OH Doc No: 22

Rec'd From: Mr. Kevin Cullen

Date Rec'd: 15/3/08
10.05am.

Oral Hearing into Objections to the Granting of a Waste Licence to Fingal County Council in Respect of a facility at Fingal landfill, Nevitt, Lusk, County Dublin.

Waste Licence Application W 0231-01

Submission by: EurGeol Kevin Cullen PGeo.

Qualifications of Kevin Cullen

My name is Kevin Cullen. I have a B.Sc. (Hons.) degree in geology from University College Dublin and a Masters degree in Hydrogeology from Birmingham University. I hold the title of Professional Geologist from the Institute of Geologists of Ireland and the title of EurGeol from the European Federation of Geologists.

I have practiced as professional geologist in Ireland since 1971, firstly in mineral exploration and subsequently in hydrogeology and waste management.

Up to 2001 I was the managing director of K.T.Cullen & Co. Ltd. From 2001 to 2004 I was the director in charge of the White Young Green plc. environmental business unit in Ireland. I am self employed since 2004.

I have provided hydrogeological advice on the dewatering of mines and quarries located in Irish limestones and have contributed to EIS's associated with such projects.

I have also developed groundwater supplies for a range of industries including the mineral water, agri-industry, electronic, and leisure industries.

I have been responsible for the hydrogeological assessment of a number of landfill sites and have project managed the planning and licence applications for a variety of waste facilities. I have also attended as an expert witness at the An Bord Pleanala oral hearings for the Knockharley, Usk, Drehid, Bottlehill, Gortadrumma, Ballygûyroe and East Galway landfills.

I have been responsible for the identification and development of numerous public groundwater supplies throughout the country including those for Wexford Town, Enniscorthy, Gorey, Portlaoise, Ashbourne, Slane, Monaghan Town, Enfield, Roscommon Town, Kinvarra, The Cooley Peninsula, The Aran Islands, and Balbriggan

Background To Objection

I have been involved with the development of groundwater supplies in the Loughshinny Formation from the 1980's. Since then, the Loughshinny Formation has been shown to constitute an important groundwater resource as demonstrated by the Bog of the Ring well field and other public water abstractions such at Ashbourne, Dunshaughlin and Kilmessan. Numerous high yielding wells have been located in these rocks across north Dublin and south Meath from Loughshinny in the east to Dunshaughlin in the west and over the full outcrop of the Loughshinny Formation.

Individual well yields from 1,000 to 4,000m^3/day have been recorded from the Loughshinny Formation. For example, the combined output from the 4 production wells that make up the Bog the Ring well field is reported as 4,000m^3/day. I arranged for the testing of a single well at Trim which had a yield of 4,000m^3/day. It is possible given the high degree of faulting reported by the Applicant from the Nevitt area that a similarly very high yielding well could be located on or beside the proposed landfill site, even possibly at the Applicants P2 site as shown on Figure 2 of the May 2007 submission.

The Loughshinny, Naul and part of the Lucan Formations together make up the only recognized important bedrock aquifer in County Dublin. The groundwater productivity of these formations is attributed to faulting as they do not have any primary permeability. Where faulting is absent these formations have reduced groundwater potential. The capacity of the bedrock aquifer is also greatly enhanced when the bedrock aquifer is overlain by sand and gravel deposits.

It appears to me that the geological and hydrogeological information described in the EIS for the Nevitt landfill clearly indicates that a significant groundwater resource is located beneath the landfill footprint and also within the wider study area covered by the Applicants' investigations.

The Applicant has accepted (page 15 of its January '07 Response to 3rd Party Submissions) that the objective of the investigations carried out as part of the landfill study was not to establish the extent of groundwater resources but rather to examine the possible pathways for any leachate migrating from the footprint. The Applicant has also accepted that wells similar to those completed at the Bog of the Ring would have been required to investigate the groundwater resources beneath the landfill and surrounding study area. Accordingly, the investigations carried out by the Applicant did not, nor were they intended, according to the Applicant, to establish the full extent of the groundwater resources beneath the Nevitt area.

Furthermore, as the Applicant has stressed on numerous occasions to the Agency that it has no plans to develop a further groundwater resource in this part of Fingal. Clearly then it can be assumed that the Applicant had no interest in or reason to establish the full potential of the groundwater resources beneath the footprint in or in the area generally.

The Agency requested the Applicant to submit a numerical modeling exercise to establish the resource potential and associated zone of contribution of a well filed located to the east of the landfill footprint. Such a model would have, if properly constructed and calibrated, indicated to the Agency the likely full potential of the groundwater resources in this part of Fingal in general and beneath the landfill footprint in particular.

The Applicant did not carryout the requested numerical modeling exercise and the absence of the numerical model has prevented any assessment or determination by the Agency of the full potential of the groundwater resources at the Nevitt site.

The resource model requested of the Applicant to investigate a well field to the east of the footprint would have included for the distribution of transmissivity values over the full depth of the bedrock aquifer and the overlying sand and gravel aquifer over the Tooman / Nevitt area, including the footprint. The subsequent calibration exercise would have indicated whether transmissivity values lower than, equal to or greater than those found at the Bog of the Ring were required to properly model and reproduce the base line conditions recorded by the Aplicant. This exercise would therefore, had it been carried out, would have established the groundwater potential of the bedrock and gravel aquifers that exist below the footprint by attributing appropriate transmissivity values to the gravel and bedrock aquifers beneath the development site.

While undoubtedly the series of deeper wells mentioned by the Applicant (page 15 of Jan. '07 Submission) would provide additional information the model would have provided an initial indication to the Agency as to the likely groundwater potential of the Nevitt site. In the event that any uncertainty remained after the initial calibration exercise a series of deeper wells could then be installed and targeted to provide a fuller understanding of the distribution of the transmissivity values throughout the bedrock aquifer beneath and around the development site.

In the absence of the requested model the Agency has , in my opinion, insufficient information on which to determine the full groundwater potential of the bedrock aquifer that underlies the Nevitt site. Therefore the Agency has no knowledge at to the capacity of the groundwater resource that it seeks to sterilize by licensing the landfill. That resource could be similar to that established at the Bog of the Ring or many times larger if the conditions at Nevitt reflect those found in the same Loughshinny Formation at Trim.

It appears to me that as the geological and hydrogeological conditions found at Nevitt are exactly the same as those found at the nearby Bog of the Ring abstraction that a groundwater resource of similar, if not greater, capacity lies beneath the site landfill. My contention as to the groundwater potential beneath the Nevitt site has not, as far as I aware, been contested by either the Applicant, the GIS or the Agency.

It is also my opinion that a similar significant groundwater resource will not be readily available elsewhere in the Fingal area as the groundwater potential beneath the Nevitt site relies on and reflects the high degree faulting found in the limestone bedrock underlying this area. Such favorable bedrock conditions together with the overlying sand and gravel deposits have yet, as far as I am aware, to be identified by the Applicant from another area.

I also respectfully suggest that the Agency could not have made an accurate hydrogeological assessment of the hydrogeological conditions on and in the environs of the development site based on the drawings and section contained in the EIS and later submitted to the Agency by the Applicant in December '06, January '07 and May '07 some of which are now accepted to be factually incorrect.

I wish therefore to object to this development on the following grounds and those outlined in my submissions to the Agency;

A. The proposed landfill is to be located above a proven and significant groundwater resource;

Hydrogeological investigations carried out by the Applicant at and in the environs of the proposed landfill have established that a significant groundwater resource exists beneath the footprint of the proposed landfill. The available data, which includes pumping tests, indicates that a groundwater supply similar in quantity to that developed at the nearby Bog of the Ring abstraction is available beneath the footprint of the proposed landfill.

The groundwater resource beneath the landfill footprint is contained within both the limestone bedrock and the overlying Nevitt Gravel Aquifer the general outline of which is shown on the attached map (Figure 1) and which accompanied my submission to the Agency dated 7th Nov., 2006.

The existence of the gravel aquifer overlying the limestone bedrock aquifer is first identified by the Applicant on page 35 of the EIS and more recently in Dr. Kelly's latter dated 17-1-'08 to the Chairman of the Committee on Petitions of the European Parliament.

The location of the landfill immediately above this proven groundwater resource will prevent its use in the future as highlighted by in the Inspector's report at page 25.

B. The Applicant failed to quantify the magnitude of the groundwater resource identified beneath the landfill footprint;

The EIS is silent on the magnitude of the groundwater resource located beneath the landfill footprint but which has been clearly identified by the Applicants' investigations.

The Conceptual Site Model which is presented in the EIS (Fig. 9 of Vol. 5) underestimates the magnitude of the of groundwater resource identified beneath the landfill footprint by failing to record the;

- extent of the fault controlled bedrock trough located beneath the landfill footprint
- extent of the gravel aquifer overlying the bedrock
- the high degree of faulting recorded by the geophysical survey
- dramatic change in the piezometric surface known to exist along the south western edge of the landfill

A draft conceptual model accompanies this submission as Figure 2.

Map 21.1 submitted to the Agency in Dec. '06 and subsequently amended and lodged at this Hearing fails to identify the full thickness of the Nevitt Gravel Aquifer that underlies the development site.

Map 21.5 submitted to the Agency in Dec.'06 fails to incorporate the results of the geophysical investigation and so underestimates the extent of the fault bounded bedrock trough.

Cross – Section A-A & B-B submitted to the Agency in January '07 fails to reflect the geological information contained in Maps 21.1 and 21.5 submitted earlier to the Agency in Dec.'06 and so completely mis-represents the proven depth and extent of both the fault bounded bedrock trough and the related gravel aquifer beneath the site.

Dr. Sleeman of the Geological Survey of Ireland (GSI) has indicated that as a matter of probability the entire foot print of the proposed landfill is underlain by the productive Loughshinny Formation. The Applicant failed to incorporate this information into its submissions to the Agency of Dec. '06 and Jan. '07.

The Applicant was incorrect to advise the Agency that the GSI classification of a locally important gravel aquifer required a thickness of 10m over an area of 1km2 and that such a gravel aquifer did not occur at Nevitt. The GSI classification for a locally important aquifer in fact only requires 5m of saturated gravel over 1km2 and this situation does exist at Nevitt.

The failure of the Applicant to properly describe the extent of the Nevitt Gravel Aquifer both within the EIS and its later submissions so mis-informed the Inspector's view of the this resource that the Inspector refers to it is only as a 'gravel layer'(page 11) in the Inspector's report.

In fact, as far as I am aware, the Inspector did not comment in his report on the groundwater resource identified by the Applicant beneath the landfill footprint.

C. Failure of the Applicant to Fully Report on the Residual Impact / Effects of the Landfill on the Groundwater Source Identified by the Applicant Beneath the Landfill Footprint;

The EIS on page 52 of Vol. 5 reports that 'No significant residual impact on the geology and hydrogeology is anticipated as a result of development of this scheme.' The same conclusion is presented in the original Non Technical Summary and is reproduced in the most recent amended version of the Non Technical Summary.

This assertion is now clearly at variance with the EPA Inspector's conclusion that the development of the landfill will prevent the exploitation of the groundwater sources that are located beneath the landfill footprint itself and along the area immediately to the east of the footprint.

Therefore, there will be a very significant **Residual Impact / Effect** on the groundwater resources of the region.

D. The development of the landfill at this location is contrary to the national guidelines on groundwater protection;

The DELG/EPA/GSI publication on Groundwater Protection Schemes of 1999 is generally accepted as the national policy on groundwater protection. This publication *'provides guidelines for the planning and licensing authorities in carrying out their functions, and a framework to assist in decision-making on the location, nature and control of developments and activities in order to protect groundwater. Use of a scheme will help to ensure that within the planning and licensing processes due regard is taken of the need to maintain the beneficial use of groundwater.'*

It is evident from the investigations carried out by the Applicant that a significant source of groundwater exists beneath the landfill footprint, most likely of a similar nature to that being exploited at the Bog of the Ring groundwater abstraction. In this situation, the groundwater protection measures and responses relating to groundwater sources should be considered, not simply those relating to Resource Protection Zones.

The DELG/EPA/GSI guidelines on groundwater protection deem that a landfill development is **Unacceptable** i.e. Response R^4,where the landfill falls within the 100-day Time of Travel (TOT) Zone of a groundwater source but is acceptable under certain conditions where the landfill falls outside the TOT Zone but within the Zone of Contribution of the well or well field (ZOC).

Clearly the landfill falls within both the TOT Zone and ZOC of wells located within the footprint to develop the groundwater resource identified by the Applicant. Under the DELG/EPA/GSI guidelines the development of the landfill here would also be **Unacceptable** i.e. Response R^4.

The EPA Inspector has accepted that the landfill will fall within the TOT Zone and ZOC of wells located to the east of the proposed landfill to develop the groundwater source identified here by the Applicant. Again in this situation under the DELG/EPA/GSI guidelines the development of the landfill here would be **Unacceptable** i.e. Response R^4.

The Applicant has indicated that a groundwater resource could be developed to the south of the landfill. This might be possible under the DELG/EPA/GSI groundwater guidelines where the landfill falls outside the 100 day TOT Zone. However, as the landfill here will fall within the ZOC of the Applicants' proposed wells the development could only proceed if it also meets the additional conditions outlined by the DELG/EPA/GSI guidelines.

The purpose of the GSI guidelines is to protect groundwater. This is achieved by ensuring that no landfill is located within the 100 day travel time of groundwater source, and that a landfill is only located within the zone of contribution of such a source where certain strict conditions are met. In circumstances where a known resource has been identified, and is capable of being exploited, it would defeat the purpose of the GSI guidelines to permit a landfill to be located such as to 'sterilise' this resource.

E. The development of the landfill at this location is contrary to the EPA guidelines on landfill site selection;

Under Section 2.2 of the December 2006 EPA Draft Manual on Site Selection guidance on how the principle of sustainability is best incorporated into the screening criteria;

'2.2 Sustainable Development

Sustainable development in landfill requires that we do not allow the landfill practices of this generation to adversely affect the quality of life of the next generation. This can be achieved by, inter alia:-

avoidance of areas of significant natural resource quality in terms of usable groundwater, national monuments and significant ecological areas;'

In is particularly noteworthy that the Agency has introduced the more onerous screening criteria of **'usable groundwater'** rather than the much less restrictive exclusionary criteria of **regional aquifers**. This change reflects the requirement to incorporate the principle of Sustainability into the planning and licensing processes.

In my view, based on the information submitted by the Applicant, the groundwater resource affected by this proposed development is without doubt a significant natural resource of usable groundwater within the meaning of the EPA guidelines. I would therefore respectively suggest that the location of the proposed landfill within the most productive bedrock/gravel aquifer in the whole of County Dublin and immediately overlying a proven groundwater resource does not comply with the current EPA guidance on landfill site selection.

It is of particular note that the Inspector's report, as far as I am aware, does not indicate whether the Applicant's proposal was evaluated by the Agency against the EPA's Manual on Landfill Site Selection.

It is also noted that according to Dr. Kelly's letter on page 2 that the proposal was evaluated against, inter alia:-

' The national technical standards guidance landfill engineering (Landfill Manuals – e.g., Landfill Site Design, landfill Site Investigation):' Unfortunately Dr. Kelly fails to mention whether the application was also evaluated against the EPA Manual on Site Selection.

F. The development of the landfill at this location is contrary to the concept of Sustainability;

According to the Department of Environment and Local Government;
'Sustainable Development is usually defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

It is obvious, and the EPA Inspector has acknowledged so, that the location of the landfill will prevent forever the development of the significant source of groundwater that lies beneath the landfill footprint and beneath the lands to the east of the footprint.

It is difficult to understand how the development of this landfill could be seen as any thing other than contrary to the concept of sustainability. Locating the landfill on top of this significant source of groundwater will obviously deny this source of water to future generations. The Inspector concluded so on page 25 of his report;

'effectively prevent the development of an additional abstraction system directly to the east as detailed above, purely based on the precautionary principle.'

The current water policy of the Applicant cannot possibly be used as any justification for locating the landfill above a source of groundwater than may be required by future generations. The concept of sustainability is intended to guard against decision-making based on such a short-term view.

The Inspector's report concluded erroneously on page 25 of his report that consideration of sustainable development, which is a primary pillar of sustainability, is not directly within the remit of the Agency as regards licensing of waste management facilities.

On the contrary, the Agency is required under Part III of the Environmental Protection Agency Act 1992 to 2003, to have regard to sustainable development. Section 52(2) of the 1992 Act provides as follows:
52.—(2) In carrying out its functions, the Agency shall—
(a) keep itself informed of the policies and objectives of public authorities whose functions have, or may have, a bearing on matters with which the Agency is concerned,
(b) have regard to the need for a high standard of environmental protection and the need to promote *<u>sustainable and environmentally sound development</u>, processes or operations,*
<u>(emphasis added)</u>

G. The development of the landfill at this location is in breach of the Water Framework Directive

The development of the landfill at this location will result in a deterioration of the groundwater resource beneath the footprint and is therefore unsustainable and contrary to Ireland's obligations under the Water Framework Directive.[1]

The Inspector's report concluded on page 25 that the development of the landfill at this location will;

'effectively prevent the development of an additional abstraction system directly to the east as detailed above, purely based on the precautionary principle.'

---

[1] Directive 2000/60/EC.

Article 1

Pursuant to Article 1, the purpose of the Water Framework Directive is to establish a framework for the protection of, *inter alia*, groundwater. The purpose of this framework is to:
prevent further deterioration and protect and enhance the status of aquatic ecosystems;
promote sustainable water use;
aim at enhanced protection and improvement of the aquatic environment;
ensure the progressive reduction of pollution of groundwater and prevent its further pollution; and
contribute to mitigating the effects of floods and droughts.

Thus, as an emanation of the State, the Agency is charged under the Water Framework Directive with the obligation to ensure that no deterioration takes place in the status of a groundwater body. Yet, notwithstanding, the obligations placed upon Ireland by the Water Framework Directive, the Inspector accepted that the development of an abstraction scheme akin to that at the Bog of the Ring would be affected by the proposed development, effectively preventing it.

In addition, to authorize a landfill to operate, in circumstances where the use of a major groundwater resource in the future is prevented, does not promote sustainable water use.

Article 4(1)(b)

Article 4(1)(b) of the Water Framework Directive sets a number of objectives for Member States specifically in relation to groundwater. For example, Member States shall;
implement the necessary measures to prevent or limit the input of pollutants into groundwater and prevent the deterioration of the status of all bodies of groundwater,
protect, enhance and restore all bodies of groundwater, ensure a balance between abstraction and recharge of groundwater, with the aim of achieving "good groundwater status" by 22 December 2015, in accordance with Annex V,
implement the necessary measures to reverse any significant and sustained upward trend in the concentration of any pollutant resulting from human activity.

Sterilizing a significant groundwater resource would hardly qualify as protecting a groundwater body.

It is significant that the Water Framework Directive entered into force on 22nd December 2001. In addition, article 3 of the European Communities (Water Policy) Regulations 2003 places a duty on public authorities (which definition expressly includes the Agency) to implement the Directive. Moreover, those 2003 Regulations specifically oblige those authorities to act consistently with the objectives of the Directive and to promote compliance with it. Finally, the Water Services Act 2007 (signed into law on 14th May 2007) was enacted for the purposes, *inter alia*, of giving effect to the Water Framework Directive.

H. The EPA did not receive the numerical model requested by the Inspector as part of the waste licensing process and which was deemed necessary in order to assess the application

The Inspector requested the Applicant to undertake a numerical modeling study to investigate the relationship between additional groundwater abstractions to the east of the landfill footprint on, among other issues, the impact on groundwater flows at the proposed landfill site.

In particular, as reported in the Inspector's report on page 25, the Applicant had been requested to carryout an evaluation to determine the ZOC for a proposed additional well field to the east of the landfill. The information was requested pursuant to Article 14 of the Waste Management (Licensing) Regulations 2004, and accordingly was considered necessary for compliance with those Regulations.

The benefit and output from the requested modeling exercise has been detailed in the **Background to the Objection** above.

The information provided by the numerical model would have indicated to the Inspector that the proposed landfill would fall within the 100-day TOT Zone of the groundwater source located south of Decoy Bridge and identified by the GSI. In this situation the landfill would be **Unacceptable** according to the DELG/EPA/GSI Groundwater Protection Schemes. In other words, the landfill development would be contrary to the Agency's own guidelines **i.e Unacceptable** and would automatically therefore be refused.

The output from the numerical model would also have indicated to the Inspector that the landfill would fall within the ZOC and potentially the 100-day TOT Zone associated with the source of groundwater identified by the Applicant (but as yet unproven) to the south of the landfill. In these circumstances the landfill might be **Acceptable** under certain conditions but **Unacceptable** in the event that it fell within the 100 day TOT Zone.

Furthermore, it would appear that the current EPA guidance on landfill site selection would recommend avoidance of this potentially usable source of groundwater identified by the Applicant.

The suggestion by the Applicant that an alternative groundwater source could be developed to the south of the landfill fails to recognize that;

no groundwater source has been identified in this area and much more importantly
it is proposed to locate half of the of the proposed pumping wells in an area of significantly reduced groundwater potential, as described in Section 3.4.1.2 of the EIS.

It makes little sense to sacrifice or sterilize a proven and significant groundwater source for as yet to be investigated well field half of which is to be located in a lower category aquifer.

The conceptual model presented in the EIS does not include many important geological and hydrogeological features found on the proposed development site and adjoining areas. The Draft conceptual model accompanying this submission (Figure 2) should, it is respectively suggested, now form the basis of the numerical model that was and still is required to establish the magnitude of the groundwater resource at Nevitt together with the full range of impacts associated with the development of a landfill at this location.

The unexplained failure by the Agency to secure the modeling and the information which it had requested is of significant concern. Had the modelling been conducted, it would have disclosed the extent of the resource at the application site, and would have required the Applicant to disclose the assumptions upon which they had casually decided to discard this resource. The failure by the Agency, thus far, to elicit the information from the Applicant which it considered necessary to ensure compliance with the Waste Management (Licensing) Regulations 2004 must be remedied before a final decision on this application can be reached

I. Some of the additional hydrogeological information supplied to the Agency by the Applicant is at variance with the geological and hydrogeological information provided in the EIS and supporting Technical Appendices. My concern would be that the Inspector may have relied upon this additional information as a substitute for the earlier requested numerical model.

In response to requests from the Inspector, the Applicant provided maps showing contours of the bedrock surface and gravel aquifer thickness together with an East-West cross section through the landfill footprint.

Firstly, the submitted drawings do not reflect or concur with the data and geological descriptions contained in the EIS and together give a false impression as to the proven extent and thickness of the Nevitt gravel aquifer.

Secondly, the maps presented to the Agency differ in some important aspects from similar maps presented to An Bord Pleanala (ABP) in October 2006. Having different versions of the same drawings being presented to the two regulatory agencies is somewhat disconcerting.

Applicant Drawing	EIS	ABP Oral Hearing	EPA Submissions	EPA Oral Hearing
Geological Cross Section	Version 1 (Appendix A1.1)	Version 2 dated April '06	Version 2 dated April '06	Version 2 dated April '06
Map of Bedrock Surface	None	Version 1presented Oct '06	Version 2 (no data points) dated Dec '06	Version 3 (with additional data points and measurements) dated March '08
Thickness of Gravel Map	None	Version 1presented Oct. '06	Version 2 (new measurements, re-contoured, without caption) dated Dec '06	Version 3 (new data point, re-contoured, with caption) dated March '08

i) Map of Bedrock Surface

The map presented to the Agency in the Dec '06 submission differs from that presented to the ABP Oral Hearing in that that the data points on which the earlier map was presumably based have been removed from the copy submitted to the Agency.

The map of the bedrock surface fails to incorporate the information from Boreholes SHR3 and HR 9 where the bedrock is known to be deeper than 17.7m and 8.5m AOD respectively. Also, the map of the bedrock surface contours presented to the Agency is not consistent with the depth to rock contours provided with the Final Geophysical Report that accompanied Volume 5 of the EIS.

The failure to use the output of the geophysical surveys in areas of little or no borehole information is a particular omission and therefore renders the Applicants' map of limited value.

The exclusion of the above data in the Applicants' map of the bedrock surface masks the extent and importance of the deep and continuous bedrock trough that is known to pass beneath the site. In doing so the map diminishes the extent of the Nevitt gravel aquifer identified by the different drilling programmes carried out by the Applicant.

An alternative map (Figure 3) of the bedrock surface is presented with this submission.

ii) Map of Gravel Aquifer Thickness

The map presented to the Agency in the Dec '06 submission differs from a similar map submitted to thr ABP Oral Hearing in that the cautionary comment ;

' Not all boreholes will have reached the base of the Gravel due to refusal.'

which appeared on the map presented to ABP does not appear on the map submitted to the Agency.

The absence of this cautionary comment suggests that the map submitted to the Agency represents the actual thickness of the gravel aquifer over the study area. This is clearly not the case.

The contours of gravel thickness on this map have been incorrectly drawn as a around a **third** of the **c.60** data points used in the construction of the map did not penetrate the full thickness of the gravel aquifer at those drilling locations.

In the absence of the cautionary comment, the note on the map that 'Number below borehole position indicates the thickness of gravel (m) at this location' is, I suggest, incorrect and potentially misleading.

Furthermore the replacement of the data point for borehole AGB 4 (3.8m on the ABP map) presumably with the result from borehole ASA 3 suggests that no gravel was encountered at this point below the landfill footprint. Borehole ASA 3 did not reach bedrock nor did it extend below the base of the clay layer finishing at a depth of 26.6m AOD. The bedrock at this location is projected to be around 20mAOD.

The inclusion of the erroneous **0m** thickness for the gravel aquifer at AGB 4 in the contouring process greatly underestimates the extent and thickness of the gravel aquifer at this location.

An alternative map (Figure 4) of the thickness of the Nevitt gravel aquifer accompanies this submission.

It appears that the contours of bedrock surface and gravel aquifer thickness presented by the Applicant were generated by a computer contouring package. It appears to me that the contouring package could not easily accommodate data points where the correct values (particularly gravel aquifer thicknesses) were actually greater than those recorded. It appears that the reduced values of gravel aquifer thickness were used rather than the corrected thicknesses which would easily have been derived from an inspection of the projected depth to bedrock and the recorded base of the clay horizon at each drilling location.

For example, at Borehole GS 16, the thickness of the Nevitt gravel aquifer is quoted as 2.6m on the Applicants' map while a figure of 12m would reflect the elevation of the bedrock surface and the base of the clay layer here at this location as given in the Applicants' map of the bedrock surface and the log for the borehole respectively. An identical situation is to be found at Borehole GS 10 where the depth of gravel is underestimated by the Applicants' drawing.

It would be fair to say that the underestimation of the thickness of the Nevitt gravel aquifer by some 10m along the GSI fault zone could give the Agency a reduced appreciation as to the groundwater potential of the gravel aquifer.

The use of the contouring package has also resulted in a false bedrock ridge to the north of the landfill where the geophysics record a continuation of the bedrock trough. Similarly the computer generated contours suggest that the gravel aquifer thins out completely to the south of the footprint, a picture which is contradicted by the drill hole logs from this area.

iii) Cross Section

It is a matter of record that following a direct request from the Applicant and before the Applicant was questioned by me on the Applicants' evidence relating to geology and hydrogeology at this hearing that I did indicate to the Applicant that the revised cross section submitted to the Agency in Jan. '07 did not, in my opinion, correlate with the information contained in the map of the bedrock surface and the thickness of gravel map. Furthermore, I did indicate that I had recently determined that a bedrock outcrop close to Borehole HR 10 was not recorded on the revised cross section and that this information was important regarding a significant part of the cross section. It is a matter of record that the Applicant chose to ignore this information and proceeded to assure the Hearing that the revised cross section was an accurate reflection of the geology and hydrogeology of the Nevitt site. It such circumstances, an alternative cross-section B-B (Figure 5) accompanies this submission which more accurately reflects the geological and hydrogeological information provided by the Applicant along this line of section within the EIS and in submissions made to the Agency.

The revised cross-section submitted by the Applicant to the Agency does not correlate with either the data presented in the EIS or the additional plan maps provided by the Applicant to the Agency.

The Hearing has been informed by the Applicant that the Cross Section submitted by the Applicant in its Jan.'07 submission was produced in Oct.'06 and predated both the bedrock and gravel thickness maps which were produced in Dec.'06. In this case the cross section could not possibly reflect the geological information contained on these plan maps and accordingly bears to relationship to them.

For example, it is obvious from the logs of Boreholes HR 9 and 11A that a substantial thickness of gravel occurs over the GSI fault zone along the B-B section. However, the revised cross section shows **no** gravel at this location and so the revised cross section submitted to the Agency presents a picture with a severely diminished extent and thickness of the gravel Nevitt gravel aquifer along this line of section.

The Applicants' map of the extent of the thickness of the gravel aquifer shows extensive gravel along the line the GSI fault but this picture is not shown by the Applicant's revised cross section.

The groundwater contours presented by the Applicant display a significant change in gradient immediately to the west of the footprint. This important feature is not represented on the revised cross section supplied by the Applicant.

The cross section accompanying this submission endeavors to reflect all the geological and hydrogeological information provided by the Applicant. Of particular note is the coincidence of the steep change in the bedrock piezometric surface with the western edge of the footprint. It is obvious that the change in gradient is associated with the gravel filled and fault controlled bedrock trough underlying the footprint with the change in gradient reflecting the higher permeability conditions that occur beneath the footprint.

As mentioned above the accompanying cross section shows how bedrock outcrops immediately to the east of Borehole HR 10 and which is not represented on the Applicants' cross section. This outcrop is part of a wider area of outcrop clearly shown on the GSI Sheet 16 for the area and which correlates well with the Soils Map of the area that accompanies the EIS as Figure 6 in Volume 5. The presence of rock here invalidates the Applicants suggestion that a thick layer of clay is to be found overlying the bedrock to the east of Borehole HR 10.

A north-south section(Figure 6) through the landfill accompanies this submission showing the continuous nature of the Nevitt gravel aquifer along the line of the section.

iv) Map of the Alternative Well Field South of Decoy Bridge

The Applicant, without any request from the Agency to do so, proffered to the Agency a possible groundwater abstraction to the south of Nevitt as an alternative to the one that would be lost at the landfill site.

The map presented to the Agency indicating the location of the Applicants' proposed alternative well field to the south of Decoy Bridge shows only fault lines which are taken from the GSI Sheet 13.

This is unfortunate, as had geological formation boundaries been shown together with the proposed well locations it would have been obvious to both the Applicant and the Agency that at least 2 if not 3 of the Applicants' proposed pumping wells in the alternative well field are be located in that part of the Lucan Formation which is much less productive than the Loughshinny and Lucan Formations found at Nevitt. The extent of this lower category bedrock aquifer is described at page 19 Volume 5 of the EIS and indicated on the accompanying Figure 7.

I respectively suggest that the Agency might review its confidence in the Applicants' alternative well field in light of this information and which was not indicated to the Agency by the Applicant in its May 2007 submission.

Furthermore, the Inspector was incorrect to conclude on Page 11 of the Inspector's Report that;

'It is also noted that the development of the landfill would not preclude the development of wells further to the south or east which would be unlikely to include the landfill within their Zone of Contribution'

As clearly demonstrated on the accompanying Figure 7 the landfill lies within the Zone of Contribution of the Applicants' wells located to the south.

It would appear that the Inspector mis-interpreted the Zone of Influence shown on the Applicants' map as being equivalent to their Zone of Contribution. This mis-interpretation is significant as the Zone of Contribution around a groundwater source underpins the entirety of the source protection element of the national Groundwater Protection Schemes.

Figure 2 Draft Conceptual Hydrogeological Model

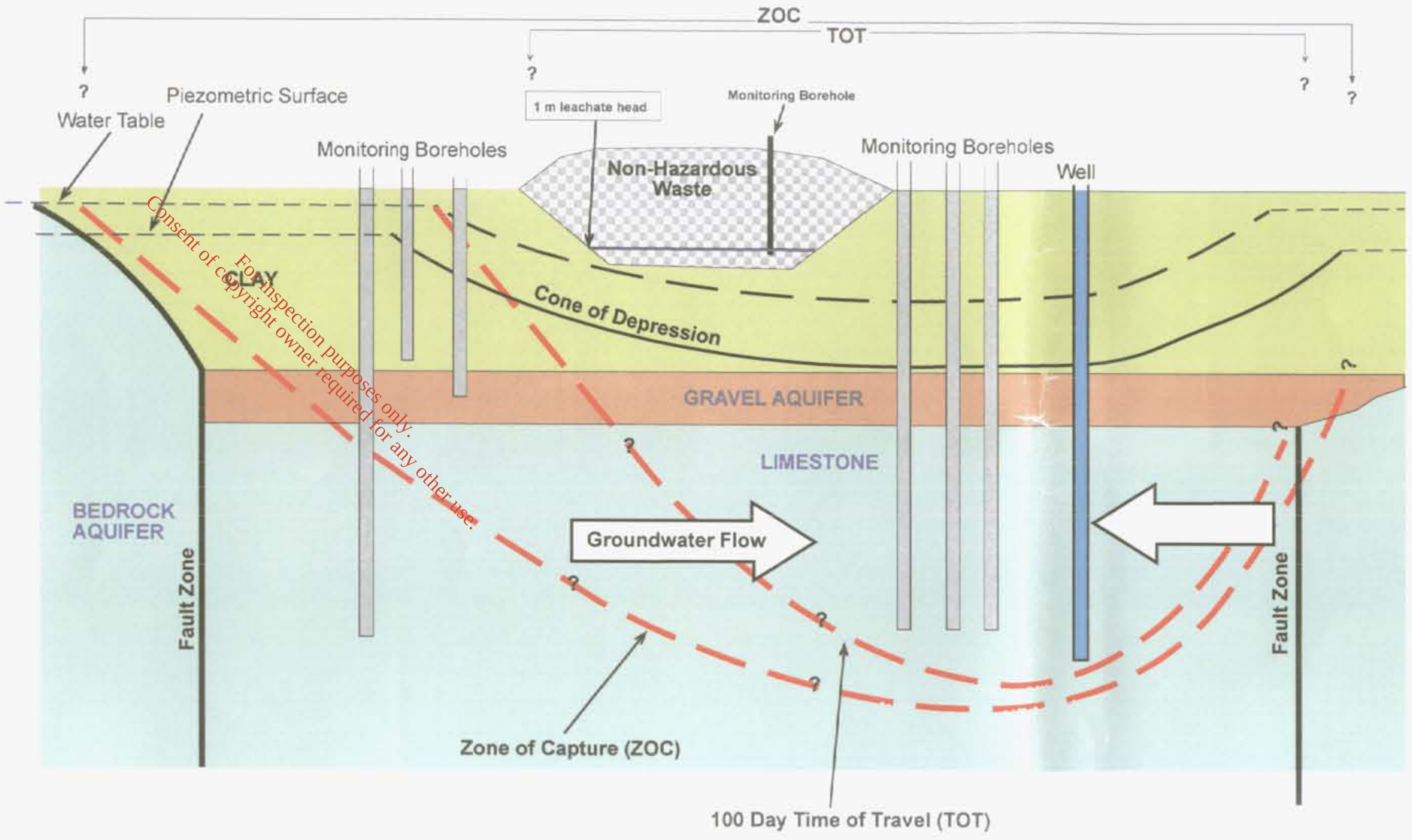


Figure 3 Bedrock Surface Contours

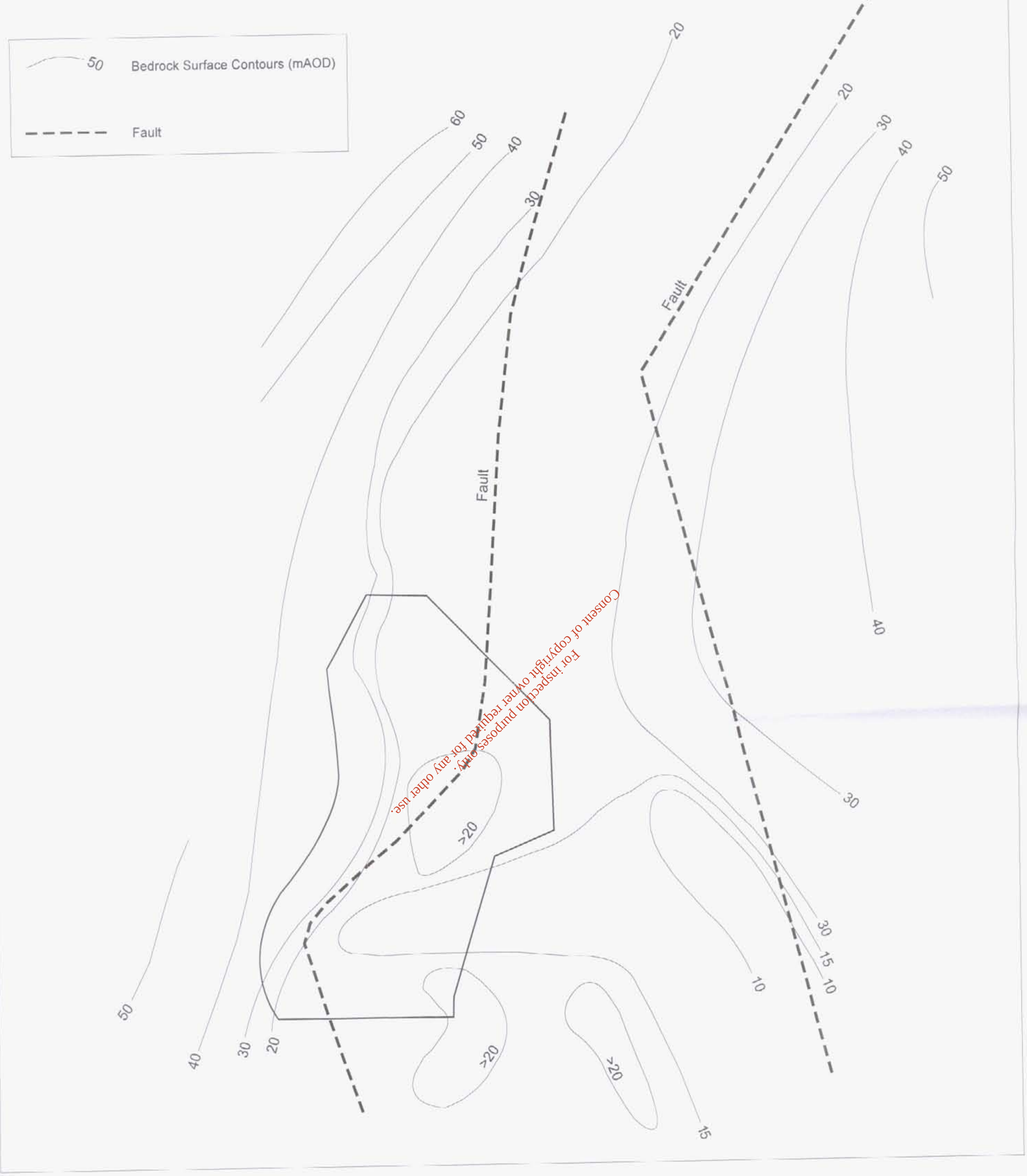
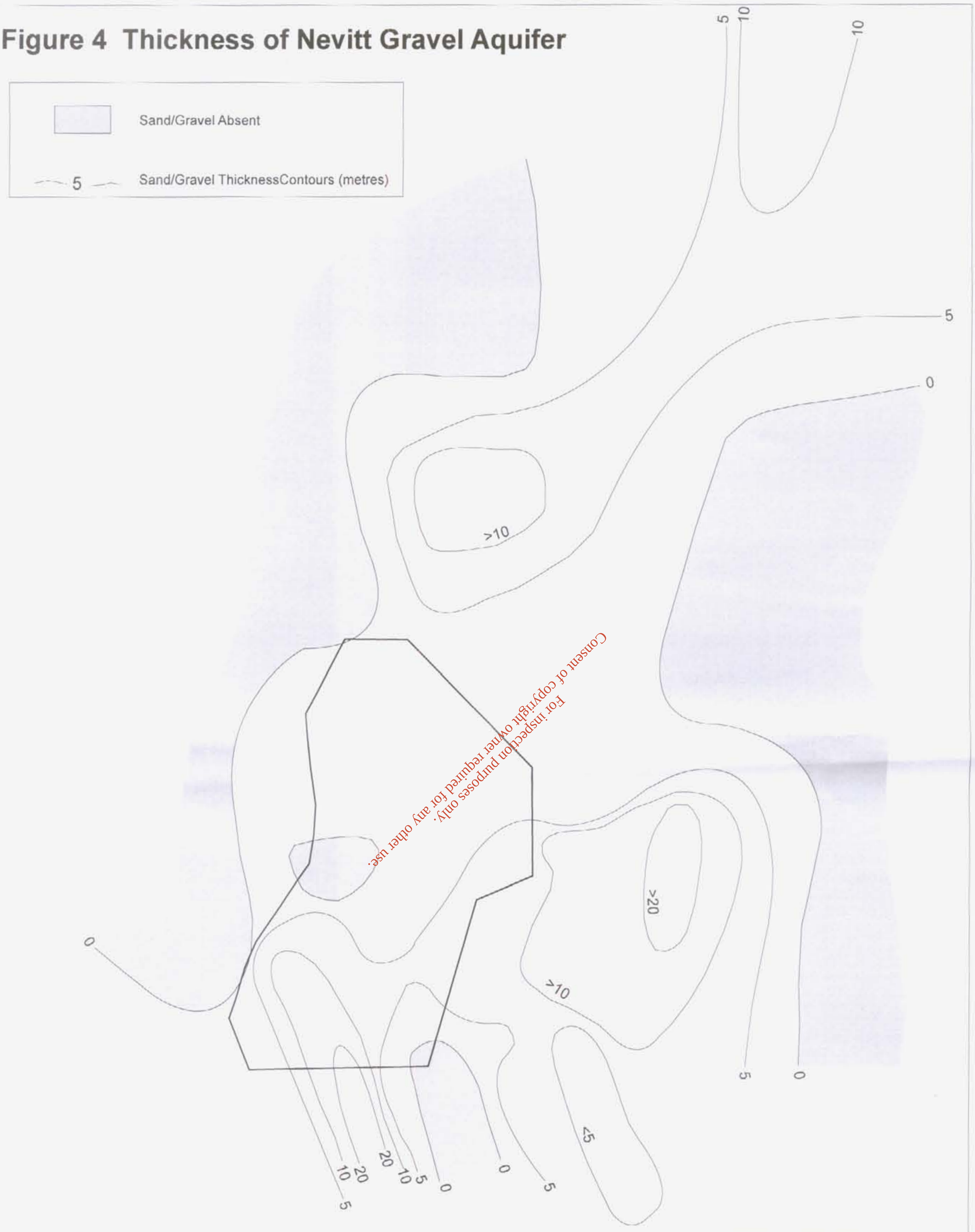


Figure 4 Thickness of Nevitt Gravel Aquifer



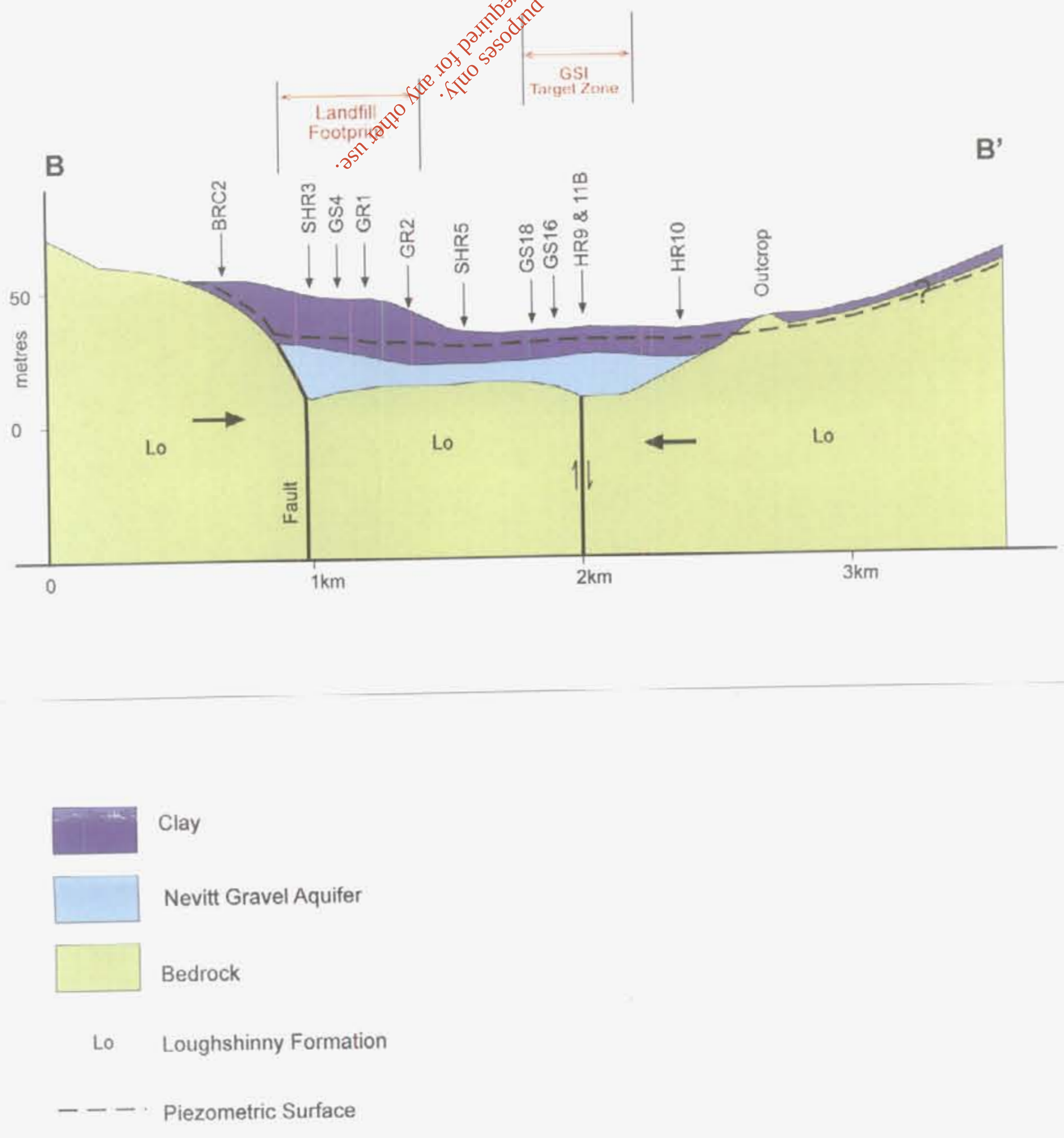


Figure 5 Cross-Section B-B'

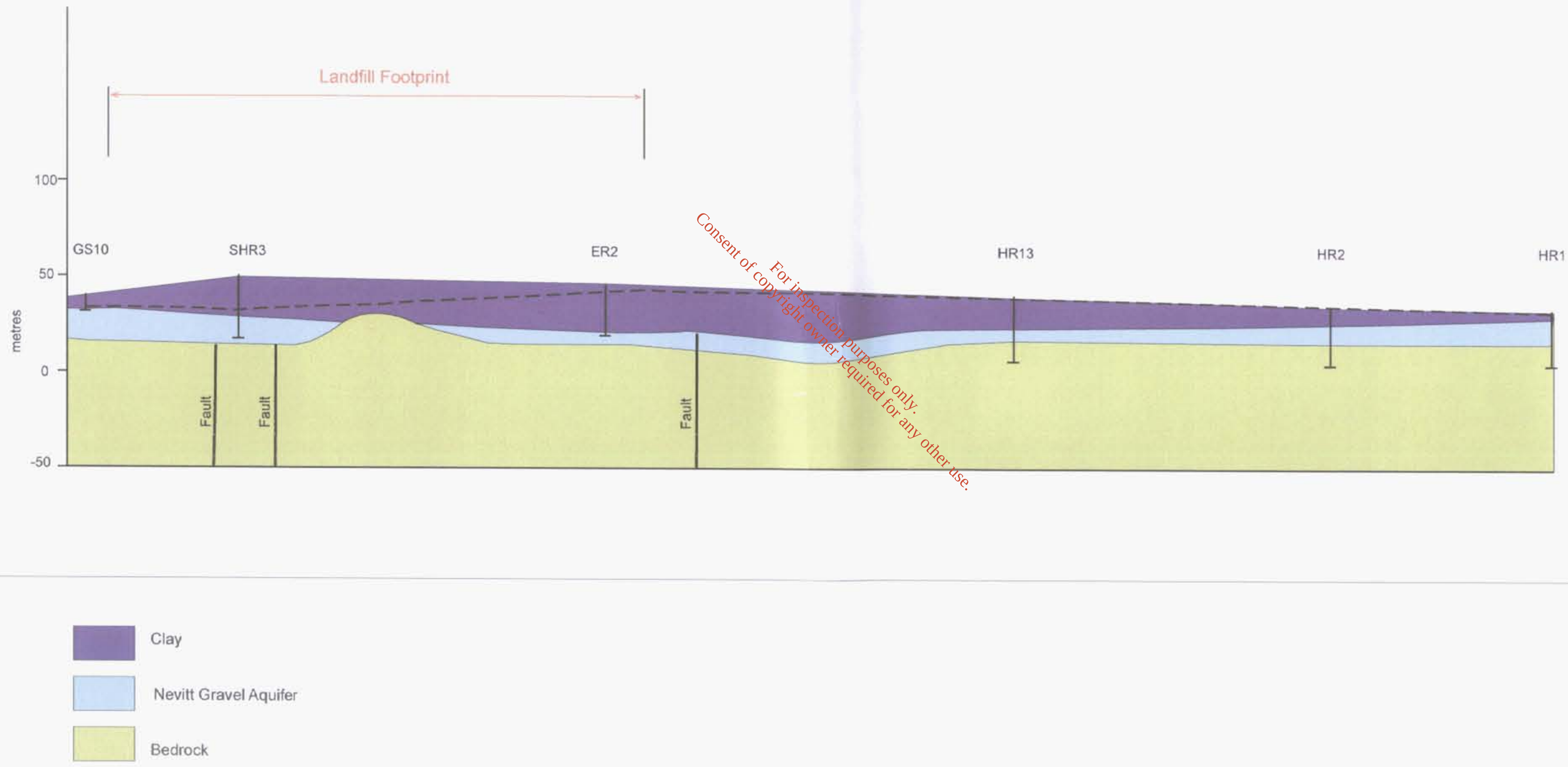


Figure 6 N-S Cross-Section Through Proposed Landfill

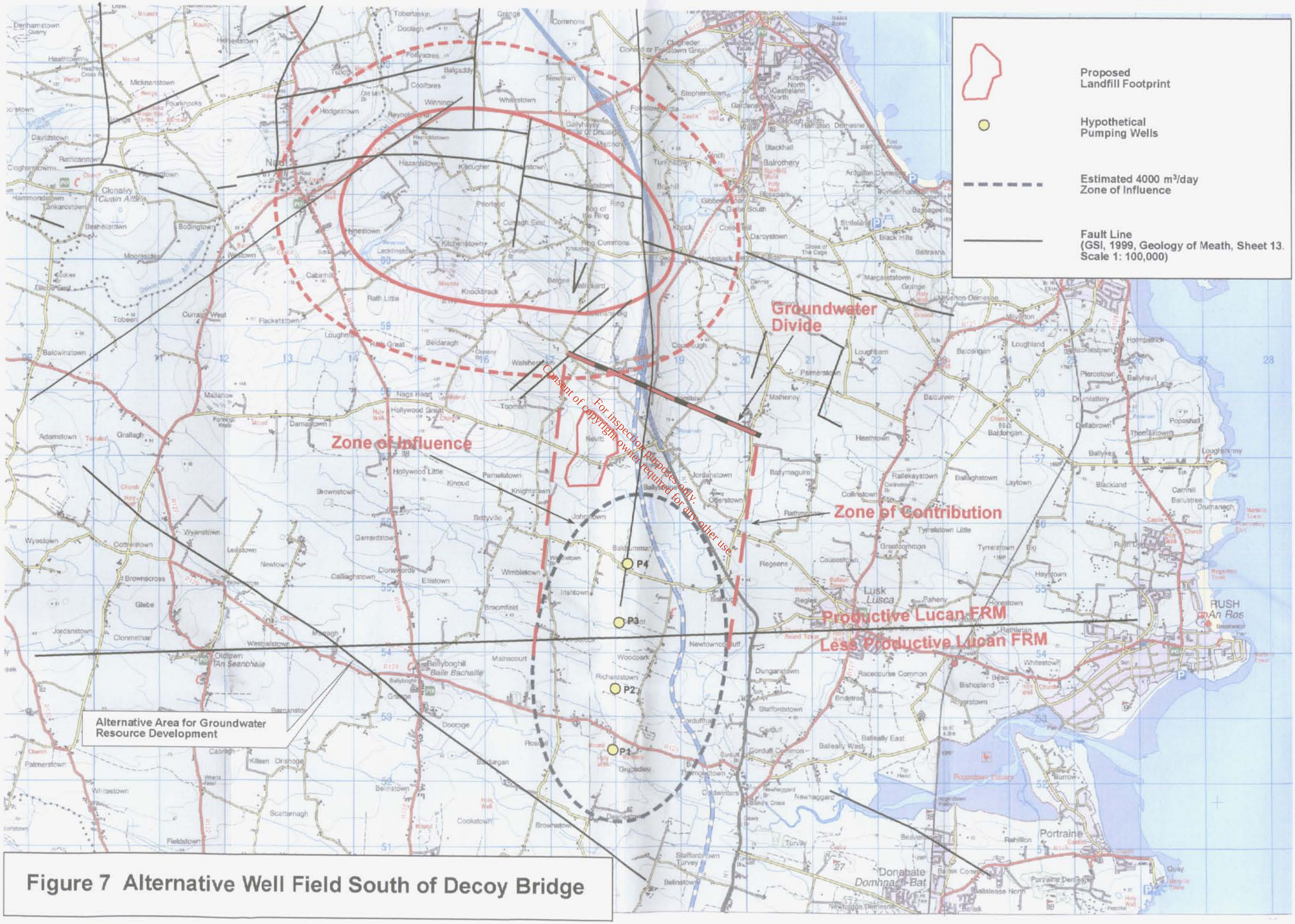


Figure 7 Alternative Well Field South of Decoy Bridge