Appendix 11

Apex Geophysical Survey Report

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AGL09005_01

REPORT

ON THE

GEOPHYSICAL SURVEY

AT

FOYNES,

COUNTY LIMERICK

FOR

MICHAEL PUNCH & PARTNERS

March 31 2009

PRIVATE AND CONFIDENTIAL

THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOSERVICES LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

AGL09005_01

PROJECT NUMBER	AGL09005		
AUTHOR	**CHECKED**	**REPORT STATUS**	**DATE**
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March 31 2009

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1. INTRODUCTION

APEX Geoservices Ltd. was requested by Michael Punch and Partners to carry out a geophysical investigation at a development site at Foynes, Co. Limerick as part of the ground investigation for re-development of the site.

1.1 Survey Objectives

The objectives of the survey were:

- To assess the subsoil conditions across the site.
- To estimate the depth to bedrock under the site.
- To identify possible karst features in the bedrock.

1.2 Survey Methodology

- **EM31 Conductivity Mapping** to indicate overburden type across the site and to identify areas of shallow bedrock.
- **Seismic Refraction Surveying** to profile depth to bedrock and to indicate overburden stiffness/rock quality.
- **2D Resistivity Profiling** to further indicate overburden and bedrock type and depth to weathered/fresh bedrock..

1.3 Site Background

The survey was carried out over an area of approximately 6.4 hectares (approximately 15.8 acres) of mainly made ground immediately east of Foynes, Co. Limerick. The site lies close to the southern shore of the Shannon Estuary with the Robertstown River estuary close to the east. Topography across the site varies from approximately 2.9 mOD in the north-east to 7.1 mOD in the south-west.

The geological map for the area (Geology of the Shannon Estuary, Geological Survey of Ireland, Sheet 17) indicates that the survey area is underlain by well bedded, blue-black, cherty limestone of the Durnish Formation.

The Teagasc subsoils map for the area indicates marine or estuarine silts or clays in the eastern and central portions of the site and made ground in the western parts of the site.

The Geological Survey of Ireland 6 inch: 1 mile original nineteenth century geological field map for the area indicates a large outcrop area approximately 150m west of the site of blue limestone with chert and with bedding recorded as dipping at 25^{o} to ESE and 30$^{o\ to}$ SW. This map also indicates a second large outcrop area approximately 25m south of the site of blue limestone with chert layers and bedding dipping at 36^{o} to NW.

The ground surface was found to consist of concrete in the north-western portion in the vicinity of the existing large building and hard core generally across the remainder of the site, with some asphalt roadways as, for instance, along the western boundary.

It was not possible to maintain full EM conductivity station coverage in parts of the south-east and south of the site owing to obstructions including large machinery/plant components.

A ground investigation on the site was carried out in June 2008 by Priority Geotechnical Ltd. during which 22 No. trial pits and 5 No. rotary core boreholes were completed. These indicated generally 0.5-2.0m fill and/or clayey gravel with cobbles and boulders over shallow limestone in the centre and west-centre of the site with thicker gravelly clay and silt/clay (maximum c.8m thick recorded) in the east and north-east. Groundwater was recorded where encountered in the trial pits and boreholes and monitored in standpipes in some instances. The trial pit and borehole locations have been plotted on Drawing No. 1, Figure 1 and on the resistivity sections. Standard Penetration Tests (SPT) were carried out in the rotary cored boreholes and 21 N-values ranging from 4 to 74 were recorded. Summary descriptions have been plotted on the resistivity sections on Drawing No. 9005/1.

2. INTERPRETED RESULTS

2.1 EM31 Conductivity

The EM31 conductivity contoured values are shown on Drawing 9005/2, Figure 1. The conductivity meter provides bulk conductivity data from 0 – 6.0m bgl. The conductivity values ranged from 7.0-42.5 milliSiemens/metre (mS/m). EM values due to anomalous in-phase data attributed to likely cultural noise, for instance in the vicinity of the building in the north-eastern portion of the site, were removed from the dataset before contouring, reducing the conductivity range to 8-22mS/m. The EM conductivity data has been generally interpreted on the following basis:

Conductivity (mS/m)	**Interpretation for material 0-6m below ground level**
8-12	0.5 – 1m of Fill/Clayey gravel/Cobbles/Boulders over Weathered/Fractured Limestone
12 - 15	1-2m of Fill/Clayey gravel/Cobbles/Boulders over Weathered/Fractured Limestone
15 - 21	c.0.5m Fill over 2-6m of Clayey Gravel/Sandy Gravelly Clay
21 - 22	c.0.5-1.5m Fill over c.1.5-4.5m of Clayey Gravel/Sandy Gravelly Clay over 0-4m Silt/Clay

The EM conductivity contour map generally shows low conductivity values in the central and western parts of the site with values increasing towards the east and north-east. Small high conductivity anomalies are also present to the west of the main building in the north-west of the site. A summary interpretation map based on the EM conductivity data along with the other geophysical and available direct site investigation data is included with this report (Drawing No. 9005/2, Figure 4).

The EM data shows a cultural effect peripheral to the northern and eastern perimeter fence. A pipe is shown here also on the Client map. The zone of EM cultural effect is summarised in Drawing 9005/1, Figure 1.

Anomalous high conductivity values in the south-western corner of the site (Drawing 9005/2) appear to be situated on a bank or mound. There is a building shown on the map at the eastern end of these anomalies. Corresponding EM in-phase values are moderate to low and do not indicate buried metal sources or other cultural effects at this locality. Neither does the pattern of these anomalies indicate they are due to the perimeter fence in this area as the EM conductivity values show a decrease going towards the fence. They may indicate conductive fill and/or underlying silts/clays.

As mentioned in Section 1.3 the EM conductivity line spacing is wider than usual in parts of the south-east and south of the site and this should be taken into consideration when assessing the data in this area.

2.2 Seismic Refraction Profiling

Seven seismic refraction spreads were recorded in the survey area (Drawing 9005/1), Four of these seismic spreads (S1-S4) were situated around the periphery of the building in the north-west of the site to provide information on subsoil conditions and depth to bedrock in that area. One seismic spread (S7) was located near the north-eastern corner of the site where limestone with a possible karstic cavity had been recorded in a borehole. The remaining two spreads (S5 and S6) were located as evenly as possibly across the rest of the site (in the south-east and east-centre).

The seismic data indicated the presence of three subsurface velocity layers. The seismic data was interpreted on the following basis:

Layer	Seismic Velocity (m/sec)	Interpretation	Estimated Stiffness/ Rock Quality
1	400-1417	Fill/Overburden	Firm-Stiff/Medium Dense-Dense
2	1200-2200	Overburden	Stiff/Dense
		Weathered/Fractured Rock	Poor - Fair
3	3495-7230	Slightly Weathered - Fresh Bedrock	Good-Very Good

2.3 2D Resistivity Profiling

Seven resistivity profiles were recorded (Drawing 9005/1). The resistivity data was interpreted on the following basis:

Apparent Resistivity (Ohm.m)	Interpretation
15-60	Silt/clay
60-275	Sandy gravelly clay
275-500	Fill/ Clayey gravel/Cobbles/Boulders
100-900	Limestone/shale
900-7000	Limestone
15-100	Saline ingress/ Limestone/shale

2.4 Integrated Interpretation

The resistivity data and the seismic refraction data have been integrated to result in the interpreted profiles R1-R7 and S1-S7 as shown. The integrated interpretation is conducted on the following basis:

Layer	Velocity (m/s)	Average Velocity (m/sec)	Resistivity (ohm-m)	Interpretation	Estimated Stiffness/ Rock Quality	Excavatability/ Rippability
1	400-1417	763	275-500	Fill/ Clayey gravel/Cobbles/Boulders	Firm-Stiff/Medium Dense-Dense	Diggable
			60-275	Sandy gravelly clay		
2	1263-1882	1702	275-500	Fill/ Clayey gravel/Cobbles/Boulders	Stiff/Dense	Diggable
			60-275	Sandy gravelly clay		
			15-60	Silt/clay		
	1200-2200	1796	100-900	Weathered/Fractured Limestone/Shale	Poor - Fair	Rip-Break/Blast
			900-7000	Weathered/Fractured Limestone		
3	3495-7230	5224	100-900	Slightly Weathered - Fresh Limestone/shale	Good-Very Good	Break/Blast
			900-7000	Slightly Weathered - Fresh Limestone		

Overburden

Material with a resistivity of 275-500 Ohm-m has been interpreted as fill overlying or mixed with clayey gravel/cobbles/boulders. This material has been recorded from boreholes and trial pits across the site and has been interpreted as varying in thickness from approximately 0.3m on Resistivity Profile R1 in the west of the site to approximately 4m on the eastern part of Resistivity Profile R7 and 5.8m on the eastern part of Resistivity Profile R5 in the north-east and east-centre of the site respectively.

The P-wave seismic velocities for this material are 400-1417 and 1200-2200 m/s for Layers 1 and 2 respectively. This indicates firm-stiff/medium dense-dense material which is underlain by stiff/ dense material which should be diggable.

Material with a resistivity of 60-275 Ohm-m has been interpreted as sandy gravelly clay. This has been interpreted as occurring up to 3m in thickness at the eastern end of Resistivity Profile R3 and the northern end of Resistivity Profile R4, 1.8-3.6m thick under fill/clayey gravel/cobbles/boulders at the eastern end of Resistivity Profile R5 and generally 0.5-2.0m thick and up to c.2.8m thick under fill/clayey gravel/cobbles/boulders on Resistivity Profile R7.

The seismic velocities for this sandy gravelly clay are 533-1122 m/s and 1263-1882 m/s for Layers 1 and 2 respectively. This indicates firm-stiff material which should be diggable.

Material with resistivities of 15-60 Ohm-m has been interpreted as silt/clay. This is probably marine or estuarine silt clay – sea shells were recorded from this material in a trial pit. The low resistivity values together with the proximity to salt or brackish water indicate the likelihood of saline ingress in the groundwater. This material has been interpreted as occurring up to approximately 4m in thickness on

Resistivity Profile R7 in the north-east of the site, and possibly also at the eastern end of Resistivity Profile R3 in the northern portion of the site.

The seismic velocities for this silt/clay are 1412-1882 m/s indicating that this material is stiff.

Weathered/Fractured Bedrock
Bedrock with resistivities of 100-900 Ohm-m and seismic velocities of 1200-2200 m/s has been interpreted as moderately to slightly weathered/fractured limestone with shale. Bedrock with resistivities of 900-7000 Ohm-m and P-wave seismic velocities of 1200-2200 m/s has been interpreted as moderately to slightly weathered/fractured limestone. This weathered/fractured rock is estimated to be poor to fair quality and to be diggable/rippable or requiring breaking/blasting.

This weathered/fractured rock layer has been interpreted on all profiles except R7 and the eastern parts of R3 and R5. It is thickest on R1 and R3 (up to c.4.8m thick). Weathered/fractured limestone with shale can be expected to be somewhat poorer quality and to be more easily excavated.

In Rotary Core Borehole RC 103 a void was recorded in limestone from 2.7to 6.0m. However the resistivity and seismic data does not indicate significant karstification.

Bedrock
Bedrock with resistivities of 100-900 Ohm-m has been interpreted as limestone with shale. Bedrock with resistivities of 900-7000 Ohm-m has been interpreted as limestone. Seismic velocities for the bedrock are 3495-7230 m/s which indicate slightly weathered to fresh, good to very good quality bedrock which will require breaking/blasting.

Bedrock with resistivities of 15-100 Ohm-m has been interpreted as limestone/shale with ingress of saline groundwater. This saline ingress could be expected as the site is situated close to the Shannon estuary.

Depth to bedrock (slightly to moderately weathered bedrock where present) is interpreted to range from approximately 0.3m to 7m (bedrock surface elevation 6.5mAOD - 4.6mBOD). Drawing No.9005/2, Figure 4 shows the summary geophysical interpretation of depth to bedrock and indicates an area of thin overburden and shallow rock between c.0.3 and 2m below ground level underlying the centre, west and north-west-centre of the site with thicker overburden and deeper rock at depths of 2m to greater than 7m to the east and north-east.

3. SUMMARY & RECOMMENDATIONS

- Subsoil conditions across the site have been interpreted as generally consisting of fill and/or clayey gravel/cobbles/boulders (0.3-5.8m thick).
- Firm to stiff sandy gravelly clay 0.5-3.0m thick has been interpreted mainly in the north-east and east generally underlying clayey gravel/cobbles/boulders.
- Silt /clay (probably estuarine) has been interpreted up to 4m thick mainly in the north-east of the site.
- A layer of moderately to slightly weathered/fractured limestone and limestone/shale has been interpreted across most of the site except in the east and north-east.
- Depth to bedrock (slightly to moderately weathered bedrock where present) is interpreted to range from approximately 0.3m to 7m, deepest in the north-east.
- The geophysical survey indicates that the competent bedrock is slightly weathered to fresh limestone and limestone/shale.
- The resistivity profiles did not indicate significant karstification in the limestone.
- The low resistivity bedrock on Resistivity Profile R2 and the moderate-low resistivity bedrock on Resistivity Profile R3, to the west and north of the main building, should be investigated by rotary core drilling, as follows:

Proposed Rotary Core Borehole	National Grid Co-Ordinates		Location	Target
	Easting	Northing		
BH1	125992	151883	R2	Confirm interpretation of limestone/shale/saline ingress
BH2	126067	151917	R3	Confirm interpretation of limestone/shale/

- The geophysical data should be reviewed upon the completion of any further direct investigation.

4. REFERENCES

Bell F.G., 1993, *Engineering Geology,* Blackwell Scientific Press.

Campus Geophysical Instruments, 2000, *RES2DINV ver. 3.4 Users' Manual.* Birmingham, U.K..

Geological Survey of Ireland, 1:100,000 Scale Bedrock Series, Sheet 17, *Geology of the Shannon Estuary.*

Golden Software, 2001, *Surfer 7 Surface Mapping System Users Manual*, Golden Software, Colorado., USA.

Hagedoorn, J.G., 1959, *The plus - minus method of interpreting seismic refraction sections*, Geophysical Prospecting, 7, 158 - 182.

Palmer, D., 1980, *The Generalized Reciprocal Method of seismic refraction interpretation*, SEG.

Redpath, B.B., 1973, *Seismic refraction exploration for engineering site investigations*, NTIS, U.S. Dept. of Commerce.

Soske, J.L., 1959, *The blind zone problem in engineering geophysics*, Geophysics, 24, pp 359-365.

APPENDIX I GEOPHYSICAL METHODOLOGY

M1. Methods Used

1.1 Seismic Refraction Profiling

1.2 Resistivity Profiling

1.3 EM31 Conductivity

M2. Equipment Used

2.1 Seismic Refraction Profiling

2.2 Resistivity Profiling

2.3 EM31 Conductivity

M3. Field Procedure

3.1 Seismic Refraction Profiling

3.2 Resistivity Profiling

3.3 EM31 Conductivity

M4. Data Processing

4.1 Seismic Refraction Profiling

4.2 Resistivity Profiling

4.3 EM31 Conductivity

M1. Methods Used

1.1 Seismic Refraction Profiling

This method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

1.2 2D-Resistivity Profiling

This surveying technique makes use of the Wenner resistivity array. The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. The 2D-resistivity profiling method involves the use of 32 electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

1.3 EM31 Conductivity Mapping

This method operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). As the effective penetration of this method is around 6m below ground level the measured conductivity is a function of the different overburden layers and/or rock from 0 to 6m below ground level.

M2. Equipment Used

2.1 Seismic Refraction Profiling

Seven seismic spreads were recorded on the 11th and 12th March 2009 using a Geode high resolution 24 channel digital seismograph with geophone spacings of 3m. The source of the seismic waves was a sledgehammer.

2.2 2D-Resistivity Profiling

The profiles were recorded using a Tigre resistivity meter, imaging software, a 32 takeout multicore cable and up to 32 stainless steel electrodes. The recorded data was processed and viewed immediately after the survey. Seven resistivity profiles were recorded.

2.3 EM31 Conductivity Mapping

The equipment used was a GF EM31 Conductivity meter equipped with data logger. This instrument features a real time graphic display of the previous 20 measurement points to monitor data quality and results. 2535 conductivity readings were recorded on the 11th March 2009.

M3. Field Procedure

3.1 Seismic Refraction Profiling

The seismic refraction profiles have the following recording parameters:

Profile	Spacing	Length	Minimum depth of Investigation	Azimuth
No.	(m)	(m)	(m)	
1	3	69	23	W-E
2	3	69	23	S-N
3	3	69	23	W-E
4	3	69	23	S-N
5	3	69	23	E-W
6	3	69	23	E-W
7	3	69	23	E-W

3.2 2D-Resistivity Profiling

The 2D-Resistivity profiles have the following recording parameters:

Profile	Spacing	Length	Approximate depth of Investigation	Azimuth
No.	(m)	(m)	(m)	
1	3	93	18	W-E
2	3	93	18	S-N
3	3	93	18	W-E
4	3	93	18	S-N
5	3	93	18	E-W
6	3	93	18	E-W
7	3	93	18	E-W

3.3 EM31 Conductivity Mapping

Conductivity and in-phase values were recorded on an approximate 2.5m x 7.5m grid over an approximate area of 5.2 hectares. Local conditions and variations were recorded. Certain parts of the site were obstructed by machinery or plant and could not be surveyed.

M4. Data Processing

4.1 Seismic Refraction Profiling

The recorded data was interpreted using the ray-tracing and intercept time methods.

4.2 2D-Resistivity Profiling

The field readings were stored in computer files and inverted using the RES2DINV package (Campus Geophysical Instruments, 1997) with up to 3 iterations of the measured data carried out for each profile to obtain a 2D-Depth model of the resistivities.

The inverted 2D-Resistivity models and corresponding interpreted geology are displayed as Profiles R1-R7. The distance is indicated along the horizontal axis of the profile. All profiles have been contoured using the same contour intervals and colour codes.

4.1 EM31 Conductivity Mapping

The data were downloaded and plotted. Data which was contaminated by metallic objects was removed. Assignation of material types and possible anomaly sources was carried out, with cross-reference to other data. A scaled plot of conductivity against distance was prepared with annotated interpretation.

APPENDIX II EXCAVATABILITY RATING

Excavatability

The seismic velocity of a rock formation is related to characteristics of the rock mass which include rock hardness and strength, degree of weathering and discontinuities. Usually the velocity is just one of several parameters used in the assessment of excavatability. The excavatability of a rock formation is favoured by the following factors:

- Open fractures, faults and other planes of weakness of any kind
- Weathering
- Brittleness and crystalline nature
- High degree of stratification or lamination
- Large grain size
- Low compressive strength

Weaver (1975) presented a comprehensive rippability rating chart (Fig.1) in which the p-wave velocity value and the relevant geological factors could be entered and assigned appropriate weightings. The total weighted index was found to correlate very well with actual rippability.

Fig.1 Rippability Rating Chart

Rock class	**I**	**II**	**III**	**IV**	**V**
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock
Seismic velocity (m/s)	>2150	2150-1850	1850-1500	1500-1200	1200-450
Rating	26	24	20	12	5
Rock hardness	Extremely hard rock	Very hard rock	Hard rock	Soft rock	Very soft rock
Rating	10	5	2	1	0
Rock weathering	Unweathered	Slightly weathered	Weathered	Highly weathered	Completely weathered
Rating	9	7	5	3	1
Joint spacing (mm)	>3000	3000-1000	1000-300	300-50	<50
Rating	30	25	20	10	5
Joint continuity	Non continuous	Slightly continuous	Continuous-no gouge	Continuous-some gouge	Continuous-with gouge
Rating	5	5	3	0	0
Joint gouge	No separation	Slight separation	Separation <1mm	Gouge <5mm	Gouge >5mm
Rating	5	5	4	3	1
Strike and dip orientation	Very unfavourable	Unfavourable	Slightly unfavourable	Favourable	Very favourable
Rating	15	13	10	5	3
Total rating	**100-90**	**90-70***	**70-50**	**50-25**	**<25**
Rippability assessment	Blasting	Extremely hard ripping and blasting	Very hard ripping	Hard ripping	Easy ripping
Tractor horsepower		770/385	385/270	270/180	180
Tractor kilowatts		575/290	290/200	200/135	135

APPENDIX III SEISMIC REFRACTION PLATES

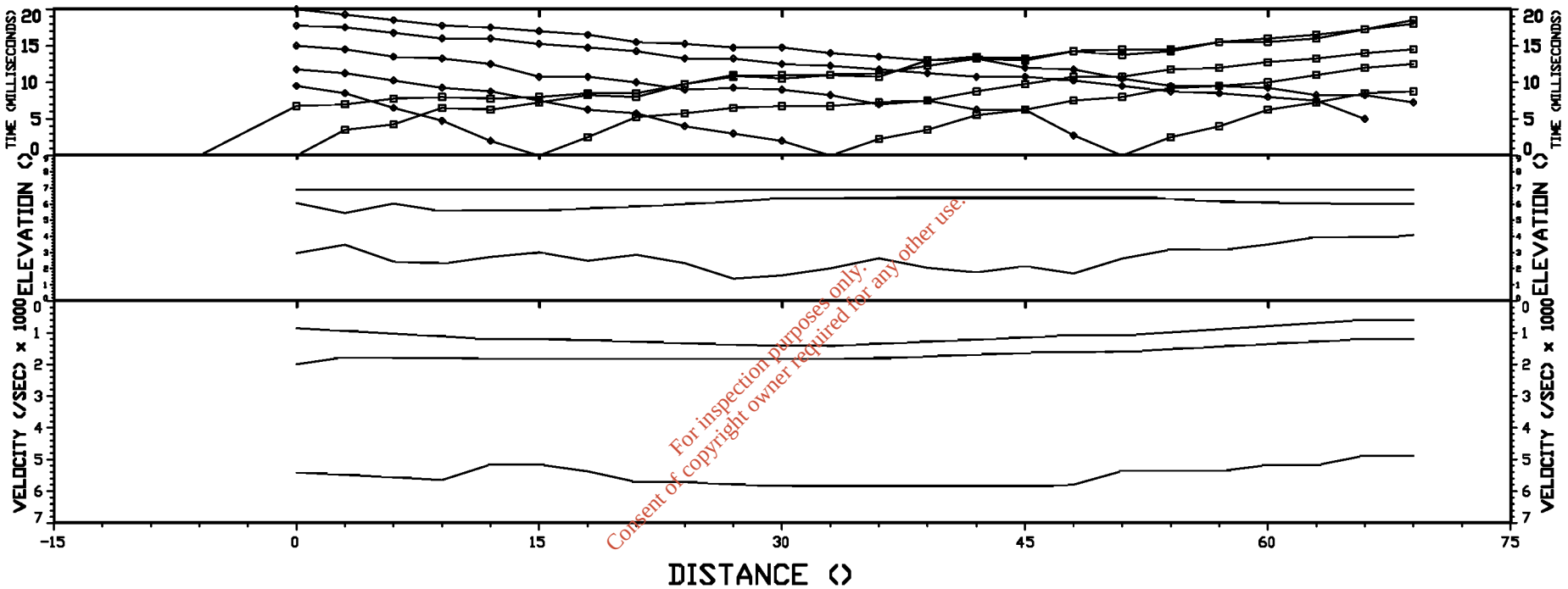
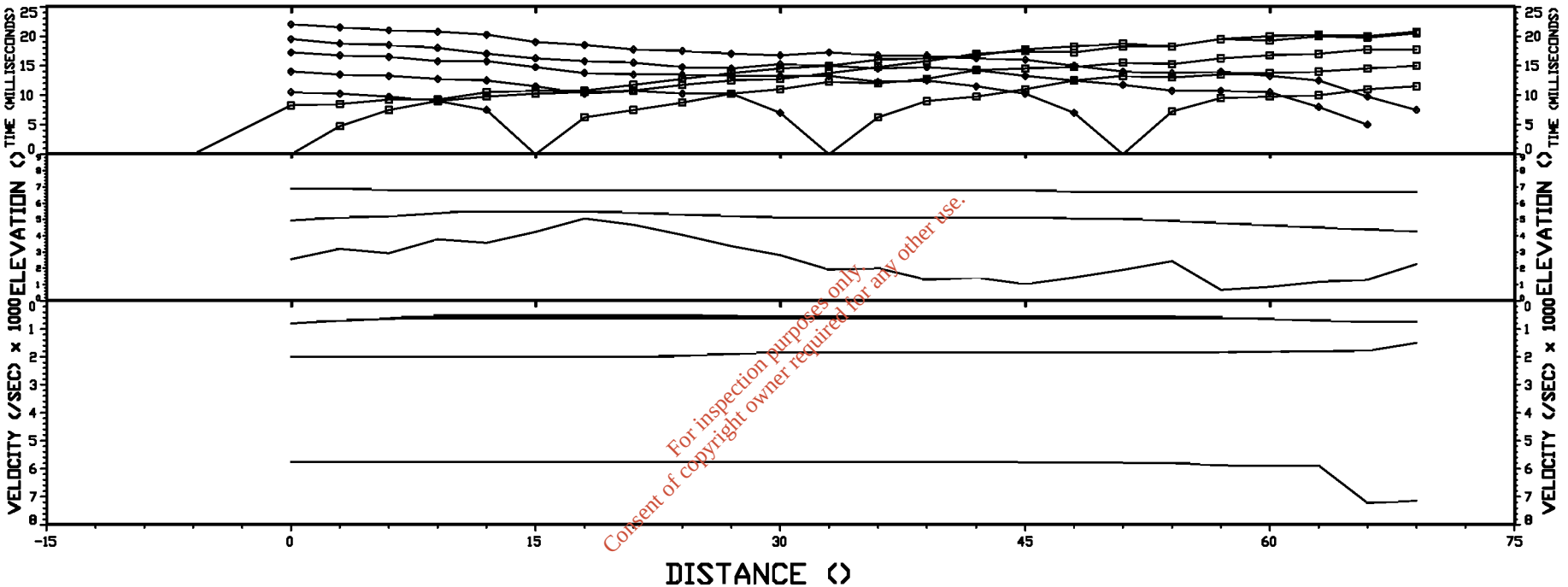


Plate: 10a

for: Michael Punch & Partners	9005
by: APEX Geoservices Ltd.	Foynes Limerick
Data SetS1 / Date: 02-04-2009	
Equipment: Seistronix RAS / Spread: S1	Azimuth:



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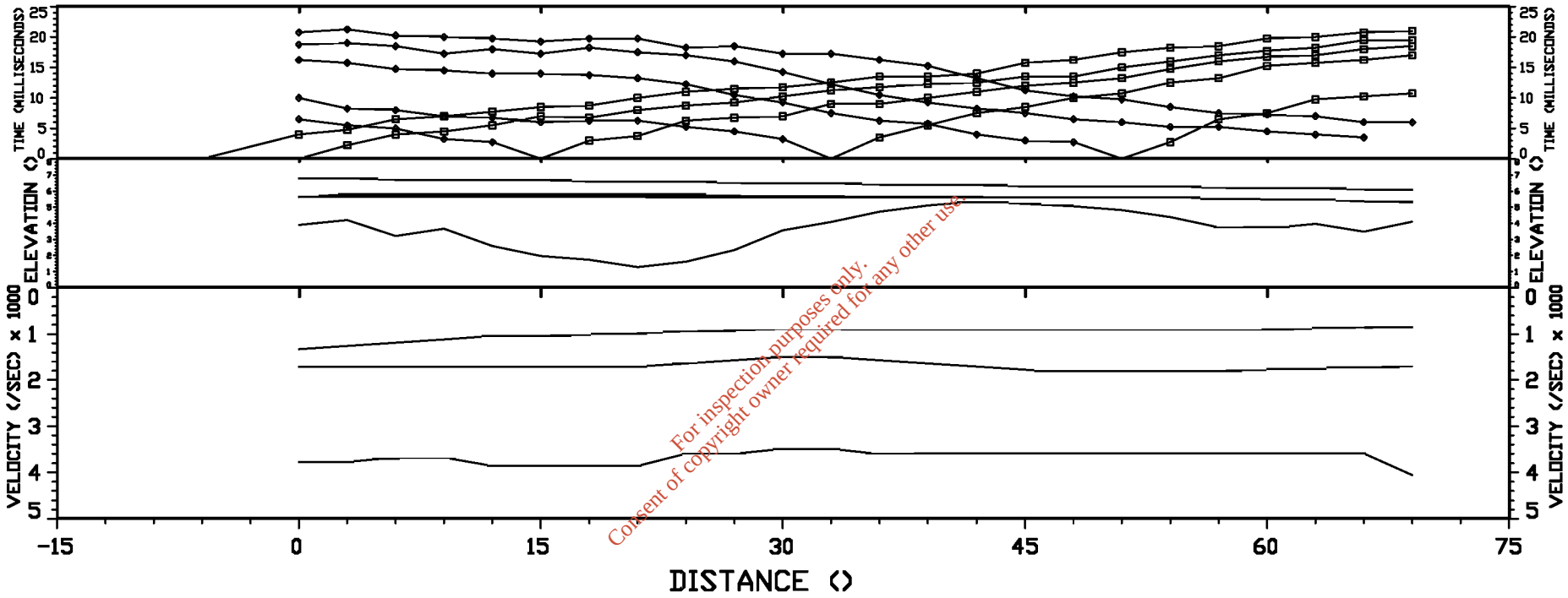

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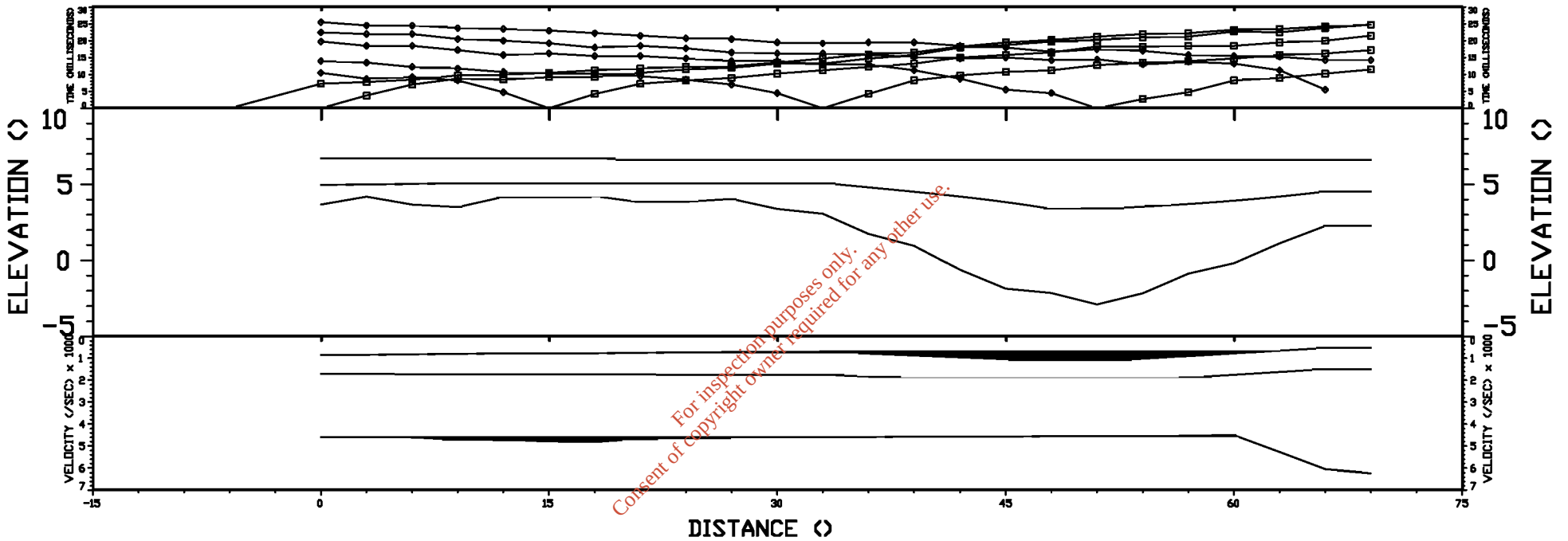

Plate: 10a

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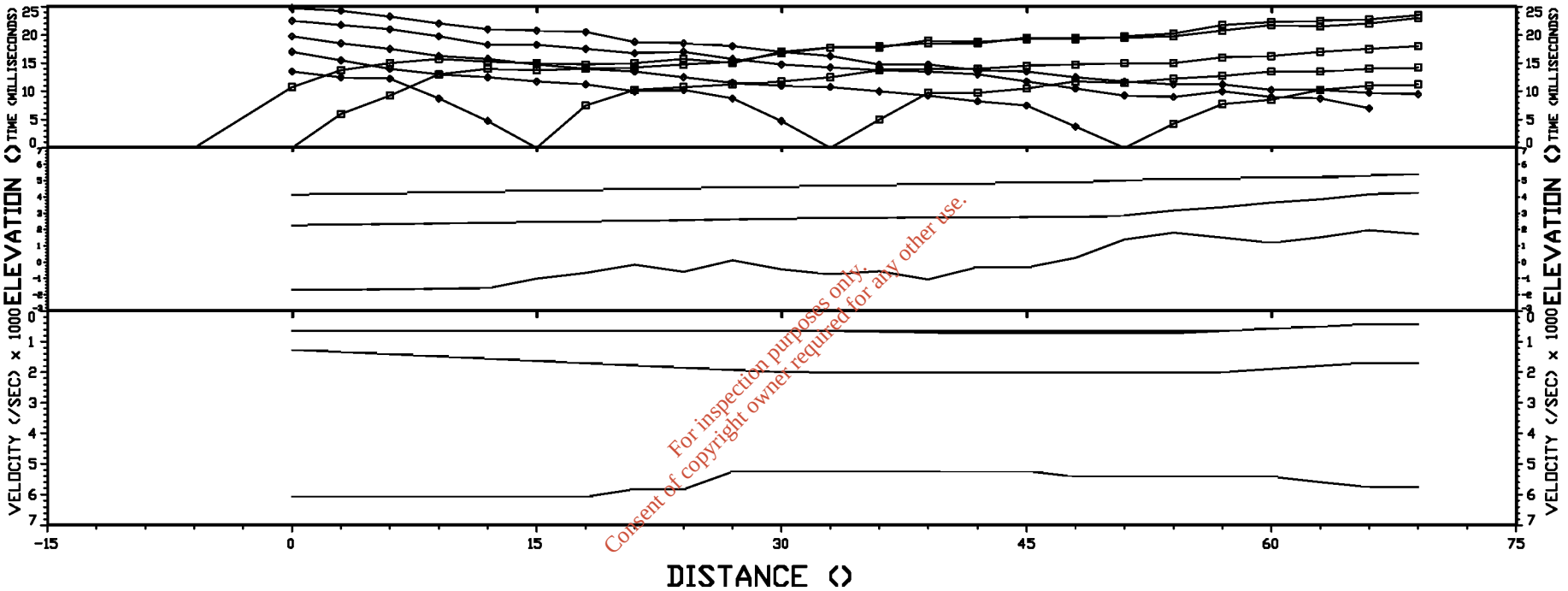

Plate: 10a

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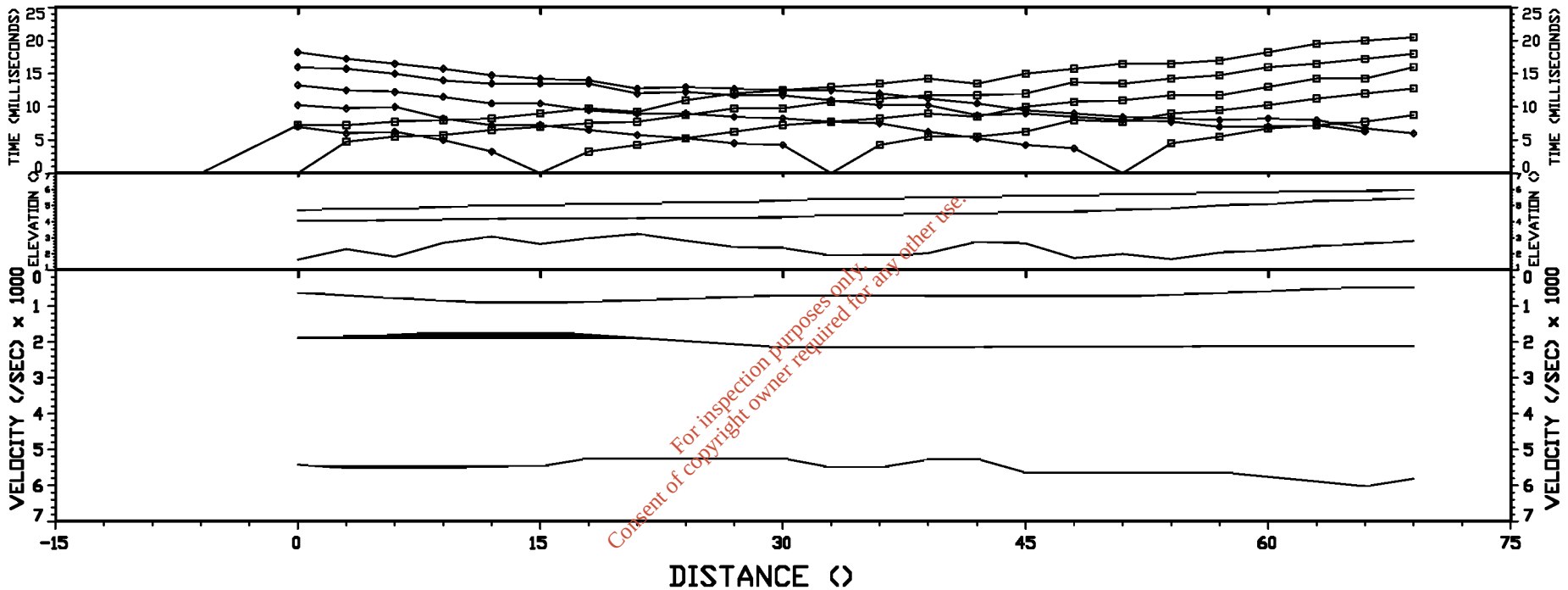
Equipment: Seistronix RAS / Spread: S5	Azimuth:



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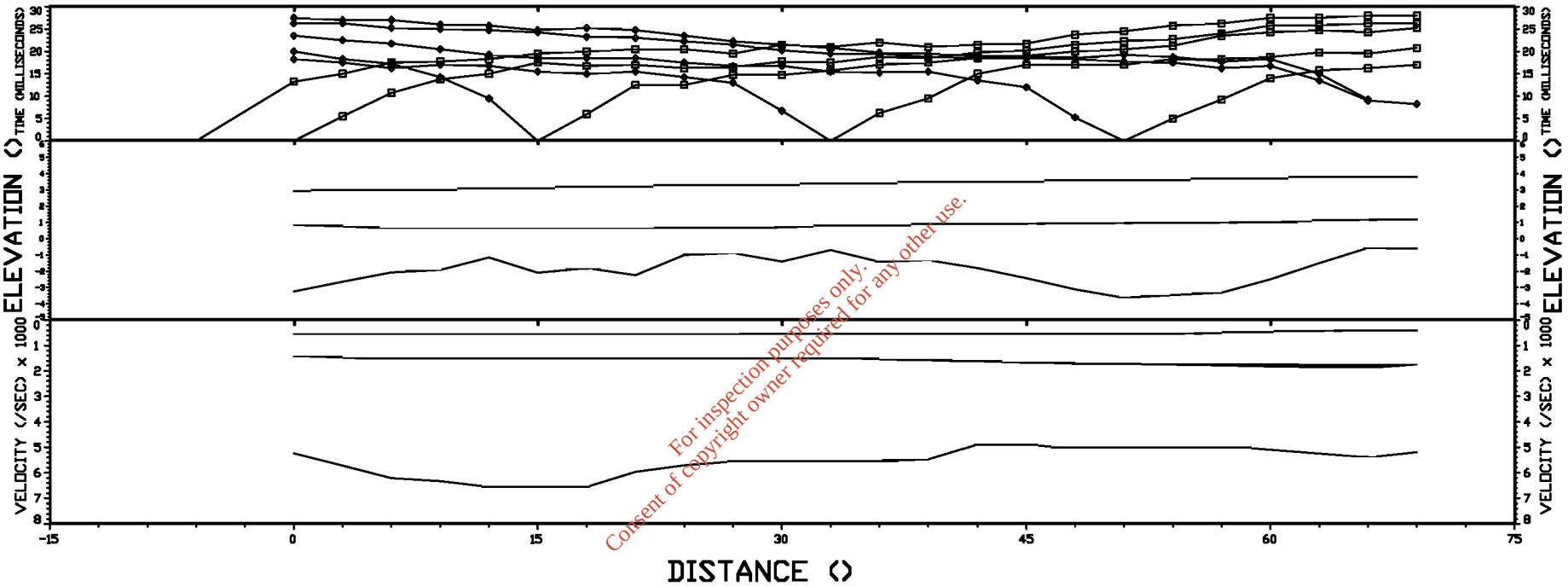

Plate: 10a

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by: APEX Geoservices Ltd.	Foynes Limerick
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Equipment: Seistronix RAS / Spread: S7	Azimuth:

APPENDIX IV DRAWINGS

FIGURE 1: SURVEY LOCATION MAP, Scale 1:1250

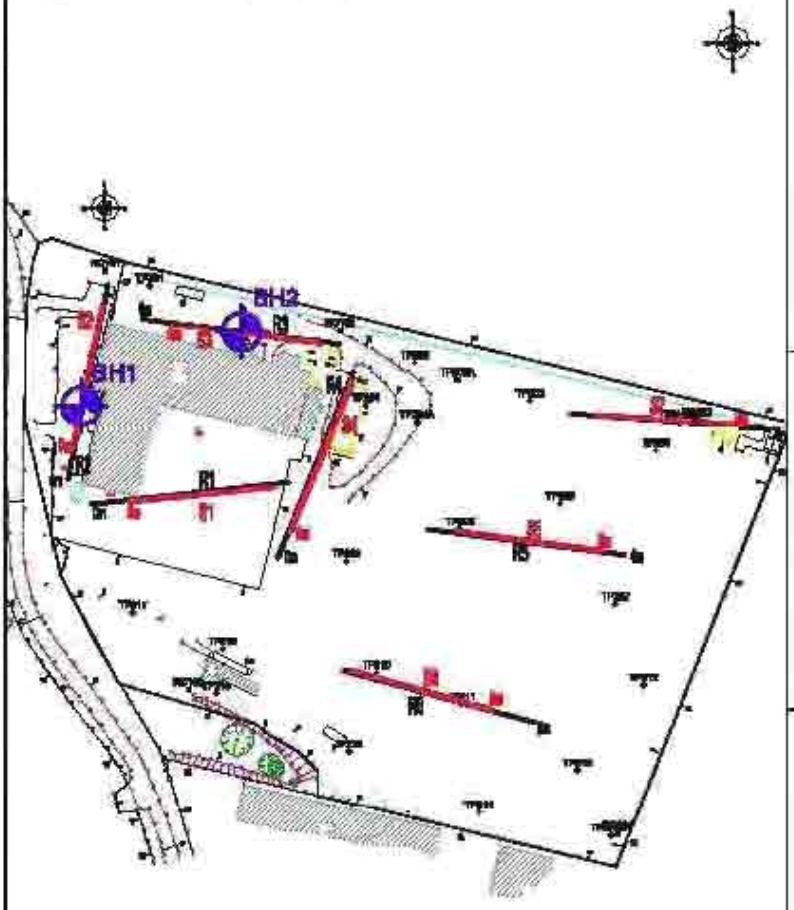


FIGURE 2: RESISTIVITY PROFILE R1 & SEISMIC SPREAD S1

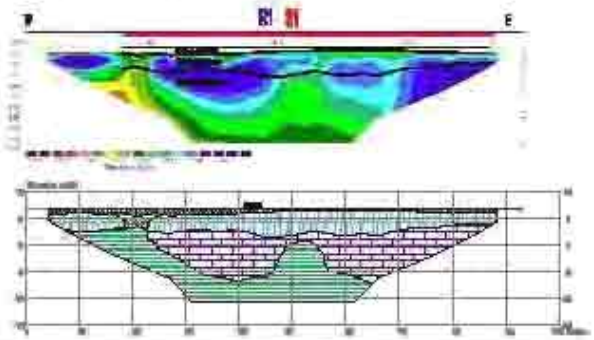


FIGURE 3: RESISTIVITY PROFILE R2 & SEISMIC SPREAD S2

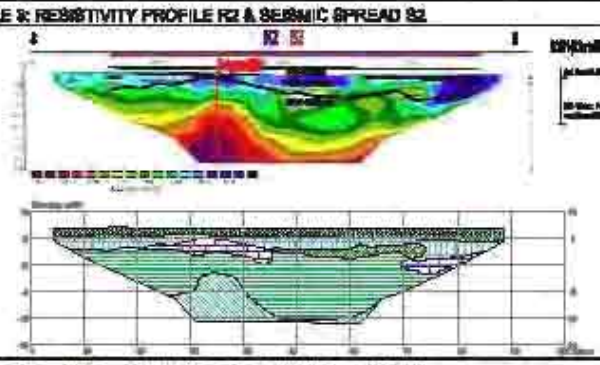


FIGURE 4: RESISTIVITY PROFILE R3 & SEISMIC SPREAD S3

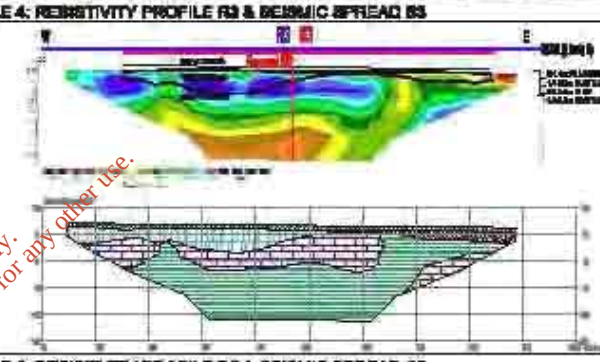


FIGURE 5: RESISTIVITY PROFILE R4 & SEISMIC SPREAD S4

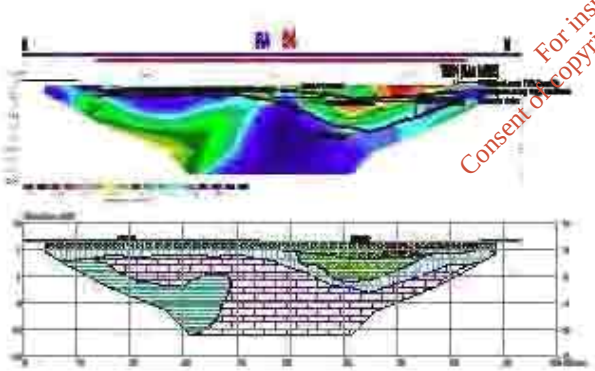


FIGURE 6: RESISTIVITY PROFILE R5 & SEISMIC SPREAD S5

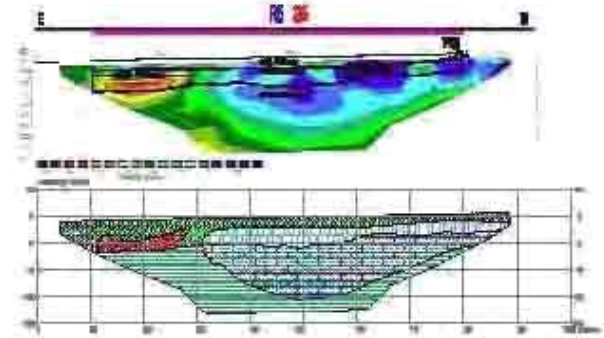


FIGURE 7: RESISTIVITY PROFILE R 6 & SEISMIC SPREAD S6

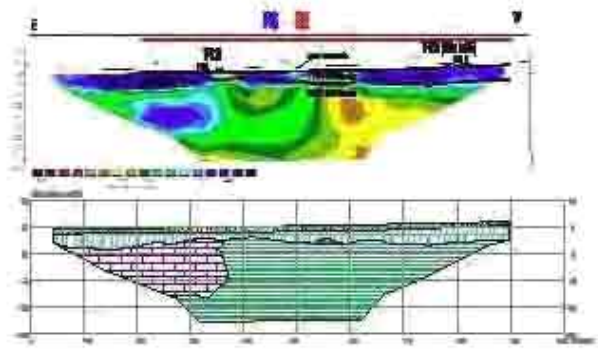
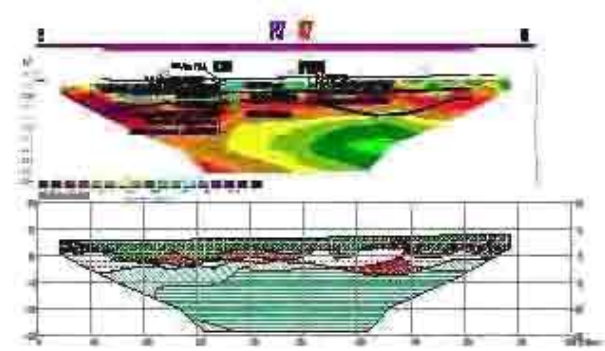


FIGURE 8: RESISTIVITY PROFILE R7 SEISMIC SPREAD S7



GEOPHYSICAL SURVEY

POWER

MICHAEL FLYNN & PARTNERS

RESISTIVITY & SEISMIC SECTIONS

apex

FIGURE 1: EM CONDUCTIVITY CONTOURED, Scale 1:1000

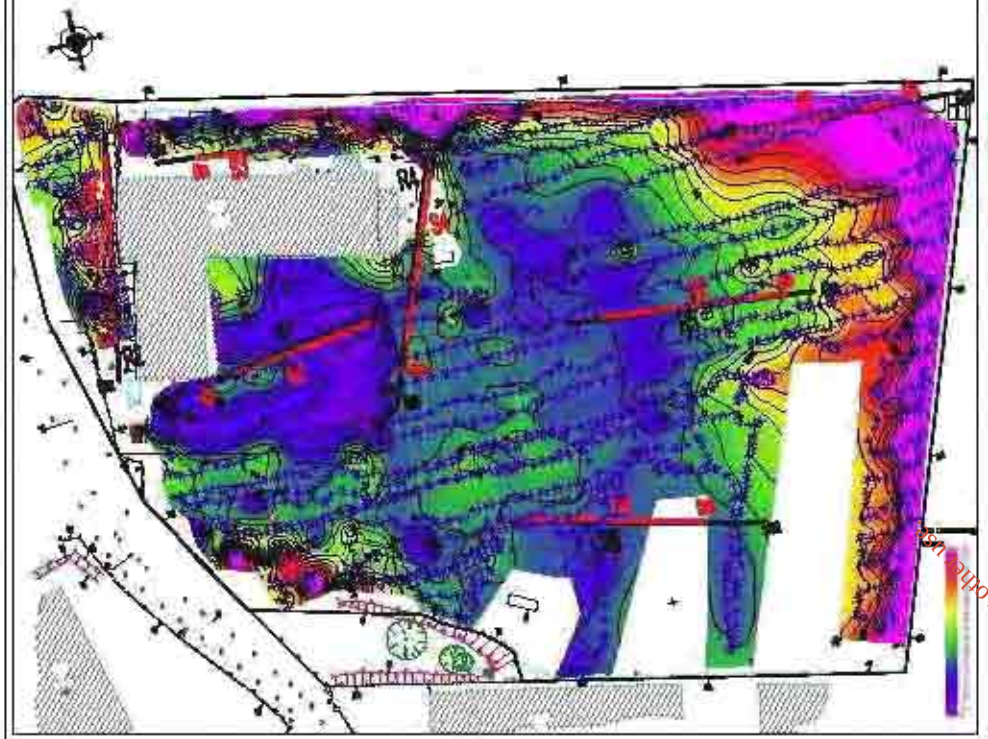


FIGURE 2: DEPTH TO BEDROCK, Scale 1:1000

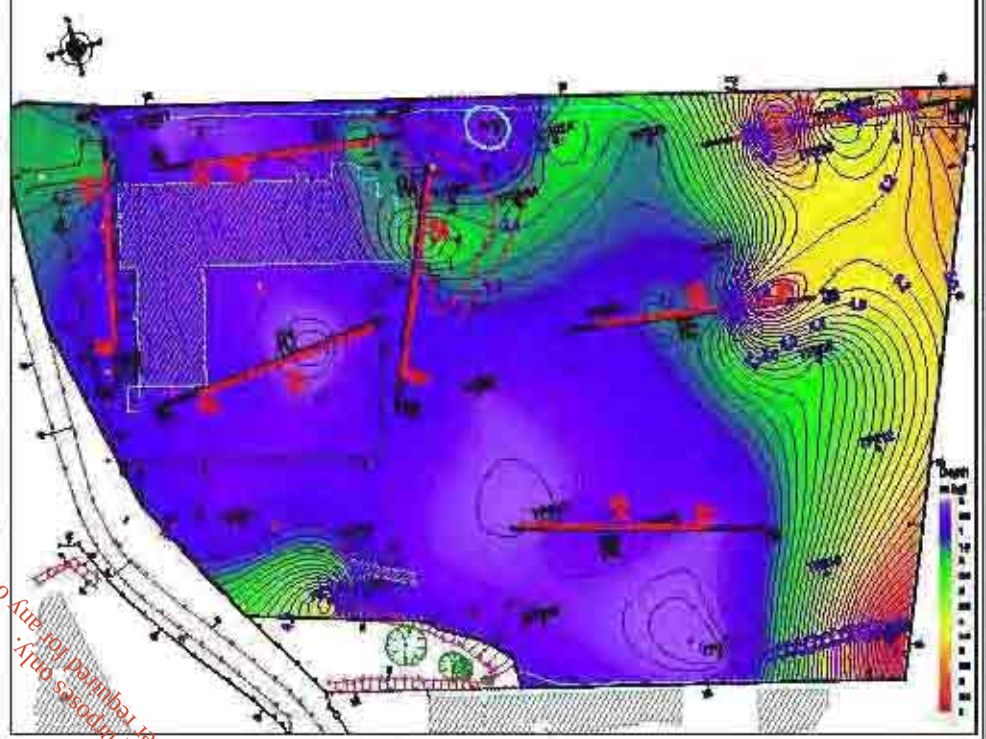


FIGURE 3: TOP OF ROCK ELEVATIONS, Scale 1:1000

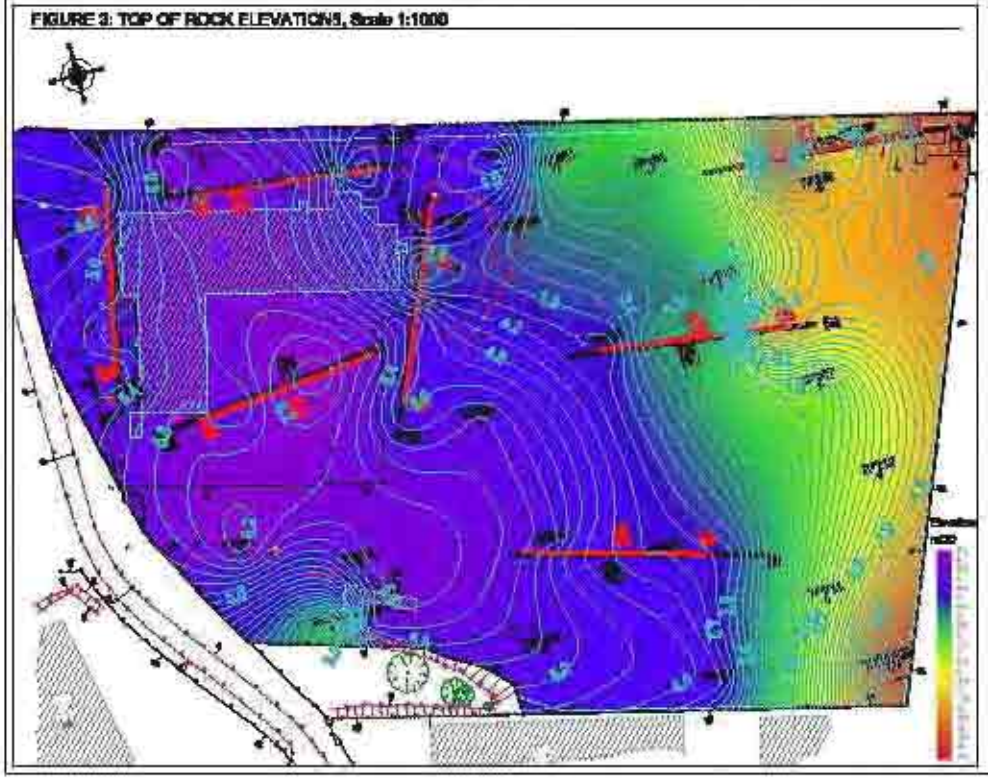
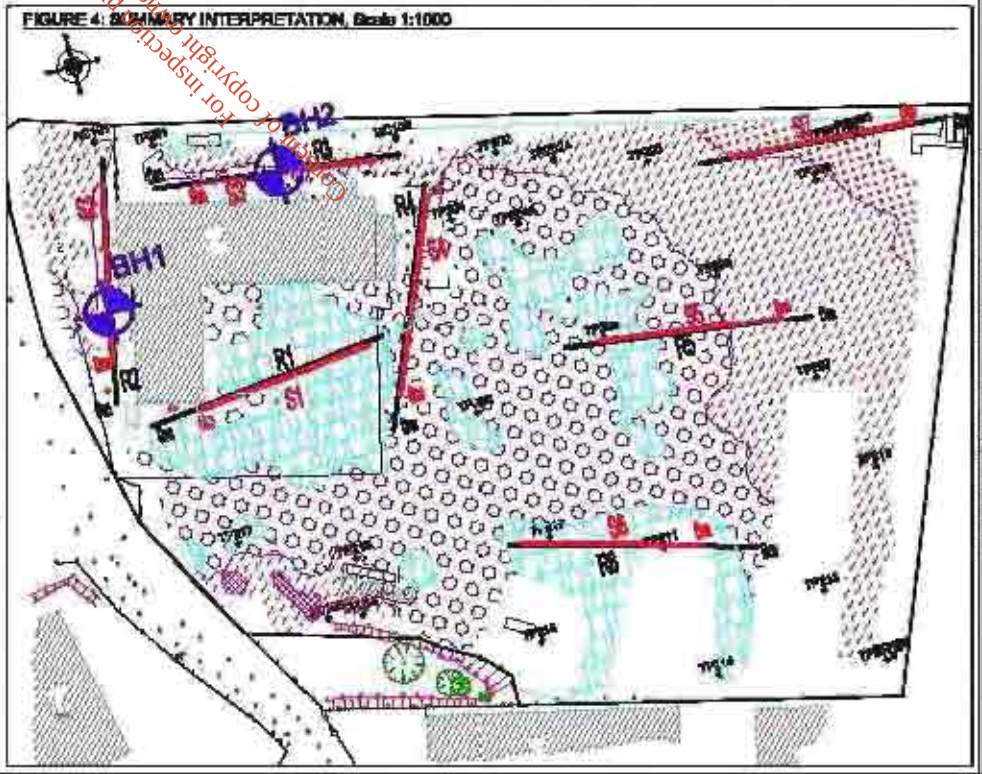


FIGURE 4: SUMMARY INTERPRETATION, Scale 1:1000



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Appendix 12

Mouchel Phase 1 Report – Desk Study

mouchel

Sinéad Kennedy
Michael Punch & Partners
97 Henry Street
Limerick

Contact Thomas Smeeton
Tel 0161 838 6012
Mobile 07770 2321 724
E-mail Thomas.smeeton@mouchel.com

13th June 2008

Our Ref

Dear Sinéad,

PHASE 1 GEO-ENVIRONMENTAL DESK STUDY ASSESMENT - FOYNES PORT, LIMERICK, IRELAND

We are pleased to report our findings of the Phase 1 Geo-environmental assessment desk study report for the proposed waste transfer site located in Foynes Port, County Limerick.

Introduction and Background

Mouchel was instructed by Michael Punch & Partners to undertake a Phase 1 Geo-environmental assessment desk study at a site located in Foynes Port to assess the ground based environmental risks and constraints associated with the potential acquisition and subsequent redevelopment. We understand the intention is for the site to be used as a yard with possible redevelopment in the future.

Site Description

Site Location

The site comprises of 6.54ha in a mainly industrial area adjacent to Foynes Port in the Durnish area of Foynes. The River Shannon lies to the north and east of the site.

A site walkover was undertaken on 5th June 2008 by a Mouchel Environmental Consultant. The results of the site walkover are summarised below.

The site is surrounded by a 2.1m secure high chainlink fence. There are 3 gates into the site. These are 5.4m wide and are located to the north and south of the buildings along the western boundary. To the south west, the chainlink fencing is covered with climbing vegetation. To the north, the boundary also include coniferous trees.

Approximately 10% of the site is covered by warehouse buildings (in the north west of the site) covered in plastic coated, steel cladding. No evidence of asbestos was noted within the roof structure of the building. This assertion is based on a visual check only

and would need to be confirmed by an appropriately qualified asbestos surveyor. No guttering was observed on the building and the roof water drains to a soak away area adjacent to the walls of the buildings.

The area immediately to the north, east and south of the building is covered by concrete hardstanding. This consists of concrete slabs which appear to be in good repair, however the joints are occasionally up to 10mm wide, unsealed and infilled with 'very black' soil.

There is an over ground water mains surrounding the site along the southern, eastern, and northern boundaries. These pipes appear to be fed from 2 large water storage tanks located in the north east corner of the site. There is also an open water storage tank located in the north east corner of the site.

The foundations of the old weighbridge and weighbridge office are still visible on the site. Ducting, manholes and wires were still in place as were tower lights.

There is a bunded fuel storage area approximately 10m^2 located to the east of the buildings. The fuel bund visually appears to be in good repair. Hydrocarbon staining was located up to 0.6m above ground level on the inside walls of the bunded area. A transformer is also present.

The majority of the site is covered with hardcore. The site is relatively flat but visually there appears to be a very slight fall to the east of the site. Along the east of the site there is a concrete channel constructed, which appears to run to a former settlement tank located in the north east of the site.

The south west corner of the site is overgrown with grasses, with a hummocky and uneven ground surface. The underlying material comprised fine granular coal material. Fly tipping was also a problem in this area with wood, paper, plastic, metal, cardboard, one full sodium hydrochloride drum, one empty phosphoric acid solution container, ITEC procedure manuals and metal joiners for roof trussers noted during the site walkover.

A large stockpile of spoil material predominantly clay and (surface) waste is present to the east. Waste materials including concrete, wood off cuts, tyres, plastic, unidentifiable orange steel cyclinder and an additional stockpile of waste material including wood, plastic, metal and paper are located to the east.

Possible coal residues were noted at various locations on the site, due to historic coal storage.

Surrounding area land uses

There is a warehousing facility located immediately to the south of the site. Warehouses are built to within 2-3m of the site boundary. The warehouses appear to be of mixed use.

There is an Irish Rail site located to the east of the site. The site is generally covered in grass and other vegetation and there does not appear to be any structures on the site.

The area immediately to the north of the site is to be developed as a fuel tank farm. It is currently being used as a rock storage area for rock from a site across the road and to the west of the site under study.

Site History

The earliest available historical maps for review dated c1829 – 1841 indicate that the site was undeveloped open fields. By c1897 – 1913, no further changes had been observed. No other historical maps were available for review.

Anecdotal evidence states that the site has been used for a number of industrial activities over the years including a coal yard and a timber processing facility.

Geology

Drift Geology
The information obtained from the ERSI website indicates that the site is underlain by marine / estuarine silts and clays. There may also be made ground present.

Solid Geology
The information obtained from the ERSI website indicates that the site is underlain by Dinantian Upper Impure Limestone. The limestone is of Carboniferous age and is known to be karstic in the area. Karstic features are characterised by frequent fissures and fractures or caves which can provide preferential migration routes for contaminated groundwater.

Hydrogeology

The information received from the ERSI website states that the site is located in an area where the groundwater vulnerability is shown as High to Low as an interim study took place for the production of the map. Therefore, the groundwater vulnerability and

soil class has not been determined. It is recommended that the groundwater vulnerability should be assessed as part of the observations.

Hydrology

The nearest water body is River Shannon located to the north and east of the site.

Environmental Data

Planning application details from Limerick County Council show that the following applications have been accepted in the Foynes area:

- Construction of internal two-storey extension to offices for administration use by Allied Smokeless Fuels Ltd;
- Change of use of part existing smokeless fuel manufacturing plant to a fertilizer blending plant and bulk storage facility by Albatros Fertilizers Ltd;
- Importing, exporting, storing, screening, bagging, processing/finding, of coal and construction of plants and site works by Allied Smokeless Fuels Ltd;
- Construction of factory for dismantling of petrol storage tanks and their reduction to scrap and storage of scrap in bins and installation of septic tanks by C.C.B.I Ltd;
- Construction of warehouse by Foynes Engineering Ltd;
- Construction of a shed for the purpose of storing anti-pollution equipment for the Shannon Estuary Anti-Pollution Team (SEAPT) by Shannon Foynes Port Company;
- Construction of a bulk liquid warehouse and oil terminal consisting of 14 no. oil storage tanks, loading yard area, truck wash facility, truck loading bay, car & truck parking, water storage tank, two storey operations building with proprietary foul water treatment system & outfall to estuary, single storey electrical service building with electrical sub-station and boiler house, perimeter security fence and gating, landscaping, oil pipelines and associated fittings by Inver Energy.

None of these applications relate to the study site.

Conceptual Ground Model

Sources

Historically the site was used as a coal import yard. Coal was stockpiled on concrete hardstanding. As such, there is the potential for contamination to be associated with

this area as well as coal overspill. The site was also used as a timber process yard, which again has the potential to generate contamination.

As highlighted previously, there is a concrete gully running along the eastern boundary of the site carrying surface water to the settlement tank. The water intercepted by this gully would have most probably carried coal residues. The integrity of the settlement tank should be verified.

General waste was located at various locations around the site. Waste materials included paper, plastic, card, wood, scrap metal, construction and demolition material, two chemical drums (one full and one empty) and a fridge freezer.

Construction and demolition infilling was noted in the north west corner of the building on site. This consisted of mainly broken reinforced concrete but also significant amounts of re-bar and lesser quantities of paper, plastic and wood.

Surface waste was visible in the banks surrounding the site and included papers, plastics, metals and wood.

Use	Potential Contaminants Associated with the Site and Surrounding Area	Comments
Timber Yard	Heavy metals, sulphate, asbestos, pH, phenols, oil / fuel hydrocarbons, polyaromatic hydrocarbons, chlorinated aliphatic hydrocarbons	Contaminants may have entered the ground underlying the site and have the potential to leach and migrate into groundwater present
Coal Storage	Heavy metals, sulphate, asbestos, pH, polyaromatic hydrocarbons, oil / fuel hydrocarbons	
Electricity transformer	Polychlorinated biphenyls	
Fuel Storage	Oil / fuel hydrocarbons	

Receptors
Potential receptors include:

- Current and future site / offsite users,
- Construction workers,
- Controlled waters
- Infrastructure (foundations and pipe-work),

- Landscaping / vegetation.

Pathways

Potential pathways are listed below in relation to the relevant receptors:

- Direct Contact– Site users and construction workers could come into direct contact with contamination present on site. Infrastructure and services such as water mains and foundations present within the soil matrix could be damaged by contact with contamination. Phytotoxic contaminants may be present within the soil and these may have an adverse impact on vegetation on site.
- Ingestion– Contaminants may be directly ingested e.g. through dirt on hands or ingested following inhalation if wind blown dust is present.
- Inhalation– Contaminants may be inhaled via wind blown dust or directly if the source is gaseous.
- Leaching and migration of contaminants – Contaminants may leach and migrate into uncontaminated areas of the site or offsite.
- Venting and migration of ground gas – If ground gas is being produced on site, it could migrate and vent into buildings on site or adjacent to the site. Similarly, off site gas sources could migrate to the site. This may have implications for proposed infrastructure / buildings.

Source	Pathway	Receptor	Risk	Justification
Contaminated Soil	Direct contact / ingestion / inhalation	Site users / construction workers	Medium / high	There are areas of the site that include open ground and stockpiles of material
	Leaching / migration	Controlled waters – River Shannon	Medium	Leachable contaminants may be present, open areas will allow infiltration of rainwater / surface runoff.
		Controlled waters - groundwater	Low / Medium	Alluvial deposits beneath the site may be relatively impermeable and as such may offer a degree of protection to the underlying aquifer
	Direct contact	Infrastructure	High	Infrastructure in ground such as water mains / foundations is likely to come into contact with contamination
	Direct contact	Vegetation	Medium	Potential for phytotoxic contaminants to be present within

Source	Pathway	Receptor	Risk	Justification
				growing medium
Ground Gas	Migration	Site users	Low / Medium	Unlikely to be significant quantities of biodegradable material present

Conclusions

The desk study concludes that:

- The site was previously used as a coal storage depot and a timber processing yard although the site is now derelict.
- Buildings are present in the north west of the site with a transformer and a bunded fuel storage area adjacent. The majority of the site is covered with concrete slabs or hardcore although there are areas of open ground present.
- The River Shannon is located to the east and north of the site. There is a limestone aquifer underlying the site although the groundwater vulnerability is unclear (recorded as low to high) as only an interim study has been undertaken by ERSI.
- The site history indicates the potential for contamination to exist at the site which may pose a risk to site users, controlled waters, infrastructure and vegetation.

As such, an intrusive ground investigation is recommended to determine and quantify the physical and chemical nature of the ground conditions at the site.

Yours sincerely

T. A. Smeeton

pp

Thomas Smeeton
Principal Geo-Environmental Consultant
For Mouchel

Appendix 13

Mouchel Phase 2 Report – Ground Investigation

Former Coal Storage Facility, Foynes, Limerick

Intrusive Ground Investigation Report

January 2009

Produced for
Michael Punch and Partners

Prepared by
Mouchel

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797036/R/Foynes/02

Document Control Sheet

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Report Title	Intrusive Ground Investigation Report
Revision	B
Detail	797036/R/02/A
Control Date	January 2009

Record of Issue

Issue	Detail	Author	Check	Authorised	Date
A	First Issue	S Elliott	T Smeeton	J Crowther	22/08/08
B	Second Issue	S Shaw	D Watts	J Crowther	23/01/09

Distribution

Organisation	Contact	Copies
Michael Punch and Partners	Sinead Kennedy	1

Executive Summary

Introduction	Mouchel have been commissioned by Michael Punch and Partners on behalf of their Client to undertake an intrusive ground investigation of a site in Foynes, County Limerick. The purpose of the ground investigation was to provide an indication of potential geo-environmental risks and liabilities associated with acquisition of the site and subsequent redevelopment as a waste management facility (composting).
Desk Study	A desk study was carried out at the site which identified a number of potential environmental issues which warranted further investigation.
Site Investigation	The preliminary investigation comprised the excavation of eighteen trial pits and the drilling of five rotary boreholes. Gas and groundwater monitoring wells were installed in selected installations.
Human Health Risk Assessment	The assessment identified some elevated levels of total petroleum hydrocarbons. Given that hard standing is anticipated across the majority of the active site, the direct contact pathway is considered to be broken. Therefore, the results are unlikely to pose a significant long-term risk to human health.
Potential risk to Controlled Waters	Leachable metals were encountered from leachate samples, but no elevated contaminants were identified in groundwater samples. As such the potential risks to controlled waters are considered to be low.
Conclusions	The results indicate a low risk posed to the site by contaminants present within the site.
Recommendations	The assessment undertaken indicates that the site is suitable in its current use and for the proposed use as a waste management facility assuming that this comprises hard standing and buildings only. However, should the site be redeveloped with soft landscaping or for a more sensitive end use it is recommended that further assessment is carried out to address the uncertainties this report has identified.

Contents

Appendices

797036/R/Foynes/02

1 Introduction

1.1 Background

Mouchel was commissioned by Michael Punch and Partners to undertake an environmental assessment which includes an appraisal of environmental liabilities associated with contaminated land ahead of a potential acquisition of the site by Greenport Environmental Limited.

The site is located to the east of Foynes, in County Limerick. It is understood that the site is to be acquired and redeveloped as a Waste management facility (composting).

This is an interpretative report, summarising the key findings of the assessment. It should be read in conjunction with the Phase 1 Geo-environmental Desk Study Report (report reference 797036/R/001), June 2008, produced by Mouchel.

1.2 Aims and Objectives

This report has been prepared and written based on information gained from the Phase I desk based assessment and the preliminary Phase II intrusive ground investigation conducted between the 16th June and the 20th June 2008 for due diligence purposes.

The objective is to provide an interpretation of the summarised ground conditions and potential environmental liabilities that may be incurred from the acquisition and subsequent re-development as a waste management facility (composting).

Further works may be required to facilitate the redevelopment of the site. Such work may include, but not be restricted to, ground investigations to provide detailed geotechnical properties for detailed design. If the anticipated end land changes a re-assessment will be required.

Furthermore, it should be noted that due to structures on site it was not possible to assess all areas of the site for sampling. Therefore, there may be areas of contamination that have not been encountered during this investigation.

1.3 Scope of Works

The scope of the investigation and interpretative works are detailed in our proposal (dated 09/06/08) correspondence and include:

1. Provision of an exploratory hole location plan
2. Design of ground investigation including specification and requirements for monitoring
3. Attendance and supervision of on-site works including scheduling chemical testing
4. Check and review the Contractor's factual report
5. Prepare an interpretative report suitable for due diligence purposes

1.4 Disclaimer

This report has been prepared by Mouchel on the basis of the available information received during the study period within the site boundary as provided by the client. Although every reasonable effort has been made to obtain all relevant information, all potential contamination, environmental constraints or liabilities associated with the site may not necessarily have been revealed.

The investigations works assessed in this report were designed by Mouchel Limited but were undertaken by Priority Geotechnical. Mouchel Limited did supervise the ground investigation works and identified samples for analysis for Priority Geotechnical who submitted the samples to Euro Environmental Services. However, Mouchel Limited did not supervise the monitoring work of Priority Geotechnical. As a result, Mouchel Limited is relying on the information provided by Priority Geotechnical for the production of this report.

Mouchel has also used reasonable skill, care and diligence in the design of the investigation of the site. The inherent infinite variation of ground conditions allow only definition of the actual conditions at the location and depths of exploratory holes, while at intermediate locations conditions can only be inferred.

This report has been prepared and written for the exclusive benefit of Michael Punch and Partners for the purpose of providing environmental information relevant to the environmental liability of the site, data and geotechnical constraints relevant to the redevelopment of the site. The report contents should be only be used in that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

2 Site Description

The description of the site and surrounding area including the environmental setting and background of the site is described in detail within the Mouchel Desk Study Letter Report (797036-06/06/08 Lx tcs to SK). As such this report should be viewed in conjunction with the Phase I Interpretative Geo-Environmental Assessment Desk Study Report by Mouchel issued in June 2008[1].

The below is a summary of the information obtained from the desk study report.

2.1 Site Layout and Surroundings

Approximately 10% of the site is covered by warehouse buildings (in the north west of the site) covered in plastic coated, steel cladding. The area immediately to the north, east and south of the building is covered by concrete hard standing.

At the time of the site walkover the foundations of the old weighbridge and weighbridge office are still visible on the site. Ducting, manholes and wires were still in place as were lighting towers.

There is a bunded fuel storage area approximately 10m^2 located to the east of the buildings. The fuel bund visually appears to be in good repair. Hydrocarbon staining was noted up to 0.6m above ground level on the inside walls of the bunded area. A transformer is also present.

The south west corner of the site is overgrown with grasses, with a hummocky and uneven ground surface. The underlying material comprised fine granular coal material. Fly tipping was also a problem in this area with wood, paper, plastic, metal, cardboard, one full sodium hydrochloride drum, one empty phosphoric acid solution container, ITEC procedure manuals and metal joiners for roof trusses noted during the site walkover.

A large stockpile of spoil material predominantly clay and (surface) waste is present to the east. Waste materials including concrete, wood off cuts, tyres, plastic, unidentifiable orange steel cylinder and an additional stockpile of waste material including wood, plastic, metal and paper are located to the east.

Possible coal residues were noted at various locations on the site, potentially related to historic coal storage.

2.2 Site History

Anecdotal evidence states that the site has been used for a number of industrial activities over the years including a coal yard and a timber processing facility.

2.3 Geology

Drift Geology

The information obtained from the Geological Survey of Ireland (GSI) website indicates that the site is underlain by marine / estuarine silts and clays. There may

also be made ground present which was not encountered during the ground investigation.

Solid Geology

The information obtained from the GSI website indicates that the site is underlain by Dinantian Upper Impure Limestone. The limestone is of Carboniferous age and is known to be karstic in the area. Karstic features are characterised by frequent fissures and fractures or caves which can provide preferential migration routes for contaminated groundwater.

2.4 Hydrogeology

The information received from the GSI website states that the site is located in an area where the groundwater vulnerability is shown as High to Low as an interim study took place for the assessment of this area. Therefore, the groundwater vulnerability and soil class has not been determined.

2.5 Hydrology

The nearest water body is the Robertstown River located to the north and east of the site.

3 Ground Investigation

The intrusive ground investigation was designed by a suitably qualified Mouchel Environmental Engineer. The intrusive ground investigation was undertaken during the period of 16th June to 20th June 2008.

The ground investigation intrusive works were conducted by Priority Geotechnical under the supervision of an Environmental Engineer from Mouchel and chemical analysis performed by an accredited laboratory - Euro Lab subcontracted to Priority Geotechnical.

3.1 Rationale

The initial conceptual model developed in the desk study identified a number of potential pollutant linkages and consideration of the most likely to be 'significant' has been integrated in to the development of the ground investigation with the aim of providing sufficient information to prove or disprove this in each case.

The pollutant linkages identified comprise the potential for contaminated ground to be present on site which could potentially affect site users/construction workers, controlled waters (Robertstown River and the groundwater), infrastructure and vegetation. It was also identified that ground gas may be potentially present on site which could pose a potential risk to site users through migration.

Trial pits and boreholes have been located across the site in order to provide information on the general ground conditions coverage of the site. Furthermore, trial pits and boreholes have also been located to try to identify and quantify the presence and distance that a potential leakage from the fuel storage area located near TP204 and BH102 may have migrated to affect adjacent land and buildings.

Four boreholes installations were located at the outer most four corners of the site to identify direction of groundwater flow across the site. This is to consider the potential movement of any ground contamination present on the site.

3.2 Intrusive Ground Investigations

The intrusive ground investigation was designed test the potential pollutant linkages to provide an indication of potential geo-environmental liabilities given the proposed land use of a waste management facility (composting).

Eighteen trial pits were excavated and five rotary boreholes were drilled and subsequent gas and groundwater monitoring wells were installed. A location plan of the exploratory holes can be found within Priority Geotechnical's factual report contained in Appendix D.

Bulk, small and undisturbed samples of soil were taken from exploratory holes.

Soil samples were tested for a range of contaminants identified from the desk study (contaminants of concern) and associated with the former land use.

During drilling, water ingresses were encountered at depths between 2.2 to 8.5m bgl. Other water ingresses were noted during excavation of trial pits at 5 locations. These

were all located at the eastern border of the site. Two locations encountered water levels rises from 3.2 to 2.3 m bgl (TP206) and 2.8 to 2.4m bgl (TP207).

3.3 Sampling Acquisition Protocols

All sampling was carried out in accordance with BS 5930[3] and BS 10175[2]. Soil obtained from the various excavations was examined visually, unusual odours were noted and the appearance and type of soil was recorded and logged to BS 5930[3] and Eurocode 74 standards. Soil profile logs displaying conditions encountered at each excavation are presented in Priority Geotechnical Report in Appendix A. Testing of the chemical samples was carried out in accordance with BS1377[5] and UKAS. Most of the boreholes were installed with dual 19 and 50mm installations.

A selected number of soil samples from the trial pits and boreholes and a groundwater sample were taken from boreholes RC101, RC102 and RC103 (referred to in the factual report as: BH102, BH103 and BH104) and were sent for analysis for the identified contaminants of concern.

Three ground gas monitoring visits and one groundwater sampling visit have been conducted by Priority Geotechnical.

All results can be viewed in the Priority Geotechnical Report in Appendix A of this report (chemical analytical results in Appendix B and ground gas monitoring results are within section 5.2 of the Priority report).

3.4 Ground Conditions

The ground investigation encountered three main strata types during the investigation. The borehole logs providing a detailed description of the encountered ground conditions and are contained within Priority Geotechnical Report in Appendix A of this report and have been summarised in the table below:

Table 3.4: Summarised Ground Conditions

Stratum	Description	Min depth (m)	Max depth (m)
1	***MADE GROUND: slightly clayey slightly sandy gravely COBBLES and sandy GRAVEL with reinforced concrete slabs***	***0***	***2.45***
2	***NATURAL GROUND: soft to slightly sandy slightly gravely CLAY***	***0.2***	***8.0***
3	***NATURAL GROUND: soft blue / grey peaty CLAY***	***1.1***	***3.5***
4	***NATURAL GROUND: Slightly sandy slightly gravely SILT***	***3.5***	***4.5***

Stratum	Description	Min depth (m)	Max depth (m)
5	*NATURAL GROUND: slightly clayey gravely SAND*	*0.6*	*1.5*
6	*NATURAL GROUND: Very silty very sandy GRAVEL*	*2.0*	*5.0*
7	*NATURAL GROUND: Clayey sandy gravely COBBLES*	*0.65*	*3.3*
8	*Dinantian Upper Impure LIMESTONE*	*2.0*	*10.4**

*Base of Rotary Core

4 Environmental Appraisal

4.1 Introduction and framework of assessment

The UK approach has been selected as the most appropriate method in the absence of such an established risk assessment process in Ireland.

4.2 Purpose and Criteria of Assessment

The investigation was carried out in order to confirm or discount the potential pollutant linkages identified in the Phase I interpretative Geo-Environmental Assessment Desk study for due diligence purposes. The below results are presented as a Tier 1 Generic Assessment.

4.2.1 Soils

Chemical analysis results were screened against Generic Assessment Criteria (GAC), derived by LQM (Land and Quality Management) and the Chartered Institute of Environmental Heath (CIEH)[6] using CLEA UK, following guidance from the EA (Environment Agency) and DEFRA (Department for Environment Food and Rural Affairs). Remaining GACs have been derived by Mouchel using CLEA UK and the same guidance. This was to provide a Tier 1 Quantitative Risk Assessment of the potential harm to human health generated from encountered ground contamination.

Total Petroleum Hydrocarbon (TPH) C10-C36 was reported as total in the laboratory results. Therefore, the most conservative GAC chemical determinant has been used to assess the worst case scenario. This was also carried out for Volatile Organic Carbons (VOC)'s, semi VOC's and Polychlorinated biphenyls (PCBs) determinants.

4.2.2 Groundwater

The chemical results were assessed to calculate any potential environmental liabilities.

Analytical results were screened against EQS (Environmental Quality Standards) for a marine, estuarine and coastal, with a hardness of 200-250 mg/l. Dutch intervention values (DIV) have also been used to screen the analytical results, alongside non European standards.

4.2.3 Leachate

Leachate samples were analysed against the same criteria as for groundwater.

4.2.4 Waste Acceptance Criteria

A representative sample from the stockpile TP202a and TP203 was screened in line with the UK Waste Acceptance Criteria (WAC). This assessment indicated that the material was non hazardous.

4.2.5 Ground Gas

During monitoring flow and atmospheric pressure were not recorded so it is not possible to undertake an assessment in line with current best practice.

4.3 Generic Quantitative Risk Assessment

4.3.1 Human Health: Soils

Analysis results for samples TP212 0.6-0.7, TP212 1.5-1.6, TP213 1.5-1.6 and TP206 1.0-1.5m showed exceedences in TPH C10-C36 when compared to the appropriate GAC as described in 4.2.1.

4.3.2 Controlled Waters: Groundwater

There were no exceedances identified in relation to EQS. Selenium was recorded as elevated in boreholes BH102 and BH103 when compared to the US EPA (2006) National Recommended Water Quality Criteria (CCC) of 5µg/l. Free cyanide was found to be elevated in all samples in comparison to the proposed EQS - Annual Average (R&D Technical Summary PS310) of 1µg/l. The screening results can be viewed in Appendix B of this report.

4.3.3 Controlled Waters: Leachate

Exceedences were noted for a range of determinants in multiple samples, over a range of depths. The summarised results of both DIV and EQS are presented in the following tables a full set of the chemical screening results are recorded in Appendix B.

Table 4.3.3a: Summarised exceedence of EQS from leachability analysis

Determinants	Screening Value	units	Number of sample exceedences	Concentration Ranges above Screening Value (µg/l)	Depth range (mbgl)
As	25	µg/l	20	26-235	0.2-3.0
Cd	5	µg/l	34	26-59	0.2-3.0
Cr	30	µg/l	25	38-595	0.2-3.0
Cu	30	µg/l	4	31-183	0.5-1.5
Hg	1	µg/l	15	6-47	0.2-1.5
Ni	50	µg/l	11	25-616	0.-1.6
Pb	10	µg/l	6	12-52	0
Zn	100	µg/l	13	108-1691	1.5-1.6

Table 4.3.3b: Summarised exceedence of DIV from leachability analysis

Determinants	Screening Value	units	Number of sample exceedences	Concentration Ranges above Screening Value (µg/l)	Depth range (mbgl)
As	60	µg/l	20	26-235	0.2-3.0
Cd	6	µg/l	34	26-59	0.2-3.0
Cr	30	µg/l	25	38-595	0.2-3.0
Cu	75	µg/l	4	31-183	0.5-1.5
Hg	0.3	µg/l	15	6-47	0.2-1.5
Ni	75	µg/l	11	25-616	0.-1.6
Pb	75	µg/l	0	-	-
Zn	800	µg/l	1	108-1691	1.5-1.6

Summary of potential risk to controlled waters

As noted previously, the site's groundwater vulnerability has not been assessed and it is not known if the area is located within a Source Protection Zone (SPZ). No water abstraction points are known to be located within the area. The nearest water course is located 200m of the site (North East). Therefore, the potential risk to ground water at this time is deemed to be low to medium in relation to the risk matrix detailed in CIRIA 522[7].

Due to the location of the water course this is not thought to pose a significant risk to the study site but may pose a risk to adjacent land.

4.3.4 *Ground Gas*

The limited ground gas monitoring conducted by Priority Geotechnical did not reveal any elevated levels of ground gas. It is however extremely unlikely that, bearing in mind the proposed use of the site, risks in this context will be other than low.

5 Revised Conceptual Ground Model

5.1 Introduction

The initial conceptual ground model from the Phase I desk study[1] identified significant pollutant linkages from the coal stockpiles, timber yard process, the fuel storage tank and settlement ponds located on the site.

Following the intrusive ground investigation the described Conceptual Ground Model (CGM) for the site has been revised and assessed to identify the potential liabilities and risks to human health and the environment associated with the acquisition and subsequent redevelopment of the site as a waste management facility (composting).

5.2 Source

Due to scheduling problems with the laboratory, testing was not carried out for metal determinands in soil. As such it is not currently possible to provide a robust assessment of the risk of these contaminants.

Within the made ground there was one elevated contaminant recorded on site. The contaminant present in concentrations where the Chartered Institute of Environmental Health's Generic Assessment Criteria (CIEH GACs) for commercial use criteria was Total Petroleum Hydrocarbon (TPH) C10-C36. However, the most conservative determinant was used which was aromatic C5-C7 at 1% soil organic matter (SOM). For a more robust assessment the individual species should need to be assessed which may prove to reduce the risk associated with TPH contamination.

Groundwater results indicated elevated concentrations of selenium and free cyanide. However, selenium does not have an EQS and so is not viewed as a contaminant of concern in European groundwaters. In addition, Mouchel would raise concerns about the use of a colorimeter for environmental testing. This is not a recognised or accredited method and as such we would recommend that advice be sought from the Environmental Protection Agency as to whether this is appropriate.

Leachate analysis revealed that there were exceedances of standard metal suite contaminants which were present in the soil underlying the site, or had the potential to leach into groundwater in concentrations exceeding the screening values. The concentrations of these metals were recorded in many samples across the site, showing a need for further assessment. The close proximity of the Robertstown River may mean that it is at risk from the leachate contamination found to be present on site.

No elevated concentrations of ground gas were recorded during the monitoring. However, monitoring has not been carried out in accordance with best practice so risks, although anticipated to be low, cannot be discounted entirely.

5.3 Pathway

The exceedances of TPH's found on site are located within 0.6m bgl from the surface and due to its close proximity to potential receptors; they are likely to be at risk dermal, ingestion and inhalation pathways.

No sources of contamination were identified from groundwater and ground gas samples. Elevated concentrations of metals were identified in leachate samples, but were not encountered within the groundwater samples. However, the potential is there for such contaminant to leach into the groundwater.

5.4 Receptor

Key identified potential receptors were:

- Future site users – human health risk
- Surrounding water courses including the Robertstown River
- Building Structures
- Groundwater abstractions (SPZ)

Based on information collated during the intrusive ground assessment, coupled with analysis of all chemical data pertaining to the site and with the understanding that the site will be redeveloped a reassessment of conceptual ground model has been undertaken, as summarised in Table 5.4a overleaf.

Table 5.4a: Summarised Potential Risk and Environmental Liability						
Source	**Pathway**	**Receptor**	**Consequence**	**Probability**	**Risk**	**Justification**
Contaminated Ground	Direct contact	Future Site users	Medium	Unlikely	Low	The site comprises mainly hardstanding, thereby reducing the potential linkage between source and receptor
	Ingestion		Medium	Unlikely	Low	
	Inhalation		Medium	Unlikely	Low	
	Leaching / Migration	Controlled waters - Surface waters	Medium	Unlikely	Low	Elevated leachable metal contaminants identified, however, the underlying silt and clays may attenuate the contaminants. No elevated contaminants within groundwater samples. If conditions remain the same with hard standing then it is unlikely that infiltration will facilitate the movement of these leachable contaminants.
		Building structures & services	Mild	Unlikely	Very Low	Contaminants are unlikely to be able to permeate service pipes, polluting water supplies or damage building infrastructure.
Ground Gas	Migration	Site users & Building structures	Medium	Unlikely	Low	No significant quantities of biodegradable material present and no elevated concentrations of ground gas were recorded.
Overall Sensitivity/Risk to on site receptors	**Low risk**					

The risk is assessed using the Table 5.4b below, derived from guidance of CIRIA C552[7]:-

Table 5.4b: Determination of overall potential risk - Source Risk Category

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very High Risk	High risk	Moderate risk	Moderate /low risk
	Likely	High Risk	Moderate risk	Moderate/ low risk	Low risk
	Low Likelihood	Moderate risk	Moderate /low risk	Low risk	Very low risk
	Unlikely	Moderate/Low risk	Low risk	Very low risk	Very low risk

The different risk categories are summarised below:

High	– Action must be taken to reduce the risk which is judged to be too high.
Moderate	– There is sufficient evidence to suggest that there may be an unacceptable risk. Further work is needed before this can be rejected or accepted.
Low	– There is a low risk to the identified receptors, which should still be addressed with the aim of reducing the risk to a minimal acceptable level.

6 Conclusions and Recommendations

Based on the findings of this assessment, the following conclusions and recommendations are proposed:

6.1 Conclusions

The results of the assessment indicate that there is a low risk posed to the site by contaminants present.

The findings and assessment carried out indicate that the site is suitable for use in its current state and in its proposed use as a waste compositing site assuming that this will comprise mainly buildings and hard standing.

6.2 Recommendations

The assessment undertaken indicates that the site is suitable in its current use and its proposed use. However, should the site be redeveloped to include areas of soft landscaping or for a more sensitive end use it is recommended that further assessment is carried out to address the uncertainties this report has identified.

References

[1] Mouchel (April 2008) Phase I Interpretative Geo Environmental Assessment Desk Study Report: Kingston Park Material Recycling Facility, Mouchel

[2] British Standards Institute (2001), BS10175: Investigation of Potentially Contaminated Land - Code of Practice

[3] British Standards Institute (1999). BS5930: Code of Practice for Site Investigations

[4] Eurocode 7 (2007): Geotechnical design – Part 2: Ground investigation and testing

[5] British Standards Institute (1990). BS1377: Methods of test for Soils for Civil Engineering Purposes

[6] Nathanail, C.P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillett, A., Hooker, P. and Ogden, R.C. (2007). Generic Assessment Criteria for Human Health Risk Assessment, Land Quality Press, Nottingham.

[7] Rudland, D, J., Lancefield R.M. and Mayell P.N. (2001) Contaminated Land Risk Assessment. A Guide to Good Practice (C552), CIRIA

APPEDNIX A – PRIORITY GEOTECHNICAL LTD FACTUAL REPORT

See Appendix 11 of the EIS

APPENDIX B – CHEMICAL SCREENING RESULTS

See over

ANALYSIS OF GROUNDWATER - Foynes, 797036

Screening Values - Environmental Quality Standards

Receptor water type: Freshwater suitable for all fishlife / game fish / coarse fish
Receptor water hardness: mg/l
Relevant EQS Hardness Band: <250 mg/l

* Hardness related Freshwater EQS - based on cyprinid/coarse fish

Concentration exceeds screening value
Concentraion exceeds screening value becaue limit of detection is greater than screening value

					Ground type			
					Borehole	BH103	BH104	BH102
					Depth (mbgl)	1.07	2.75	0.82
Determinand	**Units**	Method Detection Limit	**Screening Value (ug/l)**		**Source of screening value**			
			Freshwater	Coastal/Estuary/ Marine				
Inorganics								
Arsenic (dissolved)	ug/l		50	25	EQS List II - Annual Average	4	2	-
Boron (dissolved)	ug/l		2000	7000	EQS List II - Annual Average	178	174	359
Cadmium (dissolved)	ug/l		-	2.5	EQS List I	0.09	0.09	0.09
Chromium (dissolved)	ug/l		250	15	EQS List II - Annual Average	0.93	0.93	0.93
Copper (dissolved)	ug/l		10	5	EQS List II - Annual Average	2	1	7
Lead (dissolved)	ug/l		250	25	EQS List II - Annual Average	0.38	0.38	0.38
Nickel (dissolved)	ug/l		250	30	EQS List II - Annual Average	10	5	5
Selenium (dissolved)	ug/l		5	71	US EPA (2006) National Recommended Water Quality Criteria (CCC)	14	5	4
Zinc (dissolved)	ug/l		250	40	EQS List II - Annual Average	82	41	43
Mercury (dissolved)	ug/l		-	0.3	EQS List I	0.2	0.2	0.2
Sulphate (soluble)	ug/l		400000	-	Proposed EQS - Annual Average (R&D Technical Summary P2-115/TS1)	93130	34560	30110
Phenols	ug/l		4	-	Canadian Environmental Quality Guidelines, updated 2001	0.1	0.1	-
Free Cyanide	ug/l		1		Proposed EQS - Annual Average (R&D Technical Summary PS310)	5	18	25
pH Value	ug/l		>6	>6	EQS List II - 95th Percentile	6.8	7.2	7.7
pH Value	ug/l		<9	<8.5	EQS List II - 95th Percentile	6.8	7.2	7.7
Aliphatics C5-C6	ug/l		-	-	-	0.01	0.01	-
Aliphatics C6-C8	ug/l		-	-	-	0.01	0.01	-
Aliphatics C8-C10	ug/l		-	-	-	0.01	0.01	-
Aliphatics C10-C12	ug/l		-	-	-	0.01	0.01	-
Aliphatics C12-C16	ug/l		-	-	-	0.01	0.01	-
Aliphatics C16-C21	ug/l		-	-	-	0.01	0.01	-
Aliphatics C21-C35	ug/l		-	-	-	0.01	0.01	-
Aromatics C6-C7	ug/l		-	-	-	0.01	0.01	-
Aromatics C7-C8	ug/l		-	-	-	0.01	0.01	-
Aromatics 8-10	ug/l		-	-	-	0.01	0.01	-
Aromatics 10-12	ug/l		-	-	-	0.01	0.01	-
Aromatics 12-16	ug/l		-	-	-	0.01	0.01	-
Aromatics 16-21	ug/l		-	-	-	0.01	0.01	-
Aromatics 21-35	ug/l		-	-	-	0.01	0.01	-
TPH (Aliphatics and Aromatics C5-C35)	ug/l		-	-	-	0	0	-
PAHs								
2-Chloronaphthalene	ug/l		-	-	-	10	10	-
2-Methylnaphthalene	ug/l		-	-	-	10	10	-
Acenaphthene	ug/l		5.8	-	Interim Guideline, 1999 - Canadian Environmental Quality Guidelines (updated 2001)	0.01	0.01	-
Acenaphthylene	ug/l		-	-	-	0.01	0.01	-
Anthracene	ug/l		0.012	-	Interim Guideline, 1999 - Canadian Environmental Quality Guidelines (updated 2001)	0.01	0.01	-
Benzo(a)anthracene	ug/l		0.018	-	Interim Guideline, 1999 - Canadian Environmental Quality Guidelines (updated 2001)	0.01	0.01	-
Benzo(a)pyrene	ug/l		0.015	-	Interim Guideline, 1999 - Canadian Environmental Quality Guidelines (updated 2001)	0.01	0.01	-
Benzo(b)fluoranthene	ug/l		-	-	-	0.01	0.01	-
Benzo(ghi)perylene	ug/l		-	-	-	0.01	0.01	-
Benzo(k)fluoranthene	ug/l		-	-	-	0.01	0.01	-
Chrysene	ug/l		-	-	-	0.01	0.01	-
Dibenzo(ah)anthracene	ug/l		-	-	-	0.01	0.01	-
Fluoranthene	ug/l		0.04	-	Interim Guideline, 1999 - Canadian Environmental Quality Guidelines (updated 2001)	0.01	0.01	-

ANALYSIS OF GROUNDWATER - Foynes, 797036

Screening Values - Environmental Quality Standards

Receptor water type: Freshwater suitable for all fishlife / game fish / coarse fish
Receptor water hardness: mg/l
Relevant EQS Hardness Band: <250 mg/l

* Hardness related Freshwater EQS - based on cyprinid/coarse fish

Concentration exceeds screening value
Concentraion exceeds screening value becaue limit of detection is greater than screening value

					Ground type			
					Borehole	BH103	BH104	BH102
					Depth (mbgl)	1.07	2.75	0.82
Determinand	**Units**	Method Detection Limit	**Screening Value (ug/l)**		**Source of screening value**			
			Freshwater	Coastal/Estuary/ Marine				
Fluorene	ug/l		3	-	Interim Guideline, 1999 - Canadian Environmental Quality Guidelines (updated 2001)	0.01	0.01	-
Indeno(123cd)pyrene	ug/l		-	-	-	0.01	0.01	-
Naphthalene	ug/l		10	5	EQS List II - Annual Average	0.01	0.01	-
Phenanthrene	ug/l		0.4	-	Interim Guideline, 1999 - Canadian Environmental Quality Guidelines (updated 2001)	0.01	0.01	-
Pyrene	ug/l		0.025	-	Interim Guideline, 1999 - Canadian Environmental Quality Guidelines (updated 2001)	0.01	0.01	-
Total PAH	ug/l		-	-	-	0	0	-
Phenols								
2-Nitrophenol	ug/l		-	-	-	0.01	0.01	-
2,4-Dichlorophenol	ug/l		20	20	EQS List II - Annual Average	10	10	-
2,4-Dimethylphenol	ug/l		-	-	-	10	10	-
2,4,6-Trichlorophenol	ug/l		18	-	1987 - Canadian Environmental Quality Guidelines (updated 2001)	10	10	-
4-Chloro-3-methylphenol	ug/l		40	40	EQS List II - Annual Average	10	10	-
4-Nitrophenol	ug/l		-	-	-	10	10	-
Pentachlorophenol	ug/l		2	2	EQS List I	50	50	-
Other Semi-volatiles								
1,2-Dichlorobenzene	ug/l		0.7	42	Interim Guideline, 1997 - Canadian Environmental Quality Guidelines (updated 2001)	1	1	-
1,2,4-Trichlorobenzene	ug/l		24	5.4	Interim Guideline, 1997 - Canadian Environmental Quality Guidelines (updated 2001)	2.5	2.5	-
1,4-Dichlorobenzene	ug/l		26	-	Interim Guideline, 1997 - Canadian Environmental Quality Guidelines (updated 2001)	1	1	-
Hexachlorobenzene	ug/l		0.03	0.03	EQS List I	1	1	-
1.1.1-Trichloroethane	ug/l		100	100	EQS List II - Annual Average	1	1	1
1.1.2-Trichloroethane	ug/l		400	300	EQS List II - Annual Average	1	1	1
1.2.3-Trichlorobenzene	ug/l		0.4	0.4	EQS List I (Trichlorobenzene)	2.5	2.5	2.5
1.2-Dichloroethane	ug/l		10	10	EQS List I	2.5	2.5	2.5
1.2-Dichloropropane	ug/l		-	-	-	2.5	2.5	2.5
Chlorobenzene	ug/l		1.3	25	Interim Guideline, 1997 - Canadian Environmental Quality Guidelines (updated 2001)	1	1	1
Chloroform	ug/l		12	12	EQS List I	1	1	1
Dichloromethane	ug/l		2	2	Proposed EQS - Annual Average (R&D Technical Report P2-115/TR6)	1	1	1
Tetrachloromethane	ug/l		12	12	EQS List I (Listed as Carbon Tetratchloride)	1	1	1
Tetrachloroethene	ug/l		10	10	EQS List I (Listed as Perchlorethylene)	1	1	1
trans-1-2-Dichloroethene	ug/l		-	-	-	1	1	1
trans-1-3-Dichloropropene	ug/l		-	-	-	1	1	1
Trichloroethene	ug/l		10	10	EQS List I	1	1	1
Vinyl Chloride	ug/l		-	-	-	0.5	0.5	0.5

Foynes Soil Screening Assessment

ParameterName	Determinand	Units	Screening Value	Source	Check	Sample Units	TP203 1_7 1_8 (PC8056)	TP204 0_5 0_6 (PC8056)	TP205 0_2 0_3 (PC8056)	TP205 1_5 1_6 (PC8056)	TP206 0_5 0_6 (PC8056)	TP202 0_3 0_4 (PC8056)	TP202A 0_5-0_6 (PC8056)	TP203 0_2 0_3 (PC8056)	TP203 1_2 1_3 (PC8056)	BH103 0_5-0_6	BH103 1_5-1_6	BH104 2_2
Asbestos Screening	No Asbestos Detected					N/A			N/D		N/D	N/D				N/D		
Acenaphthene (Soil)	Acenaphthene 1% SOM	mg/kg	181.88	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Acenaphthylene (Soil)	Acenaphthylene 1% SOM	mg/kg	94.1	Mouchel CLEA derived GAC	ok	mg/Kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene (Soil)	Anthracene 1% SOM	mg/kg	307958.48	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzo(a)anthracene (soil)	Benzo(a)anthracene 1% SOM	mg/kg	280.68	Mouchel CLEA derived GAC	ok	mg/Kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)-pyrene (Soil)	Benzo(a)pyrene 1% SOM	mg/kg	29.7	LQM/CIEH derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzo(b)-fluoranthene (Soil)	Benzo(b)fluoranthene 1% SOM	mg/kg	283.13	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzo(ghi)perylene (soil)	Benzo(ghi)perylene 1% SOM	mg/kg	2817.47	Mouchel CLEA derived GAC	ok	mg/Kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)-fluoranthene (Soil)	Benzo(k)fluoranthene 1% SOM	mg/kg	283.55	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chrysene (Soil)	Chrysene 1% SOM	mg/kg	279.86	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dibenzo(a,h)anthracene (soil)	Dibenzo(ah) anthracene 1% SOM	mg/kg	29.7	LQM/CIEH derived GAC	ok	mg/Kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene (Soil)	Fluoranthene 1% SOM	mg/kg	55891.24	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50		<0.50	<0.50	<0.50
Fluorene (Soil)	Fluorene 1% SOM	mg/kg	59000	LQM/CIEH derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Indeno(1, 2, 3-cd)pyrene (Soil)	Indeno(123cd)pyrene 1% SOM	mg/kg	284.5	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Naphthalene (Soil)	Naphthalene 1% SOM	mg/kg	290	DRAFT SGV Commercial / industrial	ok	mg/Kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenanthrene (Soil)	Phenanthrene 1% SOM	mg/kg	27788.23	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Pyrene (Soil)	Pyrene 1% SOM	mg/kg	42604.12	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
pH (Soil)	Alkaline pH	pH units	9	screen - looking at alkalinity	ok	pH Units	7.0	8.1	8.3	8.3	8.2	7.4	7.5	7.4	7.2			
TPH C10-C36 (Soil)	Aromatic C5-C7 1% SOM	mg/kg	26.90	LQM/CIEH derived GAC	Exceedences	mg/Kg			3.6	2.2		<0.00050	<0.00050	<0.00050	<0.00050	1		2.9
VOC (Solid)	Vinyl Chloride 1% SOM	mg/kg	0.06	LQM/CIEH derived GAC	ok	ug/Kg					<1	<1						
Semi VOC (Solid)	Hexachlorobutadiene 1% SOM	mg/kg	1.98	LQM/CIEH derived GAC	ok	mg/Kg					<1	<1						
PCB's (Soil)	Dioxins, furans, dioxin like PCBs 1	mg/kg			ok	mg/Kg												

Foynes Soil Screening Assessment

ParameterName	Determinand	Units	Screening Value	Source	Check	Sample Units	BH104 2_5-3_0	TP207 0_5 0_6	TP207 1_4 1_7	TP209 0_4 0_5	TP210 0_3-0_4	TP211 0_4 0_5	TP212 0_6 0_7	TP212 1_5 1_6	TP213 1_5-1_6	TP213 0_5 0_6	TP214 0_1 0_2	TP215 0_4 0_5
Asbestos Screening	No Asbestos Detected					N/A				N/D	N/D		N/D					
Acenaphthene (Soil)	Acenaphthene 1% SOM	mg/kg	181.88	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Acenaphthylene (Soil)	Acenaphthylene 1% SOM	mg/kg	94.1	Mouchel CLEA derived GAC	ok	mg/Kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene (Soil)	Anthracene 1% SOM	mg/kg	307958.48	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzo(a)anthracene (soil)	Benzo(a)anthracene 1% SOM	mg/kg	280.68	Mouchel CLEA derived GAC	ok	mg/Kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)-pyrene (Soil)	Benzo(a)pyrene 1% SOM	mg/kg	29.7	LQM/CIEH derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzo(b)-fluoranthene (Soil)	Benzo(b)fluoranthene 1% SOM	mg/kg	283.13	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzo(ghi)perylene (soil)	Benzo(ghi)perylene 1% SOM	mg/kg	2817.47	Mouchel CLEA derived GAC	ok	mg/Kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)-fluoranthene (Soil)	Benzo(k)fluoranthene 1% SOM	mg/kg	283.55	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chrysene (Soil)	Chrysene 1% SOM	mg/kg	279.86	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dibenzo(a,h)anthracene (soil)	Dibenzo(ah) anthracene 1% SOM	mg/kg	29.7	LQM/CIEH derived GAC	ok	mg/Kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene (Soil)	Fluoranthene 1% SOM	mg/kg	55891.24	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluorene (Soil)	Fluorene 1% SOM	mg/kg	59000	LQM/CIEH derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Indeno(1, 2, 3-cd)pyrene (Soil)	Indeno(123cd)pyrene 1% SOM	mg/kg	284.5	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Naphthalene (Soil)	Naphthalene 1% SOM	mg/kg	290	DRAFT SGV Commercial / industrial	ok	mg/Kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.50	<0.50	<0.50
Phenanthrene (Soil)	Phenanthrene 1% SOM	mg/kg	27788.23	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.05	<0.05	<0.05
Pyrene (Soil)	Pyrene 1% SOM	mg/kg	42604.12	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
pH (Soil)	Alkaline pH	pH units	9	screen - looking at alkalinity	ok	pH Units												
TPH C10-C36 (Soil)	Aromatic C5-C7 1% SOM	mg/kg	26.90	LQM/CIEH derived GAC	Exceedences	mg/Kg		2.6		3.4	3.1	23	34	69	103			
VOC (Solid)	Vinyl Chloride 1% SOM	mg/kg	0.06	LQM/CIEH derived GAC	ok	ug/Kg		<1		<1	<1						<1	
Semi VOC (Solid)	Hexachlorobutadiene 1% SOM	mg/kg	1.98	LQM/CIEH derived GAC	ok	mg/Kg		<1		<1	<1						<1	
PCB's (Soil)	Dioxins, furans, dioxin like PCBs 1	mg/kg			ok	mg/Kg												

Foynes Soil Screening Assessment

ParameterName	Determinand	Units	Screening Value	Source	Check	Sample Units	TP216 0_7-0_8	TP217 0_5 0_6	TP218 0_5-0_6	TP218 0_7-0_8	TP201 0_4-0_5	BH104 0_5	Stockpile	TP204 0_4 0_5	TP206 1_0 1_5	TP208 0_3 0_4	TP202A 1.5_1.6
Asbestos Screening	No Asbestos Detected					N/A		N/D	N/D			N/D					
Acenaphthene (Soil)	Acenaphthene 1% SOM	mg/kg	181.88	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50		<0.50	<0.50	<0.50	
Acenaphthylene (Soil)	Acenaphthylene 1% SOM	mg/kg	94.1	Mouchel CLEA derived GAC	ok	mg/Kg	<0.05	<0.05	<0.05	<0.05	<0.05	0.084		0.513	<0.05	<0.05	
Anthracene (Soil)	Anthracene 1% SOM	mg/kg	307958.48	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50		1.20	<0.50	<0.50	
Benzo(a)anthracene (soil)	Benzo(a)anthracene 1% SOM	mg/kg	280.68	Mouchel CLEA derived GAC	ok	mg/Kg	<0.5	<0.5	<0.5	<0.5	<0.5	3.62		12.516	0.995	2.607	
Benzo(a)-pyrene (Soil)	Benzo(a)pyrene 1% SOM	mg/kg	29.7	LQM/CIEH derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	7.971		24.813	1.324	3.745	
Benzo(b)-fluoranthene (Soil)	Benzo(b)fluoranthene 1% SOM	mg/kg	283.13	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	8.471		41.51	1.734	2.828	
Benzo(ghi)perylene (soil)	Benzo(ghi)perylene 1% SOM	mg/kg	2817.47	Mouchel CLEA derived GAC	ok	mg/Kg	<0.5	<0.5	<0.5	<0.5	<0.5	3.911		18.765	1.099	1.617	
Benzo(k)-fluoranthene (Soil)	Benzo(k)fluoranthene 1% SOM	mg/kg	283.55	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	6.28		30.18	1.246	2.051	
Chrysene (Soil)	Chrysene 1% SOM	mg/kg	279.86	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	2.371		13.572	0.845	1.865	
Dibenzo(a,h)anthracene (soil)	Dibenzo(ah) anthracene 1% SOM	mg/kg	29.7	LQM/CIEH derived GAC	ok	mg/Kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		6.446	0.644	1.985	
Fluoranthene (Soil)	Fluoranthene 1% SOM	mg/kg	55891.24	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	0.547		12.264	<0.50	<0.50	
Fluorene (Soil)	Fluorene 1% SOM	mg/kg	59000	LQM/CIEH derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50		12.264	<0.50	<0.50	
Indeno(1, 2, 3-cd)pyrene (Soil)	Indeno(123cd)pyrene 1% SOM	mg/kg	284.5	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	15.085		26.297	1.849	6.31	
Naphthalene (Soil)	Naphthalene 1% SOM	mg/kg	290	DRAFT SGV Commercial / industrial	ok	mg/Kg	<0.50	<0.05	<0.05	<0.05	<0.05	<0.05		0.192	0.546	0.835	
Phenanthrene (Soil)	Phenanthrene 1% SOM	mg/kg	27788.23	Mouchel CLEA derived GAC	ok	mg/Kg	<0.05	<0.50	<0.50	<0.50	<0.50	<0.50		2.549	0.582	0.834	
Pyrene (Soil)	Pyrene 1% SOM	mg/kg	42604.12	Mouchel CLEA derived GAC	ok	mg/Kg	<0.50	<0.50	<0.50	<0.50	<0.50	0.751		12.424	0.79	0.727	
pH (Soil)	Alkaline pH	pH units	9	screen - looking at alkalinity	ok	pH Units								10.1	8.5		
TPH C10-C36 (Soil)	Aromatic C5-C7 1% SOM	mg/kg	26.90	LQM/CIEH derived GAC	Exceedences	mg/Kg	1.8		2	5.8	4.3			19.8	44		2.2
VOC (Solid)	Vinyl Chloride 1% SOM	mg/kg	0.06	LQM/CIEH derived GAC	ok	ug/Kg	<1	37	23	26	32			36.612			
Semi VOC (Solid)	Hexachlorobutadiene 1% SOM	mg/kg	1.98	LQM/CIEH derived GAC	ok	mg/Kg	<1							<1			
PCB's (Soil)	Dioxins, furans, dioxin like PCBs 1	mg/kg			ok	mg/Kg					<1		<1				

Appendix 14

Extract from Environmental Protection Agency (EPA) Database

Station No: 0900
River Code: 24A01
Situated On: AHACRONANE
Location: Bridge S.W. of Barrigone
Hydrometric Area: Shannon Estuary South
Chemical Data Available For:

2001 to 2003
1998 to 2000

Biological Data:

YEAR	QUALITY
2002	3
1999	3
1996	3
1993	3
1989	3

Close Window

Station No: 2000
River Code: 24S02
Situated On: SHANAGOLDEN STREAM
Location: Br NW of Stokesfield
Hydrometric Area: Shannon Estuary South
Chemical Data:

Unavailable

Biological Data:

YEAR	QUALITY
2002	3-4*
1999	4
1994	3-4
1989	3

Close Window

Station No: 0900 **Location:** Bridge S.W. of Barrigone **Date From:** 2001 **To:** 2003

A value displayed in **BOLD** indicates the value falls outside either an upper or lower threshold and highlights stations where there may be water quality problems.

Parameter	Parameter Units	Minimum	Median	Maximum	No of Samples	Source	Source Type
B.O.D	mg O21-1	**<2.0**	**<2.0**	**4.1**	32	Limerick Co Co	LA
Conductivity	µS cm-1	610	626	660	8	Limerick Co Co	LA
Ortho-Phosphate	mg P 1-1	**0.00**	**0.03**	**0.08**	32	Limerick Co Co	LA
Oxidised Nitrogen	mg N 1-1	**0.1**	**8.7**	**14.7**	32	Limerick Co Co	LA
pH		**7.3**	**8.1**	**8.4**	32	Limerick Co Co	LA
Temperature	oC	**6.1**	**11.1**	**17.6**	32	Limerick Co Co	LA
Total Ammonia	mg N 1-1	**<0.02**	**0.03**	**0.12**	32	Limerick Co Co	LA

Close Window

Station No: 0900 **Location:** Bridge S.W. of Barrigone **Date From:** 1998 **To:** 2000

A value displayed in **BOLD** indicates the value falls outside either an upper or lower threshold and highlights stations where there may be water quality problems.

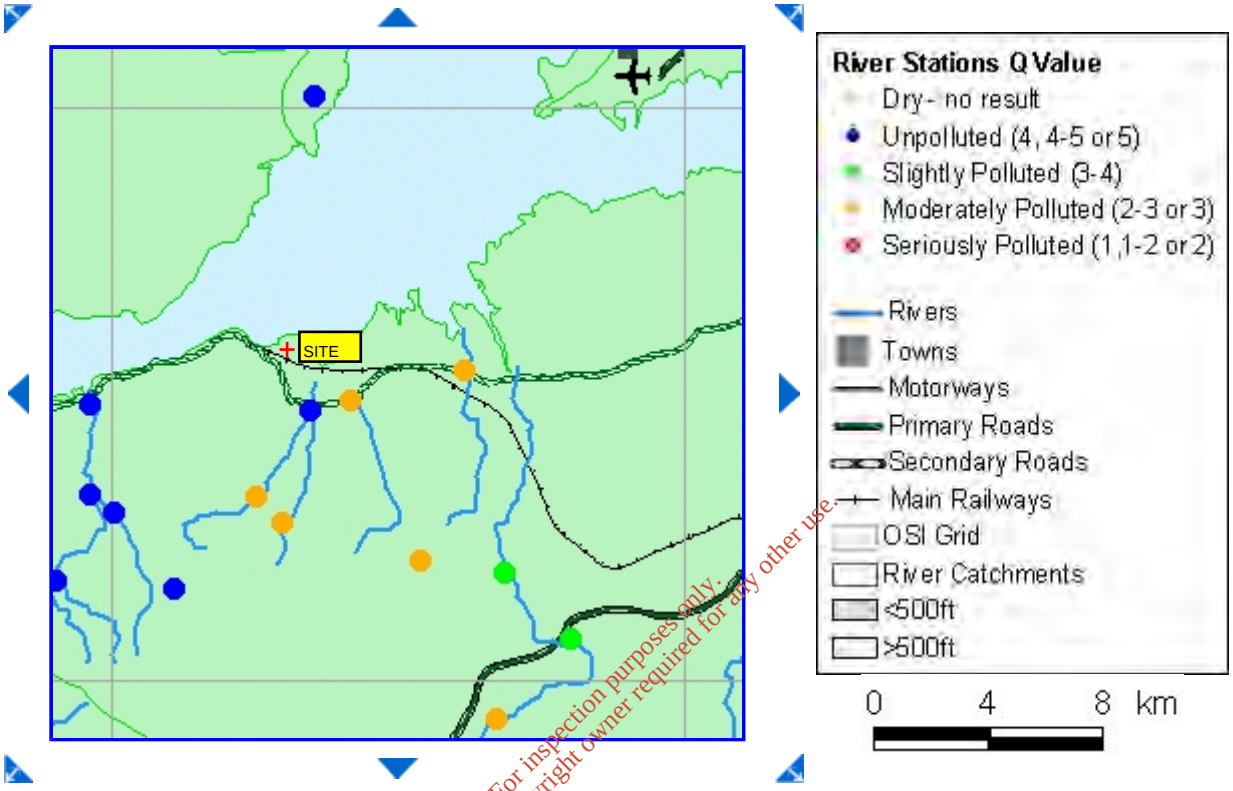
Parameter	Parameter Units	Minimum	Median	Maximum	No of Samples	Source	Source Type
B.O.D	mg O21-1	**<2.0**	**<2.0**	**<2.0**	10	Limerick Co Co	LA
Ortho-Phosphate	mg P 1-1	**0.01**	**0.03**	**0.05**	10	Limerick Co Co	LA
pH		**7.5**	**8.0**	**8.7**	10	Limerick Co Co	LA
Temperature	oC	**6.7**	**11.2**	**14.9**	10	Limerick Co Co	LA
Total Ammonia	mg N 1-1	**<0.02**	**0.02**	**0.09**	10	Limerick Co Co	LA

Close Window

EPA Water Quality Map

Read the supporting documentation here

X: Y:



Maps Designed By Compass Informatics 2004 ©

Appendix 15

Extract from Office of Public Works (OPW) Database

OPW National Flood Hazard Mapping

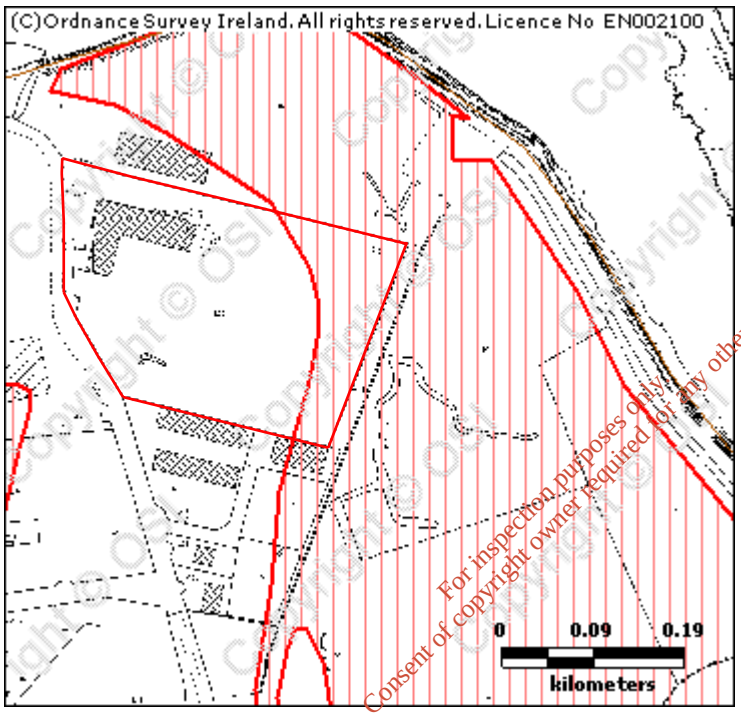
Summary Local Area Report

This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Limerick

NGR: R 262 517



Map Scale 1:7,766

Map Legend	
	Flood Points
	Multiple / Recurring Flood Points
	Areas Flooded
	Hydrometric Stations
	Rivers
	Lakes
	River Catchment Areas
	Land Commission *
	Drainage Districts *
	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

7 Results

1. Shannon Estuary Foynes Feb 2002
Start Date: 01/Feb/2002
County:
Flood Quality Code:2
Additional Information: Reports (4) Press Archive (2) More Mapped Information

2. Foynes 8th Jan 2005
Start Date: 08/Jan/2005
County: Limerick
Flood Quality Code:3
Additional Information: Reports (1) More Mapped Information

3. Foynes Feb 1995
Start Date: 22/Feb/1995
County: Limerick
Flood Quality Code:3
Additional Information: Reports (1) More Mapped Information

4. Robertstown Shanagolden Recurring
Start Date:
County: Limerick
Flood Quality Code:3

Report Produced: 05-Mar-2009 9:57

Additional Information: Reports (1) More Mapped Information

5. Foynes Limerick recurring

Start Date:

County: Limerick

Flood Quality Code:3

Additional Information: Reports (5) More Mapped Information

6. Horan's Cross Limerick recurring

Start Date:

County: Limerick

Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

7. Foynes near Castle recurring

Start Date:

County: Limerick

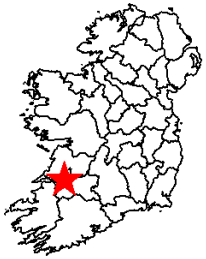
Flood Quality Code:3

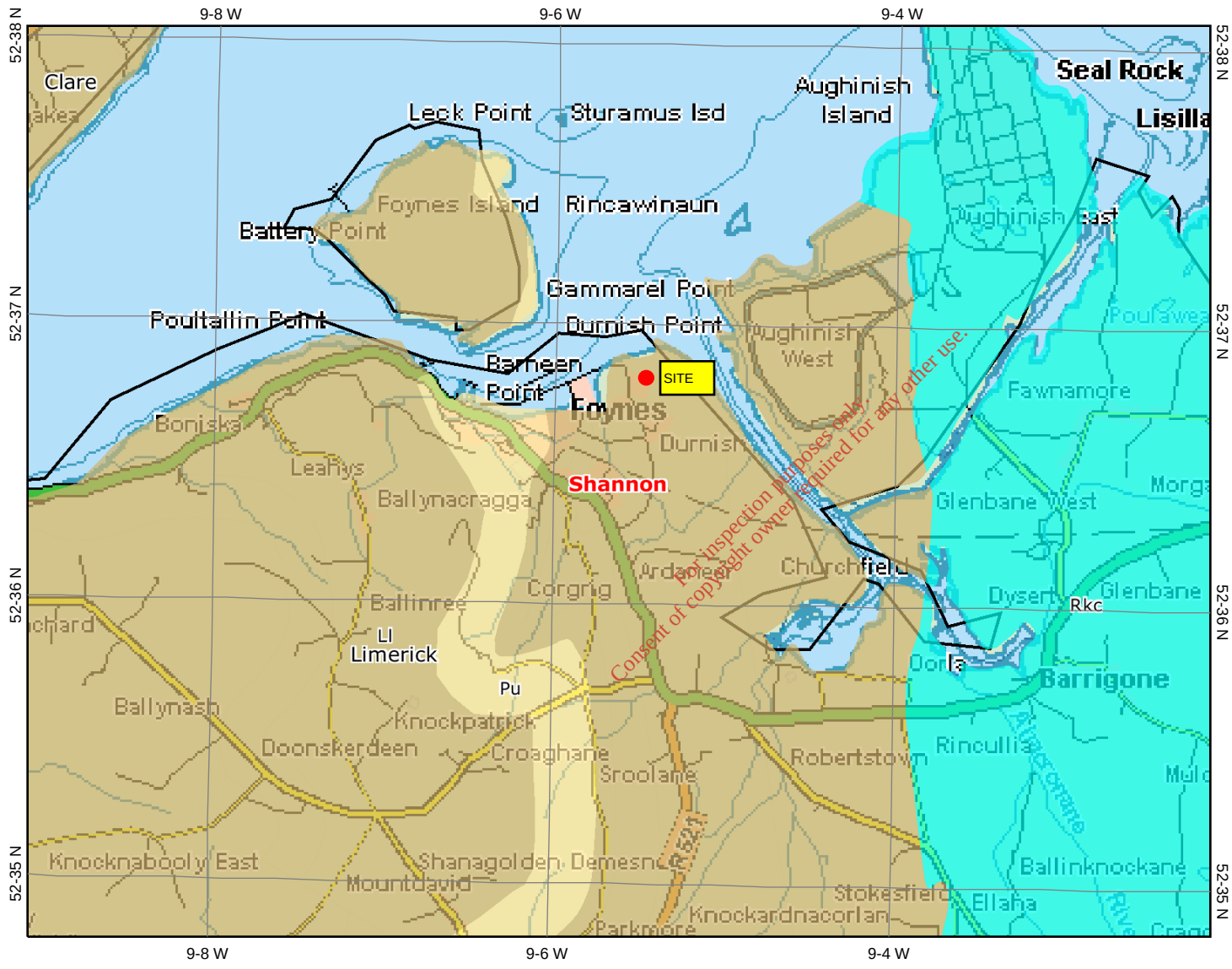
Additional Information: Reports (2) More Mapped Information

Appendix 16

Extracts from Geological Survey of Ireland (GSI) Database

Bedrock Acquifer Mapping





Legend

National Draft Bedrock Aquifer Map

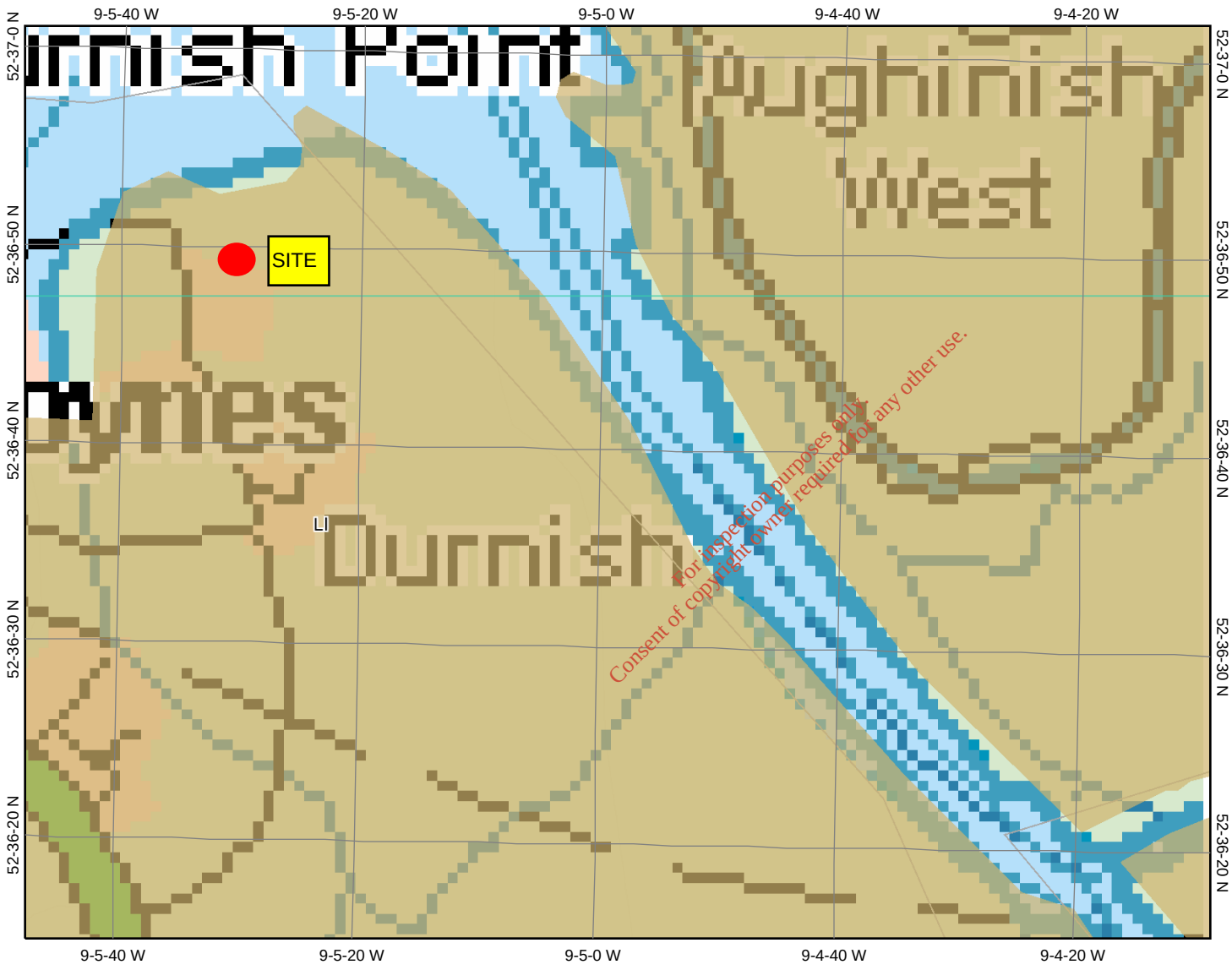
- Rf - Regionally Important Aquifer - Fissured bedrock
- Rk - Regionally Important Aquifer - Karstified
- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- Rkc - Regionally Important Aquifer - Karstified (conduit)
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Unclassified
- RBD Boundaries
- County Boundaries

Scale: 1:42,229

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Snapshot Date: 04-Dec-2008

Bedrock Aquifer Mapping GSI



Map center: 126652, 151587

Legend

National Draft Bedrock Aquifer Map

- Rf - Regionally Important Aquifer - Fissured bedrock
- Rk - Regionally Important Aquifer - Karstified
- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- Rkc - Regionally Important Aquifer - Karstified (conduit)
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Unclassified

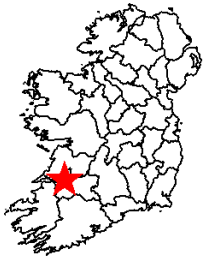
National Draft Gravel Aquifer Map

- Rg - Regionally important, extensive sand/gravels aquifers
- Lg - Locally important, sand/gravel aquifers
- No gravels present
- Not Mappe…

Quaternary

- A
- Ac
- Ag
- As

GSI Local Wells Mapping



Legend

- Wells Accuracy within 10m to 50m
- Wells Accuracy within 100m
- Wells Accuracy within 200m
- Wells Accuracy within 500m
- Wells Accuracy within 1km

Karst Features

- Borehole
- Cave
- Dry Valley
- Enclosed Depression
- Estevelle
- Spring
- Superficial Solution Features
- Swallow Hole
- Turlough
- Tracer Lines
- Tracer Output Site

0 250 500 750 m.

Scale: 1:10,000

Map center: 126219, 151319

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Snapshot Date: 05-Mar-2009

Appendix 17

Drainage Calculations

A - Storm Drainage Calculations

B - Foul Drainage Calculations

C - Storage Calculations

Michael Punch & Partners	
97 Henry Street	Greenport Environmental
Limerick	Foynes
Ireland	Job No: 061306
Date 24 April 2009	Designed By SKennedy
File 061306 REVISED SCHEME 20 MAY 20...	Checked By
Micro Drainage	System1 W.10.4 net

STORM SEWER DESIGN by the Modified Rational Method

Global Variables

Pipe Size File d:\apps\WinDes\STANDARD.PIP
Manhole Size File d:\apps\WinDes\STANDARD.MHS

Location - Scotland & Ireland

Return Period (years)	5
M5-60 (mm)	15.800
Ratio R	0.300
Maximum Rainfall (mm/hr)	50
Foul Sewage (l/s/ha)	0.00
O'flow Setting (*Foul only)	0
Volumetric Runoff Coeff.	0.75
Infiltration %	0
Minimum Backdrop Height (m)	0.200
Depth from Soffit to G.L. (m)	1.200
Min Vel. (m/s - Auto Design Only)	1.00
Min Slope (1:X - Optimisation)	500
Minimum Outfall Invert (m)	0.290
Ground Level at Outfall (m)	2.270
Outfall Manhole Name	
Outfall Manhole Dia/Length (mm)	0
Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	56.00	0.280	200.0	0.196	5.00	0.0	0.600	o	300
1.001	48.00	0.240	200.0	0.185	0.00	0.0	0.600	o	300
1.002	31.00	0.295	105.1	0.108	0.00	0.0	0.600	o	300
2.000	84.00	0.420	200.0	0.630	5.00	0.0	0.600	o	375
2.001	48.00	0.320	150.0	0.538	0.00	0.0	0.600	o	375
1.003	25.00	0.083	301.2	0.087	0.00	0.0	0.600	o	525

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Infil. (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	50.0	5.8	5.425	0.196	0	0	0	1.11	78	27
1.001	50.0	6.6	5.145	0.381	0	0	0	1.11	78	52
1.002	50.0	6.9	4.905	0.489	0	0	0	1.53	108	66
2.000	50.0	6.1	5.275	0.630	0	0	0	1.28	141	85
2.001	50.0	6.6	4.855	1.168	0	0	0	1.46	163	158
1.003	50.0	7.2	4.385	1.744	0	0	0	1.29	278	236

Michael Punch & Partners	
97 Henry Street	Greenport Environmental
Limerick	Foynes
Ireland	Job No: 061306
Date 24 April 2009	Designed By SKennedy
File 061306 REVISED SCHEME 20 MAY 20...	Checked By
Micro Drainage	System1 W.10.4 net

Micro Drainage

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
3.000	47.00	0.235	200.0	0.175	5.00	0.0	0.600	o	300
1.004	32.00	0.160	200.0	0.112	0.00	0.0	0.600	o	525
1.005	76.00	0.380	200.0	0.266	0.00	0.0	0.600	o	525
4.000	57.00	0.285	200.0	0.539	5.00	0.0	0.600	o	300
4.001	68.00	0.340	200.0	0.580	0.00	0.0	0.600	o	450
1.006	70.00	0.117	598.3	0.000	0.00	0.0	0.600	o	750
1.007	42.00	0.070	600.0	0.000	0.00	0.0	0.600	o	750
1.008	2.00	0.003	666.7	0.000	0.00	0.0	0.600	o	750

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Infil. (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
3.000	50.0	5.7	5.425	0.175	0	0	0	1.11	78	24
1.004	50.0	7.6	4.302	2.031	0	0	0	1.58	342	275
1.005	49.9	8.4	4.142	2.297	0	0	0	1.58	342	310
4.000	50.0	5.9	5.350	0.539	0	0	0	1.11	78	73
4.001	50.0	6.6	4.915	1.119	0	0	0	1.43	228	152
1.006	47.2	9.4	3.800	3.416	0	0	0	1.14	502	437
1.007	45.8	10.0	2.883	3.416	0	0	0	1.14	501	437
1.008	45.7	10.0	2.813	3.416	0	0	0	1.08	475	437

Time Area Diagram

Time From (mins)	Time To (mins)	Area (ha)
0	4	0.523
4	8	2.527
8	12	0.365

Total Area Contributing (ha) = 3.416

Total Pipe Volume (m^3) = 121.443

FOUL SEWERAGE DESIGN

Global Variables

Pipe Size File d:\apps\WinDes\STANDARD.PIP
Manhole Size File d:\apps\WinDes\STANDARD.MHS

Industrial Flow (l/s/ha)	0.00
Industrial Peak Flow Factor	0.00
Flow Per Person (l/per/day)	250.00
Persons per House	4.00
Domestic (l/s/ha)	0.00
Domestic Peak Flow Factor	6.00
O'flow Setting (*Foul only)	0
Infiltration %	0
Minimum Backdrop Height (m)	0.200
Depth from Soffit to G.L. (m)	1.200
Min Vel. (m/s - Auto Design Only)	0.75
Min Slope (1:X - Optimisation)	500
Minimum Outfall Invert (m)	1.741
Ground Level at Outfall (m)	3.190
Outfall Manhole Name	
Outfall Manhole Dia/Length (mm)	225
Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Hse	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	41.00	0.273	150.2	0.000	5	0.0	1.500	o	225
1.001	20.40	0.450	45.3	0.000	0	1.0	1.500	o	225
1.002	15.00	0.090	166.7	0.000	0	0.0	1.500	o	225
1.003	16.35	0.069	237.0	0.000	0	0.0	1.500	o	225
1.004	21.00	0.090	233.3	0.000	0	0.0	1.500	o	225
1.005	33.76	0.151	223.6	0.000	0	0.0	1.500	o	225
1.006	32.96	0.400	82.4	0.000	0	0.0	1.500	o	225
1.007	34.00	0.151	225.2	0.000	0	0.0	1.500	o	225
1.008	12.00	0.053	226.4	0.000	0	0.0	1.500	o	225

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Hse	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	4.200	0.000	0	5	0	16	0.35	0.94	37	0
1.001	3.635	0.000	1	5	0	22	0.66	1.71	68	1
1.002	3.185	0.000	1	5	0	30	0.42	0.89	35	1
1.003	3.095	0.000	1	5	0	33	0.57	0.74	30	1
1.004	3.026	0.000	1	5	0	33	0.58	0.75	30	1
1.005	2.936	0.000	1	5	0	33	0.58	0.77	30	1
1.006	2.785	0.000	1	5	0	26	0.54	1.27	50	1
1.007	2.385	0.000	1	5	0	33	0.56	0.76	30	1
1.008	2.234	0.000	1	5	0	33	0.38	0.76	30	1

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Hse	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.009	44.00	0.196	224.5	0.000	0	0.0	1.500	o	225
1.010	48.00	0.213	225.4	0.000	0	0.0	1.500	o	225
1.011	7.00	0.031	225.8	0.000	0	0.0	1.500	o	225

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Hse	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.009	2.181	0.000	1	5	0	33	0.38	0.76	30	1
1.010	1.985	0.000	1	5	0	33	0.38	0.76	30	1
1.011	1.772	0.000	1	5	0	33	0.38	0.76	30	1

Michael Punch & Partners
97 Henry Street
Limerick
Ireland

Date 20 May 2009 15:52
File 061306 STORAGE.SRC
Micro Drainage

Designed By SKennedy
Checked By
Storage Design W 10.4 net

Summary of Results for 30 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	193.1	193.1	3.2123	0.8123	243.7	O K
30 Summer	192.3	192.3	3.3878	0.9878	296.4	O K
60 Summer	192.2	192.2	3.4513	1.0513	315.4	FLOOD RISK
120 Summer	193.4	193.4	3.3423	0.9423	282.7	O K
180 Summer	193.3	193.3	3.2053	0.8053	241.6	O K
240 Summer	181.0	181.0	3.1118	0.7118	213.6	O K
360 Summer	161.4	161.4	2.9877	0.5877	176.4	O K
480 Summer	139.8	139.8	2.9207	0.5207	156.2	O K
600 Summer	123.7	123.7	2.8757	0.4757	142.7	O K
720 Summer	110.8	110.8	2.8422	0.4422	132.7	O K
960 Summer	92.7	92.7	2.7952	0.3952	118.6	O K
1440 Summer	71.2	71.2	2.7392	0.3392	101.8	O K
2160 Summer	53.8	53.8	2.6927	0.2927	87.8	O K
2880 Summer	44.2	44.2	2.6623	0.2622	78.6	O K
4320 Summer	33.1	33.1	2.6273	0.2273	68.2	O K
5760 Summer	27.1	27.1	2.6083	0.2083	62.4	O K
7200 Summer	23.0	23.0	2.5923	0.1923	57.6	O K
8640 Summer	20.2	20.2	2.5778	0.1778	53.3	O K
10080 Summer	18.1	18.1	2.5668	0.1668	50.0	O K
15 Winter	192.6	192.6	3.3233	0.9233	276.9	O K
30 Winter	192.6	192.6	3.5193	1.1193	335.8	FLOOD RISK
60 Winter	192.9	192.9	3.4458	1.1458	343.7	FLOOD RISK
120 Winter	193.0	193.0	3.3108	0.9708	273.2	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	53.95	19
30 Summer	36.62	28
60 Summer	23.64	44
120 Summer	14.86	76
180 Summer	11.25	106
240 Summer	9.21	136
360 Summer	6.94	196
480 Summer	5.66	254
600 Summer	4.84	314
720 Summer	4.25	374
960 Summer	3.47	496
1440 Summer	2.60	738
2160 Summer	1.95	1104
2880 Summer	1.59	1468
4320 Summer	1.19	2200
5760 Summer	0.97	2928
7200 Summer	0.82	3632
8640 Summer	0.72	4376
10080 Summer	0.65	5104
15 Winter	53.95	19
30 Winter	36.62	30
60 Winter	23.64	48
120 Winter	14.86	80

Summary of Results for 30 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
180 Winter	182.8	182.8	3.1248	0.7248	217.4	O K
240 Winter	166.6	166.6	3.0093	0.6093	182.8	O K
360 Winter	133.3	133.3	2.9007	0.5007	150.2	O K
480 Winter	110.8	110.8	2.8422	0.4422	132.7	O K
600 Winter	95.6	95.6	2.8027	0.4027	120.8	O K
720 Winter	84.4	84.4	2.7737	0.3737	112.1	O K
960 Winter	69.3	69.3	2.7342	0.3342	100.3	O K
1440 Winter	52.1	52.1	2.6872	0.2872	86.2	O K
2160 Winter	39.3	39.3	2.6467	0.2467	74.0	O K
2880 Winter	32.0	32.0	2.6238	0.2238	67.1	O K
4320 Winter	24.0	24.0	2.5973	0.1973	59.1	O K
5760 Winter	19.5	19.5	2.5743	0.1743	52.2	O K
7200 Winter	16.6	16.6	2.5593	0.1593	47.7	O K
8640 Winter	14.6	14.6	2.5488	0.1488	44.6	O K
10080 Winter	13.1	13.1	2.5408	0.1408	42.2	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
180 Winter	11.25	110
240 Winter	9.21	138
360 Winter	6.94	196
480 Winter	5.66	256
600 Winter	4.84	318
720 Winter	4.25	378
960 Winter	3.47	496
1440 Winter	2.60	740
2160 Winter	1.95	1104
2880 Winter	1.59	1472
4320 Winter	1.19	2204
5760 Winter	0.97	2920
7200 Winter	0.82	3664
8640 Winter	0.72	4384
10080 Winter	0.65	5008

Tank/Pond Details

Invert Level (m) 2.400 Ground Level (m) 3.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	300.0	0.60	300.0	1.20	300.0	1.80	300.0	2.40	300.0
0.10	300.0	0.70	300.0	1.30	300.0	1.90	300.0	2.50	300.0
0.20	300.0	0.80	300.0	1.40	300.0	2.00	300.0		
0.30	300.0	0.90	300.0	1.50	300.0	2.10	300.0		
0.40	300.0	1.00	300.0	1.60	300.0	2.20	300.0		
0.50	300.0	1.10	300.0	1.70	300.0	2.30	300.0		

Hydro-Brake Outflow Control

Design Head (m) 3.000 Hydro-Brake Type MD4 Invert Level (m) 2.400
Design Flow (l/s) 209.0 Diameter (mm) 393

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	5.2	0.80	193.4	2.00	172.2	4.00	241.2	7.00	319.1
0.20	24.5	1.00	184.3	2.20	179.6	4.50	255.9	7.50	330.3
0.30	56.1	1.20	168.0	2.40	187.2	5.00	269.7	8.00	341.2
0.40	94.5	1.40	160.3	2.60	194.6	5.50	282.9	8.50	351.7
0.50	133.1	1.60	160.7	3.00	208.9	6.00	295.5	9.00	361.9
0.60	165.3	1.80	165.5	3.50	225.7	6.50	307.5	9.50	371.8

Appendix 18

Traffic Count Results

Mr. Binman					Times of Survey:		08:00-10:00				
Manual Classified Junction Counts							15:30-18:30				
										DATE:	27/11/08
Description of Census Point:			Ind. Estate Junction with Main Road								
Location:			Foynes							DAY:	Thursday

TURNING MANOEUVRE 1 (Lmk to Port)

TIME	PEDAL CYLE	MOTORCYCLE	CARS	LGV	HGV	MISC	BUSES	TOTAL	HR. TOTAL	PCU	PCU/HR
08:00	0	0	14	1	2	0	0	17		19	
08:15	0	0	5	0	6	0	0	11		18	
08:30	0	0	2	0	3	0	0	5		9	
08:45	0	0	4	1	6	0	0	11	44	18	65
09:00	0	0	4	1	5	0	0	10	37	16	61
09:15	0	0	4	1	5	0	0	10	36	16	59
09:30	0	0	1	1	5	0	0	7	38	13	64
09:45	0	0	0	0	7	0	0	7	34	15	61
15:30	0	0	0	1	5	0	0	6		12	
15:45	0	0	2	0	5	0	0	7		13	
16:00	0	0	2	0	2	0	0	4		6	
16:15	0	0	2	0	1	0	0	3	20	4	36
16:30	0	0	0	1	4	0	0	5	19	10	34
16:45	0	0	0	0	5	0	0	5	17	11	32
17:00	0	0	0	1	0	0	0	1	14	1	26
17:15	0	0	1	0	0	0	0	1	12	1	23
17:30	0	0	0	0	0	0	0	0	7	0	13
17:45	0	0	0	0	0	0	0	0	2	0	2
18:00	0	0	1	0	0	0	0	1	2	1	2
18:15	0	0	1	0	2	0	0	3	4	5	7

TURNING MANOEUVRE 2 (Lmk to Foynes)

TIME	PEDAL CYLE	MOTORCYCLE	CARS	LGV	HGV	MISC	BUSES	TOTAL	HR. TOTAL	PCU	PCU/HR
08:00	0	0	27	8	3	0	0	38		42	
08:15	0	0	16	6	3	0	0	25		29	
08:30	0	0	17	6	1	0	0	24		25	
08:45	0	0	27	4	3	0	0	34	121	38	133
09:00	0	0	33	5	6	0	0	44	127	51	143
09:15	0	0	39	4	3	0	0	46	148	50	164
09:30	0	0	22	4	7	0	0	33	157	41	180
09:45	0	0	15	7	3	0	0	25	148	29	171
15:30	1	0	38	9	2	0	0	50		52	
15:45	0	0	28	5	3	0	0	36		40	
16:00	0	1	34	7	4	0	2	48		55	
16:15	0	1	33	7	3	0	1	45	179	50	197
16:30	0	0	52	10	2	0	0	64	193	66	211
16:45	0	0	46	7	3	0	1	57	214	62	234
17:00	0	0	52	12	6	0	0	70	236	77	256
17:15	0	0	52	6	3	0	1	62	253	67	273
17:30	0	0	53	6	1	0	0	60	249	61	267
17:45	0	0	63	12	0	0	0	75	267	75	281
18:00	0	0	41	9	1	0	0	51	248	52	256
18:15	0	0	36	5	1	0	0	42	228	43	232

Mr. Binman					Times of Survey:		08:00-10:00				
Manual Classified Junction Counts							15:30-18:30				
										DATE:	27/11/08
Description of Census Point:			Ind. Estate Junction with Main Road								
Location:			Foynes							DAY:	Thursday

TURNING MANOEUVRE 3 (Foynes to Lmk)

TIME	PEDAL CYLE	MOTORCYCLE	CARS	LGV	HGV	MISC	BUSES	TOTAL	HR. TOTAL	PCU	PCU/HR
08:00	0	0	22	8	2			32		34	
08:15	0	0	29	6	1			36		37	
08:30	0	0	35	7	5			47		53	
08:45	0	0	26	5	4			35	150	40	165
09:00	0	0	22	9	2			33	151	35	166
09:15	0	0	36	6	1			43	158	44	173
09:30	0	0	30	8	1			39	150	40	160
09:45	0	0	33	2	5			40	155	46	166
15:30	0	0	29	5	7	0	0	41		49	
15:45	1	0	37	6	1	0	0	45		46	
16:00	0	1	30	7	4	0	0	42		47	
16:15	0	1	26	3	2	0	0	32	160	34	177
16:30	0	0	32	7	7	1	1	48	167	59	187
16:45	0	0	39	5	3	0	0	47	169	51	191
17:00	0	0	51	10	0	0	0	61	188	61	205
17:15	0	0	25	10	3	0	0	38	194	42	212
17:30	0	0	35	3	2	0	1	41	187	45	198
17:45	0	0	29	6	2	0	0	37	177	39	187
18:00	0	0	27	10	2	0	0	39	155	41	167
18:15	0	0	27	4	1	0	0	32	149	33	159

TURNING MANOEUVRE 4 (Foynes to Port)

TIME	PEDAL CYLE	MOTORCYCLE	CARS	LGV	HGV	MISC	BUSES	TOTAL	HR. TOTAL	PCU	PCU/HR
08:00	0	0	6	1	0	0	0	7		7	
08:15	0	0	2	0	1	0	0	3		4	
08:30	0	0	4	1	0	0	0	5		5	
08:45	0	0	2	0	2	0	0	4	19	6	23
09:00	0	0	5	0	1	0	0	6	18	7	23
09:15	0	0	1	0	0	0	0	1	16	1	20
09:30	0	0	3	0	1	0	0	4	15	5	20
09:45	0	0	2	1	2	0	0	5	16	7	21
15:30	0	0	1	1	0	0	0	2		2	
15:45	0	0	1	0	1	1	0	3		5	
16:00	0	0	1	0	0	0	0	1		1	
16:15	0	0	4	0	0	0	0	4	10	4	13
16:30	0	0	0	1	0	0	0	1	9	1	12
16:45	0	0	1	0	1	0	0	2	8	3	10
17:00	0	0	0	1	0	0	0	1	8	1	10
17:15	0	0	0	0	1	0	0	1	5	2	8
17:30	0	0	0	1	0	0	0	1	5	1	8
17:45	0	0	0	1	2	0	0	3	6	5	10
18:00	0	0	0	0	0	0	0	0	5	0	9
18:15	0	0	0	0	0	0	0	0	4	0	7

Mr. Binman					Times of Survey:		08:00-10:00				
Manual Classified Junction Counts							15:30-18:30				
										DATE:	27/11/08
Description of Census Point:			Ind. Estate Junction with Main Road								
Location:			Foynes							DAY:	Thursday

TURNING MANOEUVRE 5 (Port to Foynes)

TIME	PEDAL CYLE	MOTORCYCLE	CARS	LGV	HGV	MISC	BUSES	TOTAL	HR. TOTAL	PCU	PCU/HR
08:00	0	0	3	0	0	0	0	3		3	
08:15	0	0	0	0	0	0	0	0		0	
08:30	0	0	3	1	0	0	0	4		4	
08:45	0	0	0	0	1	0	0	1	8	2	10
09:00	0	0	2	0	2	0	0	4	9	6	13
09:15	0	0	3	0	0	0	0	3	12	3	16
09:30	0	0	1	0	0	0	0	1	9	1	13
09:45	0	0	16	6	1	0	0	23	31	24	35
15:30	0	0	3	2	0	0	0	5		5	
15:45	0	0	1	0	0	0	0	1		1	
16:00	0	0	0	0	1	0	0	1		2	
16:15	0	0	1	1	0	0	0	2	9	2	11
16:30	0	0	5	1	0	0	0	6	10	6	12
16:45	0	0	3	1	0	0	0	4	13	4	15
17:00	0	0	4	4	0	0	0	8	20	8	20
17:15	0	0	1	1	0	0	0	2	20	2	20
17:30	0	0	5	0	0	0	0	5	19	5	19
17:45	0	0	11	4	0	0	0	15	30	15	30
18:00	0	0	4	0	0	0	0	4	26	4	26
18:15	0	0	1	2	0	0	0	3	27	3	27

TURNING MANOEUVRE 6 (Port to Lmk)

TIME	PEDAL CYLE	MOTORCYCLE	CARS	LGV	HGV	MISC	BUSES	TOTAL	HR. TOTAL	PCU	PCU/HR
08:00	0	0	3	0	4	0	0	7		12	
08:15	0	0	0	0	7	0	0	7		15	
08:30	0	0	0	0	11	0	0	11		24	
08:45	0	0	1	0	6	0	0	7	32	14	66
09:00	0	0	0	0	11	0	0	11	36	24	78
09:15	0	0	0	0	4	0	0	4	33	9	72
09:30	0	0	3	0	8	0	0	11	33	21	68
09:45	0	0	5	0	4	0	0	9	35	14	68
15:30	0	0	3	0	3	0	0	6		10	
15:45	0	0	2	2	4	0	0	8		13	
16:00	0	0	4	2	6	0	0	12		19	
16:15	0	0	6	1	4	0	0	11	37	16	58
16:30	0	0	7	2	2	0	0	11	42	13	62
16:45	0	0	7	5	3	0	0	15	49	19	67
17:00	0	0	9	1	2	0	0	12	49	14	63
17:15	0	0	2	2	1	0	0	5	43	6	53
17:30	0	0	5	1	3	0	0	9	41	13	52
17:45	0	0	11	5	1	0	0	17	43	18	52
18:00	0	1	5	3	0	0	0	9	40	9	46
18:15	0	0	2	1	0	0	0	3	38	3	43

Mr. Binman				Times of Survey:			08:00-10:00		
Manual Classified Junction Counts							15:30-18:30		
									DATE:
Description of Census Point:			Ind. Estate Junction with Main Road						
Location:			Foynes						DAY:

TIME	All Movements HR. TOTAL	All Movements PCU/HOUR
08:00		
08:15		
08:30		
08:45	374	462
09:00	378	484
09:15	403	504
09:30	402	505
09:45	419	522
16:15	415	492
16:30	440	518
16:45	470	549
17:00	515	580
17:15	527	589
17:30	508	557
17:45	525	562
18:00	476	506
18:15	450	475

Appendix 19

PICADY Analysis Results

TRL LIMITED

CAPACITIES, QUEUES, AND DELAYS AT 3 OR 4-ARM MAJOR/MINOR PRIORITY JUNCTIONS

PICADY 5.1 ANALYSIS PROGRAM
RELEASE 4.0 (SEPT 2008)

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TRL SOFTWARE BUREAU
TEL: CROWTHORNE (01344) 770758, FAX: 770356
EMAIL: Software@trl.co.uk

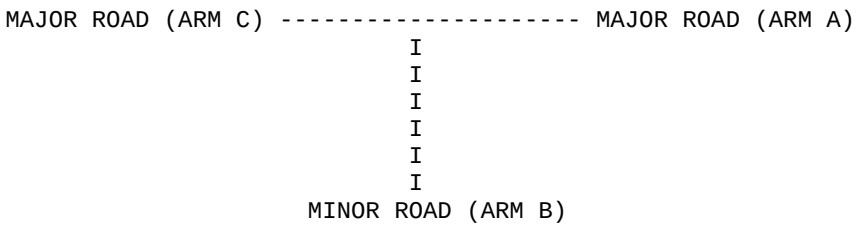
Run with file:-
"C:\Documents and Settings\francis\My Documents\108319 Foynes Mr Binman\2025 AM Peak - with Development.vpi" (drive-on-the-left) at 14:06:16 on Friday, 30 January 2009

.RUN INFORMATION
****

RUN TITLE : **108319 2025 AM Peak Hour - Composting/Biogas Facility Fully Operational**
LOCATION : **Foynes, Co Limerick**
DATE : 05/12/08
CLIENT : Mr Binman
ENUMERATOR : F Fidgeon
JOB NUMBER : 108319
STATUS : EIA
DESCRIPTION :

.MAJOR/MINOR JUNCTION CAPACITY AND DELAY
****

INPUT DATA



ARM A IS To Foynes
ARM B IS Foynes Port Access
ARM C IS To Limerick

.STREAM LABELLING CONVENTION

STREAM A-B CONTAINS TRAFFIC GOING FROM ARM A TO ARM B
STREAM B-AC CONTAINS TRAFFIC GOING FROM ARM B TO ARM A AND TO ARM C
ETC.

.GEOMETRIC DATA

DATA ITEM	MINOR ROAD B
TOTAL MAJOR ROAD CARRIAGEWAY WIDTH	(W) 9.00 M.
CENTRAL RESERVE WIDTH	(WCR) 0.00 M.
MAJOR ROAD RIGHT TURN - WIDTH	(WC-B) 3.00 M.
- VISIBILITY	(VC-B) 90.00 M.
- BLOCKS TRAFFIC	YES
MINOR ROAD - VISIBILITY TO LEFT	(VB-C) 10.0 M.
- VISIBILITY TO RIGHT	(VB-A) 10.0 M.
- LANE 1 WIDTH	(WB-C) 3.00 M.
- LANE 2 WIDTH	(WB-A) 0.00 M.

.SLOPES AND INTERCEPT

(NB:Streams may be combined, in which case capacity will be adjusted)

Intercept For STREAM B-C	Slope For STREAM A-C	Slope For Opposing STREAM A-B
630.23	0.21	0.08

Intercept For STREAM B-A	Slope For STREAM A-C	Slope For Opposing STREAM A-B	Slope For Opposing STREAM C-A	Slope For Opposing STREAM C-B
485.86	0.19	0.08	0.12	0.28

Intercept For STREAM C-B	Slope For STREAM A-C	Slope For Opposing STREAM A-B
680.59	0.23	0.23

(NB These values do not allow for any site specific corrections)

.TRAFFIC DEMAND DATA

ARM	FLOW SCALE(%)
A	100
B	100
C	100

.Demand set: 2025 AM Peak Hour - Facility Fully Operational

TIME PERIOD BEGINS 08.45 AND ENDS 10.15

LENGTH OF TIME PERIOD - 90 MIN.
LENGTH OF TIME SEGMENT - 15 MIN.

DEMAND FLOW PROFILES ARE SYNTHESISED FROM TURNING COUNT DATA

ARM	NUMBER OF MINUTES FROM START WHEN FLOW STARTS TO RISE	TOP OF PEAK IS REACHED	FLOW STOPS FALLING	RATE OF FLOW (VEH/MIN) BEFORE PEAK	AT TOP OF PEAK	AFTER PEAK
ARM A	15.00	45.00	75.00	3.26	4.89	3.26
ARM B	15.00	45.00	75.00	2.28	3.41	2.28
ARM C	15.00	45.00	75.00	4.51	6.77	4.51

.Demand set: 2025 AM Peak Hour - Facility Fully Operational

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C
08.45 - 09.00	ARM A	0.000	0.115	0.885
		0.0	30.0	231.0
		(0.0)	(0.0)	(0.0)
	ARM B	0.478	0.000	0.522
		87.0	0.0	95.0
		(0.0)	(0.0)	(0.0)
	ARM C	0.659	0.341	0.000
		238.0	123.0	0.0
		(0.0)	(0.0)	(0.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

FOR COMBINED DEMAND SETS
AND FOR TIME PERIOD 1

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
08.45-09.00									
B-AC	2.28	8.05	0.284		0.00	0.39	5.6		0.17
C-AB	1.54	10.59	0.146		0.00	0.17	2.5		0.11
A-B	0.38								
A-C	2.90								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
09.00-09.15									
B-AC	2.73	7.82	0.349		0.39	0.53	7.6		0.20
C-AB	1.84	10.45	0.176		0.17	0.21	3.2		0.12
A-B	0.45								
A-C	3.46								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
09.15-09.30									
B-AC	3.34	7.49	0.446		0.53	0.78	11.2		0.24
C-AB	2.26	10.25	0.220		0.21	0.28	4.2		0.12
A-B	0.55								
A-C	4.24								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
09.30-09.45									
B-AC	3.34	7.49	0.446		0.78	0.79	11.8		0.24
C-AB	2.26	10.25	0.220		0.28	0.28	4.2		0.13
A-B	0.55								
A-C	4.24								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
09.45-10.00									
B-AC	2.73	7.82	0.349		0.79	0.55	8.5		0.20
C-AB	1.84	10.45	0.176		0.28	0.22	3.2		0.12
A-B	0.45								
A-C	3.46								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
10.00-10.15									
B-AC	2.28	8.05	0.284		0.55	0.40	6.2		0.17
C-AB	1.54	10.59	0.146		0.22	0.17	2.6		0.11
A-B	0.38								
A-C	2.90								

WARNING NO MARGINAL ANALYSIS OF CAPACITIES AS MAJOR ROAD BLOCKING MAY OCCUR

QUEUE FOR STREAM B-AC

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
09.00	0.4	
09.15	0.5	*
09.30	0.8	*
09.45	0.8	*
10.00	0.5	*
10.15	0.4	

QUEUE FOR STREAM C-AB

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
09.00	0.2
09.15	0.2
09.30	0.3
09.45	0.3
10.00	0.2
10.15	0.2

QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

STREAM	TOTAL DEMAND (VEH)	TOTAL DEMAND (VEH/H)	* QUEUEING * DELAY * (MIN)	* QUEUEING * DELAY * (MIN/VEH)	* INCLUSIVE QUEUEING * DELAY * (MIN)	* INCLUSIVE QUEUEING * DELAY * (MIN/VEH)
B-AC	250.5	167.0	50.9	0.20	51.0	0.20
C-AB	169.3	112.9	20.0	0.12	20.0	0.12
A-B	41.3	27.5				
A-C	318.0	212.0				
ALL	1106.6	737.8	70.9	0.06	70.9	0.06

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES
WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS
A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

*******END OF RUN*******

TRL LIMITED

CAPACITIES, QUEUES, AND DELAYS AT 3 OR 4-ARM MAJOR/MINOR PRIORITY JUNCTIONS

PICADY 5.1 ANALYSIS PROGRAM
RELEASE 4.0 (SEPT 2008)

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EMAIL: Software@trl.co.uk

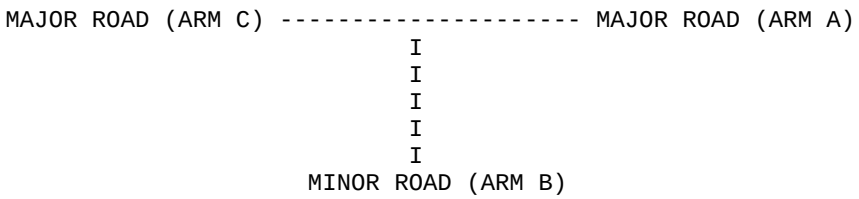
Run with file:-
"C:\Documents and Settings\francis\My Documents\108319 Foynes Mr Binman\2025 PM Peak - with Development.vpi"
(drive-on-the-left) at 14:04:33 on Friday, 30 January 2009

.RUN INFORMATION

RUN TITLE : **108319 2025 PM Peak Hour - Composting/Biogas Facility Fully Operational**
LOCATION : **Foynes, Co Limerick**
DATE : 05/12/08
CLIENT : Mr Binman
ENUMERATOR : F Fidgeon
JOB NUMBER : 108319
STATUS : EIA
DESCRIPTION :

.MAJOR/MINOR JUNCTION CAPACITY AND DELAY

INPUT DATA



ARM A IS To Foynes
ARM B IS Foynes Port Access
ARM C IS To Limerick

.STREAM LABELLING CONVENTION

STREAM A-B CONTAINS TRAFFIC GOING FROM ARM A TO ARM B
STREAM B-AC CONTAINS TRAFFIC GOING FROM ARM B TO ARM A AND TO ARM C
ETC.

.GEOMETRIC DATA

DATA ITEM	MINOR ROAD B
TOTAL MAJOR ROAD CARRIAGEWAY WIDTH	(W) 9.00 M.
CENTRAL RESERVE WIDTH	(WCR) 0.00 M.
MAJOR ROAD RIGHT TURN - WIDTH	(WC-B) 3.00 M.
- VISIBILITY	(VC-B) 90.00 M.
- BLOCKS TRAFFIC	YES
MINOR ROAD - VISIBILITY TO LEFT	(VB-C) 10.0 M.
- VISIBILITY TO RIGHT	(VB-A) 10.0 M.
- LANE 1 WIDTH	(WB-C) 3.00 M.
- LANE 2 WIDTH	(WB-A) 0.00 M.

.SLOPES AND INTERCEPT

(NB:Streams may be combined, in which case capacity will be adjusted)

Intercept For STREAM B-C	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
630.23	0.21	0.08

Intercept For STREAM B-A	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B	Slope For Opposing STREAM C-A	Slope For Opposing STREAM C-B
485.86	0.19	0.08	0.12	0.28

Intercept For STREAM C-B	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
680.59	0.23	0.23

(NB These values do not allow for any site specific corrections)

.TRAFFIC DEMAND DATA

ARM	FLOW SCALE(%)
A	100
B	100
C	100

.Demand set: 2025 PM Peak Hour - Facility Fully Operational

TIME PERIOD BEGINS 16.15 AND ENDS 17.45

LENGTH OF TIME PERIOD - 90 MIN.
LENGTH OF TIME SEGMENT - 15 MIN.

.DEMAND FLOW PROFILES ARE SYNTHESISED FROM TURNING COUNT DATA

ARM	NUMBER OF MINUTES FROM START WHEN FLOW STARTS TO RISE	TOP OF PEAK IS REACHED	FLOW STOPS FALLING	RATE OF FLOW (VEH/MIN) BEFORE PEAK	AT TOP OF PEAK	AFTER PEAK
ARM A	15.00	45.00	75.00	1.69	2.53	1.69
ARM B	15.00	45.00	75.00	2.65	3.98	2.65
ARM C	15.00	45.00	75.00	0.76	1.14	0.76

.Demand set: 2025 PM Peak Hour - Facility Fully Operational

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C
16.15 - 16.30	ARM A	0.000	0.615	0.385
		0.0	83.0	52.0
		(0.0)	(10.0)	(10.0)
	ARM B	0.854	0.000	0.146
		181.0	0.0	31.0
		(10.0)	(0.0)	(10.0)
	ARM C	0.705	0.295	0.000
		43.0	18.0	0.0
		(10.0)	(10.0)	(0.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

FOR COMBINED DEMAND SETS
AND FOR TIME PERIOD 1

TIME		DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
16.15-16.30										
	B-AC	2.66	7.29	0.365		0.00	0.56	7.9		0.21
	C-AB	0.23	9.92	0.023		0.00	0.02	0.3		0.10
	A-B	1.04								
	A-C	0.65								

TIME		DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
16.30-16.45										
	B-AC	3.18	7.22	0.440		0.56	0.76	11.0		0.25
	C-AB	0.27	9.85	0.027		0.02	0.03	0.4		0.10
	A-B	1.24								
	A-C	0.78								

TIME		DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
16.45-17.00										
	B-AC	3.89	7.14	0.545		0.76	1.15	16.2		0.30
	C-AB	0.33	9.74	0.034		0.03	0.03	0.5		0.11
	A-B	1.52								
	A-C	0.95								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
17.00-17.15									
B-AC	3.89	7.14	0.545		1.15	1.17	17.5		0.31
C-AB	0.33	9.74	0.034		0.03	0.04	0.5		0.11
A-B	1.52								
A-C	0.95								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
17.15-17.30									
B-AC	3.18	7.22	0.440		1.17	0.81	12.8		0.25
C-AB	0.27	9.85	0.027		0.04	0.03	0.4		0.10
A-B	1.24								
A-C	0.78								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
17.30-17.45									
B-AC	2.66	7.29	0.365		0.81	0.59	9.2		0.22
C-AB	0.23	9.92	0.023		0.03	0.02	0.4		0.10
A-B	1.04								
A-C	0.65								

WARNING NO MARGINAL ANALYSIS OF CAPACITIES AS MAJOR ROAD BLOCKING MAY OCCUR

QUEUE FOR STREAM B-AC

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
16.30	0.6	*
16.45	0.8	*
17.00	1.2	*
17.15	1.2	*
17.30	0.8	*
17.45	0.6	*

QUEUE FOR STREAM C-AB

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
16.30	0.0
16.45	0.0
17.00	0.0
17.15	0.0
17.30	0.0
17.45	0.0

QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

STREAM	TOTAL DEMAND (VEH)	TOTAL DEMAND (VEH/H)	* QUEUEING * DELAY * (MIN)	* QUEUEING * DELAY * (MIN/VEH)	* INCLUSIVE QUEUEING * DELAY * (MIN)	* INCLUSIVE QUEUEING * DELAY * (MIN/VEH)
B-AC	291.8	194.5	74.5	0.26	74.5	0.26
C-AB	24.8	16.5	2.6	0.10	2.6	0.10
A-B	114.2	76.2				
A-C	71.6	47.7				
ALL	561.6	374.4	77.1	0.14	77.1	0.14

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES
WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS
A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

*******END OF RUN*******