7.5.7 Groundwater as a Source of Supply

There are no Public Water Supply (PWS) or National Federation Group Water Scheme (NFGWS) groundwater protection areas mapped in the vicinity of the application site or the surrounding lands.

The GSI well database (www.gsi.ie) does not record any mapped wells within 5km of the site.

There are no residences within 500m of the sump at the site.

Information relating to local domestic water supply was extracted from Cork County Council's Planning Files and information for local water usage is reported in the 2015 EIS and the EIAR for the neighbouring site (SLR, 2021). Well survey results suggest that the domestic residences to the north of the site, along the east west trending third class road are served by mains supply. There is a farm at 700m from the sump and it uses water from a well. All potential water users are upgradient of the site and at a distance of >500m. Refer to Figure 7-11. Hydro-G did not conduct a well search because desk study suggested that the area's residents have been interviewed on numerous occasions in the past and in the Covid-19 risk environment of 2021, it was deemed safer to rely on the comprehensive detail available for the local area's well users.

7.5.8 Local Rainfall & Recharge

Using vulnerability classifications and hydrogeological settings, recharge coefficients can represent the ratio of precipitation that theoretically infiltrates vertically to the water table to that which moves as surface overland flow. Based upon a vulnerability classification of extreme and the lack of overburden within the site, the recharge coefficient applicable to the site is 60% (areas where rock is at ground surface). This indicates that under the current hydrogeological setting, approximately 15% of effective rainfall is available for surface runoff.

EPA mapping (https://gis.epa.ie/EPAMaps/Water) presents RAINFALL_SAAR = 1047mm/yr.

The GSI (www.dcenr.maps.arcgis.com) presents Groundwater Recharge information, shown here as Figure 7.12, and maps the general areas as follows:

- Hydrogeological Setting 1.iv
- Groundwater Vulnerability description Extreme
- Recharge Coefficient (%) 60.00

- Effective Rainfall 616.700
- Recharge (pre cap) mm/yr 370
- Recharge Cap Apply Y
- Maximum Recharge Capacity (mm/yr) 200

Within the quarry area itself, the nature of the rock matrix will have a low primary porosity and the rock itself is of low permeability. Therefore, recharge to groundwater is likely to be low through the rock matrix. This is why the GSI apply a Recharge Cap and only 200mm/yr of the ~1047mm/yr SAAR (https://gis.epa.ie/EPAMaps/Water) rainfall is assigned as contributing to groundwater at the site. Rainfall runoff to the sump lagoon in the quarry floor is the primary mechanism for rainfall runoff derived water to move through and from the site.

7.5.9 Regional Hydrology

On a regional scale the application site is located within the Lee, Cork Harbour and Youghal Bay surface water catchment within Hydrometric Area 19 of the South Western River Basin District. Locally, the site is in the Tibbotstown_SC_010 surface water sub-catchment and the WFD River sub-basin (IE_SW_19T250870). Hydrometric Area 19 has an overall area of 2,182km2. The overall catchment and the sites setting are presented in the Figures 7.13 series. The site lies in the Tibbotstown sub basin of Hydrometric Area 19 and that sub basin is mapped as having a catchment area of 52km2 (https://gis.epa.ie/EPAMaps/Water).

Regional Hydrology can most easily be understood with reference to the series of Figures 7.13.

Rivers on the land are only a small part of the site's hydrological setting. The site does not interact with rivers. The site was a sand and gravel pit before the underlying limestone was revealed to be a resource required for building. Sand and Gravel areas do not present land water courses. Hence there are none in the vicinity of the site. While the 'Tibbotstown_010' has small tributaries at 1.5km to the NW and the SE, the site's hydrological significance is its coastal setting. The site does not interact with any rivers.

The site sits on a northern boundary of the 'North Channel Great Island' Transitional Waterbody (IE_SW_060_0300). This transitional waterbody is a shallow mudflat type area that feeds into Cork Harbour (IE_SW_060_0000), which is mapped south of the transitional water and hence south of the site. The Lagan quarry site sits on a northern flank of the North Channel Great Island Transitional Waterbody and that waterbody is a feeder to the north-eastern part of Cork Harbour. A more significant magnitude feeder into Cork Harbour is Lough Mahon (IE_SW_060_0750), which

feeds from the northwest, and is also fed by Lough Mahon [Harper's Island] (IE_SW_060_0700) and the Lee (Cork) Estuary Upper (IE_SW_060_0950).

There are no EPA/OPW Hydrometric Gauges in the immediate area of the site. There are Hydrometric Gauges north of Middleton on the Owennacurra_040 and the Dungourney_020. However, these river systems are of no relevance to the site under consideration. There are no Hydrometric Gauges on the Tibbottstown_010. The EPA HydroTOOL model has nodes at Middleton and downstream of Carrigtwohill. The EPA HydroTOOL does not map the coastal zones as significant surface water systems (Refer to Figure Series 7.13). However, The EPA HydroTOOL model suggests that the combined National Annual Mean Flow rate (NATAMF) entering the estuary from the Tibbotstown_010, OWENNACURRA_040and DUNGOURNEY_020 is at least 5m3/s, approximately, and probably more because the HydroTOOL model nodes are significantly upgradient of the points at which the rivers discharge to the estuary. A NATAMF rate of 5m3/s is equivalent to 432,000m3/d, at a minimum, of river water being discharged to the North Channel Great Island Transitional Waterbody every day.

Based on the information presented by the EPA (https://gis.epa.ie/EPAMaps/Water). Hydro-G concludes that the potential impact on the Transitional Waterbody is of most importance in the assessment of potential impact. The catchment area of the transitional and coastal waterbody is 2,182km2.

7.5.10 Surface Water Quality and WFD Status

The quality of all surface waters in the application site's Lee, Cork Harbour and Youghal Bay surface water catchment (Hydrometric Area 19) is fully described in the EPA Report for the '3rd Cycle Draft Lee, Cork Harbour and Youghal Bay Catchment Report (HA 19)' [December 2018].

As previously described in the preceding section on Regional Hydrology, the transitional and coastal waters to the south are the surface waters of significance to this assessment. As previously stated, the Tibbotstown_010 rivers are not within influence of the site. Surface Waters and their Risk/Status classifications are shown in Figure series 7.14.

EPA maps (https://gis.epa.ie/EPAMaps/) report for Status 2013-2018 and 3rd Cycle Risk as follows:

- 'North Channel Great Island' Transitional Waterbody (IE_SW_060_0300) = MODERATE STATUS and mapped as AT RISK, which feeds into
- Cork Harbour (IE_SW_060_0000) = MODERATE STATUS & mapped as AT RISK, which is also fed from the northwest by
- Lough Mahon (IE_SW_060_0750) = MODERATE STATUS & AT RISK

- Lough Mahon [Harper's Island] (IE_SW_060_0700) = MODERATE STATUS & AT RISK, and
- The Lee (Cork) Estuary Upper (IE_SW_060_0950) = MODERATE STATUS & AT RISK

The Lee Cork Harbour and Youghal Bay (EPA, 2018) includes information of relevance to this assessment as follows:

- *For the 13 transitional waterbodies, eight (62%) are At Risk and five (38%) are in Review.*
- *For the six coastal waterbodies in the catchment, two (33%) are At Risk, one (17%) is in Review and three (50%) are Not At Risk. Cork Harbour and Youghal Bay are the coastal waterbodies At Risk.*
- *The designated Shellfish Area's Objectives for the Cork Great Island North Channel Shellfish Area (IEPA2_0049) are not being met.*
- *The estuary downstream of the Middleton WWTP's discharge is a designated Nutrient Sensitive Area. The Middleton WWTP meets the required improvement objective having Tertiary Treatment in place (EPA, 2018).*

The quarry sits in the Tibbotstown_010 WFD River sub-basin of the overall Lee, Cork Harbour and Youghal Bay surface water catchment. The catchments.ie WFD Report for the Catchment Lee, Cork Harbour and Youghal Bay Subcatchment Tibbotstown_SC_010 (Code 19_2) [EPA, 2019] reports that the Pressures in this catchment mostly relate to Urban Wastewaters and Anthropogenic Pressures. More information can be garnered from the recently released EPA (2021) "Assessment of the catchments that need reductions in nitrogen concentrations to achieve water quality objectives. WFD River Basin Management Plan – 3rd Cycle." In that 2021 report, the EPA firmly identifies Arable Pasture as the most significant pressure the Transitional Waterbodies in the vicinity of the site.

With respect to impact assessment on the downstream transitional waterbodies, baseline information relating to the quality of the rivers flowing into the estuary is important. The most recent Q ratings for the rivers contributing to the estuary adjoining the site are presented in Figure 7.14

With reference to Figure 7.15 There are two sites for which the EPA have determined Q ratings for the year 2020 as follows:

- Station Name: Cork Br, Midleton (RS19O030500) on the OWENNACURRA_040, Q Value Score 3-4, Year 2020, Q Value Status MODERATE.

- Station Name: Br in Midleton (RS19D070700) on the DUNGOURNEY_020, Q Value Score 3, Q Value Status POOR.

The OWENNACURRA river has a much larger catchment than the DUNGOURNEY and so it could be assumed that the status of the river flowing into the estuary is Moderate. However, the Q ratings are upgradient of the Middleton WWTP and so the EPA monitoring does not consider the effect of the discharge or the stormwater overflows associated with municipal WWTPs. While there is nutrient removal at the WWTP, the effect of stormwater overflows is never fully considered. We could assume Moderate to Poor WQ entering the estuary from the river in its north-eastern portion immediately downgradient of Middleton. The EPA reports no Q ratings for the river discharging to the estuary in its north-western portion, after Carrigtwohill.

7.5.11 Regional Hydrogeology

The GWB in which the proposed development site is located is the Middleton GWB (IE_SW_G_058). This GWB is reported to have an approximate area of 136km^2 (GSI, 2004). The general outline of the underlying Groundwater Body (GWB) was presented in Figure 7.4. Regional groundwater flow directions have previously been presented by Conroy (2012) for Cork County Council (shown earlier as Plate 7.5). Conroy's project brief included the requirement to account for the impact of all quarries in the area and they are listed in Conroy (2012). Some of the quarries listed by Conroy (2012) are now closed.

The GSI (2004) reports that the main aquifer lithology in this GWB is Dinantian Pure Unbedded Limestones (primarily Waulsortian Limestone Formation). Some Dinantian Pure Bedded Limestones occur in the centre of the body. A narrow area (12 km2 in total) around the margins of the body is composed of Dinantian Lower Impure Limestones.

Subsoils overlying this GWB are dominated by free draining Tills.

With respect to the site's landscape position, its upgradient groundwater flow will be towards the coast and flowing to and through the site from the north and north east on its way to coastal discharge.

The GSI have described regional groundwater flow and gradients as follows:

> *"These rocks are devoid of intergranular permeability. Groundwater flow occurs in the many faults and joints, enlarged by karstification.*
>
> *Because of the high frequency of fissures in this region, overall groundwater flow is thought to be diffuse, although solutionally enlarged conduits and cave systems occur.*
>
> *Groundwater flow occurs in an upper shallow highly karstified weathered zone in which groundwater moves quickly in rapid response to recharge.*

Groundwater flows through interconnected, solutionally enlarged conduits and cave systems that are controlled by structural deformation. In addition there is a more dispersed slow groundwater flow component in smaller fractures and joints outside the larger conduits.

The water table is generally within 10 m of the surface, except for the more elevated parts of the limestone aquifers, and the typical annual fluctuation of the water table ranges up to 6 or 7 m (Wright 1979).

Groundwater is generally unconfined. The highly permeable aquifer supports a regional scale flow system. Groundwater flow paths can be up to several kilometres long, but may be significantly shorter in areas where the water table is very close to the surface.

Regional groundwater flow is towards the rivers draining the valley, to the sea in the east and to Lough Mahon and the surface water channels to the west and southwest of the body.

7.5.12 Groundwater WFD Status

Information presented by the EPA is that the Middleton GWB (IE_SW_G_058) is assigned "Good" Status (https://gis.epa.ie/SeeMaps) for the reporting period 2013 – 2018. The Risk Classification for the GWB has been deemed "Review" in the WFD Cycle 2. The Groundwater Body has been mapped as Review in the 2nd WFD Cycle and remains as such in the 3rd, current cycle. The 'Review' risk status essentially means that the assessment resources of the EPA are needed more in other areas of the catchment. Hydro-G suggests that if there were significant problems in the Groundwater Body, the EPA would be working on its Risk/Status. The Groundwater Body remains mapped as Good Status. Figure 7.16 presents the WFD Ground Water Body Status & Risk Maps as extracted from https://gis.epa.ie/EPAMaps/Water.

7.5.13 Mapped Pressures

The EPA has mapped pressures from numerous sources for the entire country. The information is available on the EPA maps 'Water' tab (https://gis.epa.ie/EPAMaps/Water).

While, historically, the Groundwater Body may have been considered as potentially under pressure from abstractions, it is not mapped as such now (2021 data search on https://gis.epa.ie/EPAMaps/Water). Neither does EPA mapping present any suggestion for pressure on the Groundwater Body from Agricultural or Extractive Industry sources in the area.

The only mapped pressures in the area are outside the radius of significance to the site. There are mapped Agricultural Pressures on the Ballinhassig East (IE_SW_G_004) Groundwater Body to the

north of the Midleton Groundwater Body that underlies the site and on the DUNGOURNEY_020 (IE_SW_19D070700) river flowing towards Midleton.

It is therefore concluded that the two quarries operate without presenting pressures warranting mapping by the EPA (https://gis.epa.ie/EPAMaps/Water.

7.5.14 Flood Risk Assessment

A Flood Risk Assessment (FRA) was completed for the southern section of the site in 2020 as part of a planning application for the installation of a readymix concrete plant and ground limestone processing plant at the site (Planning ref. 20/4124). The FRA concluded as follows:

> **6.0 CONCLUSIONS**
>
> The topographic survey undertaken at the site has demonstrated that the crest of the berm running along the southern edge of the quarry site, between the quarry and the Cork Harbour estuary to the south, is significantly above the modelled low and medium probability flood water levels in the estuary, from the OPW CFRAM tidal / coastal flood modelling.
>
> Notwithstanding this there is a residual flood risk should the berm be breeched by coastal / tidal flood waters.
>
> The Stage 1 flood risk identification undertaken in respect of the proposed development at Rossmore identified a potential risk of flooding from coastal / tidal flooding should the berm be breeched.
>
> The Stage 2 Initial Flood Risk Assessment indicated that a small section of the northern part of the site is located in flood Zone A and Flood Zone B, while the majority of the site including the processing and readymix batching infrastructure is located in Flood Zone C where the risk of flooding is low.
>
> Based on the Flood Risk Assessment undertaken here it is concluded that:
>
> (i). the small section of the proposed development infrastructure located in Flood Zones A & B at the site is flood resilient;
> (ii). apart from the two loading hoppers and a short section of conveyor belt, all other infrastructure at the site, including the limestone processing mill, is located within Flood Zone C;
> (iii). the proposed development will not result in increased flood risk elsewhere;
> (iv). the residual flood risk to the proposed development, should there be a breech in the berm at the quarry, is Low; and
> (v). the proposed development has been shown to satisfy the requirements of the Justification Test for development management.

While the 2020 FRA was completed for the southern section of the site only, the information presented in the report is useful by virtues of the fact that surveying completed along the southern boundary berm between the site and the estuary revelated that the lowest section of the berm ranges from 4.79m OD to 7m OD, approximately, over a distance of 5m. The adjacent track along the foreshore to the south of the boundary berm ranges from 2.32 to 2.93m OD, approximately. The SLR (2020) Flood Risk Assessment also presented CFRAMS model outputs and concluded that the CFRAMS modelled water levels for many points in Cork Harbour and Little Island are significantly lower than the southern boundary berm height, indicating that the berm will not be overtopped. The FRA concluded at Stage 2 and determined that Stage 3 was not necessary.

7.5.15 Other Developments

There is a quarry adjacent, operated by Kilsaran. Kilsaran dewater substantially more water than the Lagan quarry although their discharge licence [WP(W)10/18] does not actually specify a discharge volume. SLR (2021) in their Water Chapter for the Kilsaran site present information for the likely daily dewatering volumes and suggest a probable value of up to 21,000m3/d. This adjacent development and the dewatering information presented for it (SLR, 2021) enables the cumulative impact of one large quarry to be conceptualised, albeit with two distinct business owners. The potential cumulative impact that the two dewatering sites present will be considered later in this work.

The adjacent quarry Kilsaran site that was granted planning permission, with Conditions, in 2020 to house two ESB Substations (Planning Reference 20/4199).

There are Urban WWTPs at Carrigtwohill with numerous discharge points mapped by the EPA (https://gis.epa.ie/EPAMaps/Water), including stormwater overflows, and a WWP plant at Midleton designed to serve a PE of 20,000, including Tertiary Treatment for nutrient removal. The EPA envision map system displays 14 WWTPs in the catchment of Cork Harbour. Refer to Figure 7.17.

In addition, agricultural pastureland in the upgradient catchment and alongside the site must be considered because arable pasture is listed in EPA (2021) as the most significant nutrient pressure to the transitional waterbody to the south of the site.

Also, to the south of the site, on the other side of the channel, is the Rossmore Civic Amenity Site.

7.5.16 Quarry Discharge Water Quality Data

The site monitors discharge quality four times per year as per Condition 2.6 of Trade Effluent Discharge Licence WP(W) 08/18(R).

CONDITION 2.6 = The Licensee shall establish a monitoring programme for the parameters listed in Table 1 (of the Discharge Licence) at the required frequency. Grab samples shall be taken at SW1 – Sampling Point. SW1 is at the lagoons. The Emission Limit Values (ELVs) specified in the Discharge Licence are as presented in Table 7.5.

Table 7.5 Discharge Licence Emission Limit Values (WP(W)08/18).

Parameter	Unit	ELV	Commencement Date	Monitoring Frequency
pH	pH Units	6.0 -9.0	01/01/2019	Quarterly
Temperature	°C	25	01/01/2019	Quarterly
Suspended solids	mg/L	35	01/01/2019	Quarterly
Total Heavy Metals (Ba,Cd,Cr,Cu,Hg,Ni,Pb,Zn)	mg/L	1	01/01/2019	Quarterly
Chromium VI	mg/L	0.15	01/01/2019	Annually
Phenols	mg/L	1	01/01/2019	Quarterly
Benzo(a)pyrene	mg/L	0.05	01/01/2019	Annually
Naphthalene	mg/L	0.05	01/01/2019	Annually

TMS Environment Ltd. collect samples for the site and analyse at their laboratory. Historical reports for each sampling event from 2018 to date are presented as Appendix 7.4 with Certificates of Analysis.

Summary discharge quality results are presented as Table 7.6. With reference to results presented in Table 7.6, the following can be concluded:

- pH results suggest a neutral water is discharged to the infiltration area.
- Field measurements for Temperature suggest ambient water temperature.
- The Suspended Solids ELV of 35mg/l SS is always complied with.
- All Heavy metals are recorded at below the limit of detection of the analyser.
- Chromium VI, Phenols, Benzo(a)pyrene and Naphtalene are not detected in the quarries discharge.
- Results suggest full compliance with the ELVs specified in WP(W)08/18.

Table 7.6 Lagan Site Discharge quality results
(refer to Appendix 7.4 for Certificates of Analysis)

Monitoring Results SW1 2018 - 2021		MAX Recorded	MIN Recorded	WP(W)08/18 ELVs	Hydro G Comment
*pH	pH units	9	7	6.0 to 9.0	Compliant
**Temperature	°C	24.9	4.3	25oC	Compliant
*Suspended Solids	mg/L SS	20	<3	35	Compliant
Total Heavy Metals	mg/L	<1	<1	1	Compliant
Chromium VI	mg/L	0.003	< 0.002	0.15	Compliant
Phenols	µg/L	<5.00	<5.00	1 mg/l	Compliant
Benzo(a)pyrene	µg/L	< 0.1	< 0.1	0.05 mg/l	Compliant
Naphthalene	µg/L	< 0.1	< 0.1	0.05 mg/l	Compliant

7.5.17 Historical Groundwater Quality Data

Groundwater quality sampling is carried out and reported by TMS Environment Ltd. on a bi-annual basis.

Groundwater samples are routinely collected from wells as shown in Plate 7-6.

The Biannual reports presenting results for the last three years 2019-2021, including laboratory Certificates of Analysis, are presented as Appendix 7.4.

Plate 7-6 Groundwater Quality Monitoring Points

Results for 2021 suggest as follows (TMS, 2021):

- pH values range from 7.2 to 7.4 pH units
- Electrical conductivity measurements ranged from 335 uS/cm to 879 uS/cm.
- The pH and conductivity levels are well within the expected concentration range for groundwater while accounting for some saline infiltration from Rossmore Bay.
- Ammonia levels ranged from < 0.02mg/l N at two of the monitoring locations to 0.08mg/l N at monitoring location MW4.

- The concentration of nitrite was < 0.002mg/l N at all four monitoring locations.

- Nitrate concentrations ranged from < 0.5mg/l NO3 at monitoring location MW4 to 12mg/L NO3 at MW3. The nitrate results are within the expected concentration range and are consistent with the historic data available for the site.

- Sulphate levels ranged from 4.3mg/l SO4 at MW4 to 117mg/l SO4 at MW1 which is generally within the expected concentration range for this parameter.

- Chloride levels ranged from 18mg/l Cl at MW4 to 672mg/l Cl at MW1. Elevated chloride levels have routinely been seen at a number of the monitoring wells at the site and this is due to saline intrusion arising because of the close proximity of the monitoring wells to the sea at Rossmore Bay. Chloride levels in 2021 are consistent with the historic data for the site. Elevated Chloride presents no threat to the receiving environment because it is naturally present in the receiving estuarine waters anyway. As part of an Irish Water investigation on Cape Clear Hydro-G had seawater analysed for Chloride and the laboratory result returned was 19,450 mg/l Cl (CLS Laboratory Sample No. 693980, 2016). The groundwater at the site, which was in any case heading for the coast, presents a relatively small volume of water, relative to the volume of water in the estuary, with Chloride levels already affected by the coast. This is as is expected in hydrogeology.

- Total Organic Nitrogen concentrations ranged from < 0.5mg/l N at monitoring location MW4 to 12mg/l N at MW3, which is consistent for the site relative to the historic records. These levels are within the expected concentration range for this parameter at this site (TMS, 2021).

- The groundwater samples were analysed for a number of heavy metal parameters including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Tin, Zinc and Mercury. These parameters were below the laboratory limit of detection for the most part and the parameter results are within the expected concentration range for all samples.

- Alkali Earth metals and Alkalinity Potassium, Calcium, Sodium and Magnesium all yielded positive results for all monitoring locations but in all cases were within the expected concentration ranges for these parameters. Alkalinity ranged from

180mg/L CaCO3 at BH2 to 309mg/L CaCO3 at MW4 which are again all well within the expected concentration range.

- Hydrocarbons and Chlorinated Hydrocarbons results were below the laboratory limit of detection for all monitoring locations.

It is concluded that the groundwater quality is good and there are no detectable Petroleum Hydrocarbons in the water.

7.5.18 Historical Groundwater Levels and Flow Direction

The site's monitoring boreholes are manually dipped for water levels throughout the year. The water level monitoring borehole network is shown in Plate 7.7 Manual water level dip information is presented in Appendix 7.6. A subset of boreholes is installed with continuous record dataloggers and the long-term trend is presented in Plate 7.8.

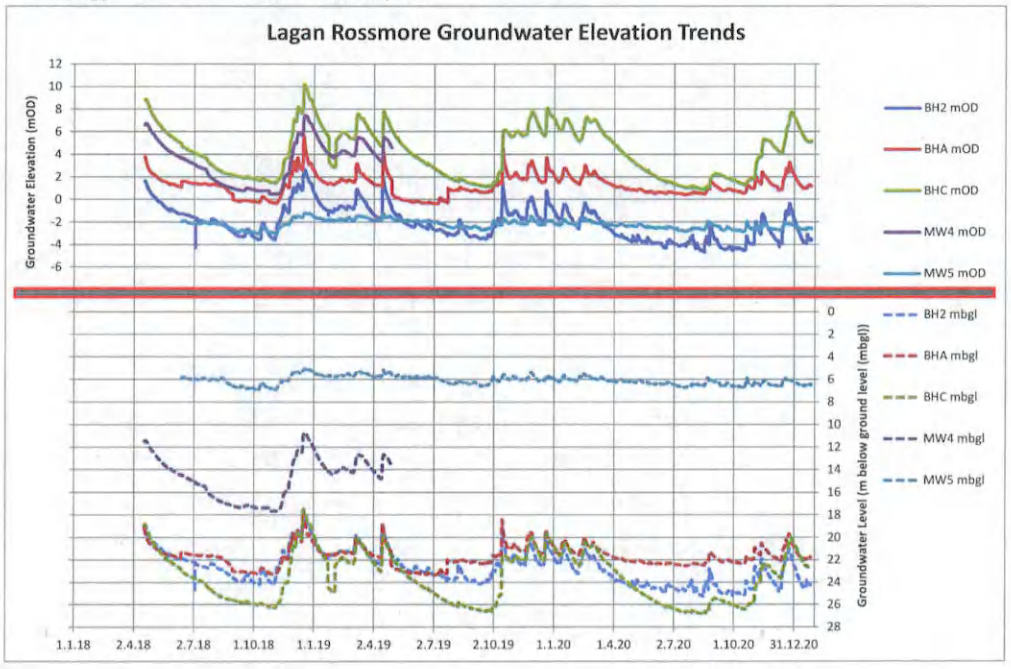
Plate 7.7 Water level monitoring borehole network
BHs with blue circle are those which extend deeper than -50mOD

With reference to the groundwater elevation trendline in the upper graph of Plate 7.7, it is clear that groundwater flows from the north and east towards the quarry *i.e.* from BHC and BHA to BHB and then MW5's water level response is steady because of the body of water adjacent.

There is also a tidal effect in some monitoring boreholes. This is expected. It is not necessarily seawater flowing into the site, rather, groundwater systems must be considered as pressure systems and when the tides rise at the coast, groundwater will be pushed back or flow impeded.

The water level record presented as Plate 7.8 spans a couple of years and the winter rises and natural summer regressions are evident.

Plate 7.8 Datalogger water level trends since January 2018



7.6 Site Investigation Results

7.6.1 Observations of Exposed Geology

Hydro G observed the walls of the working area in various recharge conditions. There was no evidence of water ingress zones. There were no mossy or iron-stained areas, neither historical nor current. There were no calcite exposures where the lime in waters come into particulate form upon exposure. Examples of the competency of the walls and the dense nature of the limestone are presented in Plate 7.9. The site does not present as a major groundwater ingress zone. Neither was there any evidence of seawater intrusion in the southerly walls excavated at the site.

7.6.2 Karst Walkover

Upon completion of review of the published information regarding karst in the area (e.g. Conroy, 2012 and GSI, 2014) and desk based map reviews, Hydro-G walked the entire landholding and drove roads around the site, occasionally stopping for walks. In the lands bounding the quarry, there was no evidence of karst features in the landscape. With respect to examination of the faces of the worked areas at the site, the following was noted:

- In the northern face of the quarry, there is no evidence of karst infills in the entire depth of exposed face from 15m OD, approximately, at the highest elevation of natural land surface to the base of that wall at 0m OD. Upon moving down to the floor itself, which was at c. -18.5m OD at that time, there was no evidence of deep karst. The northern face is one of the directions that groundwater flow might be expected, if there were pathways to discharge to the coastal zone.

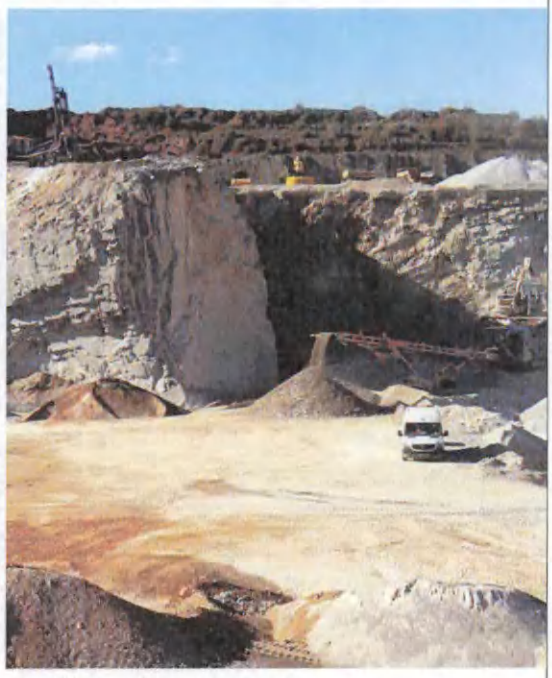
- The eastern face presented no evidence of karst systems in the subsurface from natural land surface level of 5m OD, approximately, through the walls bounding the haul roads and through to the floor of the working quarry. The limestone in the walls is competent.

- The southern zone of the quarry can be examined from various parts of the site. In this southwestern half of the walled excavation, the floor is 10m below sea level and therefore 10m height of rock face can be examined for potential for karst that might let sea water in. No evidence was found. The limestone is competent. Neither did historical karst scarring present itself.

- The western boundary of the site is the rock face wall with the neighbouring quarry. The rock along that boundary is tight and solid. There are no zones in which any karst features are present.

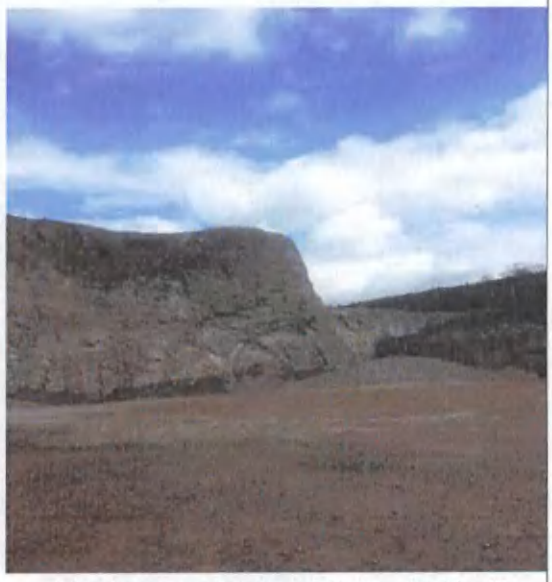
Plate 7.9 The rock faces of Rossmore Quarry

(a) Looking west towards the neighbouring quarry



(b) Looking northwest

(c) View from north, looking southwest



(d) View from the floor (@ -18m OD) looking south towards the sea (top of ridge @ 0m OD, approx.)

7.6.3 Production Well Drilling

In April 2021 three new Production Wells (PWs) were drilled by Briody Well Drilling, at 8" diameter, with Hydro-G site attendance. The 2021 PW Locations are presented with the Borehole Logs in Appendix 7.7. It is noted on the Borehole Logs that the drilling techniques is rotary percussion drilling with a large compressor. Therefore, readers should refer to the Geology section of this EIAR for discussions on the nature of the rock. The Production Wells were drilled to test potential for encountering more groundwater and to enable larger scale pump testing to the depths proposed for excavation. The Production Wells were constructed for investigative purposes only. The sump system will be maintained for collecting and dewatering to the lagoons already established at the site. The Production Wells were drilled with base target elevations as follows:

- PW1 @ 50m deep from ground level = -4m OD = -54m OD base elevation
- PW2 @ 34m deep from a floor elevation of = -18.5m OD = -53m OD base elevation
- PW3 @ 75m deep from ground level = 0m OD = -75m OD base elevation

As shown in the borehole logs, competent limestone was encountered in all PWs. Water strikes were encountered at elevations as follows:

- PW1 water strike @ -41m OD, drillers estimate <10m3/hr (*i.e.* <240m3/d)
- PW2 water strike @ -20m OD, water in the broken floor only, water return did not sustain as drilling continued
- PW3 water strike @ -53m OD, -63m OD and -70m OD, drilling estimate 10m3/hr

Hydro-G continuously monitored Electrical Conductivity of borehole drilling return waters. Results suggest as follows:

- The waters in the estuary were monitored at the start and end of each drilling day and an average value of 48,000 uS/cm was recorded.
- PW1 is the 2021 drill site closest to the estuary and the drill return waters presented an EC of 6,300 uS/cm, on average
- PW2 is the 2021 drill site on the floor of the quarry and the EC returned was 4,800 uS/cm, on average
- PW3 is the 2021 drill site farthest from the estuary and the EC returned was 1,625 uS/cm, on average

Results for EC are used to conclude that the influence on groundwater of the estuary's saline waters diminishes as one approaches the northern extent of the quarry.

7.6.4 Production Well Pump Testing

The results of all pump tests completed at the site are presented in Appendix 7.8.

The three Production Wells drilled in April 2021 were pump tested in May 2021. Step tests were completed in advance of pump tests. Hydro-G completed one 3-day test and two shorter duration tests on the other PWs. The reason for the short duration was the machinery on the floor. The short duration tests had to be completed when no one was working, and the site only closes on a Saturday.

Results suggest that the yields in each well are as follows:

- PW1 pump test yield = 6 m3/hr = 144 m3/d
- PW2 pump test water level drew down to pump and test ceased@ at minimum rate of the pump, which was 3m3/hr. Therefore, no sustained groundwater flow at this PW site on the working floor.
- PW3 10m3/hr = 240m3/d

There is an extensive record for pump tests on BHs in the 2015 EIS accompanying the 37L application (Planning Ref. PL04.QD.0010). The results of Hydro-G's pump tests concur with those reported previously for the site, which concluded that it was difficult to maintain constant pumping in the numerous pumping tests because the abstractions did not sustain pumping. The responses of the previous pump tests suggest isolated yields of 0m3/hr in three tests and < 10m3/hr in two borehole tests. Overall, previous hydrogeological evaluations at the site applied conventional hydrogeological equations to conclude and present a potential future dewatering value range of 6,000m3/d for the site, when the neighbours were also dewatering, and 12,000m3/d for the site if the neighbours site ceased operation and groundwater rebounded. That 6,000 to 12,000m3/d potential future dewatering volume was calculated for the workings to bring the site to -20m OD. Part of the site is now at that floor level, more or less, and the actual metered dewatering volume is 6% of that predicted. Hydro-G therefore concludes that the application of conventional hydrogeological equations is not appropriate for the site. No significant groundwater was encountered during drilling previously and none of significance, considering the setting, in this investigation.

Hydro-G considers that the 12,000 m3/d maximum dewatering volume accepted and sanctioned in the previous permission, is fit to remain as the maximum potential dewatering volume requiring assessment for the proposal to bring the site from -20m OD to -50m OD. Hydrogeologists expect less water at depth, not more. It is Hydro-G's direct experience as a panel hydrogeologist for Irish Water, and explorations for groundwater as a source of water supply rarely, that major strikes of water are rarely encountered in the -20 to -50m OD zone.

7.7 Conceptual Groundwater Model for the Site & General Area

A conceptual Site Model, with a regional context, can be developed in consideration of site information, downstream receptors and all other hydrological and hydrogeological information presented in this Chapter.

The overall model is as follows:

Groundwater flows follow surface topography and flow to the coast with some deflection to Kilsaran's sump.

Groundwater flow paths within the site are likely to be short because no pumping tests were able to sustain significant abstractions or present any evidence of connectivity with other boreholes.

The current floor level is almost at the -20m OD level, as is the floor of the quarry site next door. However, while the Lagan site is now at a floor elevation which may be conceptualised as base depth of the aquifer, little groundwater is experienced at the site. There is no evidence of groundwater flow in the walls of the excavated rock faces exposed at the site. This may be because the neighbouring quarry is dewatering both sites.

There is some evidence of seawater influence in some of the groundwater monitored closer to the coast, as would be expected, but it is not saline water. Seawater has previously been analysed by Hydro-G in other projects and it has a concentration closer to 20,000 mg/l than the highest observed value of 700 mg/l, approximately, that was observed at the Lagan Rossmore site.

There is no risk of seawater overtopping into the Lagan site because the boundary berms are competent and at a level greater than high tides experienced (SLR, 2020).

Groundwater Status is currently mapped as "Good" for the 2013 – 2018 reporting period (https://gis.epa.ie/EPAMaps/). This GWB was also previously assigned "good" status in the WFD reporting period up to 2010.

Given the poor transmissive qualities of the rock, Hydro-G suggests that no water supply wells are within range of potential impact by the quarry. There are no PWS or GWS abstractions within range of the quarry. It is clear that groundwater flow in the area of the quarry is limited.

The primary downstream receptor is the SAC, which has parts of it mapped as a Nutrient Sensitive Area and as a Shellfish designated area.

Waters arising at the quarry are used in product creation or dust suppression and the balance, arising from management of the quarry floor's sump water level to maintain dry working area. Only surplus water is discharged, under licence, to an infiltration area in proximity to the adjacent transitional waterbody. There is therefore little or no nett loss of groundwater to the transitional waterbody referred to as the Great Island Channel SAC (Site Code 001058), immediately adjacent to the south. The site's discharge licence WP(W)08/18(R) permits a discharge, to a groundwater infiltration gallery, of 12,000 m3/d. Metered discharge volumes range from 51 to 797m3/d.

Recent AA Screening for the site (SLR, 2021) determined no potential for impact to the nearby Cork Harbour SPA (Site Code 004030) immediately adjacent to the south and at numerous inlets to the east and south.

EPA (2021) report that the threat to the 'Nutrient Sensitive' Area estuary labelled by the EPA as the "Owennacurra Estuary / North Channel" (IE_SW_060_0400) is presented by pasture agriculture and Urban WWTPs. No EPA assessment in the catchment mentions the extractive Industry as a threat (EPA 2018, 2019, 2021).

The Cork Great Island North Channel (IE_SW_060_0300) is also a designated Shellfish. Sensitivity for Shellfish includes metals and bacteria. There are no sources of either at a quarry.

There are no karst features such as caves or springs.

Conroy (2012) considered the potential impact of quarry dewatering at Rossmore, on behalf of Cork County Council, and it was concluded that "on-going dewatering activities are not considered to be causing any current groundwater flooding risk" and that overall, in the Carrigtwohill geology and hydrogeology, "Once the flooded quarry pits reach their rest groundwater level they will act as attenuation features for extreme groundwater flow events."

7.8 Impact Assessment

The procedure for determination of potential impacts on the receiving hydrogeological environment was to identify potential receptors within the site boundary and surrounding environment and use the information gathered during the field work and desk study to assess the degree to which these receptors will be impacted upon. The application site lies within an existing quarry void and there is a quarry next door. When considered as a cumulative site it is a large size. The site is therefore considered to be an attribute of high importance. In line with best practice, the individual impacts will be considered with respect to the application site, plus the cumulative impacts with respect to the existing and application site, the neighbouring quarry, the neighbouring Civic Amenity site and other municipal developments upgradient in the catchment.

The downstream transitional waters are Moderate Status. However, the nutrient impacts in the transitional water have been assessed by the EPA and are reported as related to multiple municipal wastewater treatment plants and pasture agriculture (EPA, 2021).

The Planning and Development Regulations 2001 to 2021 require Impact Assessment under the headings of Do Nothing, Transboundary, Direct, Indirect, Cumulative, Residual & Worst Case. Impacts are also assessed in relation to construction, operational and decommissioning stages.

7.8.1 Criteria for Determination of Impacts

The significance of potential impacts on geological, hydrogeological and hydrological sensitive receptors was evaluated using Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA 2008 and the Guidelines for the Preparation of Soils, Geology & Hydrogeology Chapters of Environmental Impact Statements, IGI 2013; These documents use groundwater and geological type attributes and measures to determine the magnitude of the impact on the attribute.

Table 7.7 illustrates the criteria for determining the importance of the geological and hydrogeological sensitive receptors at the site.

Table 7.8 demonstrates the criteria for estimating the magnitude of the impact on an attribute.

Table 7.9 presents the resulting estimation of significant potential impacts.

Table 7.7 Estimation of importance of sensitive attributes

Importance	Criterion	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale.	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality and rarity on regional or national scale.	River, wetland or surface water or groundwater body ecosystem protected by EU legislation. Aquifer providing a regionally important drinking water resource or supporting site protected under wildlife legislation.
High	Attribute has a high quality or value on local scale.	Aquifer providing locally important resource or supporting peat ecosystem – undesignated.
Medium	Attribute has a medium quality or value on local scale.	Aquifer providing water for agricultural or industrial use with limited connection to surface water. Eroding bog.
Low	Attribute has a low quality or value on local scale.	Non-aquifer. Cutover blanket bog.

Table 7.8 Estimation of the Magnitude of a Potential Impact of an Attribute

Magnitude	Criterion	Typical Example
Large Adverse	Results in loss of attribute and/or quality and integrity of attribute.	Loss of aquifer water supply by dewatering or major contamination event. Potential high risk of pollution to groundwater from routine run-off. Loss or change to non-SAC status etc., SAC Annex 1habitat loss.
Moderate Adverse	Results in impact on integrity of attribute, or loss of part of attribute.	Partial loss or change to aquifer characteristics. Potential medium risk of pollution to groundwater from routine run-off. Loss to a potential SAC Annex 1habitat.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Potential low risk of pollution to groundwater from routine run-off. Risk of pollution from accidental spillages. Localised impact.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	No measurable impact upon aquifer and no perceivable risk of pollution from accidental spillages. Slight impact etc.

Table 7.9 Estimation of the Significance of Potential Impacts

Importance of Attribute	Magnitude of Potential Impact			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely High	Imperceptible	Significant	Profound	Profound
Very high	Imperceptible	Significant/ Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/ Slight	Significant/Moderate	Profound/ Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

7.8.2 Description of the Likely Impacts

7.8.2.1 'Do Nothing' Scenario

If the development did not proceed, the ground of the proposed development would remain a working quarry floor for materials until cessation of activities at the site and restored as per the restoration plan.

7.8.2.2 Transboundary

The EIA Directive 2014-52-EU invokes the Espoo Convention on Environmental Impact Assessment in a Transboundary Context, 1991, and applies its definition of transboundary impacts. Given the significant distance from the border with N. Ireland), the nature, size and scale of the proposed development, it is expected that the impacts of the development would not have any significant transboundary effects with respect to water bodies.

7.8.2.3 Direct Impact to Groundwater Levels in Third Party Wells

No impacts are expected for reasons as follows:

- The only third party well is a farm well upgradient and outside the potential radius of influence of both quarry sites
- Groundwater in boreholes does not sustain pumping therefore, water strikes are locally fed

7.8.2.4 Hydrological Impact on Catchment Waters fed to the Estuary

The site is licensed to discharge a maximum potential future volume of 12,000m3/d. The waters are discharged to an infiltration area relatively close to the quarry. The infiltration area feeds the estuary. Therefore, there is no significant net loss of water to the estuary. The current volume of waters arising ranges from 50 to 800m3/d, approximately. The volumes currently encountered at <10% of those that were predicted for the excavation level of -20m OD, which some of the site is now at. Therefore, the prediction of 12,000m3/d has not been realised and that volume remains valid as a volume that could, but probably will not, be experienced in the future when the site continues to -50m OD.

7.8.2.5 'Worst Case Scenario' Impact

Hydrocarbons could end up in the lagoons only if there were two concurrent failures in mitigation measures. This is highly unlikely because it would require an occasion of refuelling only in bunded areas in combination with failure of the petrol interceptors. Site management is robust and it is not likely that refuelling outside of specified, protected areas. An additional protection would be that the lagoons are extensive, underloaded and a considerable freeboard exists to facilitate stopping flow to the infiltration area.

Although the southern boundary berms are more than 1m higher than CFRAMS predicted extreme high tides (SLR, 2020), a worst-case overtopping could cause a temporary manageable volume of water in the area of the site which is now dry but was the historical lagoon. The area can be dewatered to the new sump easily. The lagoons and infiltration system could accommodate the dewatering required.

Should the area between the proposed extraction and the coast fail, there could be a submergence of part or all the site. This is a final restoration plan in any case.

7.8.2.6 Potential Impacts of Blasting at the Site

The downstream estuary is a designated shellfish area, a Nutrient Sensitive Area and a SAC, connected to SPA area.

Mass balance calculations are presented to demonstrate potential for effects of blasting to present nitrogen residues in the discharge waters, which has potential to impact local waters. The risk to groundwater and estuarine waters is assessed by quantifying the resultant concentrations for the potential residual nitrogen compounds Nitrate (NO3), Ammonia (NH4) and Nitrite (NO2).

Peak activity rates of the extraction activities, blasting frequency and the type of explosives used were supplied to Hydro-G by the quarry manager.

The explosives used in quarry are Kemex 70, which is a site mixed bulk emulsion explosives produced from emulsion matrix. Emulsion matrix is essentially an aqueous solution of ammonium nitrate emulsified in oil. Kemex products may also contain ammonium nitrate prills, fuel oil, aluminium and/or gassing agents. The Technical Data Sheets (TDS's) and MATERIAL SAFETY DATA SHEET (MSDS's) for explosives, primers and detonators used at the site were employed by Hydro-G in the calculation of potential residues and those data sheets are held on file at Hydro-G and at the site.

Literature suggests that small percentages of N compounds can remain as residual coating on bedrock following blasting. This has the potential to be dissolved when it comes into contact with water, albeit potential concentrations are low. The study that is most referenced was completed by Environment Canada in 1988 (Ferguson & Leask, 1988). This study outlines 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, is as follows:

a) 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.

b) Separate the leached nitrogen loading among quarry components (*e.g.* entering surface water, remaining on extracted rock etc.).

c) Separate into loadings of N compounds (Nitrate, Nitrite and Ammonia); and,

d) Calculate the flow concentration.

The concentrations of N species in discharge water from the site are calculated using this procedure and results are presented as Table 7.10. 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. These are very conservative assumptions. The calculation also assumes that 100% of residual N is dissolved in drainage waters and is subsequently pumped from the quarry by dewatering. The results of calculations presented in Table 7.10 clearly show that the residual N compound would have a total N concentration of <0.001 mg/l N. Specifically, resultant concentrations in waters within the quarry, if impacted by explosives within the working quarry site area, would be: **0.0005 mg/l NO3, 0.0004 mg/l NH4 and 0.00003 mg/l NO2.**

For the purpose of context, it is offered that:

- The Total N compound residual is insignificant at <0.001 mg/l N. It is acknowledged that Nitrogen is the limiting compound, rather than Phosphorus, for eutrophication in estuary

waters. However, the use of explosives at the site has the potential to add a negligible amount of nitrogen.

- The limit for nitrate in freshwaters affected by agriculture is 50 mg/l NO3 (Nitrate & Good Agricultural Practice Regulations) and it is also 50 mg/l NO3 for the Freshwater Fish Directive (2006/44/EC). Therefore, the simulated resultant concentration of **0.0005 mg/l NO3** is significantly lower than quality standards. The fact that the calculated value is multiple orders of magnitude less than 1mg/l NO3 rules out any potential for impact to any waters.

- The limit for Ammonia in **High Status** Waters EQS (Surface Water Regulations 2009) is 0.04 mg/l NH4 and the resultant concentration calculated for the waters within the quarry that might be affected by explosive use at this quarry is two orders of magnitude lower than that High Status EQS. Therefore, environmental impact is not envisaged because the resultant concentrations calculated meet the High Status EQSs of the Surface Water Regulations (2009 as amended 2012 (S.I. No. 327/2012), 2015 (S.I. No. 386 Of 2015) and 2019 (S.I. No. 77 of 2019).

- Overall, the residual concentrations meet the requirements of the Surface Water Regulations & the targets set out in both the Freshwater Fish Directive and Salmonid Waters Regulations.

In summary, having used conservative values in this approach the resulting N species concentrations are small, and below all relevant Regulatory EQS values (refer to Table 7.10).

The risk of impact to local water quality arising from the use of explosives at the site is therefore non-existent, based on industry standard method of calculation. These calculations are based on PEAK abstraction rates.

Table 7-10: N compound concentrations from explosives in dewatering discharge

EXPLOSIVE MASS BALANCE		
9.8	TOTAL WORK Area (BLASTING)	ha
98,000	Total Area	m2
2,940,000	Volume of rock to be extracted	m3
2,499,000	Rock Volume accounting for 15% losses	m3
0.2	Explosive Mass Required	kg/m3
499,800	Explosives Mass Required	kg
12.5	Probbale Duration of extraction	years
39,984	Explosives Mass Required per year	kg/yr
NITROGEN MASS BALANCE		
94%	% Explosive mass as Ammonium Nitrate	%
35%	% Ammonium Nitrate as N	%
13,155	Mass of N	kg/yr
0.06	Residual Fraction	
789	Residual N	kg/yr
Total N Species Generated by explosive's residues (areal annual loading rate)*	***80.54***	***Kg/ha/yr***
*facilitates comparison with agricultural inputs. Compare to 170 kg N/ha/yr Total Nitrogen loadings permitted in the Good Agricultural Practice Regulations (SI 605 of 2017)		
N COMPOUNDS**		
781	Residual NO_3 *(75-99% of Residual N value)*	**kg/yr**
189	Residual NH_4 *(0.5 - 24% of Residual N value)*	**kg/yr**
47	Residual NO_2 *(0-6% of Residual N value)*	**kg/yr**
**Highest % Residual Adopted as conservative measure		
WATER BALANCE		
12,000	Envisaged MAX Daily Quarry Discharge (max)	m^3/day
4,380,000,000	Quarry Discharge	litres/yr
NITROGEN COMPOUND CONCENTRATIONS***		
Residual NO_3	***0.0005***	***mg/l/d***
Residual NH_4	***0.0001***	***mg/l/d***
Residual NO2	***0.00003***	***mg/l/d***
*** Calculation of Residual Concentrations = [(kg/yr*10^6 = mg/yr)/(litres/yr)]/365		
MASS OF NITROGEN COMPOUNDS GENERATED AT THE SITE (kg/ha/yr)*		
Residual NO_3	***79.73***	*Kg/ha/yr*
Residual NH_4	***12.63***	*Kg/ha/yr*
Residual NO2	***0.00048***	*Kg/ha/yr*

7.8.2.7 Cumulative Impacts

The 'Other Developments' were listed earlier in this Water Chapter.

With respect to the adjacent Kilsaran quarry. In the previous 2015 EIS for the Lagan site the Kilsaran plant was a Cemex site and hence that name was extensively referenced in the text. The most recent planning permission application lodged by the adjacent quarry is detailed in Planning Ref 21/5965 (July 2021) and is currently in the Further Information stage of the planning process. The recent Kilsaran development description is documented on the Cork County Council planning site as follows:

> "The development will comprise of continuance use of the existing quarry development within an overall application area of c.24.7 hectares; extraction to the permitted level of 40m below Ordnance Datum, within the extraction area permitted under Plan. Reg. 03/4570; final restoration of the quarry void area and an area of 3.8 hectares to the North adjacent to the public road. Permission is sought for twenty years plus two years for final restoration (total duration 22 years). Permission is also being sought for an extension to the existing operating hours for the ready mixed concrete plant for out of hours operation of the plant up to a maximum of 40 occasions per year, to supply critical and strategic building/infrastructure/maintenance projects whose construction requires supply of concrete outside normal plant operating hours. An Environmental Impact Assessment Report has been prepared for the planning application."

Information presented in the SLR Water chapter of the current 2021 application, available on Cork County Council's planning portal, for the adjacent Kilsaran site provides clarification as follows:

> *"At present the groundwater is being dewatered to facilitate the working of the quarry and to maintain dry working conditions on the quarry floor. Groundwater is pumped from the sump in the quarry and the groundwater is maintained at c. -21 mOD which is below the current quarry floor level of -20m OD. The dewatering has resulted in a drawdown of the groundwater level around the quarry void. The existing quarry is permitted to extract to a level of -40 m AOD, i.e. 20 metres below the current quarry floor level."*

Therefore, the 2021 application does not present any new extraction proposal. The site is already granted permission to operate to -40m OD. The 2021 application for the Kilsaran plant is to extend the duration of planning. The Tom Phillips & Associates EIS & Water Chapter (2015) for 37L application for the Lagan site already took the adjacent site's dewatering into account. The water management lagoons and infiltration area for the Lagan site can accommodate waters that would arise should the adjacent site cease. That design caveat is clearly stated in the documentation

supporting the design and construction documents for the 2019 granted Lagan site's Discharge Licence WP(W)08/18(R) licensed 12,000m3/d.

The Kilsaran site also holds a discharge licence WP(W)10/18. No discharge volume limit is specified in the Kilsaran Discharge Licence. Information presented in the SLR Water chapter of the current 2021 application, available on Cork County Council's planning portal, for the adjacent Kilsaran site suggests that the range of daily discharge is 17,000 to 21,000m3/d, approximately. The quarry is known to receive saline waters, through a high fault, at times of high tides.

The Kilsaran site that was granted planning permission, with Conditions, in 2020 to house two ESB Substations (Planning Reference 20/4199).

For the purposes of cumulative impact, the two quarries should be considered as one large void totalling extraction areas of 10ha, approximately, on the Lagan site and 26ha on the Kilsaran site = 36ha total.

The combined POTENTIAL FUTURE maximum discharge volume is 33,000 m3/d, although at present, while the Kilsaran site is reported to actual discharge up to 21,000 m3/d, the range of metered discharge on the Lagan site is currently 58 to 797m3/d. If the Kilsaran site stopped pumping, the Lagan site would not draw the full 21,000m3/d dewatering volume from the Kilsaran site. The wall between the two sites is competent. The high tides ingress at Kilsaran would be retained at its own site.

Both quarries send their waters to discharge in the same area. The Kilsaran discharge is immediately south of the Lagan infiltration area. They can therefore be conceptualised as one big lagoon and infiltration area, having two distinct licences because they are attributed to two different business owners. Details for the quality of the Kilsaran discharge are presented in the Discharge Licence Appendix 7.9. The quality Conditions of the Licence are met.

Given the coastal setting and the fact that the two quarries are on the edge of the land, no other developments are deemed to require assessment in terms of both quarries' potential for impact.

The EPA envision map system displays 14 WWTPs in the catchment of Cork Harbour. Refer to Figure 7.17. In addition, agricultural pastureland in the upgradient catchment and alongside the site must be considered another pressure because arable pasture is listed in EPA (2021) as the most significant nutrient pressure to the transitional waterbody to the south of the site.

Hydro-G concludes no potential for cumulative impact because the quarry's use of explosives will contribute hardly any nitrogen and there is no source of phosphorus in the working void. Quarries are not the issue in this landscape.

Also, to the south of the site, on the other side of the channel, is the Rossmore Civic Amenity Site. This is a Cork County Council Recycling site that should be appropriately controlled with respect to emissions. Information presented by cork county council suggests that these sites do not accept chemicals, asbestos, silage/bale wrap, pesticides, herbicides, foil lined plastics, needles/syringes. Incorrect storage of paints and problems with Scada and site supervision were reported for the site in an EPA inspection. However, one must assume correct operation of a Local Authority site and in that case, Hydro-G concludes no potential is presented by the Civic Amenity Site for cumulative impact.

7.8.2.8 Potential Impacts

Hydro-G's assessment of potential impacts from the proposed development are summarised in the Table 7.11, using the headings discussed under the criteria for determination of impacts.

7.8.1 Mitigation Measures

The predicted impacts under Table 7.11 can be resolved under the mitigation measures set out under Table 7.12.

7.8.2 Residual Impacts.

Impacts in relation to construction, operational and decommissioning stages are presented in Table 7.13. Residual impacts on the hydrological or hydrogeological environment are not envisaged to result from the proposed quarry extension in the vertical plane and the site's mitigation measures.

Table 7.11 Potential Impacts

Activity	Attribute	Character of Potential Impact	Importance of Attribute	Magnitude of Potential Impact	Significance of Potential Impact
1. Fuel storage/usage on site	Groundwater Subsoils Great Island Channel SAC Shellfish Area Cork Harbour	Accidental spillage of contaminants during site operations may cause short to long term, moderate to significant impacts to soils, groundwater, downstream habitats, birds, shellfish and fish life.	Extremely High	Moderate Adverse	Profound
2. Excavation works and vehicle movement on site		Excavation works will result in the same vulnerability of groundwater at the site as is now experienced by the same area of open bedrock. Procedures are in place for dealing with sediment and spillages. Dust and debris could be carried by rainfall runoff to the sump and discharged to the Settlement Lagoon. If the Settlement Lagoon is not appropriately sized, there could be a conveyance to and blockage of the infiltration area.	Extremely High	Moderate Adverse	Profound
3. Surface water Runoff		Quarry floor and internal road surface runoff or drainage systems have potential, if not correctly designed, to result in contamination of surface waters and groundwater. Accidental spillage could contaminate the aquifer by direct percolation or via the superficial water network. Changing the nature of surface water groundwater dynamics in the catchment could affect downstream ecosystems.	Extremely High	Moderate Adverse	Profound
4. Increased dewatering		Lowering ANY quarry bench could lead to an increase of groundwater component in the sump.	Extremely High	Large Adverse	Profound
5. Use of Explosives		Could affect water quality	Extremely High	Moderate Adverse	Profound

Table 7.12 Mitigation Measures

Construction Activity	Attribute	Character of Impact	Mitigation	Residual Impact
1. Fuel storage/ usage on site	Groundwater Subsoils Great Island Channel SAC Shellfish Area Cork Harbour	Accidental spillage of contaminants during site operations may cause short to long term, moderate to significant impacts to soils, groundwater, downstream habitats, birds, shellfish and fish life.	• Waste and fuel materials are stored in designated areas that are isolated from surface water drains or open waters (*e.g.* excavations), hazardous wastes such as waste oil, chemicals and preservatives are stored in sealed containers. There are no bulk fuels stored at the site. Lubrication and storage areas and site offices will not be located within 30m of drainage ditches or the settlement sumps. • All waste containers (including all ancillary equipment such as vent pipes and refuelling hoses) will be stored within a secondary containment systems. • Regular monitoring of water levels within drip trays and bunds due to rainfall will be undertaken to ensure sufficient capacity is maintained at all times. • A wheel wash facility exists near the site offices and the roads at the entrance/exit have sprinkler systems. • There are petrol interceptors on the roadsides in the heavy traffic area and hydrocarbon booms were agreed with Cork County Council as part of the Water management Systems Planning Compliance process. • Regular visual monitoring of the floor's sump is undertaken to ensure no visual oil or fuel contamination is present.	Neutral
2. Excavation works and vehicle movement on site	Groundwater Subsoils Great Island Channel SAC Shellfish Area Cork Harbour	Excavation works, road sediment and spillages.	• No storage of unbunded fuel tanks or other site activities (*e.g.* fuel storage, refuelling, adding hydraulic oils, etc) will be permitted. • Excavations of rock will follow best management practices for maintenance of machinery.	Neutral

Construction Activity	Attribute	Character of Impact	Mitigation	Residual Impact
3. Surface Water Runoff	Groundwater Subsoils Great Island Channel SAC Shellfish Area Cork Harbour	Quarry floor and internal road surface runoff or drainage systems have potential, if not correctly designed, to result in contamination of surface waters and groundwater. Accidental spillage could contaminate the aquifer by direct percolation or via the superficial water network. Changing the nature of surface water groundwater dynamics in the catchment could affect downstream ecosystems.	The settlement sump and the floor of the quarry have volumetric capacity to accommodate all waters for the required residence time. The site holds a valid Discharge Licence WP(W)08/18(R) and the lagoons and infiltration area will be able to deal with the waters that might arise as a result of bringing the floor from its current -20m OD to the proposed -50m OD elevation. The reason that the existing systems will be able to deal with future volumes is twofold: 1. because the previous assessments for the site provided so much factor of safety the systems are only receiving <10% of their design loading. Therefore, >90% capacity remains in the licence volume and the capacity of the lagoons and infiltration area. 2. The site next door dewaters substantial volumes. Both sites take water from the same general region and both discharge to the boundary of the estuary. Therefore, there is no net loss and no quantitative impact is predicted. The qualitative impact is mitigated by the design and engineered construction of the lagoon systems.	Neutral
4. Increased Dewatering	Groundwater Subsoils Great Island Channel SAC Shellfish Area Cork Harbour	Lowering ANY quarry bench could lead to an increase of groundwater component in the sump.	The quarry floor, its sump settlement system, lagoons and infiltration area are adequately sized to handle the water volumes they will receive.	Neutral
5. Use of Explosives	Groundwater Subsoils Great Island Channel SAC Shellfish Area Cork Harbour	Could affect water quality	The controlled nature of explosive use at all quarries and the amounts estimated for use suggest that the residuals will present no potential for harm.	Neutral

Table 7.13 Residual Impacts

Residual Effect Evaluation	No.	Potential Impact	Potential Effect	Description of Effect						Mitigation Required?	Residual Effect
				Quality	Significance	Extent	Probability	Duration	Type		
Construction Phase	1	Generated suspended solids in runoff	Discharge water & groundwater quality	Negative	Significant	Local	Likely	Temporary	Irreversible	Yes. Discharge Licence is in place to control the discharge and ensure on-going water managmement and good quality.	No
	2	Accidental leaks/spills of fuels or oils	Discharge water & groundwater quality	Negative	Significant	Local	Unlikely	Temporary	Irreversible	Yes . Spill kits will be maintained on site to stop the migration of any accidental spillages. There are petrol interceptors in the drainage system and hydrocarbon bunds on the exit area of the settlement lagoon.	No
Operational Phase	1	Increased drawdown	Groundwater Body	Negative	Imperceptible	Local	Possible	Medium-Term	Reversible	No	No
				Negative	Imperceptible	Local	Possible	Medium-Term	Reversible	No	No
				Negative	Imperceptible	Local	Possible	Medium-Term	Reversible	No	No
	2	Discharge	Discharge water & groundwater quality	Negative	Imperceptible	Local	Unlikely	Medium-Term	Irreversible	Yes. Discharge Licence is in place to control the discharge and ensure on-going water managmement and good quality.	No
	3	Blasting	Water quality	Negative	Significant	Local	Unlikely	Medium-Term	Irreversible	No, National Standards have built in Mitigation.	No
	4	Accidental leaks/spills of fuels or oils	Discharge water & groundwater quality	Negative	Significant	Local	Unlikely	Temporary	Irreversible	Yes . Spill kits will be maintained on site to stop the migration of any accidental spillages. There are petrol interceptors in the drainage system and hydrocarbon bunds on the exit area of the settlement lagoon.	No
Post-Operational Phase	1	None identified									

7.9 Application of EA Hydrogeological Risk Assessment Methodology

In addition to the conventionally applied EIAR impact assessment following NRA, IGI and EPA Guidelines relating to the description of likely impacts and mitigation measures presented above, Hydro-G applied the UK Environment Agency (Boak, R. et. al., 2007) 'best practice' approach to a hydrogeologically focussed assessment for quarries. There is no Irish based Competent Authority step-based risk assessment guidance. As previously outlined, the UK EA's approach suggests a step-wise thought-process. Following on from the completed desk and field studies, Hydro-G answers to each of the steps can now be summarised as follows:

- ***Step 1*** Establish the regional water resource status:
  - Diffuse Karst Aquifer assigned Good Status (EPA 2010-2015, https://gis.epa.ie/EPAMaps/).

- ***Step 2 Develop a conceptual model for the abstraction and the surrounding area:***
  - There are no freshwater river systems interacting with the site
  - The sites southern boundary is the coastline
  - Groundwater flows from the Midleton Groundwater Body in a southerly direction towards the quarry and the coast
  - There seems to be little potential for encountering groundwater at the site
  - It was previously estimated that the site might encounter 6,800m3/d of waters when it reached the -20m OD floor level and operated at the same time as the neighbouring quarry was also dewatering. The site and local quarry are currently operating at that level and together but the volume of water requiring management at the site ranges from 50m3/d, approximately, in the summer to 800m3/d, approximately, in the winter. Therefore, the volume of groundwater is a fraction of that previously predicted.
  - Future potential for encountering groundwater is low because the site seems to be excavated to the base level of the active aquifer.

- ***Step 3 Identify all potential water features that are susceptible to flow impacts:***
  - Groundwater is not considered a potential impact feature because there is no downgradient groundwater and the radius of impact from the dewatering at the two adjoining sites does not extend inland to the only identified farm well

- Cork Harbour SPA (Site Code 004030) to the south and at numerous inlets to the east and south
- Great Island Channel SAC (Site Code 001058) immediately adjacent to the south

Note: this estuarine channel immediately to the south of the site mapped as the Great Island Channel SAC and the Cork Harbour SPA is also mapped as a 'Nutrient Sensitive' Area estuary labelled by the EPA as the "Owennacurra Estuary / North Channel" (IE_SW_060_0400).

Cork Great Island North Channel (IE_SW_060_0300) is also a designated Shellfish Area: AREA 3.38km2, EU_PA_Code IEPA2_0049, EU_PA_Type Shellfish.

Owennacurra Estuary / North Channel (IE_SW_060_0400). EU_PA_Type Urban Waste Water Treatment Directive Sensitive Area.

LOCATION	South Western RBD	WB_TYPE	Transitional/Coastal Waters
WFD_CODE	SW_060_0300	EU_PA_Code	IETW_SW_2004_0042

- ***Step 4*** Apportion the likely flow impacts to the water features.
  - ***None:*** *Waters arising are discharged close to the site and so there is little net loss of waters to the estuary and downgradient Cork Harbour.*

- ***Step 5*** Allow for the mitigating effects of any discharges, to arrive at net flow impacts:
  - *Discharge of waters that are surplus to dust suppression requirements is from the sump to appropriately sized lagoons and groundwater infiltration area*
  - *The discharge merely returns surface water to the system that it would have flowed to in any case.*

- ***Step 6:*** Assess the significance of the net flow impacts.
  - *None, no nett loss of water.*

- ***Step 7:*** Define the search area for drawdown impacts.
  - *500m for domestic wells and no impact predicted.*
  - *Immediately adjacent SAC to the south and no impact predicted.*

- ***Step 8:*** Identify all features in the search area that could be impacted by drawdown.
  - ***None identified.***
- ***Step 9:*** For all these features, predict the likely drawdown impacts.
  - ***None predicted.***

- ***Step 10:*** Allow for the effects of measures taken to mitigate the drawdown impacts.
  - ***Not relevant.***

- ***Step 11:*** Assess the significance of the net drawdown impacts.
  - ***Not applicable***

- ***Step 12:*** Assess the water quality impacts.
  - ***None:*** *Residual N associated with explosives is miniscule*
  - *Groundwater quality is good, apart from some elevate nitrates coming in from the upgradient catchment*

- ***Step 13:*** If necessary, redesign the mitigation measures to minimise the impacts.
  - ***Not necessary. Extensively engineered systems in place (Appendix 7.1)***

- ***Step 14:*** Develop a monitoring strategy.
  - This is not a greenfield site. Planning Conditions already specify a Biannual Groundwater Monitoring Programme and Quarterly Discharge Licence Compliance Monitoring. These will continue.
  - Assessment completed in this work concludes that the existing Discharge Licence WP(W)08/18(R) specifies a discharge volume that remains fit for purpose, as are the lagoons and infiltration area operational at the site.

7.10 SAC Protection Measures

The quarry's water management system is in place and includes a sump, flow meter, appropriately sized and engineered lagoons, hydrocarbon bunds and an extensive infiltration area that has been proven as fully functioning. The site's Discharge Licence WP(W)08/18(R) was issued in 2019 and therefore has been appropriately issued cognisant of all relevant water legislation. Details are provided in Appendix 7.1,including construction details for the systems.

For the reasons stated above no protection measures are required.

7.11 Conclusions

Hydro-G considers the primary question of note, regarding deepening the existing excavation at the site, to be as follows:

> *Given that we are in an SAC setting, will deepening the quarry present a risk of an adverse effect on groundwater flow, local groundwater wells or the downstream regional receptor SACs?*

Hydro-G's overall conclusion is that there is ***no potential for impact***. This conclusion is supported by site metering of discharge and water quality monitoring reports.

The finding of no potential for impact is a confident assertion because

- The Discharge quality record at the site is good and the discharge volume is low enough to suggest no major groundwater component at the site. While the adjacent site might be dewatering the Lagan site, it is of no major significance to the overall regional environment. This can confidently be asserted because the dewatering from both sites is recharged almost immediately to appropriately sized lagoons and infiltration areas adjacent to the estuary.

- No significant net loss of groundwater is envisaged, no potential for drawdown and no potential to impact local wells is predicted.

- There are no Public Supply and no GWS abstractions within radius of influence of the quarry.

- The other quarry development adjacent was assessed by SLR (2021) to present no potential for impact and therefore there is no potential for cumulative impact.

- It is concluded that all risks are mitigated and that the proposed development shall have no impact on receiving waters and designated sites if the existing mitigating measures continue to be implemented.

Hydro-G supports this evaluation by virtue of the following works:

- Hydro-G's completed desk study & consideration of previous assessments & comments by competent authorities.

- On-site evaluation of the characteristic of the bedrock by drilling and pump testing and visual evaluation of the walls and floor of the excavation.
- Local catchment area survey and consideration of nutrients contributed in the area.
- Water quality data including the site's ongoing discharge monitoring record.
- SLR's Flood Risk Assessment (2020), which concluded no potential for coastal water's overtopping the southern berms of the site.

7.12 Bibliography & References

AGEC Ltd (2012) GEOTECHNICAL REVIEW ROSSMORE QUARRY, CARRIGTWOHILL, CO. CORK Prepared for: Irish Asphalt June 2012. Bagenalstown, Co. Carlow. Ireland.

Boak, R. et. al. (2007) Using Science to create a better place: Hydrogeological impact appraisal for dewatering abstractions. Environment Agency, Science Report – SC40020/SR1. Bristol, UK, 2007.

Conroy, P. (2012) Carrigtohill Flood Risk Assessment Study Groundwater Flood Risk Assessment. Prepared by: Peter Conroy On behalf of Cork County Council In Collaboration with: JBA Consulting. Available at http://corkcocoplans.ie/wp-content/uploads/bsk-pdf-manager/2016/07/Appendix-C-1023_CarrigtohillGroundwaterFRA_RevA-_withFig2Aand2B.pdf

Dept. of Environment, Heritage and Local Government, April 2004. Quarries and Ancillary Activities – Guidelines for Planning Authorities.

DoEHLG, 2011. Guidance, Procedures and Training on the Licensing of Discharges to Surface Waters and to Sewer for Local Authorities. Vol I and II. Department of Environment, Heritage and Local Government & Water Services Training Group.

E.P.A. (2011) Guidance on the Authorisation of Discharges to Groundwater. Version 1 - December 2011.

EPA Online Water Quality Mapping. (https://gis.epa.ie/EPAMaps/)

EPA (2002) Guidelines on the information to be contained in Environmental Impact Statements

EPA (2006) Environmental Management Guidelines for the Extractive Industry (Non-Scheduled Minerals).

EPA (2018) 3rd Cycle Draft Lee, Cork Harbour and Youghal Bay Catchment Report (HA 19)' [December 2018], available at https://catchments.ie/wp-content/files/catchmentassessments/19%20Lee,%20Cork%20Harbour%20and%20Youghal%20Bay%20Catchment%20Summary%20WFD%20Cycle%203.pdf

EPA (2019) Catchment Lee, Cork Harbour and Youghal Bay Subcatchment Tibbotstown_SC_010 (Code 19_2) available at https://catchments.ie/wp-content/files/subcatchmentassessments/19_2%20Tibbotstown_SC_010%20Subcatchment%20Assessment%20WFD%20Cycle%202.pdf

EPA (2021) "Assessment of the catchments that need reductions in nitrogen concentrations to achieve water quality objectives. WFD River Basin Management Plan – 3rd Cycle." Available at

https://www.catchments.ie/assessment-of-the-catchments-that-need-reductions-in-nitrogen-concentrations-to-achieve-water-quality-objectives/

European Communities (Quality of Salmonid Waters) Regulations, 1988. S.I. No. 293/1988

European Communities (Conservation of Wild Birds (Cork Harbour Special Protection Area 004030)) Regulations 2010. S.I. No. 237/2010.

European Communities (Birds and Natural habitats) Regulations 2011. S.I. No. 477/2011.

European Communities Environmental Objectives (Surface Water) Regulations, 2009. Statutory Instruments. S.I. No. 272 of 2009.

European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012. S.I. No. 327/2012.

European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015. Statutory Instruments. S.I. No. 386 Of 2015.

European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. Statutory Instruments. S.I. No. 77 Of 2019.

European Communities Environmental Objectives (Groundwater) Regulations, 2010. Statutory Instruments. S.I. No. 9 Of 2010.

European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016. Statutory Instruments. S.I. No. 366 Of 2016.

Ferguson & Leask (1988) The export of nutrients from surface coal mines. Environment Canada conservation and protection environmental protection pacific and Yukon region west Vancouver, British Columbia.

Guidelines for the Preparation of Soils, Geology & Hydrogeology Chapters of Environmental Impact Statements, 2013.

Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA Document.

GSI (2003, 2005) Bedrock Geology Sheets 1:100,000 Map Series. Geological Survey of Ireland.

GSI On-line Groundwater database. Aquifer Classification, Aquifer Vulnerability, Teagasc Soil Classification, Subsoils, Karst features, groundwater recharge.

GSI (2004) 1st Draft GWB Descriptions June 2004.

GWP (2014) A Quarry Design handbook. 2014 Edition. GWP Consultants and David Jarvis Associates Limited, UK.

Hogan, D. & Larkin, D. (2014) Midleton Distillery Karst. "Cork & Waterford" ANNUAL IAH FIELDTRIP 2014. https://www.iah-ireland.org/field-guides/2014.pdf

IGI (2002) Geology in Environmental Impact Statements a Guide.

IGI (2013) Guidelines for the preparation of soils, geology and Hydrogeology chapters of environmental impact statement. Institute of Geologists of Ireland.

Kelly, C. & Drew, D. (2014) KRAZY KORK KARST. "Cork & Waterford" ANNUAL IAH FIELDTRIP 2014. https://www.iah-ireland.org/field-guides/2014.pdf

Lamplugh, G.W., Kilroe, JR, Henry, M.A., Seymour, H.J., Wright, W.B. and Muff, H.B. (1905) The Geology of the Country around Cork and Cork Harbour. Memoirs of the Geological Survey of Ireland. Printed at His Majesties Stationery Office. Available at http://www.geologicalmaps.net/IrishHistMapsDownload/B02131.pdf

National Parks and Wildlife Service (NPWS). Database of Special Areas of Conservation, National Heritage Areas, National Parks, Special Protection Areas including site synopsis reports;

NPWS (2017) Conservation Objectives.

Ordnance Survey, Ireland Map Series 1:50,000 Sheets Galway.

SLR (2020) Further Information Response Planning File Ref: 20/04124 Lagan Materials Ltd., Planning Application for Proposed Readymix Concrete Batching Plant, Ground Limestone Processing Plant, Ground Limestone Storage Building etc., at Rossmore Quarry, Carrigtwohill, Co Cork. Appendix F1: 1 Flood Risk Assessment (SLR Ref 501-00396-00021).

SLR (2021) Kilsaran Planning Application 2021. Cork County Council Planning Public Files, SLR Water Chapter.

Tom Philips & Associates (2015) EIAR for Further Development of Quarry at Rossmore, Carrigtohill, Co Cork. Water Chapter 8.0. TMS 2015.

TMS Environment Limited (2013) WATER MANAGEMENT SYSTEM FOR PROPOSED DEEPENING OF EXISTING QUARRY AT ROSSMORE, CARRIGTWOHILL, CO. CORK Prepared on behalf of LAGAN BITUMEN LTD. Report Ref 18968-3 Rev. 1.0. 31st October 2013. (Appendix 8.9, PROPOSED SURFACE WATER MANAGEMENT SYSTEM 2015 EIAR Tom Phillips & Associates).

University of Sheffield (2004) Reclamation Planning in hard Rock Quarries. Department of Civil & Structural Engineering. Edge Consultants, Mineral Industry Research Organisation.

WFD Working Group (2004) Guidance document no. GW3: THE CALCAREOUS/ NON-CALCAREOUS ("SILICEOUS") CLASSIFICATION OF BEDROCK AQUIFERS IN THE REPUBLIC OF IRELAND.

WFD Working Group (2004) Guidance document no. GW5: GUIDANCE ON THE ASSESSMENT OF THE IMPACT OF GROUNDWATER ABSTRACTIONS.

Figures

NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND.

2. EXTRACT FROM OS DISCOVERY SERIES MAP REF NO'S: 1606; 1806.

LEGEND

LAND OWNERSHIP AREA

APPLICATION AREA

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WINDY ARBOUR
DUBLIN 14
T: +353-1-2964667
F: +353-1-2964676
www.slrconsulting.com

LAGAN MATERIALS LTD.

EXISTING LIMESTONE QUARRY
ROSSMORE TOWNLAND, CARRIGTWOHILL, CO. CORK

SITE LOCATION MAP

FIGURE 7-1

Scale 1:25,000 @ A3

Date SEPTEMBER 2021

0 800m 2000

Metres 1:25,000

501.00584.0 gure_7-1.Site Location Map.dwg

LEGEND:

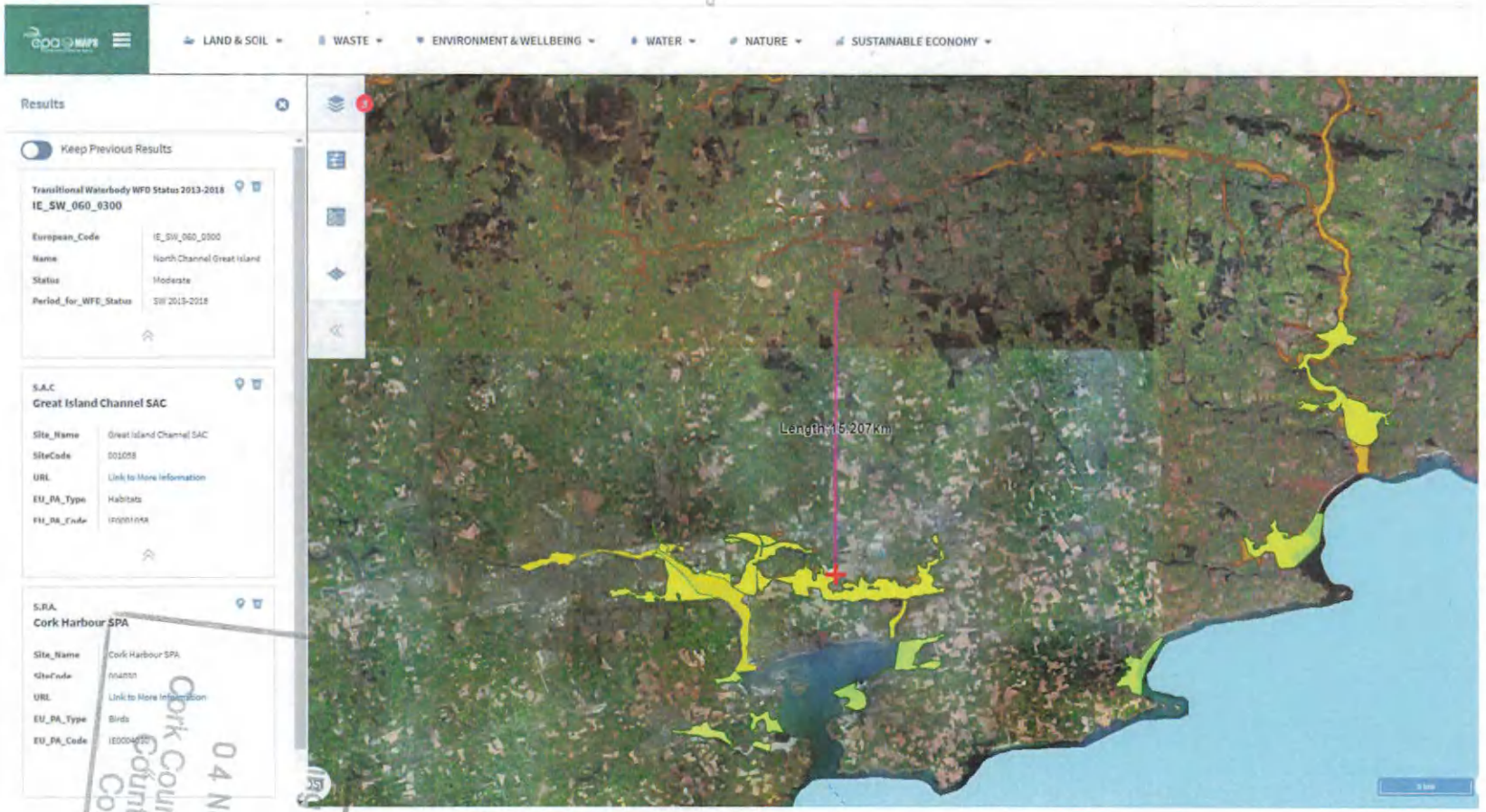
= Site Location

(GSI https://dcenr.maps.arcgis.com/apps/MapSeries/)

Hydro-G

Title Regional Topography Map
Job: Lagan, Rossmore, Co Cork
Figure No: 7.2 Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

https://gis.epa.ie/EPAMaps/Water

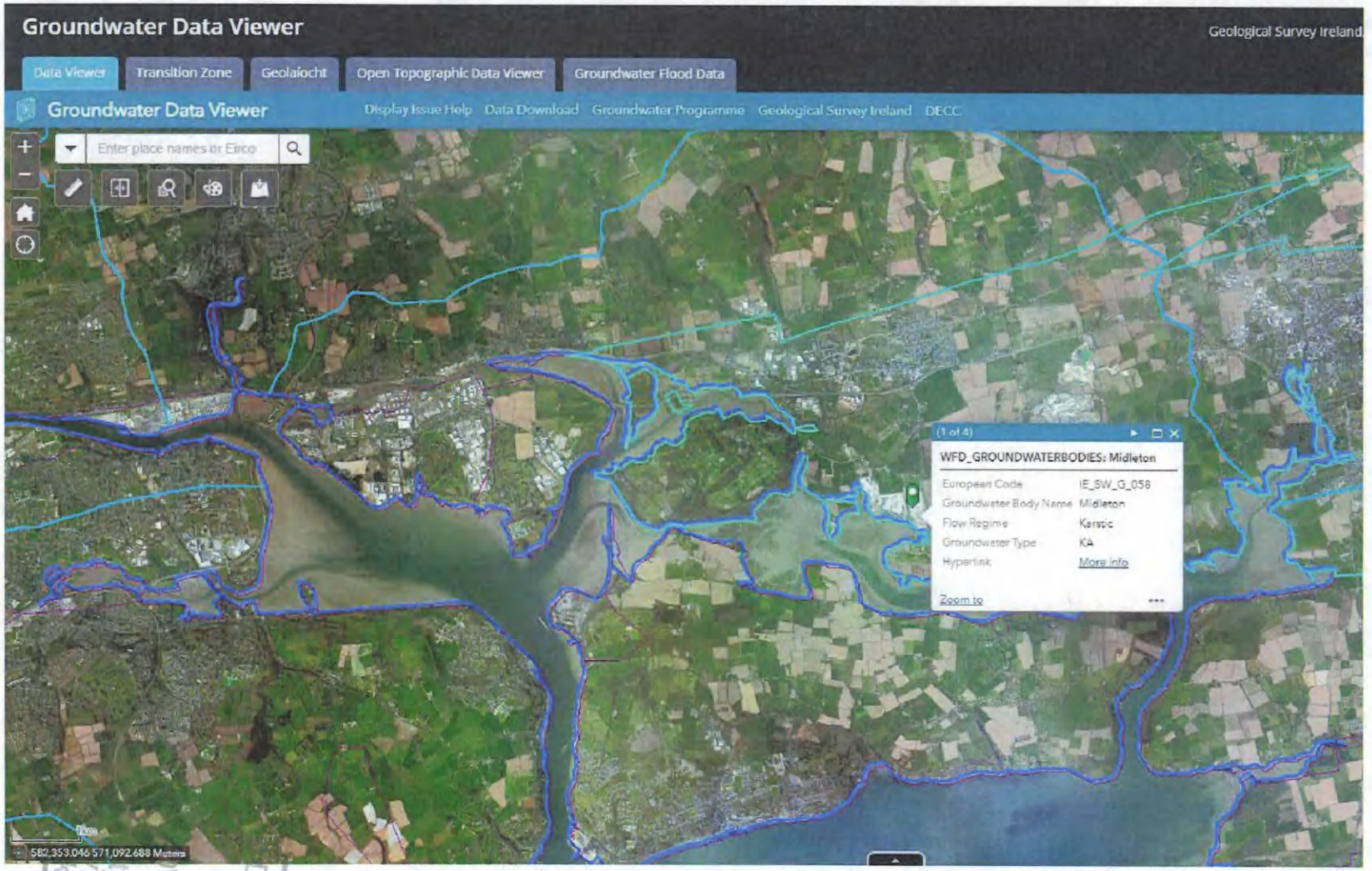


LEGEND:

Site Location

Hydro-G

Title: Designated Sites Map
Job: Lagan, Rossmore, Co Cork
Figure No: 7.3 Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021



(GSI https://dcenr.maps.arcgis.com/apps/MapSeries/)

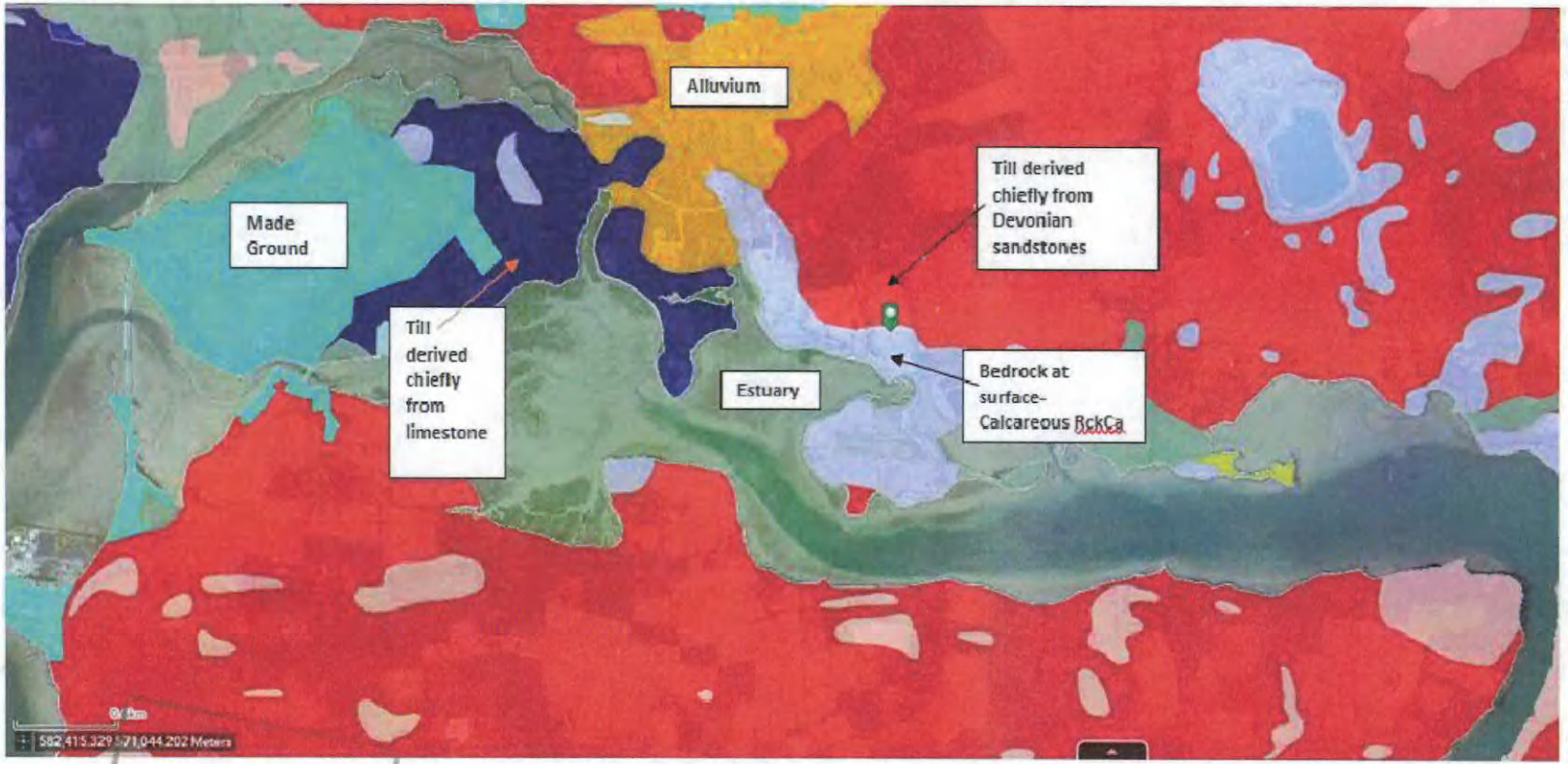
LEGEND:

= Site Location

Hydro-G

Title: Groundwater Body Delineations
Job: Lagan, Rossmore, Co Cork
Figure No: 7.4 Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

(GSI https://dcenr.maps.arcgis.com/apps/MapSeries/)



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= Site Location

Hydro-G

Title: Teagasc Soils
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Figure No: 7.5 Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

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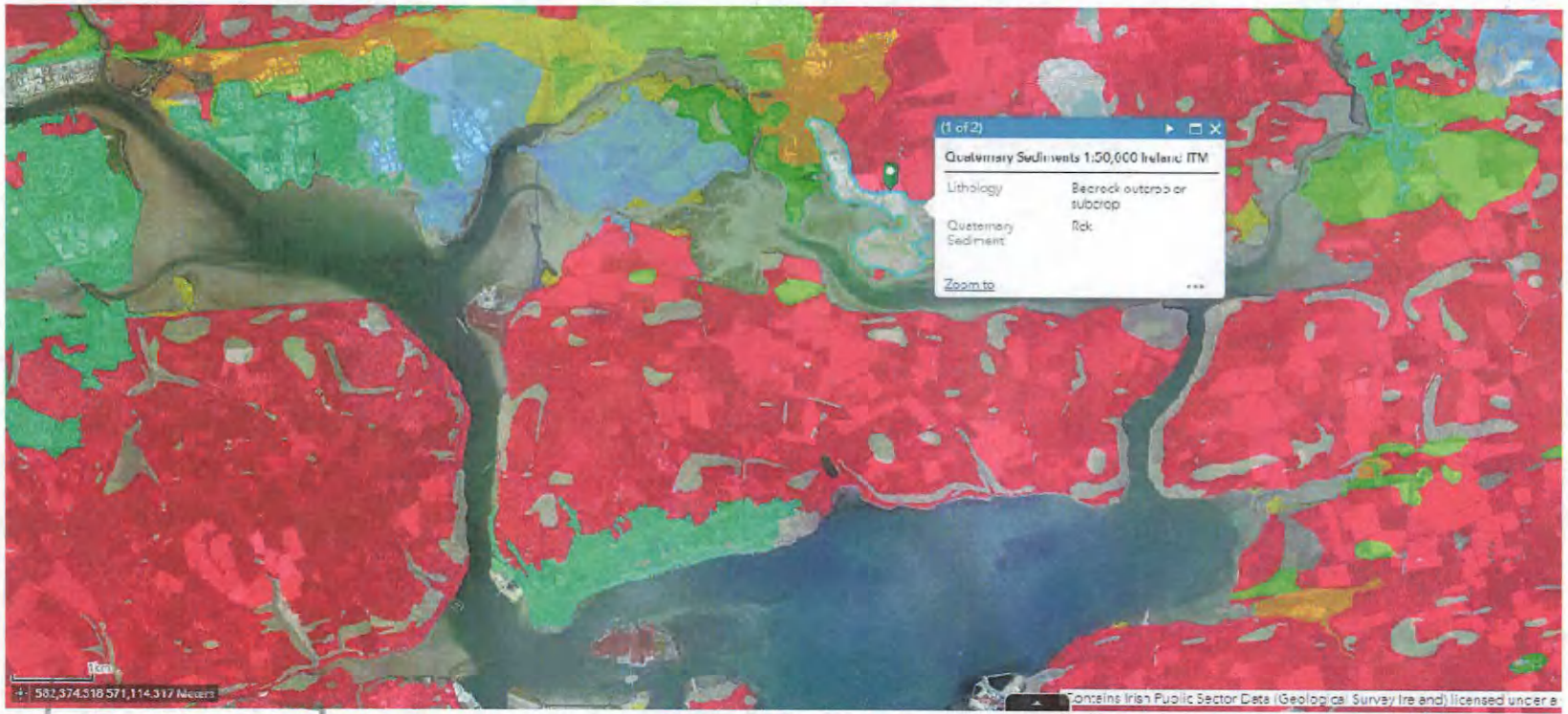

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= Site Location

Hydro-G

Title: Subsoils Map
Job: Lagan, Rossmore, Co Cork
Figure No: 7.6 Scale: on sheet
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Date: 1st October 2021

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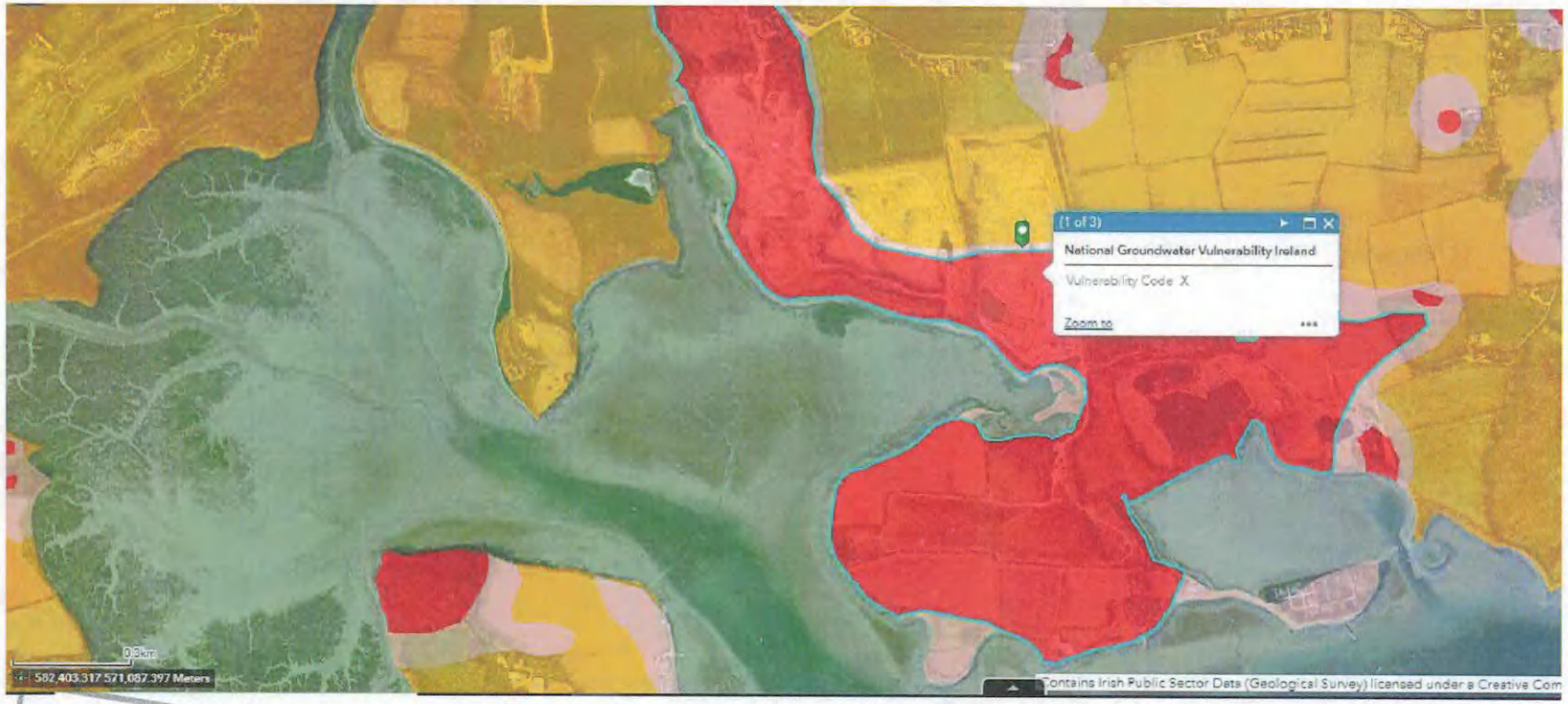


LEGEND:

Site Location

Hydro-G

Title: Groundwater Vulnerability
Job: Lagan, Rossmore, Co Cork
Figure No: 7.7 Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

Figure 7.8a Bedrock Map: Clashavodig Formation in northern portion of site.

(GSI https://dcenr.maps.arcgis.com/apps/MapSeries/)

LEGEND:

= Site Location

Hydro-G

Title: Bedrock Map (a)
Job: Lagan, Rossmore, Co Cork
Figure No: 7.8a Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

Figure 7.8b Bedrock Map: Little Island Formation in southern portion of site.

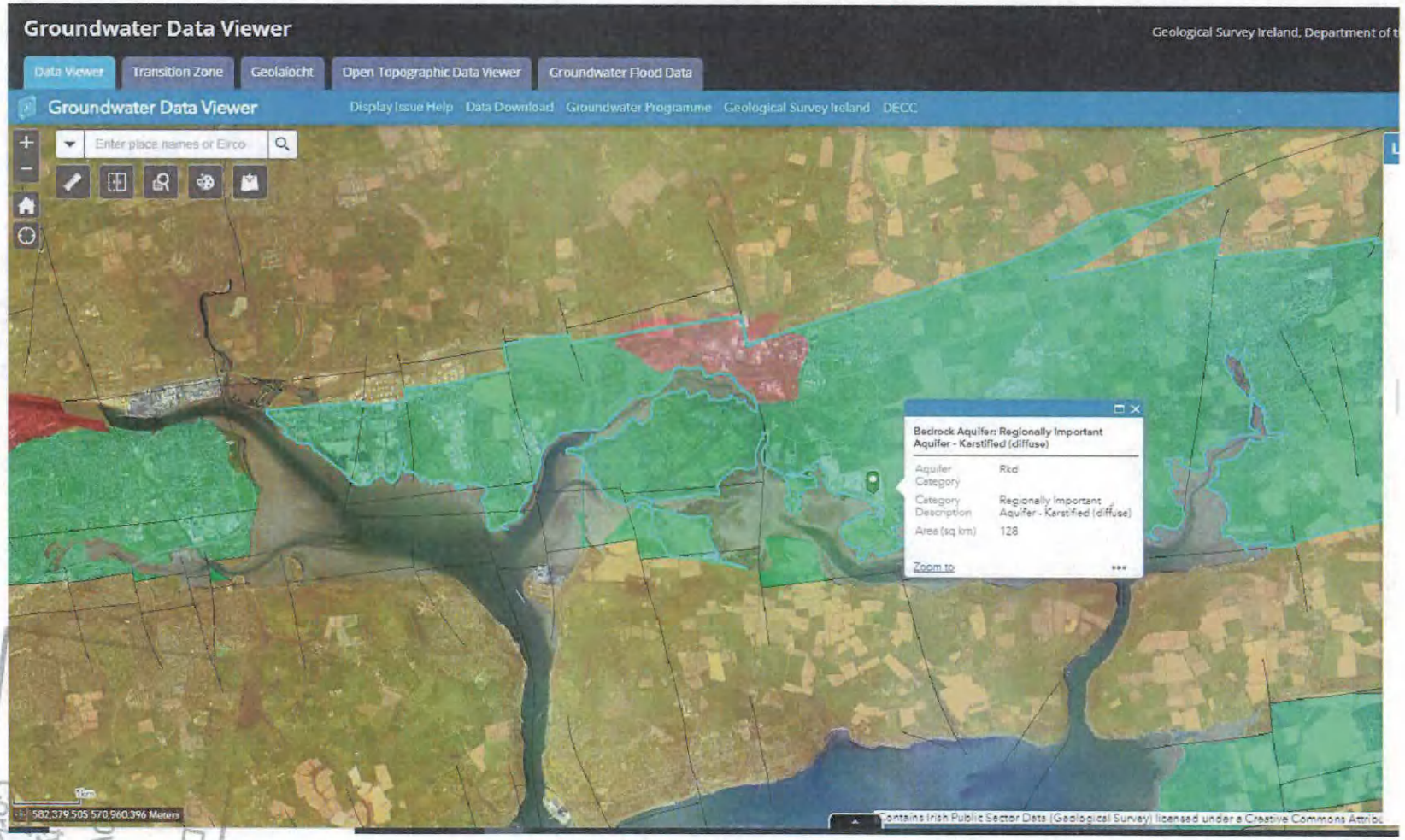
(GSI https://dcenr.maps.arcgis.com/apps/MapSeries/)

LEGEND:

= Site Location

Hydro-G

Title: Bedrock Map (b)
Job: Lagan, Rossmore, Co Cork
Figure No: 7.8b Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021



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= Site Location

Hydro-G

Title Aquifer Map
Job: Lagan, Rossmore, Co Cork
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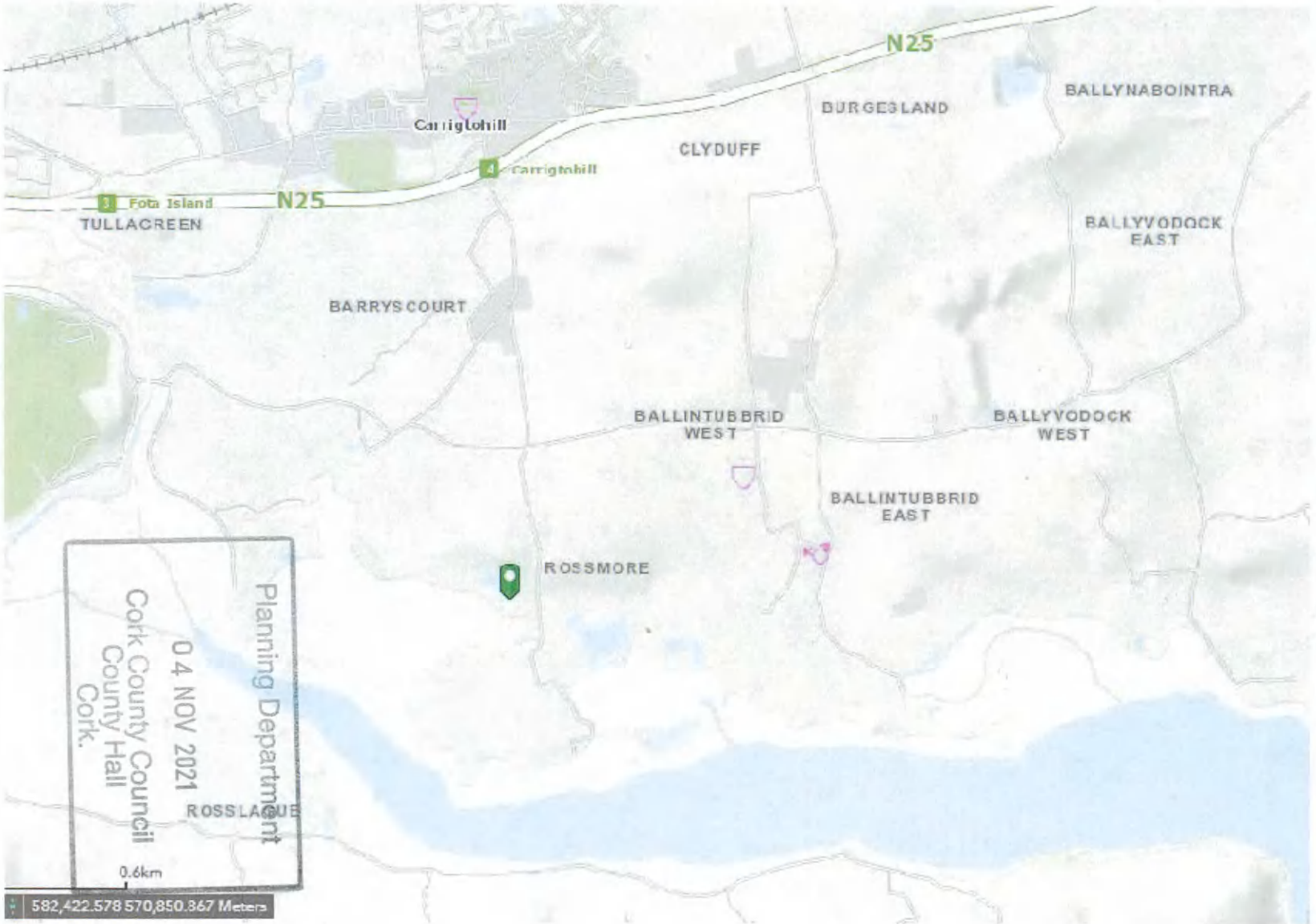

(GSI https://dcenr.maps.arcgis.com/apps/MapSeries/)

LEGEND:

Groundwater Karst Data

Karst Landforms

- Borehole
- Cave
- Dry Valley
- Enclosed Depression
- Spring
- Superficial Solution Features
- Swallow Hole
- Turlough

Traced Underground Connections

= Site Location

Hydro-G

Title: Karst Features
Job: Lagan, Rossmore, Co Cork
Figure No: 7.10 Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

(GSI https://dcenr.maps.arcgis.com/apps/MapSeries/)

LEGEND:

= Site Location

Hydro-G

Title: Local Groundwater Users
Job: Lagan, Rossmore, Co Cork
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Date: 1st October 2021

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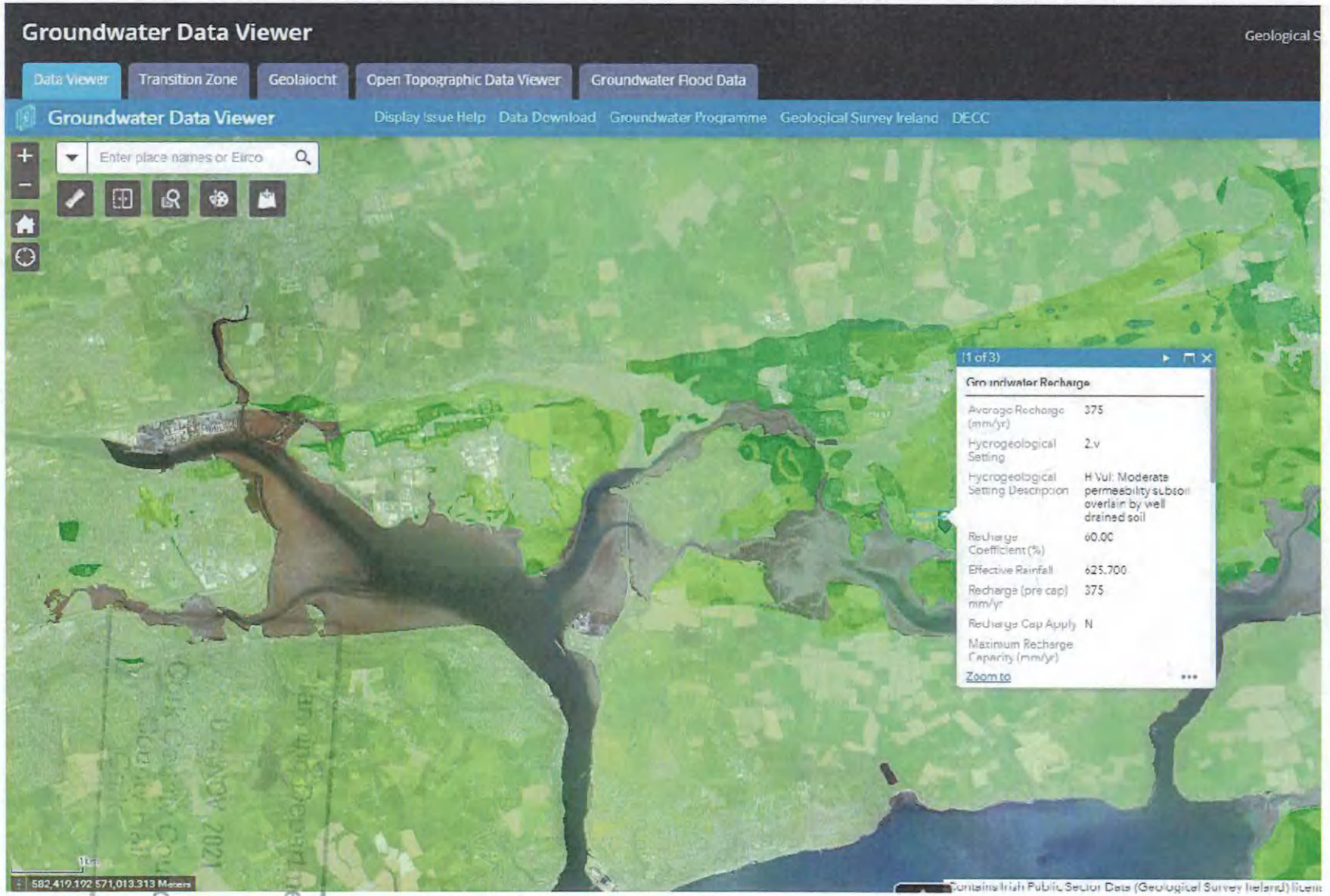

LEGEND:

= Site Location

Hydro-G

Title: GSI Recharge Map
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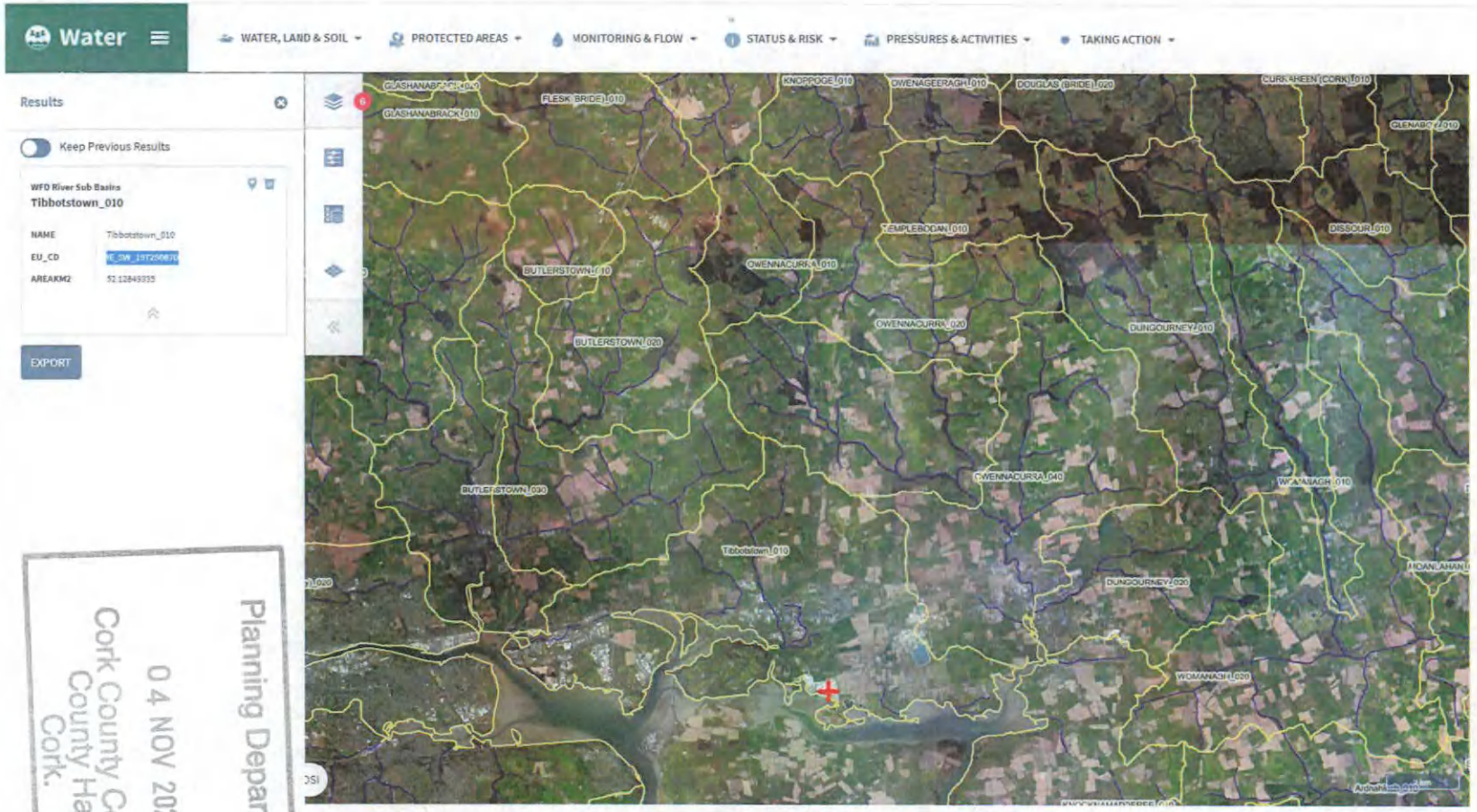

https://gis.epa.ie/EPAMaps/Water

LEGEND:

Site Location

Hydro-G

Title: Regional Hydrology
Job: Lagan, Rossmore, Co Cork
Figure No: 7.13 Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

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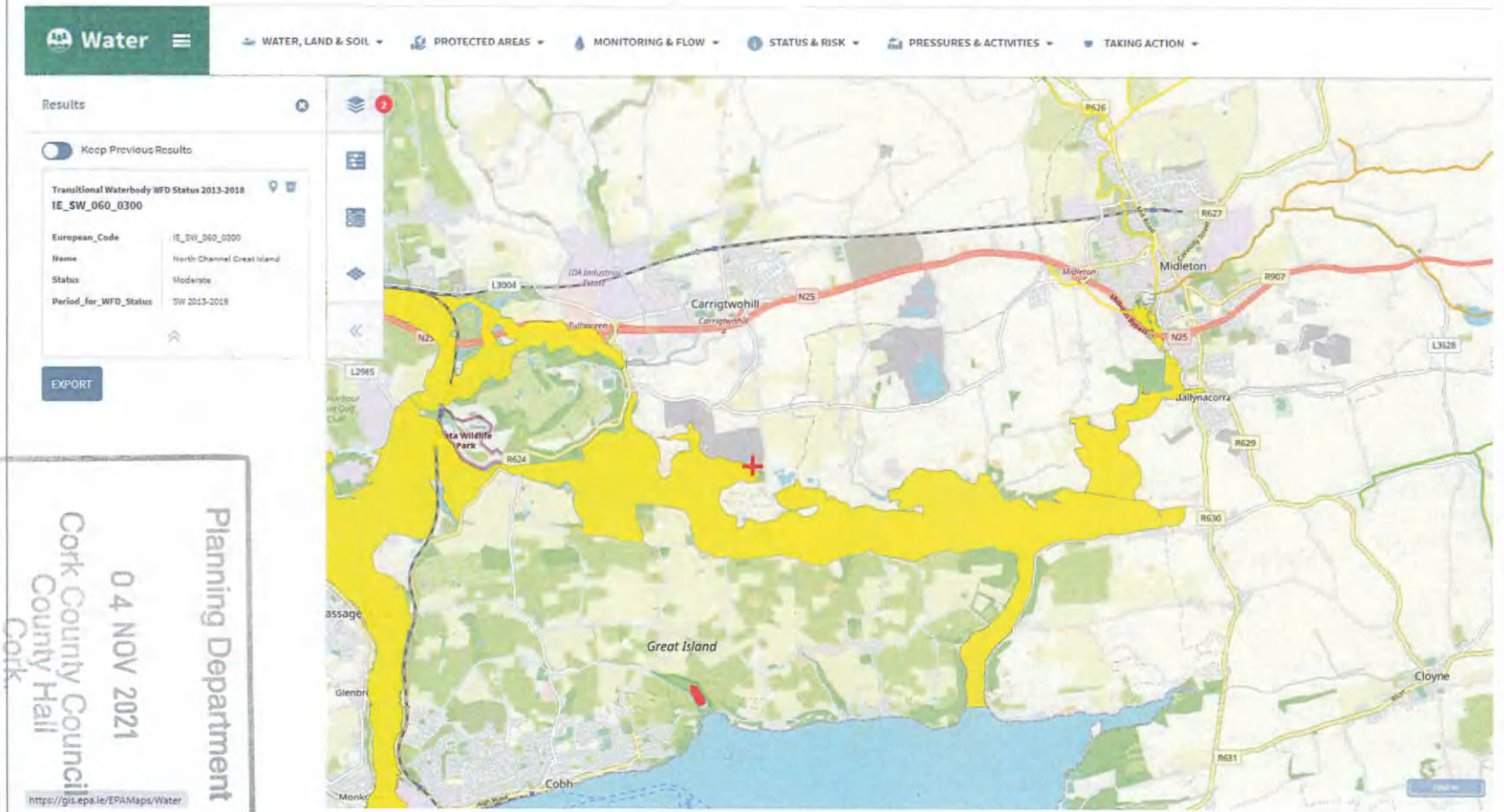


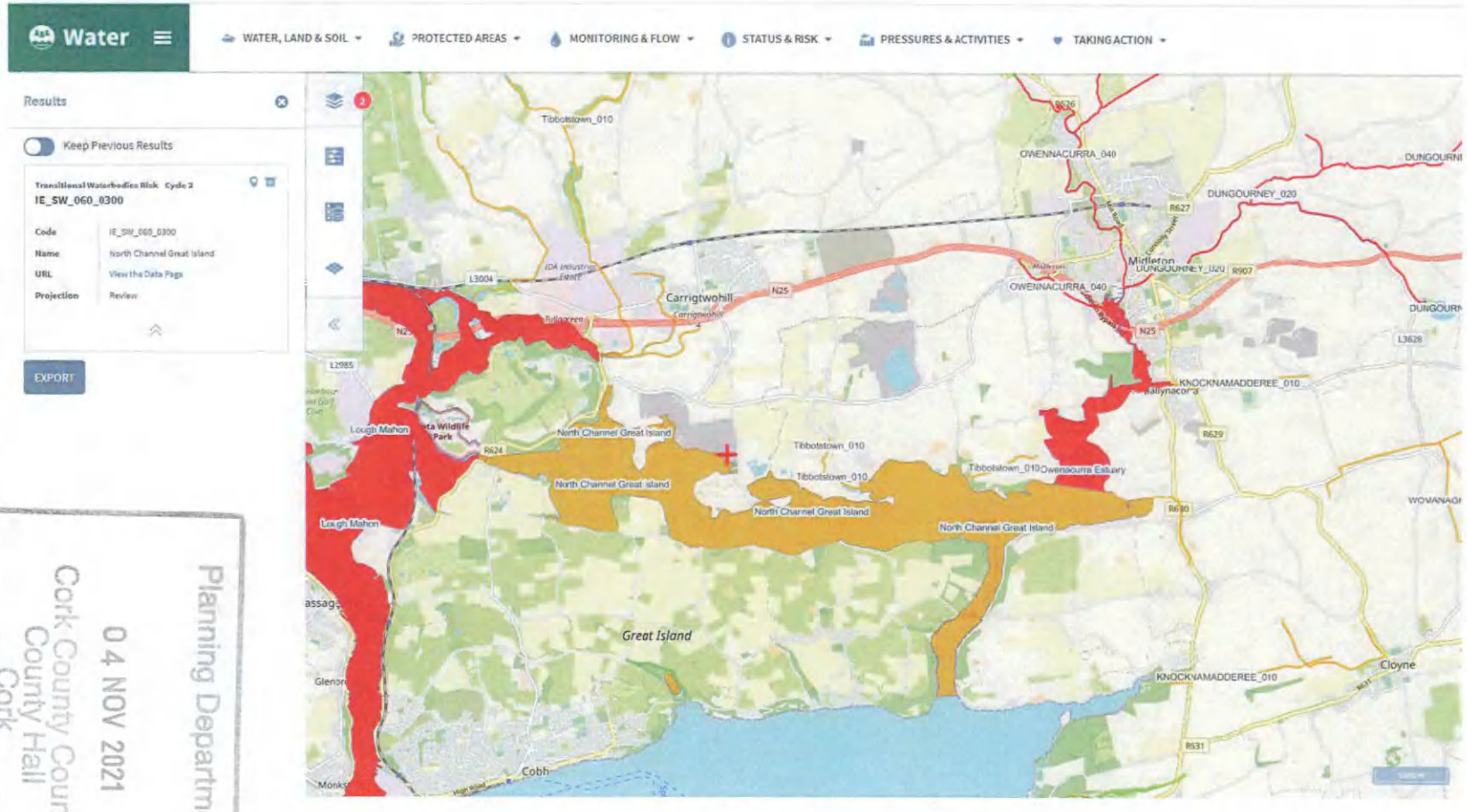
LEGEND:

Site Location

Hydro-G

Title: WFD Surface Water Body Status
Job: Lagan, Rossmore, Co Cork
Figure No: 7.14a Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

https://gis.epa.ie/EPAMaps/Water



LEGEND:

= Site Location

Hydro-G

Title: WFD Surface Water Body Risk
Job: Lagan, Rossmore, Co Cork
Figure No: 7.14b Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

https://gis.epa.ie/EPAMaps/Water

Site Location

EPA 2020 Q Ratings

Br in Midleton Q3 = Poor

Cork Br, Midleton
Q 3 – 4 = Moderate

Hydro-G

Title: EPA Q Ratings
Job: Lagan, Rossmore, Co Cork
Figure No: 7.15 Scale: on sheet
Sheet Size: A4 Drawn: PB
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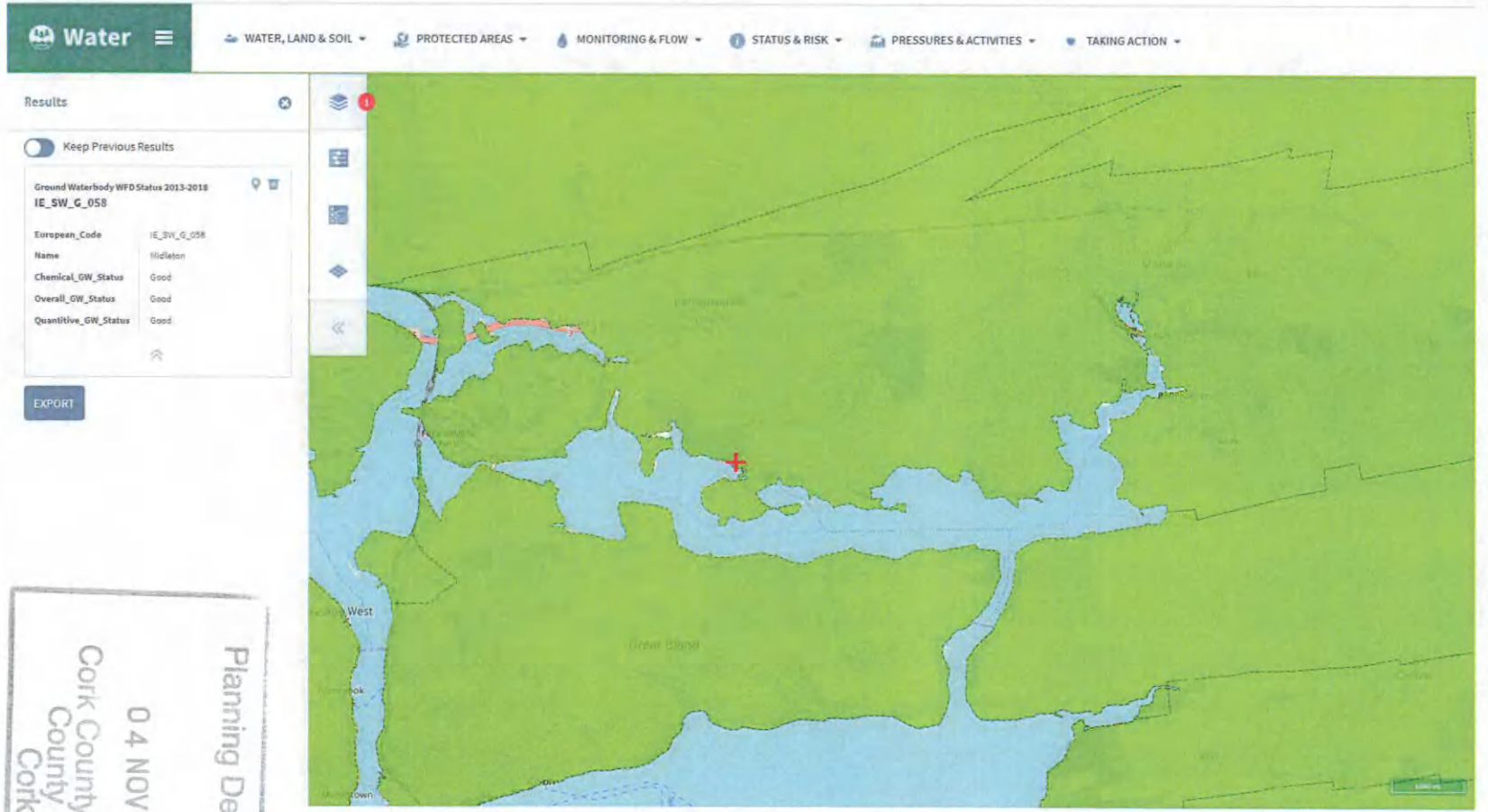
https://gis.epa.ie/EPAMaps/Water



LEGEND:

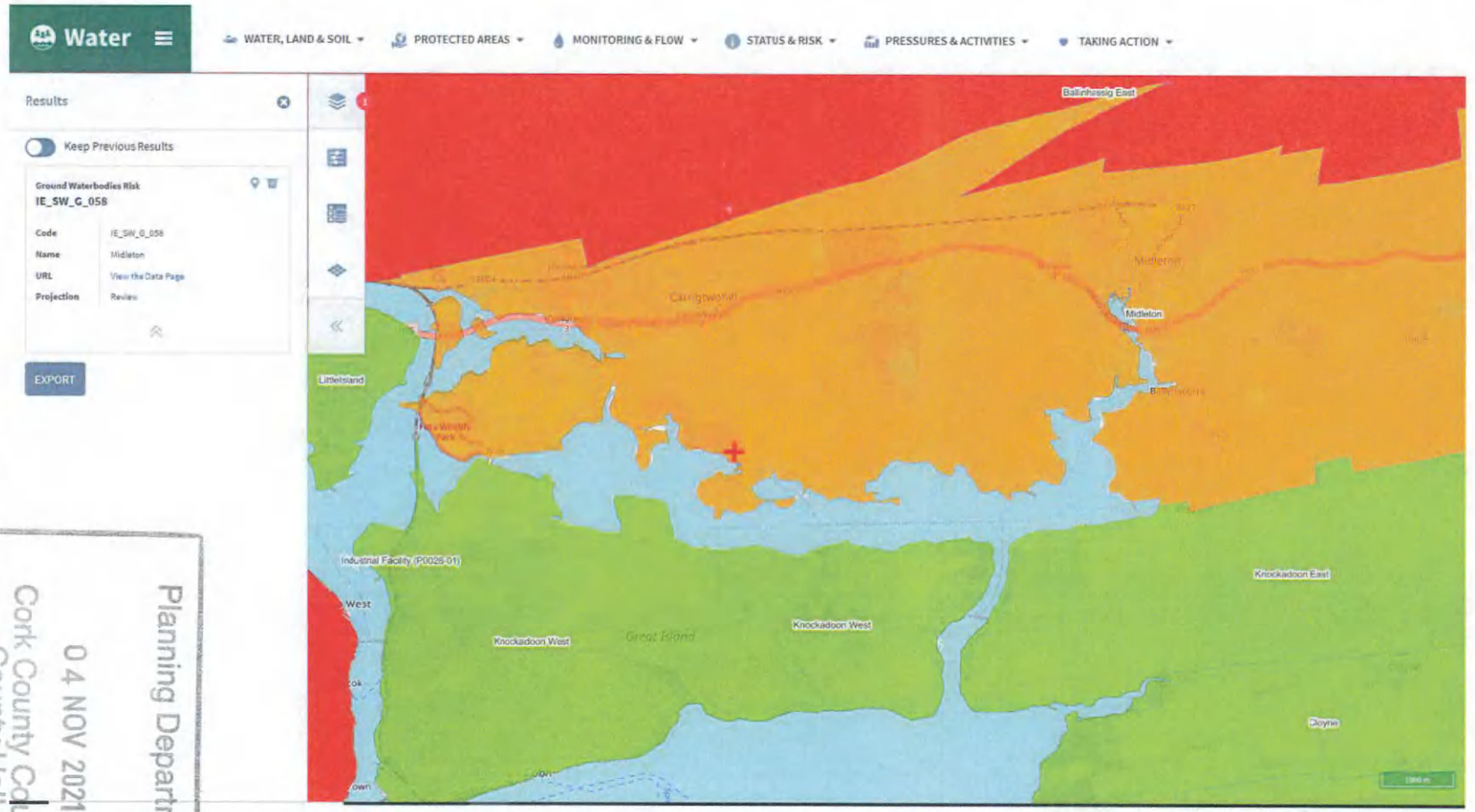
Site Location

Good Status 2013 - 2018

Hydro-G

Title Groundwater Body Status
Job: Lagan, Rossmore, Co Cork
Figure No: 7.16a Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

https://gis.epa.ie/EPAMaps/Water



LEGEND:

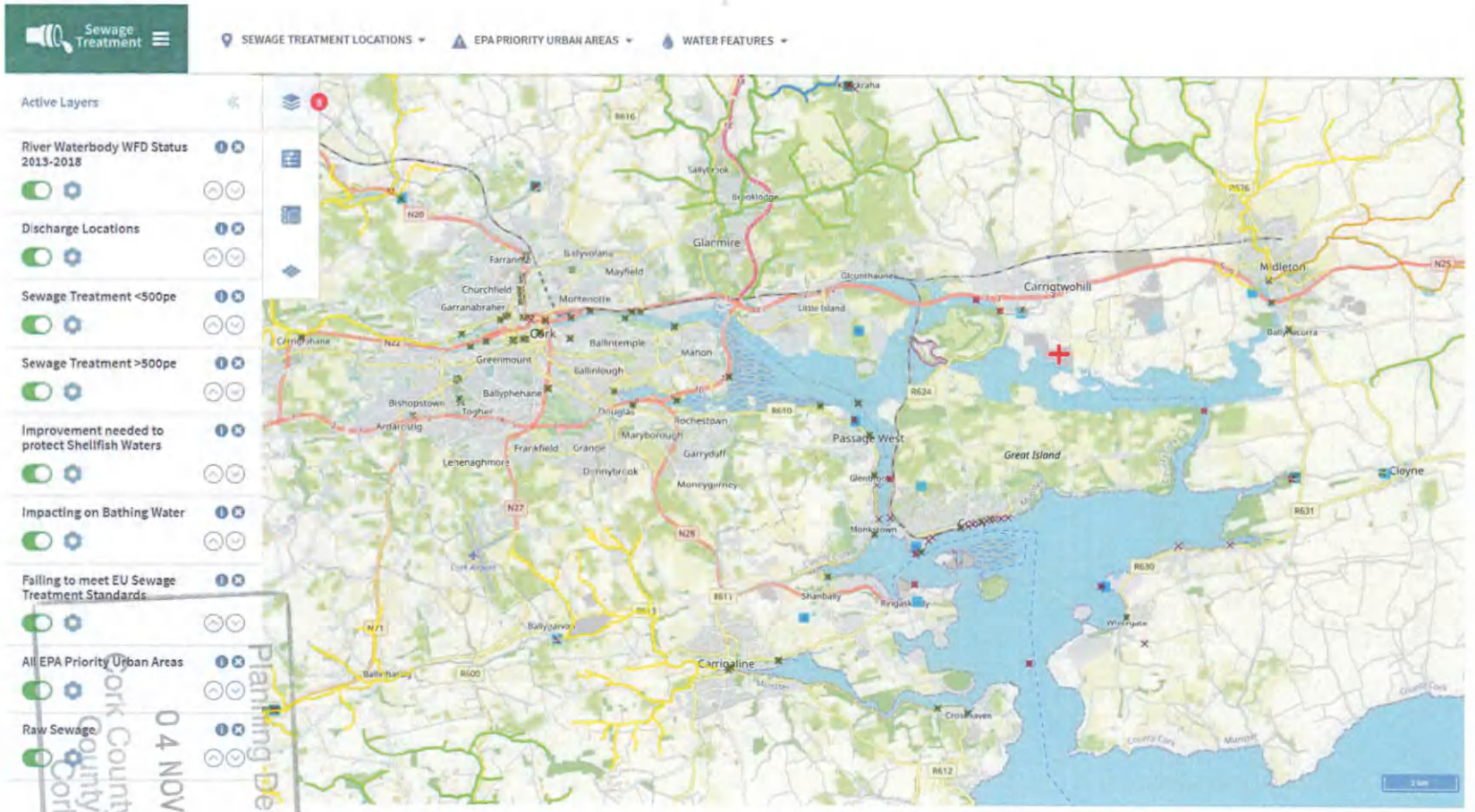
Site Location

Risk @ Review 2013 - 2018

Hydro-G

Title: Groundwater Body Risk
Job: Lagan, Rossmore, Co Cork
Figure No: 7.16b Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021

https://gis.epa.ie/EPAMaps/Water



LEGEND:

- Site Location
- Sewage Treatment Plant
- Discharge Location (includes Stormwater Overflows)

Hydro-G

Title: WWTPs Cork Harbour Catchment
Job: Lagan, Rossmore, Co Cork
Figure No: 7.17 Scale: on sheet
Sheet Size: A4 Drawn: PB
Date: 1st October 2021