Hydrogeological and Hydrological Review

Proposed Coolnabacky Sub-station site Timahoe

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IE CONSULTING
WATER-ENVIRONMENTAL-CIVIL

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Location: Proposed Coolnabacky Sub-station site, Timahoe

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Contents

Table of Contents

1. INTRODUCTION

IE Consulting were engaged to conduct an independent audit of the process undertaken (during planning) to assess the potential impact on the hydrological and hydrogeological environment from the proposed construction of a substation at Coolnabacky, near Timahoe, Co. Laois. The Substation is an element of an overall network improvement scheme for the Laois-Kilkenny Area.

IE Consulting were invited by Irish Rural Link to submit a Tender for the following brief

The scope for the independent review for Coolnabacky (also known as Laois-Kilkenny) would broadly involve reviewing the planning documentation, in particular:

- *To review scheme as planned from a hydrological/ hydrogeologic risk point of view*
- *Review of relevant planning information*
- *Recommendations on any gaps in the scheme as planned (e.g. Bunding arrangements, dealing with contaminated runoff, flooding risk etc.)*
- *Comment on whether the scheme is in line with best international practice*
- *Assessment of risk to aquifer*
- *Additional areas to focus on or any further pre-construction site investigations etc.*
- *Provide information of site specific mitigation measures for construction stage*

The main issues of concern are the potential risks to the groundwater water supply.

Irish Rural Link, requested that IE Consulting confirm that they had not undertaken work for Eirgrid or ESB in the recent past or in any way connected to the proposed scheme. This we were happy to confirm.

Irish Rural Link also stressed that IE should confirm that the audit was independent and not influenced in any way by Eirgrid or ESB. This we are happy to confirm.

2. APPROACH TO STUDY

This report is based on a review of the following;

- Documents at the public link: http://eirgridlaoiskilkenny.ie/environmental.html
- A review of the information provided on the An Bord Pleanala website, when a search for VA0015 was made http://www.pleanala.ie/search/index.php?q=va0015&case_scope=all&include_reports_etc=0
- Eirgrid and ESB reports and drawings-provided on request.
- Assessment reports By SLR and Tobins associated with the unauthorised development in
- 2017 Tobins report (Report to assess the impact of the unauthorized development on the Aquifer at Coolnabacky Construction site) 2017
- 2018 SLR Hydrogeological assessment of excavations for the construction of a substation prepared for: Eirgrid SLR Ref: 180720 00357 00004
- GSI 2000- Kyle & Orchard Springs Source Protection report
- GSI 2018 assessment and response to RTS presentation to Minister Naughten
- GSI public viewer maps
- Site walk-over visit under taken by J Keohane on 18th December 2020
- Lyons & Kelly 2016 Monitoring Guidelines for the Assessment of Petrifying Springs in Ireland. Irish Wildlife Manual No. 94 NPWS
- ESBI site drainage report PE687-F0261-R261-016 which included Traynor Environmental Site suitability assessment 2012
- 2012 Soil Mechanics Report No Y2012-12A factual report on ground investigation.

3. TOPOGRAPHY AND SURFACE WATER DRAINAGE

The site lies in a low lying, mostly flat area which extends to the east and north of the site. The surrounding land to the south and west becomes hummocky within 150m to 200m of the site. The geomorphology appears to be glacio-fluvial in origin.

The main surface water drainage feature in the area is the Timahoe River which flows in an approximately northerly direction 500m east of the site. The Timahoe River in turn joins the Honey Stream which flows in from the east and the combined flow becomes the Bauteoge River.

The watercourses in the area appear to have been modified and canalised in places, and arterial drainage has been used to improve the land and direct run-off towards the streams and rivers.

A natural unnamed watercourse skirts the northern boundary of the site, and there are also drains along the western southern and eastern boundaries of the site which were noted to be carrying some flow on the day of the site visit. The perimeter drains are typically 1.0m to 1.5m deep, and seem mainly to run to the North towards the stream.

Apart from occasional water logging after heavy rain, I am satisfied that there is no evidence of a flood risk to site from fluvial or groundwater sources. The modified drainage network in the area, does appear to work efficiently to remove water from the land.

There is surface water hydraulic connectivity between the site and an SAC (The River Barrow and River Nore SAC site code 002162), and I am satisfied that this has been adequately considered through the EIAR and consideration by the An Bord Pleanala Inspector.

I am satisfied that the proposed safeguards for surface water quality management during construction and the operational phase surface water management approach for managing run-off from paved and covered areas for the proposed development is robust. Any new information arising out of the recommended further works detailed below or the construction works when they commence should be reviewed, in the context of surface water management to ensure ultimate protection for water resources.

4. GROUNDWATER

An Bord Pleanala has approved the proposed development after an oral hearing and review of documentation. The Inspectors report (11.VA0015) states that "It appears that the substation at Coolnabacky can be constructed without undue risk to local groundwater sources. The development could be carried out and operated satisfactorily from an ecological standpoint". I have considered this decision in the context of both bedrock and shallow aquifers.

4.1 Bedrock Aquifer

I do agree that there is no significant risk posed by the development to the Kyle spring, because of the following factors

- Significant consistent thickness (8m approx.) of low permeability cohesive subsoil overlying the rock aquifer. This effectively isolates any on-site activities from the bedrock aquifer, since

there will be no excavations deeper than 2m. I am satisfied that site tests have demonstrated very low permeability for this Clay material.

- The GSI source protection report (2000- Kyle & Orchard Springs Source Protection report) concludes that the Kyle Spring is generically a bedrock derived spring, (although the output may flow through overlying gravel for a short period).
- There is no groundwater pathway linking the site and the spring.
- The site is outside of the mapped source protection zone, eventhough the GSI report does state that that some groundwater may pass beneath the Timahoe/Bauteoge River through bedrock en route to the Kyle Spring.
- There is no hydraulic connectivity between the surface water features in the area and the Kyle Spring since all surface water from the site ultimately enters the Timahoe River System and the GSI report (2000- Kyle & Orchard Springs Source Protection report) states that surface water features are hydraulically isolated from the bedrock Aquifer.

4.2 Sand and Gravel Aquifer

The GSI have mapped a locally important Sand and Gravel Aquifer (Timahoe-Stradbally Aquifer) in the area, which includes the site. The GSI have stated in their review (response 2018) that work is in progress on better defining the boundaries and characteristics of this aquifer as part of the Groundwater 3D project.

I understand that the information available to the Hydrogeology Team preparing the EIS in 2013, suggested that the site was outside of the mapped Sand and Gravel aquifer area at the time. The Inspectors report confirms and accepts this. The fact that this has been changed by and is under further review by the GSI does warrant some scrutiny.

The 2017 Tobins report (Report to assess the impact of the unauthorized development on the Aquifer at Coolnabacky Construction site) prepared for ESB acknowledges this boundary change but argues that "*no significant saturated sand and gravel deposit was encountered in the vicinity of the sub-station site".*

This is consistent with the 2018 report by SLR (Hydrogeological assessment of excavations for the construction of a substation) prepared for Eirgrid which states:

"*the site investigation showed that granular sand and gravel deposits at the site are very thin, laterally impersistent and contain limited groundwater; they are not therefore a significant groundwater source or aquifer. This conclusion is supported by GSI advice that states that gravel deposits must exceed 10m to be considered an aquifer. The subsoils at the site are not classified as an aquifer or a groundwater body due to their low permeability characteristics, shown to be typical of silt. This reflects the description of the subsoils as granular gravelly clay / clayey sand and gravel deposits and cohesive stiff – very stiff gravelly clay deposits*". "*The site investigations at the site have shown that there is no gravel aquifer (i.e. sands and gravels to a thickness exceeding 10m) at the site.*

Therefore, the shallow water ingress encountered in the subsoils at the site is representative of pore water or isolated pockets of groundwater that are not connected to the bedrock aquifer".

The GSI (GSI www.gsi.ie) does indeed state that the sand and gravel deposit must be 10m in thickness to be considered an aquifer. I therefore expect, based on this observation, that the GSI will not include this site within a revised sand and gravel aquifer boundary.

Apart from the thickness constraint which appears to be definitive, the EIAR (Chapters 9 and 10 2013) presents a number of other pieces of evidence to state why the sand and gravel deposits on the site do not comprise an aquifer.

The sand and gravel deposits at the site not found to be saturated during the site investigation of 2012.

In most cases, groundwater strikes were not recorded in the Sand and Gravel deposits.

It is noted that, due to the presence of low permeability Clay deposits beneath the sand and gravel, the inflow volumes of groundwater encountered during drilling was minimal.

As the sand and gravel was not saturated, this indicates that the quantities of groundwater present are not significant.

During a subsequent intrusive site investigation carried out by AWN Consulting in 2013, 4 no. boreholes were installed around the boundary of the site, up gradient and down gradient of the

predicted groundwater flow direction. (Appendix 10.1 Site Investigation and Hydrogeological report).

The ground conditions consisted of soft to stiff sandy gravelly Clay and silty sandy Clay to approximately 3m bgl. At approximately 3m bgl, low permeability stiff to firm boulder Clay was encountered. At borehole BH4 Boulder Clay was found to extend to 8.6m bgl when returns were of angular rock suggesting boulders or bedrock.

No fast inflow groundwater strikes were recorded during the site investigation.

Data loggers were installed to record the static groundwater levels at hourly intervals. Based on data, to date the groundwater level at the site is typically less than c.1m bgl. (See Appendix 10.1 for more detailed information)

Permeability tests carried out at each groundwater monitoring well (borehole) indicate that the hydraulic conductivity is typical of silt and clay soils.

Therefore, the water present in the deposits represents pore water, rather than groundwater. The Sand and Gravel deposits at the centre of the site which would be expected to have a higher permeability were also found to be unsaturated.

The 2018 SLR report suggests based on this information

> *"therefore, the shallow groundwater present in the subsoils represents pore water or isolated pockets of groundwater, rather than a groundwater resource, as defined by the EPA. It may not be feasible to define a water table in the subsoils as lateral movement is impeded, and so a shallow water table is not shown on the Conceptual Site Model. Should there be any flow in the granular subsoils, this flow is expected to follow the topography to the south east."*

I have reviewed the site investigation undertaken in February-March 2012. I examined the borehole and trial pit logs, which indicates reasonably consistent ground conditions across the site, comprising topsoil of approximately 300mm underlain by upto 1.9m of varying grades of granular material, which is described as Alluvium on the GSI maps. Alluvium because it is deposited by rivers (in this case probably glacial outwash rivers), often tends to be haphazard in a lateral sense.

It is accepted that the four groundwater monitoring borehole logs (from the 2013 investigation) show no granular material. However it does appear anomalous that these four boreholes around the periphery of the site encountered no granular material, and the boreholes and trial pits excavated in the middle of the site as part of a previous investigation phase did. The possible reasons for this anomaly may be of glacial origin and therefore natural, or may be related to a variation in the drilling methodology deployed in each phase. I am recommending that further investigation is undertaken to

confirm the original findings. It is suggested that a geophysical survey would be the most appropriate approach to clarifying this anomaly.

I note that groundwater strikes were recorded in 8 out of 10 boreholes in 2012. In most cases no inflows were recorded, but the mode of drilling (Shell and Auger) can effectively seal out the water with casing, particularly when the granular interval is thin, thus giving the impression of no inflows.

I consider that because the method of drilling can quickly case out water, the trial pits give a better view of shallow groundwater conditions as follows

TRIAL PIT	GROUNDWATER OBSERVATIONS
S1	ROSE
S2	NONE
S3	STEADY INFLOW
1	SLIGHT SEEPAGE
2	STEADY INFLOW
3	NONE
4	NONE
5	STEADY INFLOW
6	NONE
7	STRUCK
8	STRUCK
9	SLOW TRICKLE
10	QUICK INFLOW
11	BASE OF PIT FILLED
12	NONE

I would suggest that these observations suggest some groundwater activity.

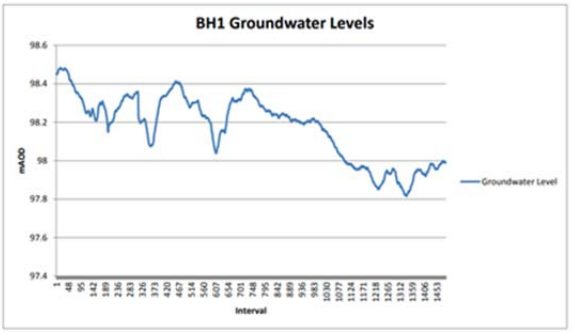
It is accepted that the borehole logs from 2013 indicate that no groundwater was encountered. However it is noted that February and March 2013, and indeed the same months in the previous year (2012) were dry months. I suspect that the Sands and Gravels on this site are actually quite free draining, and drain quite readily when there is little to no rain. The hydraulic controlling horizon is the stiff low permeability CLAY layer at 1.5m to 3m depth, which does not allow any vertical percolation.

I note the comments made by GSI in their review of the RTS presentation which highlighted the connection between the dry period and the lack of groundwater, but I suggest that conditions on this site comprise relatively free draining material close the surface, which is readily recharged by incident

rainfall, but drains away quickly. The mainly dry condition of the field on the day of my site visit, with only minor water logging supports this view.

It is noted that the site assessment undertaken by Traynor Environmental (2012) noted T values and P of 16 and 29 respectively, which indicates excellent percolation. However it is also noted that the soakaway tests did not indicate available infiltration capacity for soakaways.

The 2013 boreholes were fitted with standpipes to allow groundwater levels to be measured. It is stated in the EIAR report that the boreholes were fitted with data logger water level transducers. I examined the data in appendix 10.1 and I noted that the boreholes were instrumented for June and July 2013. Data for BH4 was not presented, but plots for boreholes 1-3 do seem to indicate some fluctuations in groundwater levels as shown below and in fact BH1 and BH2 display very similar patterns. I am surprised that no comment was made on this in the EIAR, although it does have more significance in the context of the hydrological system supporting the Tufa Springs than any significance in the overall impact assessment on drinking water supplies.



I therefore do not fully agree with the conclusion, that the Sands and Gravels on the site are not active in the groundwater sense because;

- The T and P tests indicate permeable deposits
- The groundwater monitoring undertaken indicates fluctuations in groundwater levels, albeit in the small range.
- The relatively dry topsoil layer suggests that incident rainfall does percolate into the sand and gravel layer

I expect that there will be a gradient towards the un-named watercourse to the north east, with some lateral movement to drains. I suspect that the groundwater throughput has some influence on the

tufa springs, and I have recommended that further work is undertaken on this to understand it better.

Despite this anomaly, my conclusion is that the sands and gravels on this site, are not substantially hydraulically connected with the Locally Important Sand and Gravel aquifer, for the following reasons.

1. The deposits are thin and underlain by an impermeable layer and
2. The perimeter drains and the permanent watercourse effectively intercept any flow.

The potential risk of impacts on groundwater resources beyond the site are therefore not considered significant, as a result of this lack of connectivity.

However I do feel that the groundwater from the site does have some influence/connection with the Tufa formations. Petrifying springs are lime-rich water sources that deposit tufa, a porous calcareous rock. They constitute a specialised habitat with a distinctive flora, typically dominated by bryophytes and often containing rare species. Their small extent and their vulnerability are recognised by their designation as a priority habitat in Annex I of the European Union Habitats Directive (92/43/EEC); whereby member states are obliged to monitor and report on the conservation status of such annexed habitats.

5. PETRIFYING SPRINGS-with TUFA FORMATION

The Tufa Springs were mentioned in the An Bord Pleanala Inspectors report which notes that an observer to the Oral hearing stated that a screening of these should have been undertaken in the context of the habitats directive on the basis of petrifying springs being designated a priority habitat under Annex 1 of the habitats directive. The Inspector did not agree with the argument and I fully concur with the conclusion of the Inspector, but nonetheless, I do feel that a more in depth assessment of the springs should be undertaken in the context that groundwater from the site, may have some influence on them as discussed above. This recommendation does not suggest any lacunae in the EIAR or NIS, that would have influenced the overall decision, but is a recommendation that ESB adopts an enhanced awareness of the connectivity of the site with a priory habitat.

Member states are required to monitor and report on the conservation status of such annexed habitats. An important stipulation within the habitats directive manual (Lyons and Kelly 2016) when

referring to Petrifying Springs is that " in order to preserve this habitat of very limited expanse in the field it is essential to preserve its surroundings and whole hydrological system concerned" . The presence of Tufa deposits in close proximity (along the watercourse that forms the northern boundary) to the site, and their dependence on the hydrological conditions on the site, suggests that there is a requirement to better understand the interrelationship between the site conditions and the deposits. The 2016 NPWS publication "monitoring guidelines for the protection of petrifying springs in Ireland" should be referred to for guidance.

6. PROPOSED CONSTRUCTION AND OPERATIONAL CONTROLS TO PROTECT GROUNDWATER AND SURFACE WATER

The proposed mitigation measures for dealing with potential impacts to groundwater and surface water are best international practice, provided they are adhered to and overseen and signed off by a competent person during construction.

One of the key concerns (expressed by the RTS group) relates to the storage and use of oil in the proposed transformers. I am satisfied that the proposed infrastructure and operational protocols afford the optimum security for the prevention of loss to the environment. No absolute guarantees can be provided that there will never be accidental loss of oil to the environment.

In the event of any environmental incident the ESB Networks Emergency Response Procedure will be activated.

For minor spillages that enter the drainage network, the oil water separator will provide an adequate mitigation control measure.

For other spillages, on the basis of the proposed site topography, it is expected the oil will be easy to control on the site, and an appropriate remediation strategy would involve recovery and disposal of any free product, and appropriate disposal of any oil contaminated soil, backed up by validation sampling and analysis.

If some oil were to run across the surface or become mobilised in the shallow groundwater, it will migrate towards the surrounding drainage ditches approximately 40m from the nearest proposed transformer, and ultimately the natural Stream and surface water network. Again, appropriate oil remediation strategies will limit any environmental damage. I am satisfied that any loss of oil on the site will not present a significant risk to the either the Bedrock or Sand and Gravel aquifers and as a result the proposed use of oil on the site, does not present a significant risk to any drinking water supplies.

Dewatering may be required for foundations, but inflows are expected to be manageable and will not create any lasting impacts.

7. CONCLUSIONS

- I am satisfied that the proposed development does not present a significant risk to drinking water sources in the area.
- I am satisfied that adequate controls have been proposed to mitigate any potential accidental spillages or discharges, and to ensure that the proposed site development does not present any on-going impacts.
- The substantial thickness of low permeability CLAY on the site eliminates any significant pathway developing to the bedrock aquifer, and hence the Kyle spring.
- The shallow depth of the sand and gravels on the site and the fact that they are effectively intercepted by drainage ditches, means they are not hydraulically connected to off-site sand and gravel deposits.
- The sands and gravels on this site cannot be considered an aquifer and are not considered to be more widely connected to the mapped Sand and Gravel Aquifer.
- I suspect the GSI will not include the site in the Locally Important Aquifer when they consider the boundary of the Timahoe-Stradbally Sand and Gravel Aquifer.
- I am not convinced that the lateral extent and hydraulic properties of the granular material above the CLAY is fully understood and I am therefore recommending further investigation to better understand the dynamics.
- The information from this investigation, should be reviewed by the site drainage designers to ensure full compatibility with the proposed design approach to surface water management.

- I consider that the petrifying springs-tufa deposits are not fully understood, in the context of their dependence on site hydrology and hydrogeology, and in the context that the Sands and Gravels on site may be more active than previously understood. This warrants further investigation.

8. RECOMMENDATIONS

1. I would recommend that a geophysical survey is undertaken using electromagnetic surveying (such as EM31) to map the subsurface shallow deposits to better understand the subsoil profile and to enhance the original ground model.
2. I would recommend that 5 No. shallow groundwater monitoring points are installed around the site at locations away from the proposed footprint. These can comprise simple standpipes installed in trial pits, or shallow drilled boreholes to maximum 3m depth away from the building footprint or any areas where accommodation works are planned. These should be levelled to a common datum, and groundwater levels measured every six hours using water level transducers. This monitoring period should extend over two seasons at least ideally from the Winter period into Spring until construction of the substation proper commences. This will help to better understand the groundwater hydraulics of the shallow deposits on the site and inform the further assessment of the Tufa Springs.
3. A round of groundwater samples should be taken from the shallow wells and analysed for Nitrate, Nitrite, Phosphorous, Ammonia, Chloride, Potassium and Sodium, Conductivity, pH. This will provide a baseline for any future monitoring. The wells should be sampled twice per year, for the same range of parameters. The tufa springs are very sensitive to nutrient loading, and this monitoring will provide information to assist in the protection of the habitat.
4. A more in depth ecological assessment of the tufa springs should be undertaken in the context of it being an Annex 1 habitat using the above data, and following the NPWS guidelines. This will enhance the understanding of the tufa springs and their connectivity to the site.
5. Once items 1-4 are completed I would recommend that the design of the stormwater management system be reviewed in the context of ensuring the existing hydrological system is optimised to support the tufa springs as required under the habitats directive.
6. Once drilled, groundwater quality from the proposed supply well should be monitored twice per year.