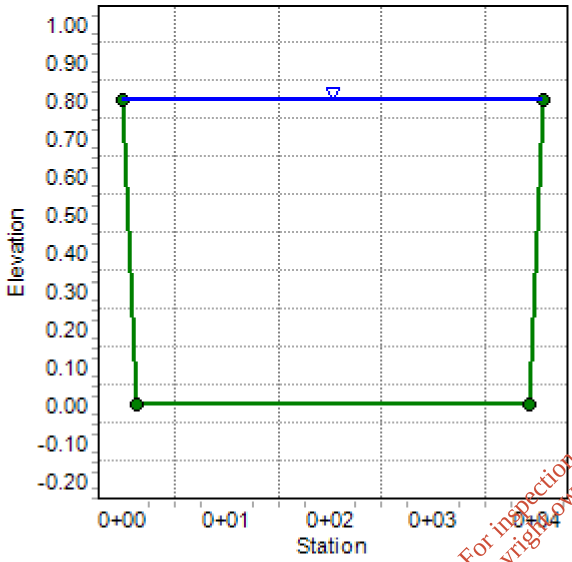
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02700	m/m
Normal Depth	0.80	m
Discharge	11.95	m^3/s

Cross Section Image



Bankfull Capacity - XS2

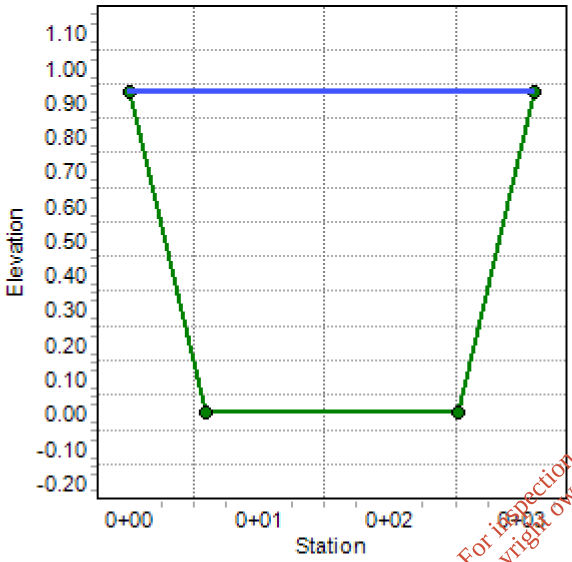
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02700	m/m
Normal Depth	0.93	m
Discharge	8.75	m³/s

Cross Section Image



Bankfull Capacity XS3

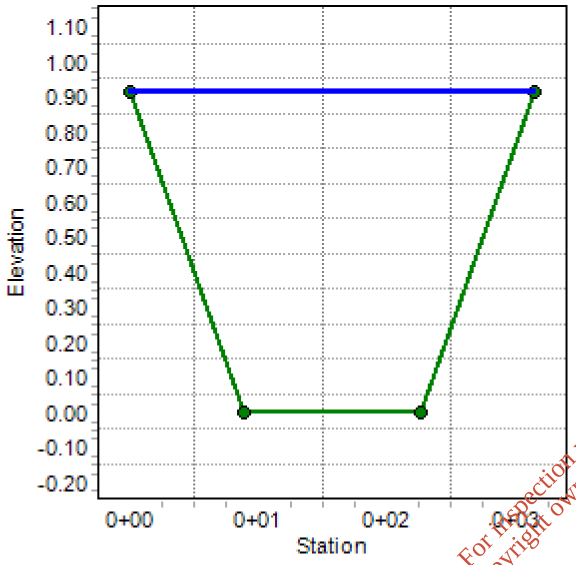
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02700	m/m
Normal Depth	0.91	m
Discharge	7.31	m³/s

Cross Section Image



Bankfull Capacity - XS4

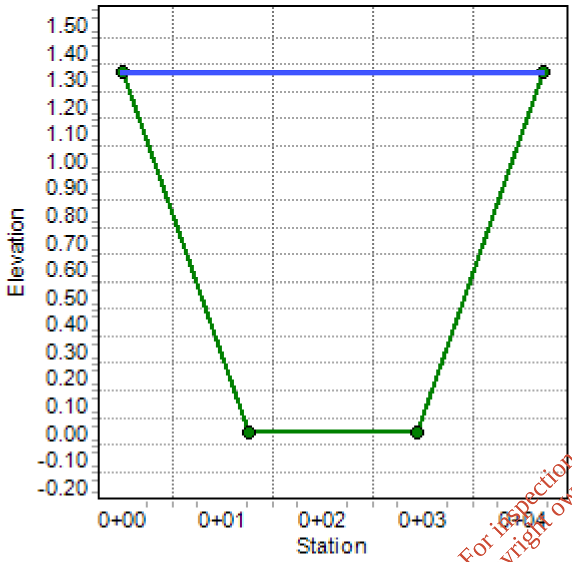
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02700	m/m
Normal Depth	1.32	m
Discharge	17.16	m³/s

Cross Section Image



Bankfull Capacity XS5

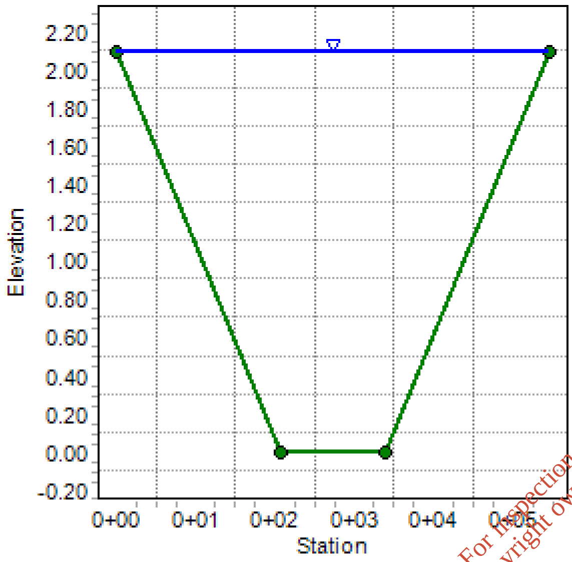
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02700	m/m
Normal Depth	2.09	m
Discharge	38.48	m³/s

Cross Section Image



Bankfull Capacity XS6

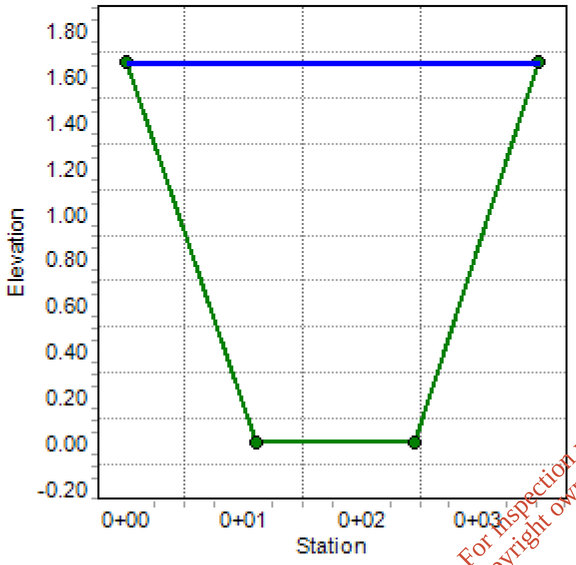
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02700	m/m
Normal Depth	1.66	m
Discharge	18.37	m³/s

Cross Section Image



Bankfull Capacity - XS7

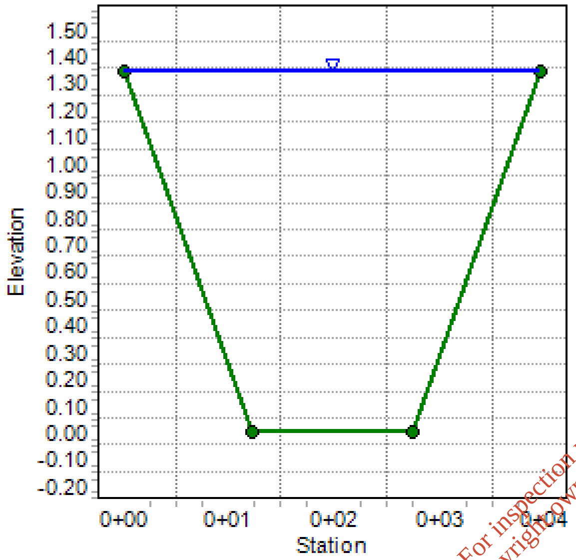
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02700	m/m
Normal Depth	1.34	m
Discharge	16.06	m³/s

Cross Section Image



Bankfull Capacity - XS8

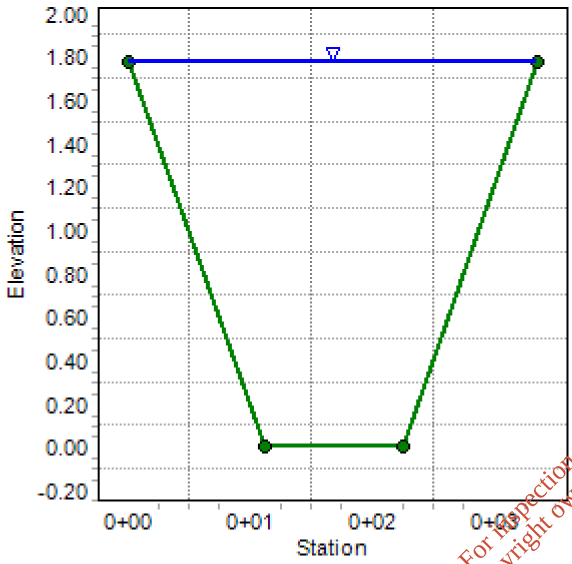
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.02700	m/m
Normal Depth	1.78	m
Discharge	18.01	m³/s

Cross Section Image



MEATH COUNTY COUNCIL

Local Government (Water Pollution) Acts, 1977 and 1990. Local Government (Water Pollution) Regulations 1978 and 1992.

Licence to Discharge Trade Effluent to Waters - AMENDMENT

Ref. No. in Register D/L 13/07

To: Kilsaran Concrete
Piercetown
Dunboyne
Co. Meath.

Having regard to the foregoing, there are no objections in recommending that Meath County Council grant **Kilsaran Concrete, Piercetown, Dunboyne, Co. Meath** a licence to discharge trade effluent to waters at Kilsaran Concrete, Tullykane, Kilmessan, Co. Meath subject to the following conditions.

1 General Layout and Operations

1.1. This Licence shall be in respect of the discharge of treated effluent arising from quarry operations at Kilsaran Concrete, Tullykane, Kilmessan, Co. Meath to surface waters.

1.2. The Licensee shall be permitted to discharge treated effluent to waters at location E 290058, N 257611.

1.3. In the event of pollution of any waters arising from the Licensee's activities, whether due to accidental discharge or discharge other than in accordance with the terms and conditions of this licence, the Licensee shall make good all damage resulting from such pollution, including, if necessary:

(i) the replacement of fish stocks,
(ii) the restoration of spawning grounds,

(iii) the removal of polluting matter from waters
(iv) the modification of its discharge regime to prevent re-occurrence,
(v) or such other measures as may be directed by the Licensing Authority.

1.4 The Licensee shall ensure all quarry sumps for dewatering are at least 950m2 in area each and are maintained to provide capacity of at least 1500m3 each. The pump intake in all sumps shall be surface mounted. Any new sump developed for de-watering shall comply with this specification. The dimensions of any new sump shall be confirmed to the Licensing Authority through submission of an as constructed survey to the Licensing Authority within 1 month of sump development..

1.5 All effluent generated by quarry operations which is discharged to waters shall be directed through at least one quarry sump followed by the final settlement pond of capacity 390m3.

1.6 The Licensee shall ensure that a Class I oil interceptor is provided on the discharge line. The oil interceptor shall have adequate capacity to treat the maximum discharge flow rate. The interceptor shall be serviced regularly to ensure that it does not become overloaded.

1.7 The Licensee shall ensure that the effluent treatment system (quarry sumps, settlement pond and oil interceptor) is operated and maintained in such a manner as to ensure the discharge of effluent is in accordance with the volume and emission limit values set out in this licence.

1.8 The Licensee's site shall be laid out, operated and maintained in such a manner as to prevent the discharge of any effluent to the receiving waters other than *via* the effluent treatment system.

1.9 Records of all maintenance, servicing and de-silting on the settlement ponds, sumps and the oil interceptor shall be maintained on site for inspection by Officers of the Licensing Authority.

1.10 A visual examination of the surface water discharge shall be carried out daily. A log of such examinations shall be maintained on the site.

1.11 In the event that any observations made on the quality or appearance of the surface water discharge should indicate that contamination has taken place, or in the event of any incident occurring on the site with the potential to cause pollution of surface or groundwater, the Licensee shall:

(i) carry out an immediate investigation to identify and isolate the source of contamination,

(ii) put in place measures to prevent further contamination and to minimise the effects of any contamination on the environment, and
(iii) notify the Local Authority and Inland Fisheries Ireland as soon as practicable.

1.12 In the event of a prolonged period of heavy or sustained rainfall the Licensee shall cease the discharge of treated effluent from the quarry site where it appears that the discharge from the quarry is causing or is likely to cause flooding of lands downstream of the quarry.

1.13 In the event of a prolonged period of heavy or sustained rainfall, the Licensing Authority shall so direct if required, that the discharge from the quarry shall cease and shall determine when the discharge can re-commence.

1.14 The Licensee shall ensure that the proposed site is at all times stocked with an adequate supply of oil/chemical spill kits including booms and suitable absorbent materials and that staff are trained in the appropriate use and deployment of such equipment. The Licensee shall prepare a documented Spill Response Procedure, to be kept on site, to cover oil and fuel spillages and shall ensure that staff are trained to implement the Spill Response Procedure.

1.15 All fuel oil and chemical storage tanks shall be provided with bunding. The capacity of the bunding shall be at least 110% of the capacity of the largest tank or 25% of the total volume which could be stored within the bunded area, whichever is greater.

1.16 Drainage from the bunded area shall be collected for safe disposal. All bunds shall be tested at least once every three years by a competent firm and test report submitted to the Licensing Authority.

1.17 The Licensee shall provide a discharge sampling and inspection point for the treated discharge downstream of the v-notch weir and shall ensure that this is maintained to provide safe access for inspection and sampling.

1.18 The Licensee shall maintain a flow-measuring device in order to measure and log flow rate of the final treated effluent discharged to waters. Records of daily flow rates (total volume discharged per day) shall be maintained and submitted to the Licensing Authority on a quarterly basis. The flow-measuring device shall be calibrated and maintained to ensure the accuracy of measurements. Evidence of flow measurement calibration shall be submitted to the Licensing Authority upon request.

1.19 Where after 3 years from the date of grant of this discharge licence no discharge of the type authorised by the licence has been made, or where such a discharge has ceased for a period of 3 years, the licence shall cease to have effect.

2. Effluent Characteristics:

2.1 Oils and grease shall not be present in the effluent in such quantities as to:

(i) form visible films on the surface of the water;
(ii) form coatings on the river bed, benthic biota or food resources;
(iii) cause deleterious effects on aquatic life; or
(iv) impart a detectable taste or odour or edible aquatic species.

2.2 The total volume of effluent to be discharged shall not exceed 62.5m^3 per hour and 1500 m3/day.

2.3 Effluent as discharged shall comply with the quality standards set out hereunder in respect of the following determinants:

Parameter:	Units:	Maximum Limit Value:
BOD5	**mg/l**	**2.0**
COD	**mg/l**	**50**
Suspended Solids	**mg/l**	**20**
pH	**pH units**	**6.0 – 9.0**
Ortho-phosphate, as P	**mg/l**	**0.060**
Nitrates, as N	**mg/l**	**8.0**
Ammonium, as N	**mg/l**	**0.10**
Total Petroleum Hydrocarbons	**µg/l**	**50**
BTEX Compounds	**µg/l**	**10**

Parameter:	Units:	Minimum Limit Value:
Dissolved Oxygen	**mg/L**	**7.0**

Monitoring Regime:

3.1 The Licensee shall arrange for monthly sampling and analysis of the discharge for the determinants listed in Condition 2.3 above, during all periods that discharges occur. The analysis shall be carried out by an independent laboratory which can demonstrate competence to undertake the relevant tests through accreditation and/or participation in relevant external proficiency testing schemes. Dissolved oxygen shall be measured on-site by calibrated dissolved oxygen meter.

3.2 Records of daily flow rates (total volume of treated effluent discharged per day) shall be maintained and submitted to the Licensing Authority on a quarterly basis.

3.3 Copies of the results of monitoring and analysis in respect of Condition 3.1 and Condition 3.2 above shall be submitted to the Licensing Authority every quarter. A copy of the original Certificates of Analysis produced by the analysing laboratory shall be included in respect of results submitted under Condition 3.1. The sample label on the certificate of analysis shall clearly identify the origin and sample date of the discharge sample. The records shall also be made available for inspection at the site office during normal working hours by Authorised Officers of the Licensing Authority, and any other person authorised under Section 28 of the Local Government (Water Pollution) Act 1977, as amended.

3.4 The Licensee shall arrange for sampling and analysis of the discharge for the determinants listed below, during all periods that discharges occur, at a frequency of once every 6 months. The analysis shall be carried out by an independent laboratory which can demonstrate competence to undertake the relevant tests through accreditation and/or participation in relevant external proficiency testing schemes. In respect of metals, the analysis shall be carried out using methods of analysis that provide a limit of detection of < 0.005 mg/L or lower.

Total Hardness, Alkalinity, Conductivity, Sulphates, Cu, Zn, Pb, Cd, Ni, As, Cr (total), Fe, Mn.

3.5 Copies of the results of monitoring and analysis in respect of Condition 3.4 shall be submitted to the Licensing Authority within 1 month of the date of sampling. A copy of the original Certificates of Analysis produced by the analysing laboratory shall be included in respect of results submitted under Condition 3.4. The sample label on the certificate of analysis shall clearly identify the origin and sample date of the discharge sample. The records shall also be made available for inspection at the site office during normal working hours by Authorised Officers of the Licensing Authority, and any other person authorised under Section 28 of the Local Government (Water Pollution) Act 1977, as amended.

3.6 The frequency of discharge sampling under Condition 3.1 may be reduced on the written agreement of the Licensing Authority, subject to satisfactory compliance with the limits set out in the Licence over a 12 month period following the grant of this licence. In the event of non-compliance with licence conditions, the Licensing Authority may direct that monthly sampling frequency is reinstated.

3.7 The discharge sampling and inspection point shall be laid out, operated and maintained in such a manner as to allow free and safe access by authorised personnel.

4. Access by Authorised Personnel:

4.1 Details of emergency contact personnel, including addresses and telephone numbers, shall be made available to the Licensing Authority within one month of the date of grant of this licence. At least one such person shall be available for contact at all reasonable times, having due authorisation from the Licensee to expedite emergency measures as may be required.

4.2 Authorised Officers of the Licensing Authority, or its agents, or any other person authorised under Section 28 of the Local Government (Water Pollution) Act, 1977, as amended, shall have access to the site at all reasonable times, including if necessary, times other than normal working hours.

5. Change of Use of the Development:

5.1 The Licensee shall notify the Licensing Authority of any proposed change in the operation of the premises, which would cause, or be likely to cause, a material alteration in the nature, or increase in the volume of effluent discharged.

5.2 No changes in relation to the discharge (flow rates, effluent concentrations) shall take place without the prior written agreement of the Licensing Authority.

5.3 The Licensing Authority shall interpret whether any such change is material or not, and whether a review of the Licence is required as a result.

5.4 Where the trade effluent discharge from the site has ceased permanently, the Licensee shall notify the Licensing Authority, within 3 months of cessation.

6. Contributions to the Licensing Authority:

6.1 The Licensee shall pay to the Licensing Authority an annual contribution of € 1174 or such sum as the Licensing Authority from time to time determines, towards the costs incurred by the Licensing Authority of monitoring the discharge. For 2013, the Licensee shall pay a *pro rata* amount from the date of this licence to the 31st of December 2013. This amount shall be paid to the Licensing Authority within one month of the date of grant of this licence. The Licensee shall in **2014** and subsequent years, pay to the Licensing Authority such revised annual contribution as the Licensing Authority determines for the monitoring of the discharge and all such payments shall be made within 1 month of the date upon which demanded.

6.2 In the event that the frequency or extent of monitoring, investigations or testing carried out by the Licensing Authority needs to be increased, the Licensee shall contribute such sums as determined by the Licensing Authority to defray its costs in relation to the additional monitoring, investigations or testing

Dated this the 25th November, 2013

SIGNED:

Senior Executive Officer

Environment Order No. 226/2013

See Schedule No. 1 (attached) for appeal procedure.

SCHEDULE NO. 1

APPEAL

An appeal under Section 8 of the Local Government (Water Pollution) Act, 1977 as amended by the Local Government (Water Pollution) (Amendment) Act 1990 may be made to An Bord Pleanála by any person within the prescribed period set out i.e. one month beginning on the date of the decision on the Licence and shall be accompanied by a fee of €126 and shall:-

a) Be made in writing
b) State the name and address of the appellant
c) State the subject matter of the appeal and
d) State IN FULL the grounds of the appeal and the reason, considerations and arguments on which they are based.

Without prejudice to Article 19 of the Local Government (Water Pollution) Regulations, 1992 an appellant shall not be entitled to elaborate in writing upon, or make further submissions in writing in relation to the grounds of appeal stated in the appeal or to submit further grounds of appeal and any such elaboration, submission or further grounds of appeal that is or are received by the Board shall not be considered by it.

A person, other than a party to an appeal, may make submission or observations, in writing, to the Board in relation to the appeal on payment of a fee of €38.

6. SURFACE WATER IMPACT ASSESSMENT

6.1 INTRODUCTION

This section of the report presents a discharge impact assessment regarding the proposed combined surface water and groundwater discharge from the extended quarry at Kilmessan. The aim of this assessment is to determine the likely impacts from the quarry discharge on the receiving waters and to determine compliance with:

- SW Regulation (2009) EQS[11]'s; and,
- Multiple other relevant regulations – by Combined Approach (as outlined below)

This evaluation is made in the context of a pumped discharge from a quarry which contains a mix of groundwater and surface water (stormwater) discharge. The maximum discharge flow will comprise the following:

- Groundwater: 0-1896m^3/day[12] (~0-22 L/s);
- Surface water: 0 to 4000 m^3/day (no surface water discharge (as currently occurs) to flows generated by a 1 in 100 year 12 hr rainfall event on quarry catchment, *i.e.* surface water that will have to be pumped out of the quarry void). This is equivalent to the pumping of surface water required following the rainfall event recorded on 06/09/2010 (refer to Figure 4.6).

The initial discharge is to an ephemeral stream. This stream then discharges to the Skane River downstream of the site, and the Skane River is in turn a tributary to the River Boyne.

6.2 EVALUATION CONCEPT

The following are the key elements of our discharge impact assessment:

- This is a pumped discharge which comprises a mix of 'groundwater' and 'surface water runoff' and will be subject to licensing. The sensitivity of downstream surface water receptors to this discharge therefore require consideration and evaluation;

- An upgrade of the on-site wastewater treatment system is proposed as part of the current planning application. The wastewater system receives a small flow from the site office (toilet and kitchen). The current and proposed discharge is to groundwater, via a secondary treatment system and percolation area. There are currently 5 staff at the site and this implies a hydraulic loading of 0.3m^3/day. The wastewater will be treated in a secondary treatment system and then discharged via subsoil to ground. At this flow rate, and with the proposed treatment, the discharge is insignificant in terms of risk to groundwater quality or surface water quality and it is not considered further in this discharge impact assessment;

- An assessment procedure has been developed by integrating the 'Combined Approach' assessment framework of the UWW Regulations (2007), Habitats Directive assessment requirements, 'High Status' Environmental Quality Standard's (EQS's) of the Surface Water Regulations (2009) and the Salmonid Regulations (1988). The Salmonid Regulations 1988 are relevant in the 'Combined Approach'. Salmon are listed as an Annex II Species under the European Habitats Directive, and are a qualifying interest of the River Boyne and Blackwater cSAC;

- The Surface Water Regulations (2009)[13] provide a basis for evaluation of impact of discharges;

---

[11] Environmental Quality Standard.
[12] Flow recorded at end of pumping test.

- A Guidance Manual issued by The DOEHLG (WSTG, 2010) provides a framework for assessment of discharges, which has also been applied in the assessment conducted here;

- The receiving waters are defined as: 1) ephemeral stream S1, 2) River Skane, 3) River Boyne. The details of these location are presented below;

- A hydromorphological assessment for stream S1 is completed as required by the Regulations; and,

- A screening assessment was completed with existing site monitoring data. Where required an assimilation capacity simulation model was then applied for different discharge volume scenarios, and mixes (of groundwater and surface water) in order to explore compliance for the proposed discharge under varying meteorological and hydrological conditions (*i.e.* a dry spell with only steady sate groundwater being pumped from the quarry, various mixes of groundwater and surface water). These details are outlined below.

6.3 DISCUSSION ON THE RECEIVING ENVIRONMENT

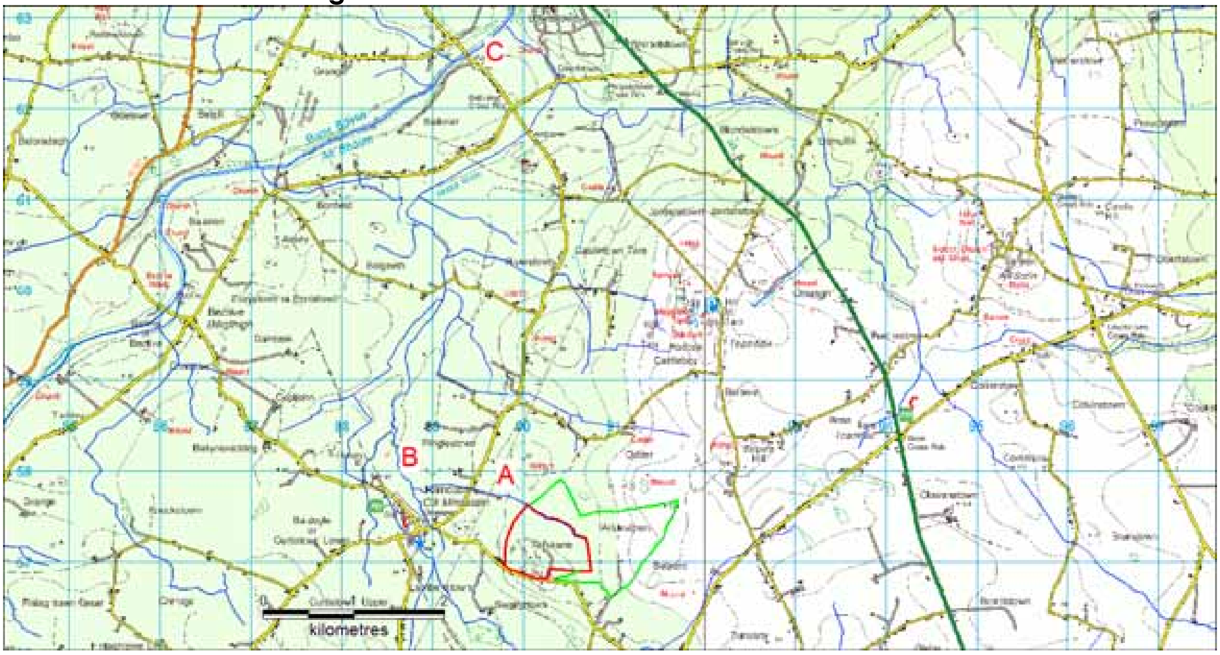
The overall aim of the Water Framework Directive and the consequent Surface Water Regulations 2009 is to ensure no deterioration in status of water bodies. The impact of discharges should be evaluated at the scale at which water bodies/protected areas are delineated/defined. Therefore the following evaluation locations are completed:

1. Ephemeral stream
2. Skane River
3. River Boyne (the River Boyne downstream of the site is part of the River Boyne and River Blackwater cSAC, Site Code: 002299)

The location of these discharge evaluation locations are shown on Figure 6.1.

- [13] These Regulations specify that a waterbody must be maintained at, or improved to, at least 'Good' Status and that no deterioration in status is permitted;
- The Agency (EPA) is responsible for assigning status. 'Status' is a descriptor term that integrates ecological and hydrochemical data. 'Status' is a descriptor tool that facilitates catchment comparisons at an EU scale;
- Part II, 5. states that 'A public authority shall not, in the performance of its functions, undertake those functions in a manner that knowingly causes or allows deterioration in the chemical status or ecological status (or ecological potential as the case may be) of a body of surface water';
- These Regulations specify conditions and concentrations that should be considered in assessment of Status. Biological and hydromorphological quality elements, physiochemical quality elements, general conditions and nutrient conditions, in addition to concentrations for specific pollutants, priority substances and priority hazardous substances are specified in the Schedules 4, 5 and 6 of the Regulations;
- With respect to discharge authorisations, these Regulations require public Authorities to ensure that the emission limits laid down in authorisations support compliance with the new water quality objectives / standards;
- When the 2009 Regulations refer to 'chemical status', it is in the context of water quality objectives for 'priority and priority hazardous substances'. Ecological status is a function of biological and physiochemical 'supporting conditions'. Discharges of treated wastewater and stormwater runoff have the potential to impact biological and physiochemical conditions. Treated wastewater does not contain the 'priority and priority hazardous substances' listed in the Regulations.

Figure 6.1: Surface water assessment locations.



With regards to the Surface Water Regulations (2009) – Table 6, Schedule 4 outlines the hydromorphological quality elements supporting the biological elements which are to be taken into account when calculating ecological status. For river water bodies, these are:

- o Hydrological regime
  - Quantity and dynamics of water flow
  - Connection to groundwater bodies
- o River continuity
- o Morphological conditions
  - River depth and width variation
  - Structure and substrate of the river bed
  - Structure of the riparian zone

With regards to the Surface Water Regulations (2009) – Table 7, Schedule 4 outlines the physico-chemical quality parameters supporting the biological elements which are to be taken into account when calculating ecological status. For river water bodies, these are:

- o transparency
- o thermal conditions
- o oxygenation conditions
- o acidification conditions
- o salinity
- o nutrient conditions

6.4 HYDROMORPHOLOGICAL ASSESSMENT

Stream S1 is known to be ephemeral. During dry periods when there is no discharge from the quarry there is no flow in this stream. Natural flow in the stream only occurs when there is sufficient rainfall to generate runoff within the catchment. When there is a dry period the flow in the stream slowly reduces to zero. This was observed at SG2 in October 2010 and is shown on **Plate 2**. The addition of groundwater and precipitation falling within the quarry to the stream by way of pumping from the quarry (to keep the quarry void dry) will be an ongoing flow throughout the operational phase of the quarry. This means that the hydrological condition of the stream S1 will improve from its current state, and stream continuity will be established. This will be a benefit to ecological life along the stream. Also, any improvement in hydromorphological condition of stream S1 will also improve conditions in the downstream River Skane.

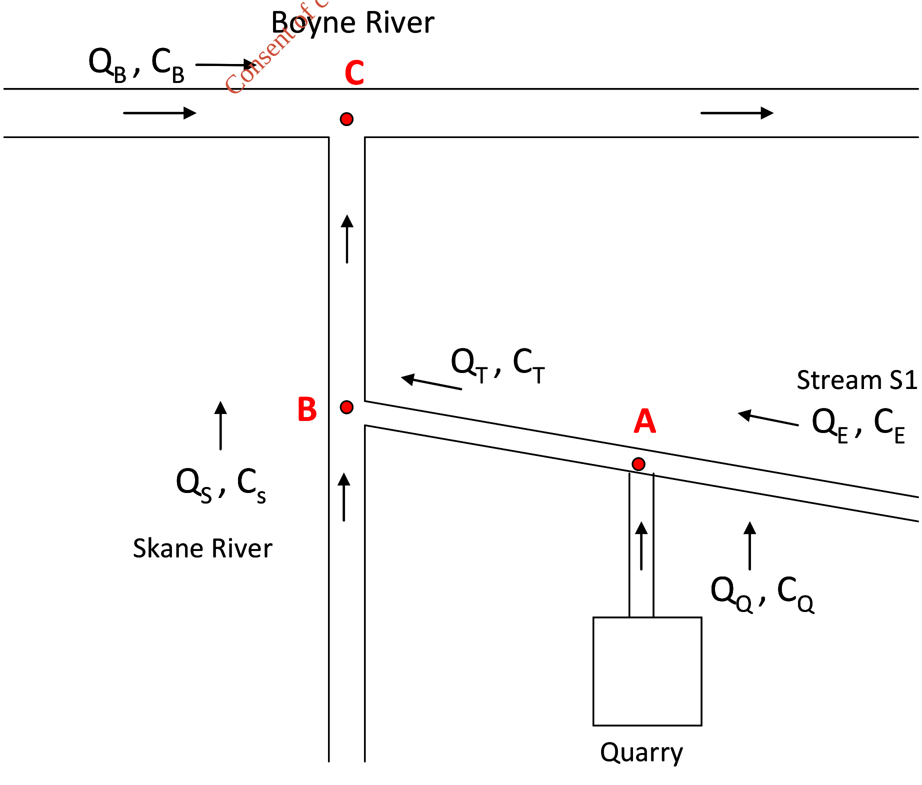
A hydraulic flow capacity assessment of the stream at two locations, up-gradient of SG2 and at the bridge at SG2, is attached in Table D. The stream at this location has a shallow bank and runs adjacent to a dwelling. The culvert at SG2 is a significant pinch point along the stream. The hydraulic capacities of both x-sections are adequate for a 100yr flood and a 1000yr flood. The pumped flow from the quarry will not be excessive, in terms of the hydraulic capacity of the stream and therefore should not alter the structure or substrate of the stream bed. The adequate conveyance capacity of the stream was proven during the pumping tests where daily discharges of up to 5235m^3/day (far in excess of the expected long term steady state proposed quarry pumping discharge) were accommodated by the stream without any out of bank flooding.

It should also be noted that the groundwater abstracted from the aquifer at the quarry would eventually end up in the River Skane anyway, albeit more slowly. This is because groundwater in the area will flow towards surface water discharge points, *i.e.* rivers are large groundwater drains. Therefore, there will be negligible impact on the hydrodynamics of the River Skane as a result of the proposed quarry dewatering, as the water will end up in the river anyway, albeit slightly further downstream.

6.5 PHYSICO-CHEMICAL ASSESSMENT

A schematic of the surface water flow system downstream of the quarry discharge point is shown in Figure 6.2. The impact of discharge on water quality from the quarry has to be established at three locations, denoted A, B and C as shown. Location A is the point at which the quarry discharge enters the stream S1, B is the point at which the stream S1 enters the Skane River, while C is the point at which the River Skane joins the Boyne River.

Figure 6.2: Schematic of discharge assessment locations and flow / mass loading descriptors.



Given the hierarchical nature of the surface water system, (*i.e.* Quarry discharges to S1 which discharges to the River Skane which in turn discharges to the Boyne) it follows that if water quality criteria are met at point A, then it will also be met at all subsequent points. Therefore, the logical first step in the physico-chemical assessment is to assess the quality of the quarry discharge itself and its impact on the receiving water of S1. If this can be shown to meet the relevant physico-chemical quality standards to be taken into account when calculating ecological status, this will ensure no deterioration in the status of water bodies receiving the proposed quarry discharge. While no status has yet been defined for the Stream S1, the Skane Lower (IE_EA_07_1629) which exists downstream of the quarry site is assigned an overall 'Moderate Status'. The primary risk posed to is from diffuse sources and morphological impacts.

Quarry Pumping Discharge Scenarios:

Discharge scenario 1), where $C_Q > C_E$

Stream S1 dilutes the quarry discharge, but the mass loading may be significant as the flow from the quarry will generally exceed the flow in the stream. This scenario is undesirable as it depends on dilution within the stream to meet water quality standards. As mentioned earlier, the stream S1 is ephemeral with no natural flow during dry periods and so no dilution of quarry discharge would occur.

Discharge Scenario 2) $C_Q > C_E$ and $C_Q < C_L$

The discharge from the quarry improves water quality in the receiving water but does not meet the relevant physico-chemical quality standards. While there would be no deterioration in water quality in this scenario, it is still undesirable as it does not help achieve the goal of "restoring" the Skane River to good status by 2021 in accordance with European Communities Environment Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009).

Discharge Scenario $C_Q > C_E$ and $C_Q > C_L$

The discharge from the quarry improves water quality in the receiving water and also meets the relevant physico-chemical quality standards. This is the ideal scenario as the quarry discharge provides for potential future improvements in water quality in both Stream S1 and the Skane River over the operational lifespan of the quarry.

In this context, the most conservative and beneficial scenario is to assume that the quarry discharge is the only flow in Stream S1. By thus ensuring that any quarry discharge meets a standard to prevent deterioration in river status, the proposed development is compatible with the requirement to improve the overall water quality in the rivers downstream of the quarry site as required by The European Communities Environment Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009).

6.5.1 Assessment of Available Monitoring Point Water Quality Data

An existing discharge licence (Register 00/3, Meath County Council) for the current discharge from the quarry to S1 has required regular monitoring of surface water quality up and downstream of the discharge location. The discharge location is at A on Figure 6.1. As a result, water quality data is available from upstream and downstream of this discharge location for the past 10 years. This data is attached in Table E. Exceedence plots for are given in Appendix 15. These plots show the general improvement in water quality between upstream and downstream of the discharge location, indicating the beneficial effect of past quarry discharges. This is particularly noticeable for recorded Nitrate concentrations, with the quarry discharge substantially diluting the concentration of NO_3 present in S1. Conductivity of the stream rose slightly downstream of the discharge, which is to be expected given the discharge is mix of surface water and groundwater, which is likely to be more mineralised (i.e. groundwater has a higher electrical conductivity than surface water).

In addition, the quarry discharge itself was sampled along with upstream and downstream on four occasions; September 1998, September 2000, in September 2008 as part of the original

EIS and most recently on 29th March 2011. The water sample taken on the 29th March 2011 was after a long period of pumping from groundwater storage, with no significant surface water input/component. Therefore the water chemistry of these samples is representative of future steady state dewatering conditions, *i.e.* this water chemistry represents proposed future discharge. These data allowed an initial assessment of which parameters may pose a risk to downstream surface water quality.

Surface water EQS limits from the Surface Water Regulations (SI 272 of 2009) and the European Communities (Quality of Salmonid Waters) Regulations (SI 293/1988), given in Table 6.1, were used to assess which, if any parameters posed a potential risk to downstream surface water quality. Where multiple EQS limits existed, the most stringent was chosen for the initial assessment. Groundwater quality data are shown in Table C.

Total Suspended Solids (TSS)
The TSS concentrations in the quarry discharge recorded in 2000, 2008 and 2011 were well below the limit of 25 mg/L set out in S.I. No. 293/1988. This is reflected in the low average concentrations shown in Stream S1. Therefore no assimilation assessment is required for TSS. The discharge complies with Salmonid EQS of 25 mg/L. Discharge concentration of TSS during the pumping test was <2 mg/L.

Table 6.1: EQS standards versus pumped groundwater quality.

Parameter	EQS Source	Unit	EQS	site discharge chemistry
Total Suspended Solids (TSS)	Salmonid[1]	mg/litre	25	<2
Temperature	Salmonid[1]	°C	<21.5°C, ΔT > 1.5°C	-
Dissolved Oxygen (DO)	Salmonid[1]	mg/litre O_2	50%ile >9	-
pH	Salmonid[1]		6 < pH < 9, ΔpH < 0.5	7.6
Conductivity	DW Reg[2]	µS/cm	1000	865
BOD	SW Reg[3]	mg/litre O_2	>1.4	-
Ammonia	SW Reg[3]	mg/litre NH_4	>0.04	<0.01 as N
Nitrite	Salmonid[1]	mg/litre NO_2	> 0.05	0.0132 as NO_2
Ortho-P	SW Reg[3]	mg/litre P	>0.025	<0.005
Zinc	Salmonid[1]	mg/litre Zn	>0.3	-
Dissolved Copper	Salmonid[1]	µg/litre Cu	112	1.096
Total Residual Chlorine	Salmonid[1]	mg/litre HOCl	<0.005	-

1 S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations, 1988.
2 European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989 (S.I. 294/1989).
3 Surface Water Regulations 2009 (SI 272 of 2009).

Temperature
As the quarry discharge had ample time to reach ambient temperature conditions; it had no effect on the temperature of Stream S1. This is clearly demonstrated by the identical upstream and downstream temperature exceedence curves (Appendix 15). No assimilation assessment is required for temperature.

Dissolved Oxygen (DO)
The Quality of Salmonid Waters requires dissolved oxygen (DO) concentrations to exceed 9mg/L O_2 for at least 50% of the time. The DO concentration of S1 met this regulatory requirement throughout the period from 2001 to 2011, with the quarry discharge improving the DO concentration in S1 by an average of 0.06 mg/L over this period. No assimilation assessment is required for DO. Measurements of DO of groundwater at the end of the pumping test indicated average concentration below this limit. However the pumping to the

settlement pond and flow along the discharge channel with check dams and riffle areas will oxygenate the discharge water and therefore the proposed discharge will likely be compliant prior to entry to S1. Initial continuous monitoring of DO is proposed to ensure this is the case, and if further oxygenation is required additional mitigation in terms of longer exposure time, or increased surface area of sumps /settlement ponds can be implemented. No assimilation capacity assessment is required.

pH

All pH measurements, both of the discharge and in the stream itself, fell within the 6 – 9 pH unit range allowable under relevant legislation. Also, at no point did the difference between upstream and downstream pH change by more than ±0.5 in the long term hydrochemical monitoring of S1. However, as the mean pH of the discharge water was consistently lower than that of the Skane River, an assimilation assessment was carried out on pH to ensure no negative impacts on water quality. This is presented in Table 6.2.

Table 6.2: pH – Assimilation Capacity Assessment.

F = upstream receiving river flow, 95%tile flow (m^3/s)	F	0.124	m^3/s
C = background/upstream concentration in receiving water (mg/l)	**C**	8.37	pH units
f = effluent flow discharging to receiving waters (m^3/s)	f	0.012	m^3/s
c = effluent pollutant concentration discharging to the receiving waters (mg/l)	c	7.60	pH units
T = downstream pollutant concentration in the receiving water (mg/l)	**T***	**8.30**	mg/l
	ΔpH <±0.5**	0.07	Regulation compliant.

***T = (FC+fc)/(F+f) **ΔpH = C-T**

Conductivity

There is no surface water EQS's for conductivity. Drinking water standards indicate a maximum allowable limit of 1000µS/cm. As the conductivity in both the discharge and stream S1 consistently measured below 1000µS/cm, no assimilation assessment is required for conductivity.

Biochemical Oxygen Demand (BOD)

The most stringent EQS available for BOD limits the mean concentration to 1.3 mg/L and 95%tile concentration to 2.2mg/L. Limited direct measurement of BOD indicated that the quarry discharge water met these requirements. Long term monitoring also showed a marked improvement in BOD concentration in the stream S1 due to quarry discharge, reducing concentrations by an average of 0.13 mg/L. Given the evidence of the low BOD concentrations in the quarry discharge together with the past improvement in BOD in the stream, an increase in quarry discharge will not change the status or affect future status of the receiving water. In fact an increase in discharge would most likely improve BOD further, hence no assimilation assessment is required.

Ortho-P

Measurements of Ortho-P taken in 2008 and 2011 fell below detection limits (<0.03 and <0.005 mg/L respectively) and so are well below EQS levels. Given the high groundwater component in the quarry discharge it is realistic to assume that these values give an accurate reflection of the low Ortho-P levels present in future discharge. Thus no assimilation assessment is required for Ortho-P.

Dissolved Zinc and Copper

As the local bedrock includes shales (as partings between the limestone beds) and because there is considerable shale bedrock along the eastern boundary of the quarry there is the potential that certain metals may be dissolved by slightly acidic rainfall and by natural weathering. Trace amounts of Zinc (<1µg/l) and Copper (1µg/l) were recorded in quarry discharges in 2008 and 2011 but as these both fall far short of the 0.3 and 0.112 mg/L EQS limits respectively no assimilation assessment is required for Zinc or Copper.

Nitrate / Ammonia / Nitrite

Common explosives used at quarry site, such as Ammonium Nitrate, often contain large percentages of N compounds. It has been found that small percentages of N compounds remain as residual coating on the rock following blasting. This has the potential to be dissolved when it comes into contact with water. The study that is most referenced was completed by Environment Canada in 1988 (Ferguson & Leask, 1988). This study outline a procedure for determining the residual N compounds for various mine site types. The stepwise procedure used in the 1988 study for predicting aqueous concentrations of N species, as outlined by Morin & Hutt (2009) is:

1. Calculate the annual leached nitrogen loading (kg/year) for the entire site based upon annual explosive mass usage and residual N fraction associated with explosive type;
2. Separate the leached nitrogen loading among quarry components (*e.g.* entering surface water, remaining on extracted rock etc.);
3. Separate the into loadings of N compounds (Nitrate, Nitrite and Ammonia); and,
4. Calculate the flow concentration

The concentrations of N species in discharge water from the proposed vertical extension at Tullykane quarry are calculated using this procedure. This is presented in Table 6.3. The highest residual is for nitrate (99%), and upper limit of the range is used in all cases to determine the concentration of N species in pumped water. The calculation also assumes that 100% of residual N is dissolved in drainage waters, and is subsequently pumped from the quarry by dewatering. Therefore this N mass enters the receiving water and could potentially impact water quality, *i.e.* 'status'.

Having used conservative values in this approach the resulting N species concentrations are small, and below all relevant EQS values. Even if these masses are added the background mass from groundwater (which will be pumped from the quarry) there is no exceedence of any EQS value for N species. Therefore, there is no requirement to complete an assimilation capacity assessment on the receiving water.

Table 6.3: Potential N compound concentrations from quarry explosives in dewatering discharge.

EXPLOSIVE MASS BALANCE			
Quarry Area	46.4		ha
Quarry Depth	36.9		m
Losses	15%		
Extraction Volume	14,553,360		m^3
Explosive Mass required per m^3	0.25		kg/m^3
Explosive Mass	3,638,340		kg
Quarry Life (years)	20		years
Explosive mass per year	181,917		kg/year
NITROGEN MASS BALANCE			
% Explosive mass as Ammonium Nitrate	94%		
% Ammonium Nitrate as N	35%		
Mass of N	59,850.69		kg
Residual Fraction (1-6%)*	0.06		
Residual N	3,591.04		kg
N COMPOUNDS			
Residual NO_3 (75-99%)*	0.99	3,555.1	kg/year
Residual NH_4 (0.5 - 24%)*	0.24	861.8	kg/year
Residual NO_2 (0-6%)*	0.06	215.5	kg/year
WATER BALANCE			
Average Annual Rainfall (SAAR)	802		mm/year
Runoff Coefficient	0.9		
Quarry Area	46.4		ha
Average Annual Runoff Volume	334,915.2		m^3/year
Average Daily Quarry Discharge	917.6		m^3/day
NITROGEN COMPOUND CONCENTRATIONS			
Residual NO_3	**0.0106**		mg/L
Residual NH_4	**0.0026**		mg/L
Residual NO_2	**0.0006**		mg/L

*Highest possible residual used in all cases.

6.6 SURAFCE WATER ASSESSMENT CONCLUSIONS

- Comparison of historical surface water quality monitoring for the existing discharge from the quarry shows that it generally has a positive impact on the receiving water, in that it improves water quality in stream S1. As a result there will be no negative impacts at either Location A (Ephemeral Stream), Location B (River Skane), or Location C (River Boyne).

- The discharge of groundwater and surface water from the quarry also adds flow to a stream that is sometimes dry. From a hydromorphological perspective this is positive.

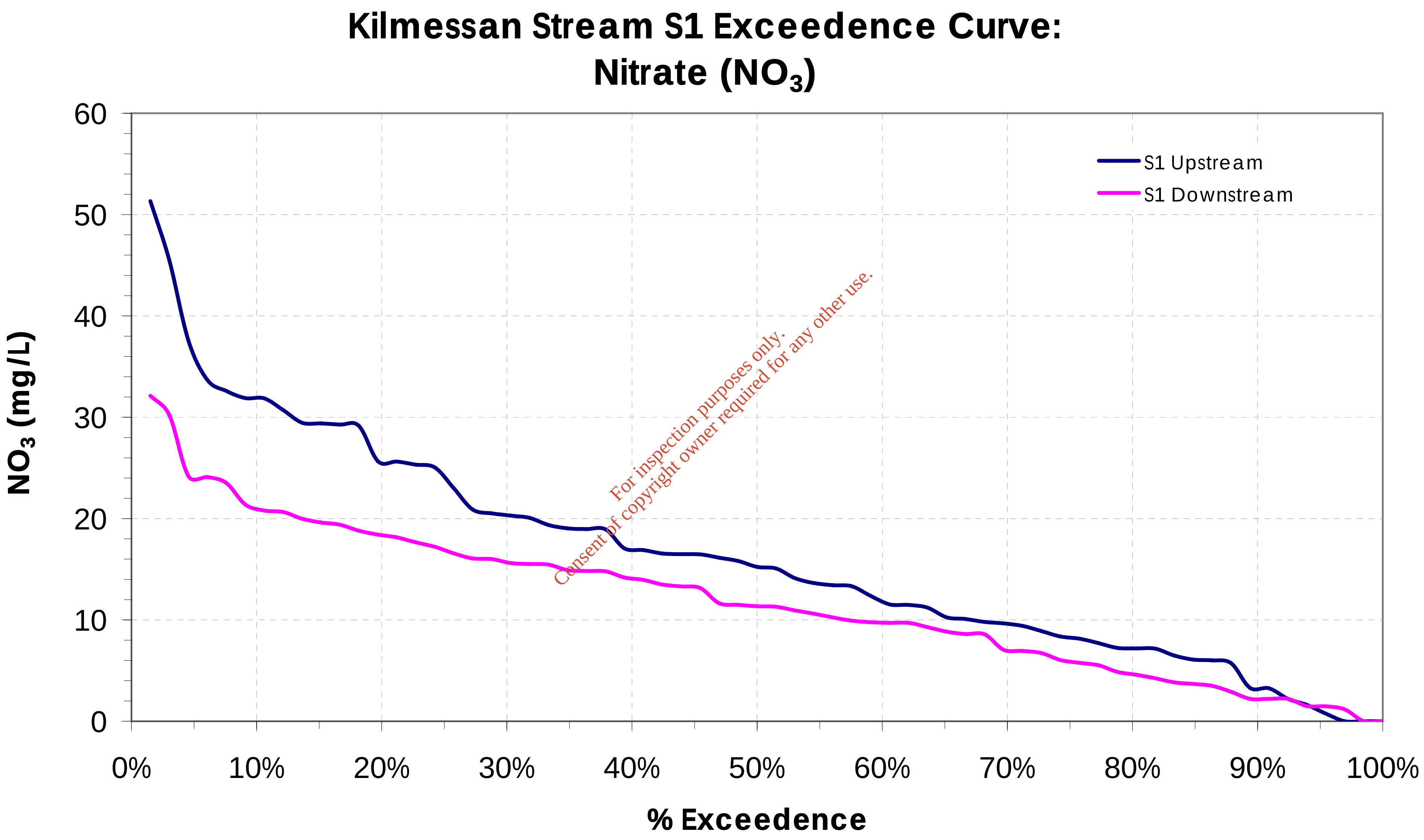
- Comparison of existing discharge water quality and future potential groundwater quality shows that most parameters are below required EQS's and therefore no assimilation assessment was required.

- An assessment of potential for increase in N species in discharge waters resulting from use of Ammonium Nitrate explosives (ANFO) has been made, and this is shown to be negligible.

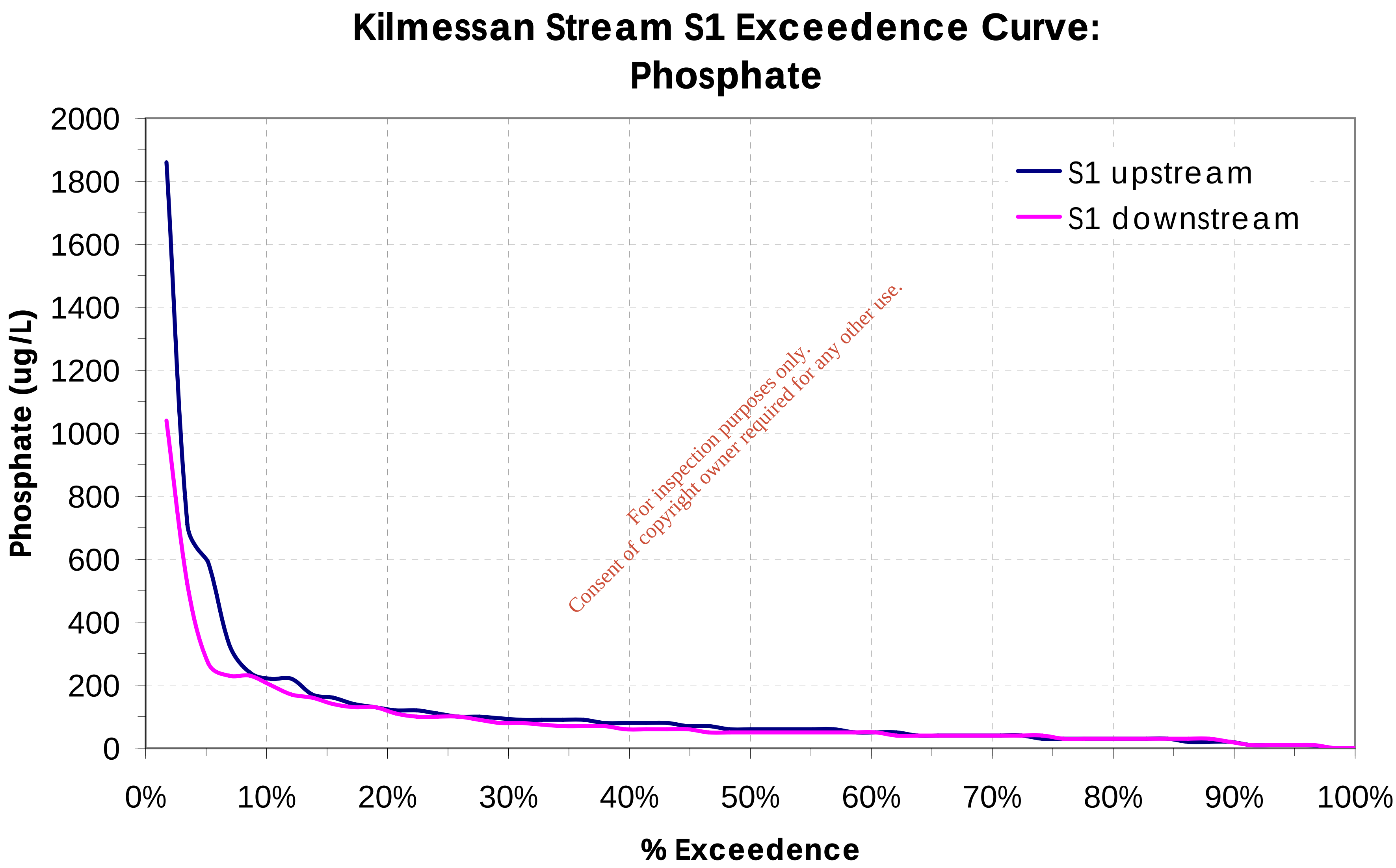
- The anticipated discharge (mix of groundwater and surface water) does not have potential to affect chemical status because the discharge will not contain those chemicals listed in SI 272 of 2009 as representative of chemical status. The anticipated discharge will not contain 'Specific Pollutants' (Part B, Schedule 5, SW Regulations 2009, S.I. 272 of 2009). Neither will the discharge contain 'Priority Substances' or 'Priority Hazardous Substances' as listed in Schedule 6 of SI 272 of 2009. This assessment of potential impact of the discharge, adopted DoEHLG Guidance (2010), using screening and where required mass balance and Schedule 5, Table 9 (S.I. 272 of 2009) evaluation EQS's for 'Physico-chemical Conditions supporting the biological elements';

- Environmental Quality Standards (water quality objectives) are adhered to and there is negligible potential for the discharge of treated water to cause deterioration in 'status' (WFD) of Sruwaddacon Bay; and,

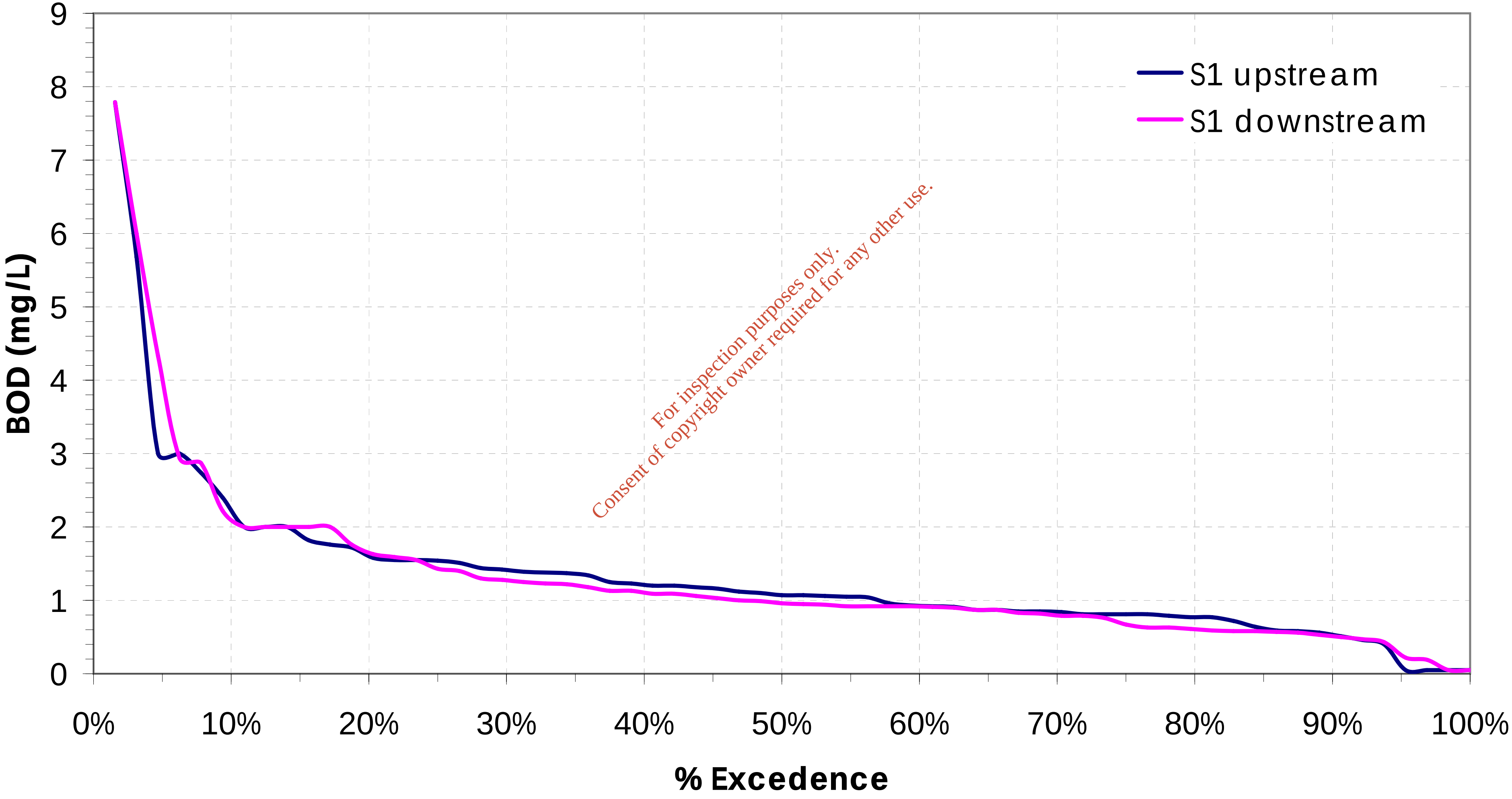
- In conclusion the future potential discharge of groundwater and surface water from Tullykane quarry site does not have the potential to affect water quality or 'Status' and is therefore Regulation compliant.

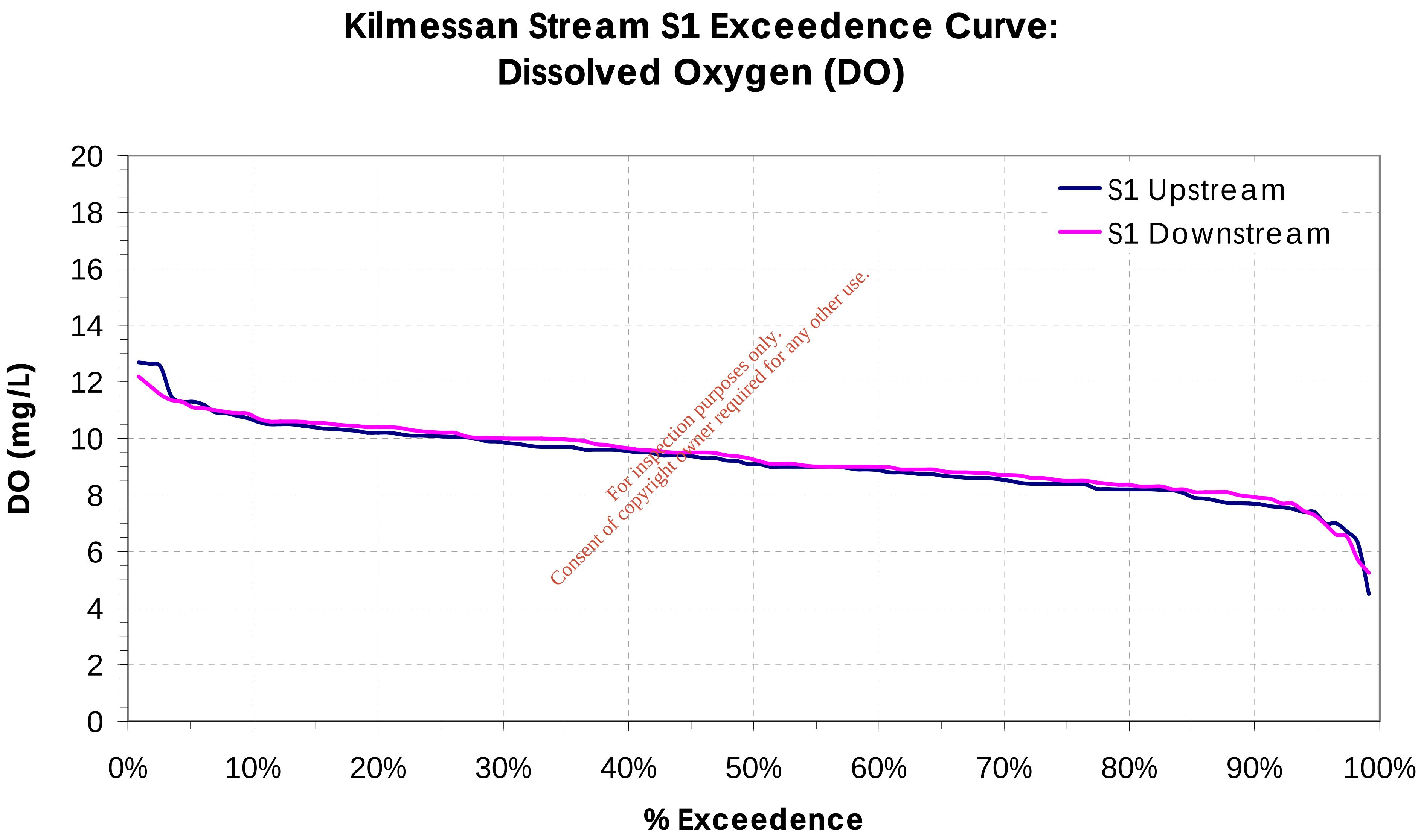


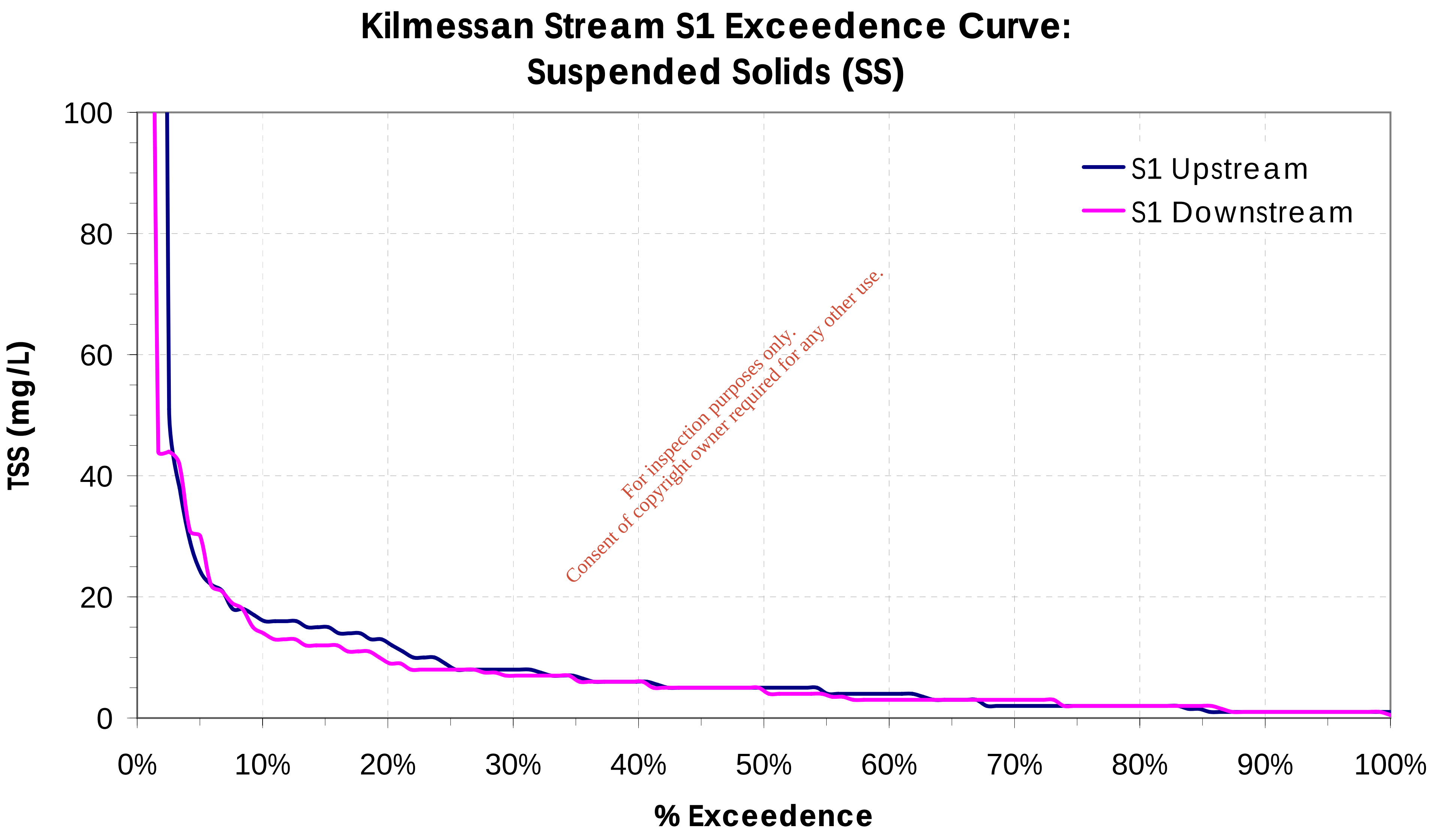
Kilmessan Stream S1 Exceedence Curve:
Nitrate (NO_3)
NO_3 (mg/L)
60
50
40
30
20
10
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% Exceedence
S1 Upstream
S1 Downstream

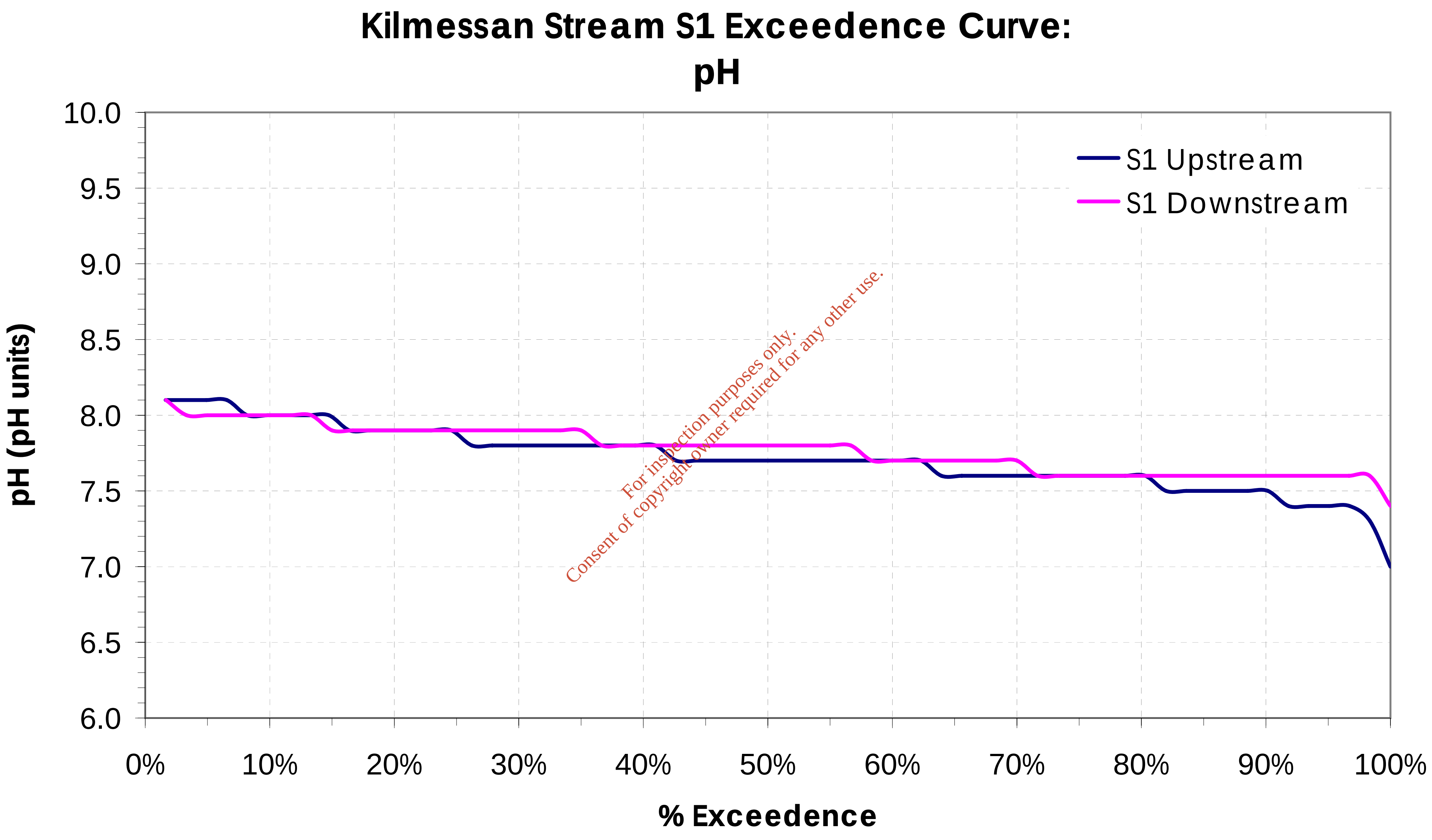

Kilmessan Stream S1 Exceedence Curve:
Phosphate
Phosphate (ug/L)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% Exceedence
S1 upstream
S1 downstream

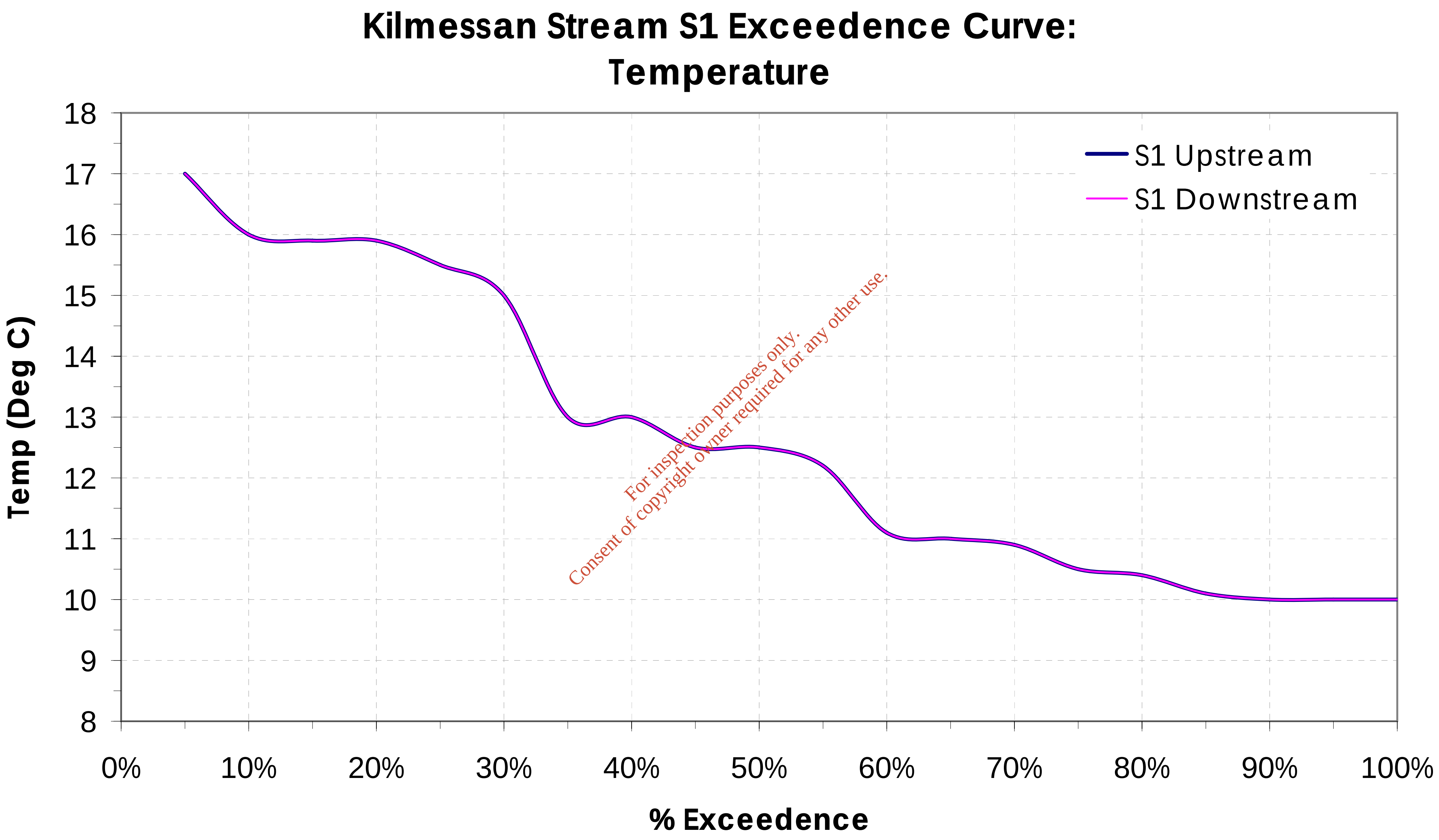
Kilmessan Stream S1 Exceedence Curve: Biochemical Oxygen Demand (BOD)

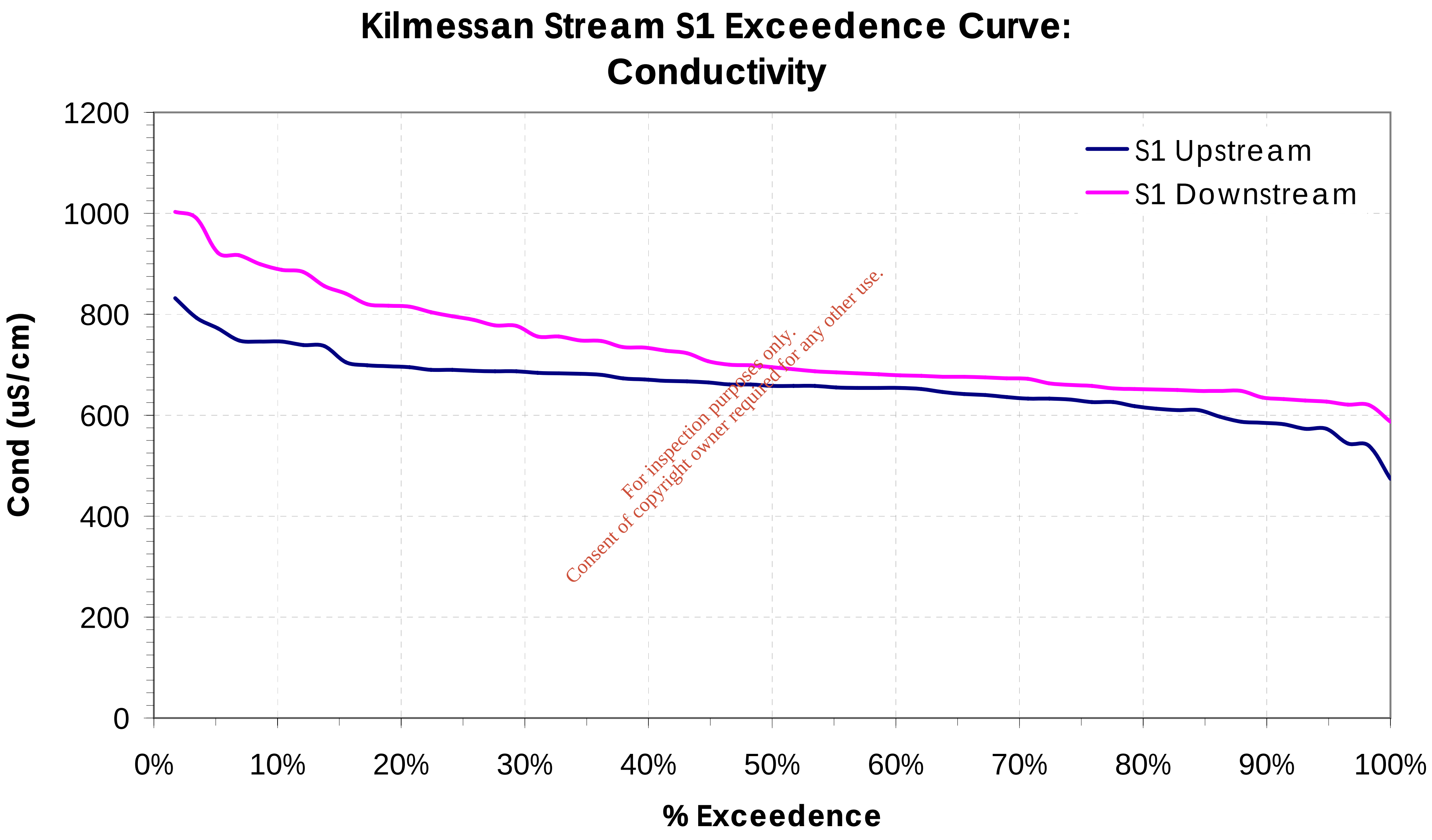


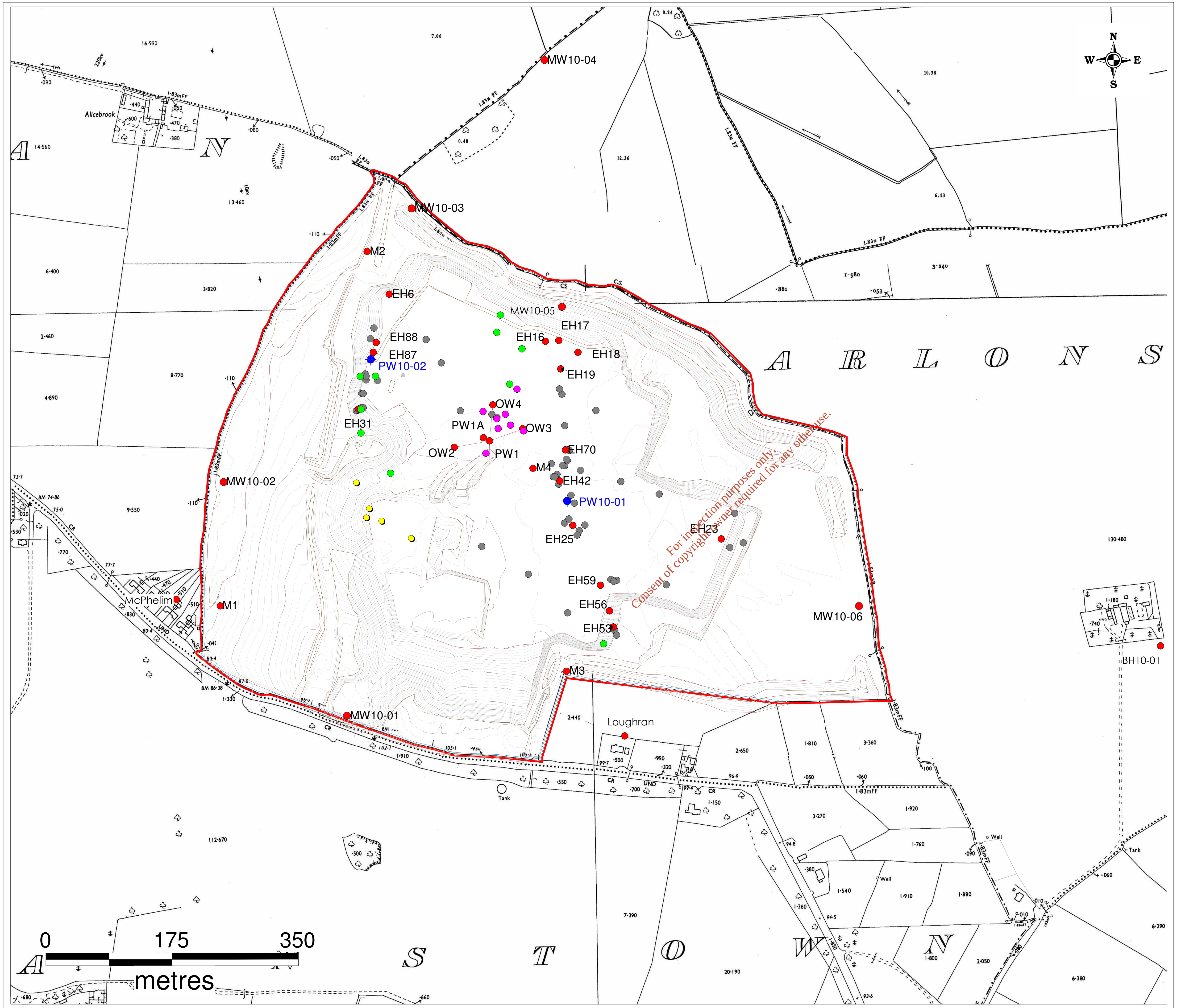

Kilmessan Stream S1 Exceedence Curve:
Dissolved Oxygen (DO)
DO (mg/L)
20
18
16
14
12
10
8
6
4
2
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% Exceedence
S1 Upstream
S1 Downstream


Kilmessan Stream S1 Exceedence Curve:
Suspended Solids (SS)
TSS (mg/L)
% Exceedence
S1 Upstream
S1 Downstream
100
80
60
40
20
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


Kilmessan Stream S1 Exceedence Curve:
pH
pH (pH units)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% Exceedence
S1 Upstream
S1 Downstream


Kilmessan Stream S1 Exceedence Curve: Temperature
Temp (Deg C)
18
17
16
15
14
13
12
11
10
9
8
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% Exceedence
S1 Upstream
S1 Downstream


Kilmessan Stream S1 Exceedence Curve: Conductivity
Cond (uS/cm)
1200
1000
800
600
400
200
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% Exceedence
S1 Upstream
S1 Downstream

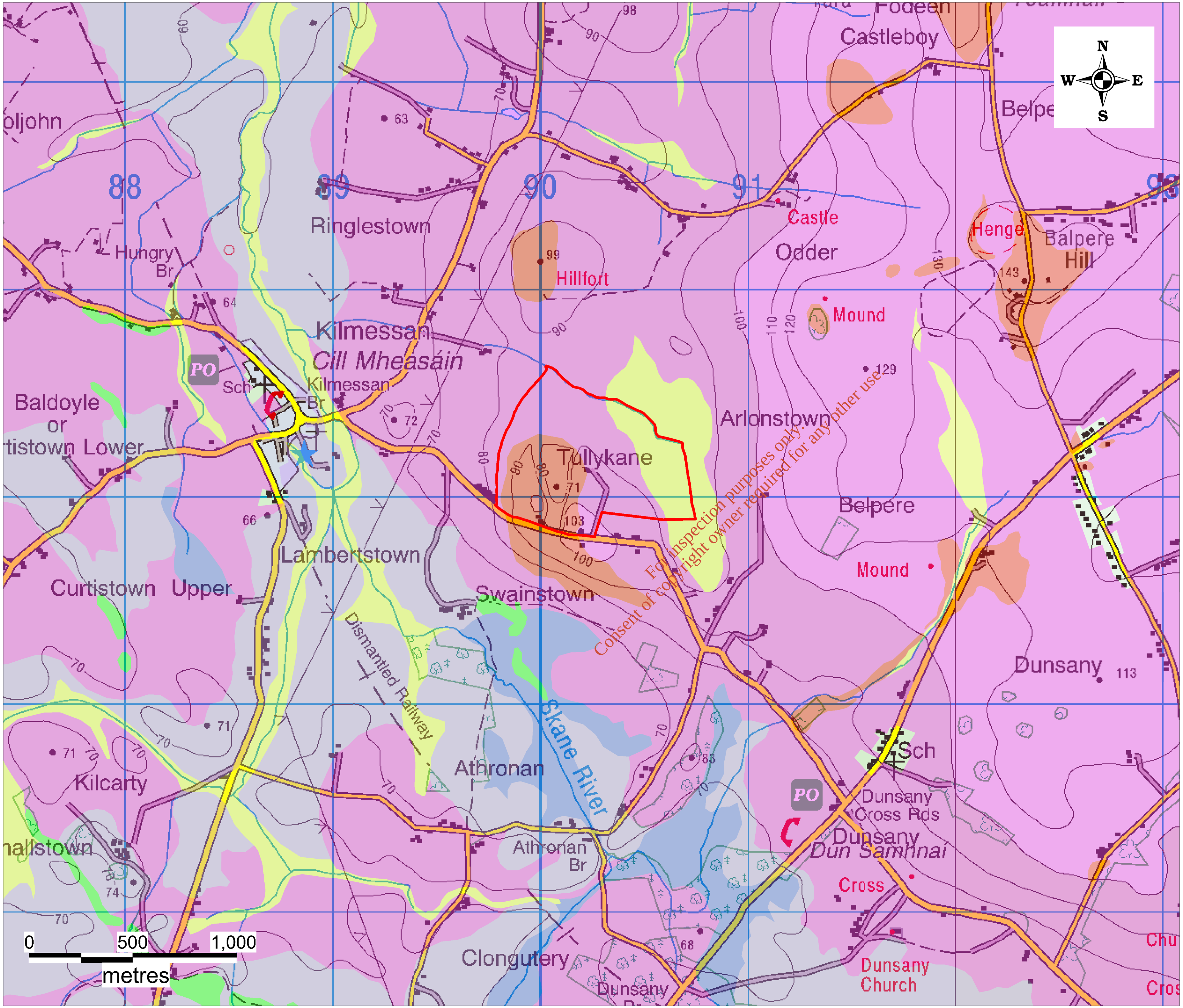


LEGEND:

- Site Boundary
- HES 2010 Exploration Hole
- HES 2011 Pumping Test Monitoring Well
- HES 2010 Pumping Well
- Tobins 2008
- JBA 1999
- OGE 1999

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Kilsaran Concrete	
Job: Kilmessan Quarry	
Title: Site Investigation Map	
Figure No: 1	
Drawing No: P1164-3-0511-A3-001-00A	
Sheet Size: A3	Project No: P1164-3
Scale: 1:5,000	Drawn By: DB
Date: 13/12/2016	Checked By: MG



Legend:

- Site Boundary
- Alluvium
- Lacustrine
- Rock at Surface
- Gravels
- Esker
- Limestone Tills

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co. Waterford
Ireland
tel: +353 (0)5844122
fax: +353 (0)5844244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Title: Local Subsoils Map

Client: Kilsaran Concrete

Job: Kilmessan Quarry

Project No: P1164-3

Figure No: 2

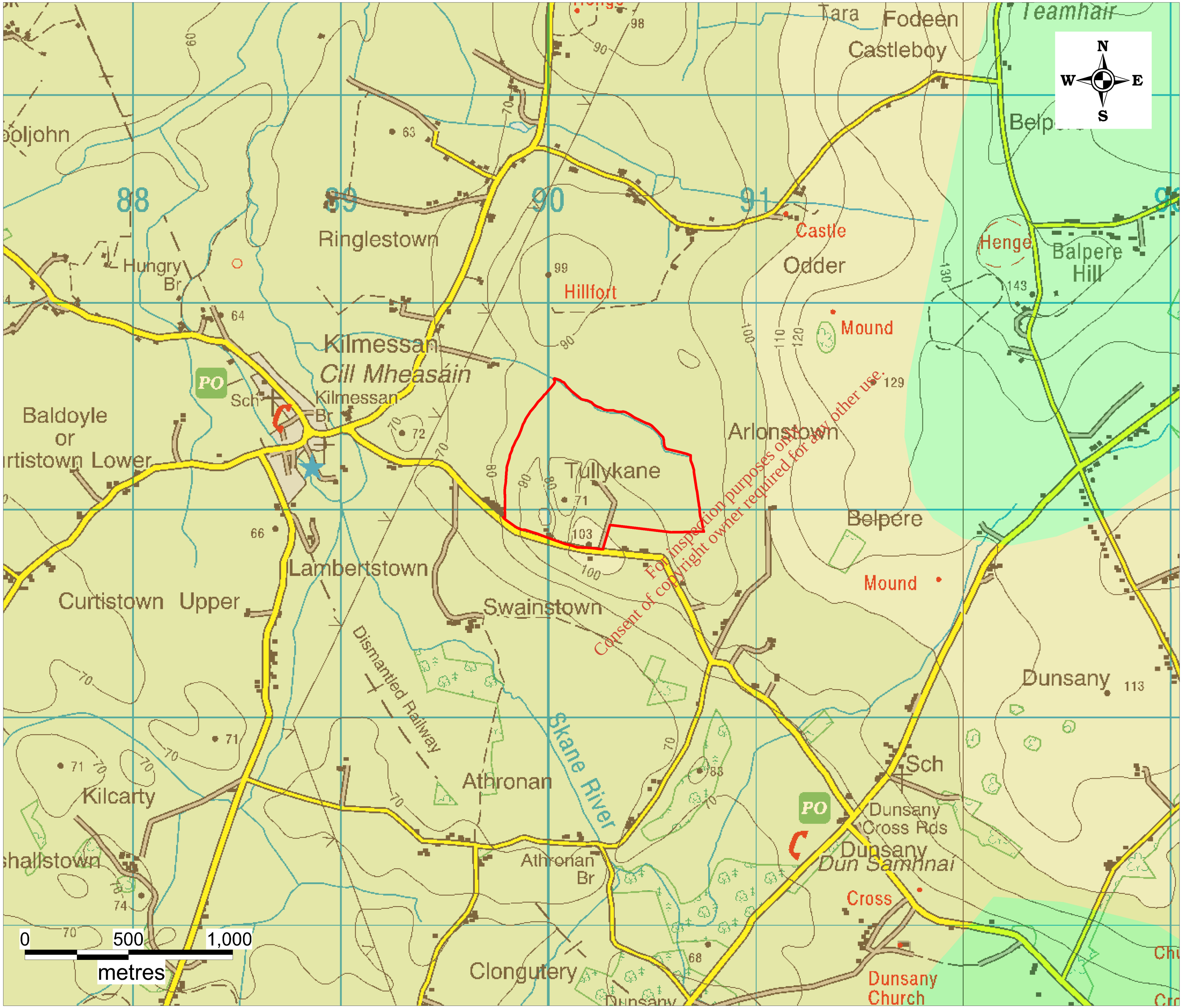
Sheet Size: A4

Drawing No: P1164-3-0511-A4-002-00A

Date: 13/12/2016

Scale: 1:25,000

Drawn By: DB | Checked By: MG



HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co. Waterford
Ireland

tel: +353 (0)5844122
fax: +353 (0)5844244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Title: Bedrock Geology Map

Client: Kilsaran Concrete

Job: Kilmessan Quarry

Project No: P1164-3

Figure No: 3

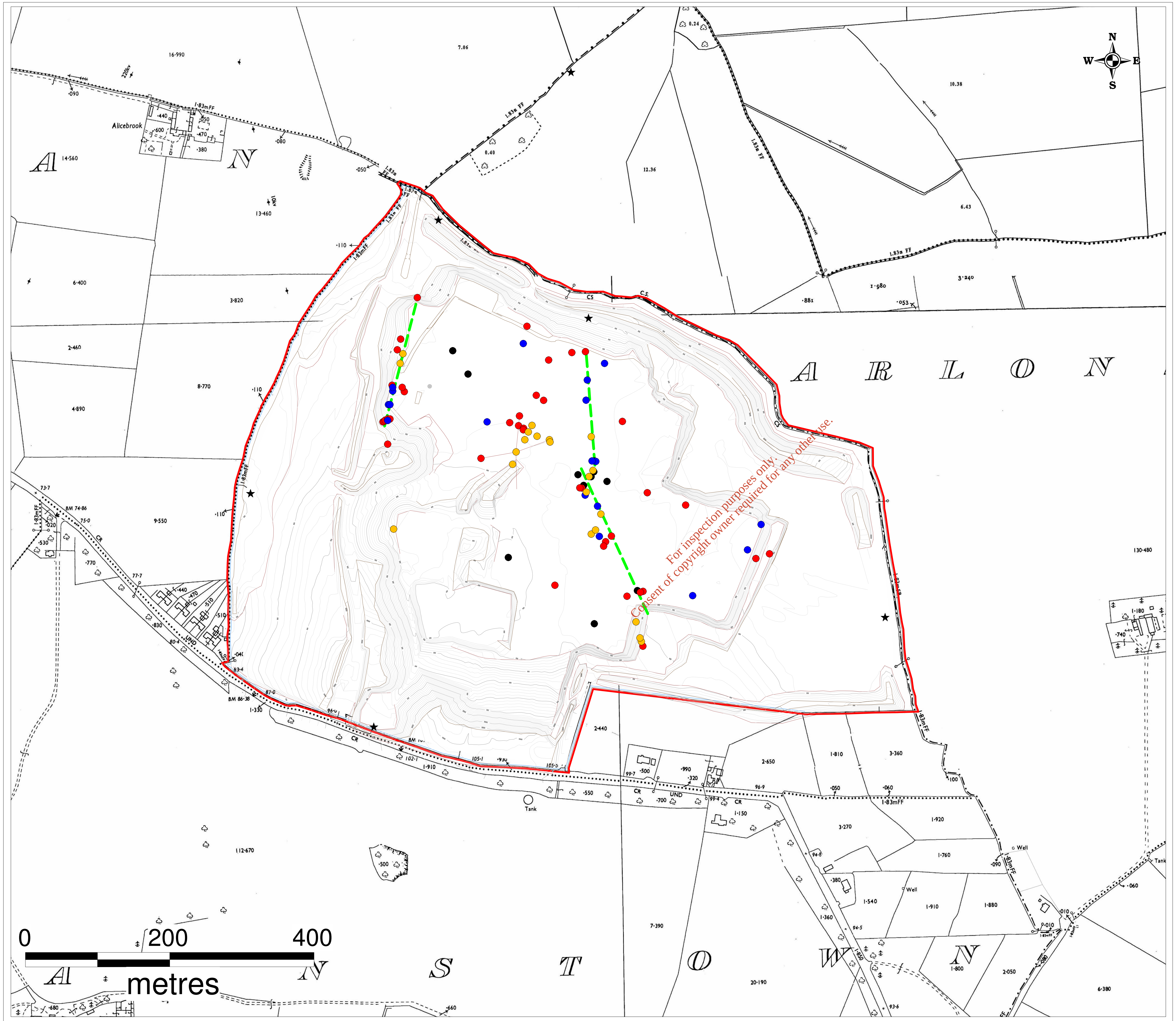
Sheet Size: A4

Drawing No: P1164-3-0511-A4-003-00A

Date: 13/12/2016

Scale: 1:25,000

Drawn By: DB | Checked By: MG

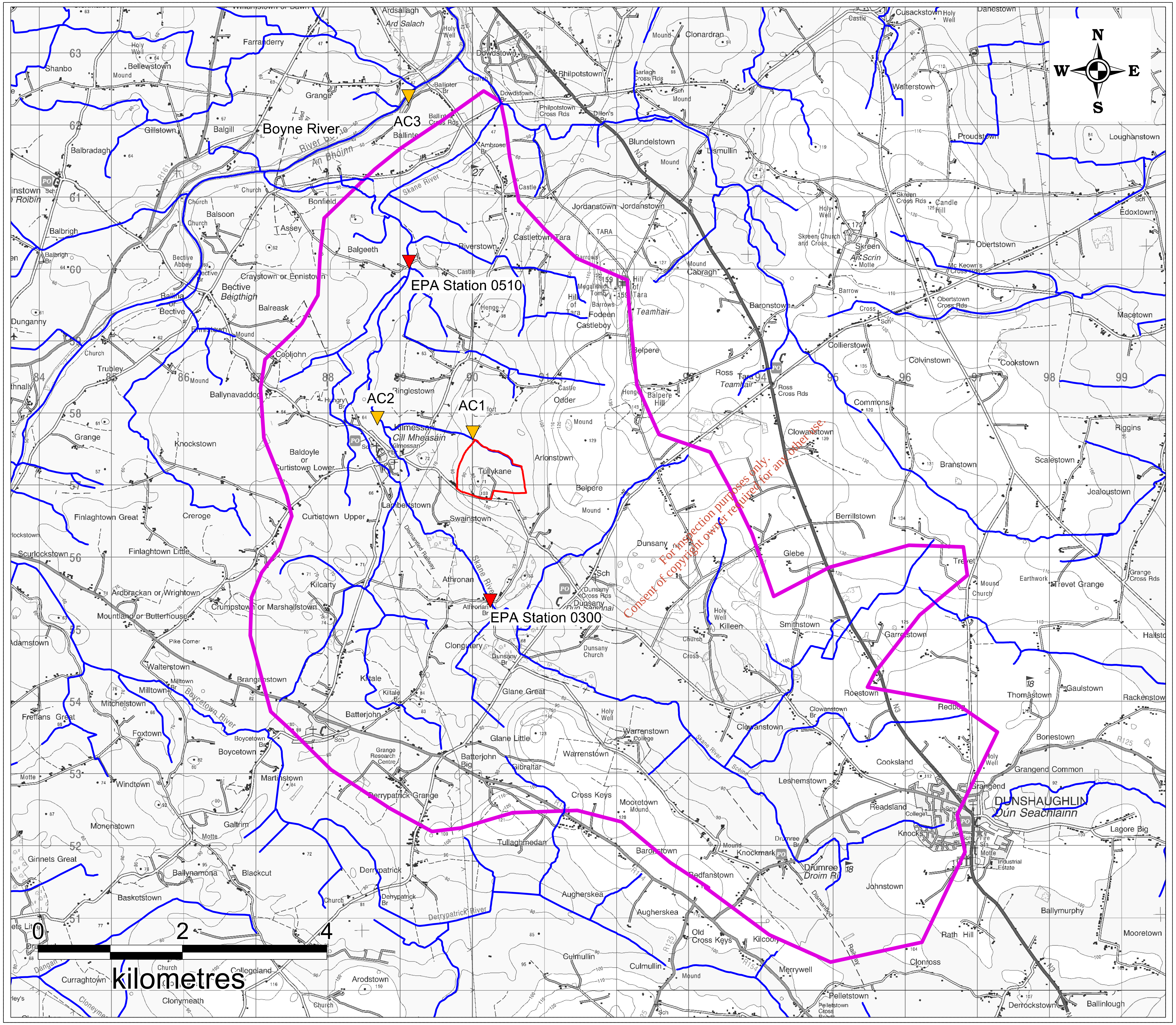


LEGEND:

- Site Boundary
- Dry Well
- Poor Yield (<40m3/day)
- Moderate Yield (40 - 100m3/day)
- Good Yield (100 - 400m3/day)
- Identified Fault Zones

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Kilsaran Concrete	
Job: Kilmessan Quarry	
Title: Results of Exploration Drilling	
Figure No: 4	
Drawing No: P1164-3-0511-A3-004-00A	
Sheet Size: A3	Project No: P1164-3
Scale: 1:5,000	Drawn By: DB
Date: 13/12/2016	Checked By: MG



LEGEND:

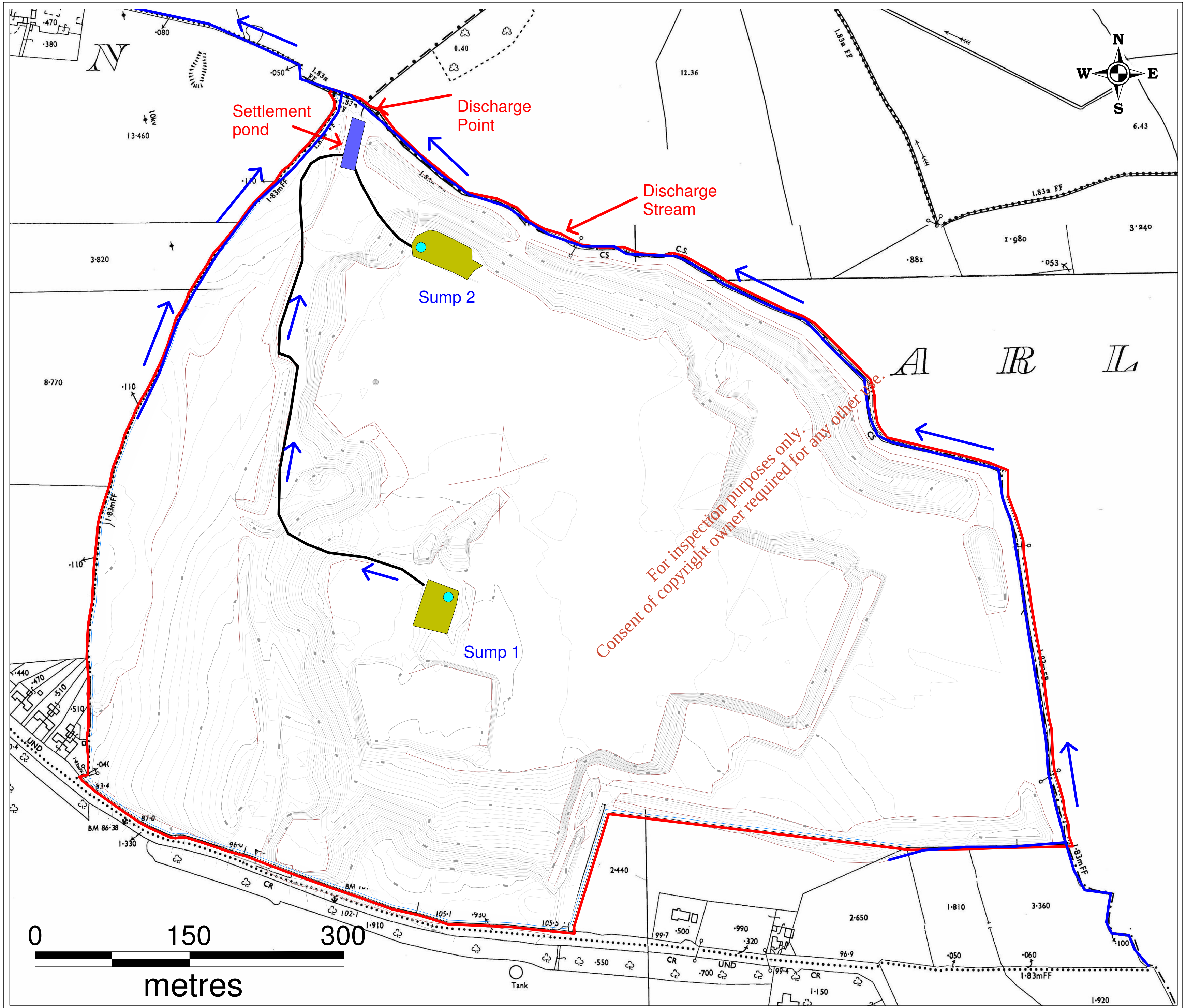
- Site Boundary
- River Skane Catchment
- Stream / River
- HES Assimilative Capacity Assessment
- EPA Surface Water Station Monitoring

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Kilsaran Concrete	
Job: Kilmessan Quarry	
Title: Regional Hydrology Map	
Figure No: 5	
Drawing No: P1164-3-0511-A3-005-00A	
Sheet Size: A3	Project No: P1164-3
Scale: 1:50,000	Drawn By: DB
Date: 13/12/2016	Checked By: MG



LEGEND:

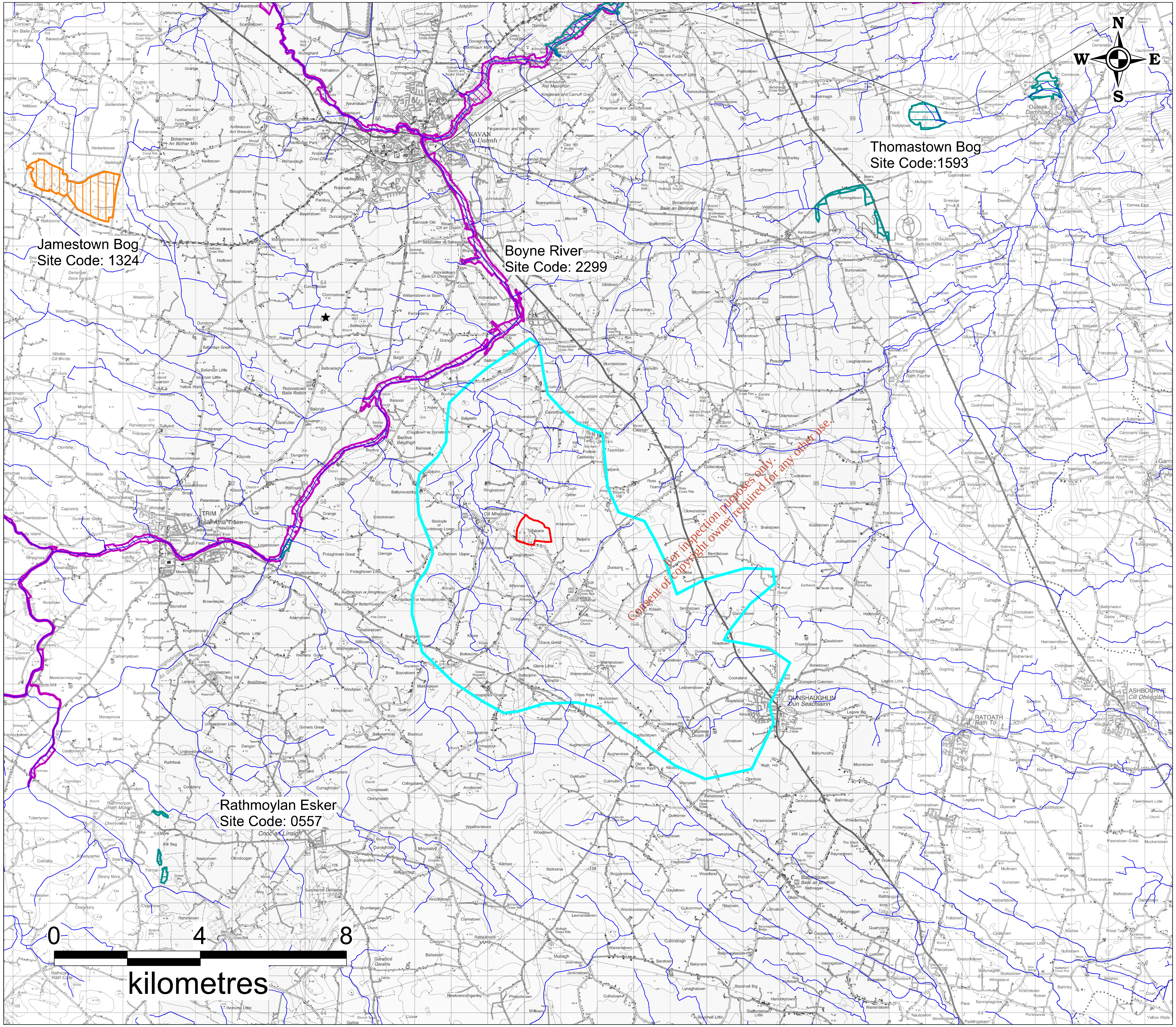
- Site Boundary
- Discharge Pipe
- Flow Direction
- Sump Pump

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co. Waterford
Ireland

tel: +353 (0)5844122
fax: +353 (0)5844244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Title: Quarry Water Management System	
Client: Kilsaran Concrete	
Job: Kilmessan Quarry	
Project No: P1164-3	
Figure No: 6	
Sheet Size: A4	
Drawing No: P1164-3-0511-A4-006-00A	
Date: 13/12/2016	
Scale: 1:5,000	
Drawn By: DB	Checked By: MG



LEGEND:

- Site Boundary
- pNHA
- NHA
- cSAC
- Skane River Catchment
- Stream / River

Note:
pNHA- Proposed National Heritage Area
NHA - National Heritage Area
cSAC - Candidate Special Area of Conservation

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Kilsaran Concrete

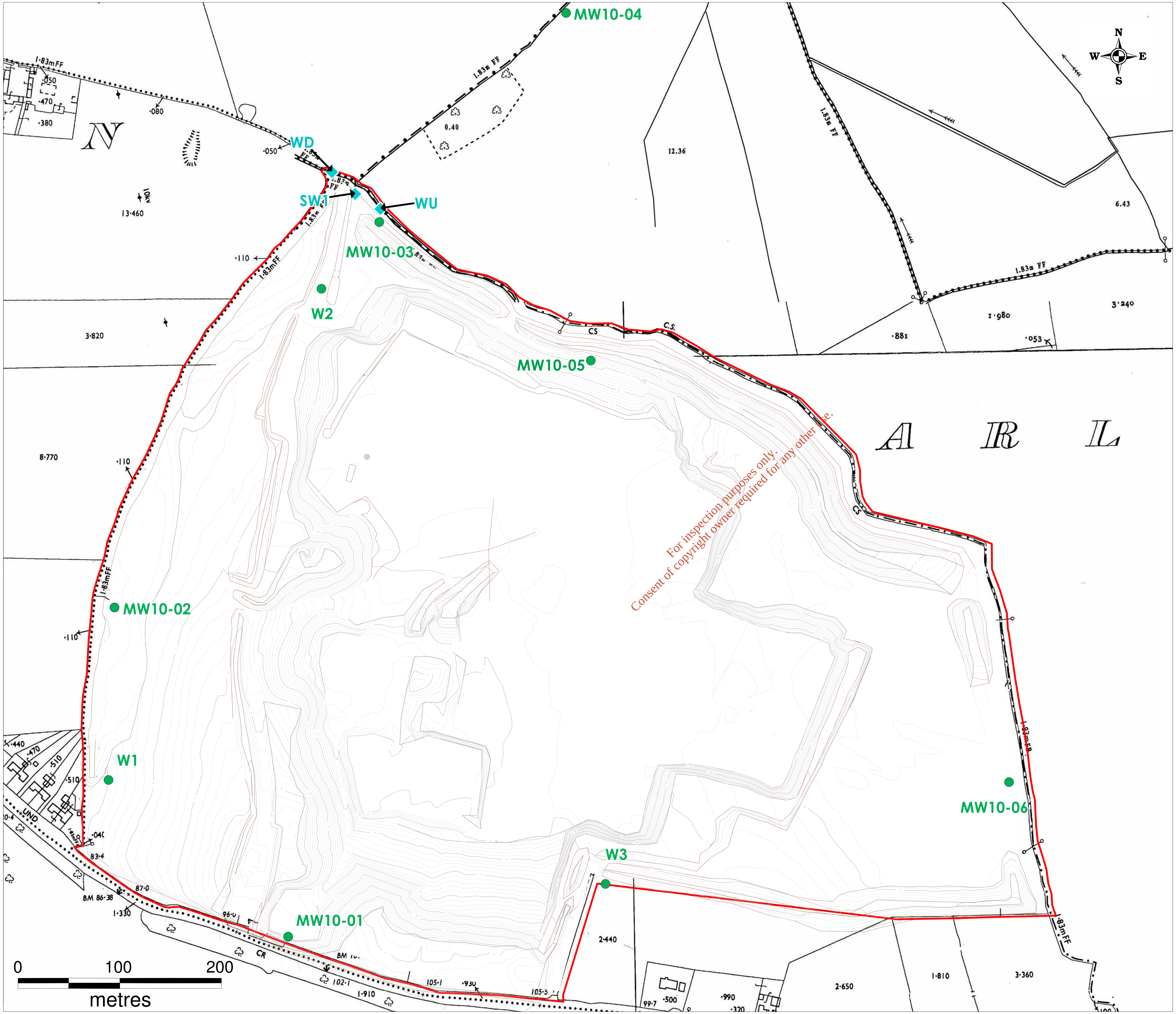
Job: Kilmessan Quarry

Title: Designated Sites

Figure No: 7

Drawing No:P1164-3-0511-A3-007-00A

Sheet Size: A3	Project No: P1164-3
Scale: 1:100,000	Drawn By: DB
Date: 13/12/2016	Checked By: MG



Legend

- Site Boundary
- Surface Water Monitoring Location
- Groundwater Monitoring Well Location
- **SW1** Quarry Discharge
- **WD** Downstream of Discharge Point
- **WU** Upstream of Discharge Point

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Kilsaran Concrete	
Job: Kilmessan Quarry	
Title: Groundwater and Surface Water Monitoring Location	
Figure No: 8	
Drawing No: P1164-3-0511-A3-008-00A	
Sheet Size: A3	Project No: P1164-3
Scale: 1:5,000	Drawn By: DB
Date: 13/12/2016	Checked By: MG

Table 1
Project: Kilmessan Quarry Waste Licence Application
Groundwater Quality Monitoring Data (2011 and 2018)

Parameter	Unit	S.I. 122 of 2014	S.I. No.9 2010	2011 Sampling			2018 Sampling			
				PW10-01 (Down-gradient)	PW10-02 (Down-gradient)	Discharge Point (Down-gradient)	PW10-01 (Down-gradient)	MW10-02 (Down-gradient)	MW10-3 (Up-gradient)	MW10-06 (Up-gradient)
Sodium	mg/l	200	150	10.54	8.689	9.94	3.2	8.1	8.6	10
Calcium	mg/l	-	-	153.6	147.4	143	71	197	170	114.2
Magnesium	mg/l	-	-	25.04	13.98	17.98	9.84	9.73	27.66	19.56
Potassium	mg/l	-	-	1.404	0.654	0.974	1	1	2	3
Iron	µg/l	200	-	<3.7	<3.7	<3.7	3	4	4	19
Manganese	µg/l	50	-	2.094	<0.7	1.566	10	**641**	3	43
Chloride	mg/l	250	24 - 187.5	20.13	19.02	18.76	5.4	17.6	14.1	16.3
COD	mg/l	-	-	-	-	-	<5	19	9	<5
BOD	mg/l	-	-	-	-	-	<2	<2	<2	<2
Sulphate	mg/l	250	187.5	186.28	135.51	153.21	129.15	42	**308**	26.79
Nitrogen (Total Kjeeldahl) as N	mg/L	-	-	5.04	1.68	1.12	1.12	1.12	1.12	1.68
Nitrogen (Total Oxidised) as N	mg/L	-	-	1.2	2.26	1.92	<0.29	0.85	0.23	<0.29
Nitrogen (Total) as N	mg/L	-	-	6.24	3.94	3.04	1.12	1.97	1.35	1.68
Nitrate (as NO_3)	mg/l	50	37.5	5.29	9.98	8.43	<0.48	3.72	1.01	<0.48
Nitrite (as NO_2)	mg/l	0.5	0.375	0.009	0.0066	0.0132	<0.007	0.009	<0.006	<0.007
Ammonia (N)	mg/l	0.3	0.065 - 0.175	<0.01	<0.01	<0.01	<0.02	0.09	0.01	**0.69**
Ortho -Phosphate	mg/l	-	0.035	<0.005	<0.005	<0.005	<0.01	**0.06**	<0.01	<0.01
Total Phosphate	mg/l	-	-	0.034	<0.011	<0.011	8	219	104	81
Alkalinity (as $CaCO_3$)	mg/l	-	-	283	292	290	-	-	-	-
Hardness - Total (as $CaCO_3$)	mg/l	-	-	467	437	433	-	-	-	-
pH	pH units	6.5 – 9.5	-	7.6	7.5	7.6	-	-	-	-
Electrical Conductivity	µs/cm	2500	800 - 1875	887	846	865	-	-	-	-
Turbidity[5]	NTU	-	-	<0.02	0.53	0.25	8	219	104	81
Total Dissolved Solids	mg/L	-	-	531	531	540	329	602	746	501
Total Suspended Solids	mg/L	-	-	<2	<2	<2	<2	81	147	26
		-								
Zinc (Dissolved)	µg/l	-	-	-	-	-	4	10	12	21
Lead (Dissolved)	µg/l	10	18.75	-	-	-	<0.173	<0.173	<0.173	<0.173
Cadmium (Dissolved)	µg/l	5	3.75	-	-	-	<0.09	<0.09	<0.09	<0.09
Arsenic (Dissolved)	µg/l	10	7.5	<0.96	<0.96	<0.96	<1.0	<1.0	<1.0	<1.0
Copper (Dissolved)	µg/l	2	-	0.315	0.809	1.096	<0.142	<0.142	<0.142	<0.142
Nickel (Dissolved)	µg/l	20	15	9.058	3.353	5.733	3	**16**	5	<0.374
TPH (<C10 - C40)	µg/l	-	0.075	<1	<1	<1	-	-	-	-
TPH (<C6 - C40)	µg/l	-	0.075	-	-	-	<1	<1	<1	<1
PRO (<C6 - C12)	µg/l	-	0.075	-	-	-	<5	<5	<5	<5
DRO (<C10 - C28)	µg/l	-	0.075	-	-	-	<1	<1	<1	<1
		-								
Coliforms (Total)	cfu/100ml	0	-	-	-	-	**20**	**8**	**21**	0
E. Coli	cfu/100ml	0	-	-	-	-	**2**	0	0	0

Note: Red Bold = Exceedance of Regulation Value