

CONSOLIDATION TEST CALCULATIONS IGSL

initial height 18.85
 Wt. soil+ring 278.7
 final wet wt. 280.1
 final dry wt 258.7
 wt. of ring 89.3
 w/c initial 11.8%
 w/c final 12.6%
 S.G. 2.65 Assumed
 e final 0.3347698
 change in e 0.0727078 *change in Ht.
 Final Height 18.358

Contract: INDAVER WASTE MANAGEMENT FACILITY,
 DULEEK
Borehole No: GC2
Sample No: AH2529
Sample Type: GCS
Depth: 2.50

Consolidation test for injection purposes only
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Pressure range	increment	change in Ht.	change in e	e at end of stage	average e	MV (m ² /MN.)	HEIGHT H	AV. HEIGHT
from	to							
0	20	0.116	0.008	0.371	0.366	0.309	18.85	18.792
20	30	0.144	0.010	0.362	0.357	0.257	18.734	18.662
50	50	0.156	0.011	0.352	0.346	0.169	18.59	18.512
100	100	0.182	0.013	0.340	0.334	0.099	18.434	18.343
200	-180	-0.106	-0.008	0.327	0.331	0.032	18.252	18.305
				0.335			18.358	
				0.335				
				0.335				
				0.335				
				0.335				



CV calculations

Pressure Range from to	t 50 mins	t 90 mins	av. Height	Cv = 0.026H ² t50	Cv=0.111H ² t90
0 20		4.84	18.792		8.10
20 50		1.44	18.662		26.85
50 100		1.21	18.512		31.44
100 200		1	18.343		37.35
200 20					

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Contract	INDAVER WASTE MANAGEMENT FACILITY, DULEEK GC2
Borehole No.	
Sample No.	AH2529
Depth	2.5

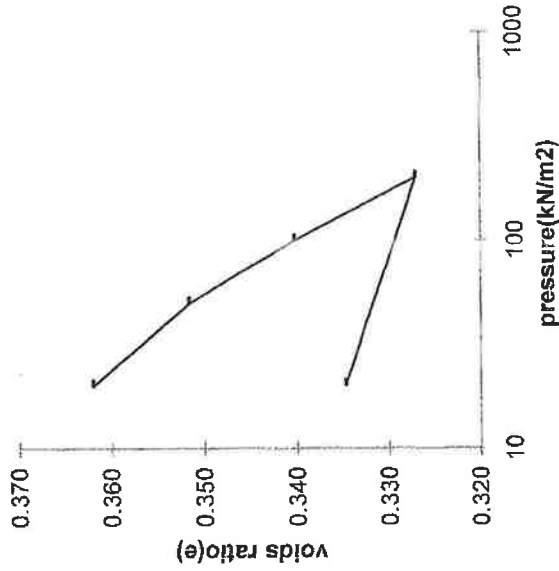
IGSL

CONSOLIDATION TEST RESULTS

Sample Description: Grey brown silty very sandy GRAVEL

Pressure Range (kN/M ²)	Voids Ratio e	MV(m ² /MN)	CV(m ² /year)
from	to		
0	20	0.31	8.10
20	50	0.26	26.85
50	100	0.17	31.44
100	200	0.10	37.35
200	20		

voids ratio



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Contract: INDAVER WASTE MANAGEMENT FACILITY, DULEEK
 Borehole No. GC2
 Sample No. AH2529
 Depth: 2.50

REPORT NO.		SULPHATE ANALYSIS										IGSL	
CONTRACT: INDAVER WASTE MANAGEMENT FACILITY, DULEEK												CONTRACT NO 14039	
BH/TP NO.	DEPTH (M)	SAMPLE NO.	SAMPLE TYPE	TEST CODE	% Passing 2mm	SULPHUR TRIOXIDE		2:1WATER SOIL EXTRACT S04 g/L	pH VALUE	CONTRACT NO 14039			
						2:1WATER SOIL EXTRACT S03 g/L	TOTAL SOIL S03 %			(S03 X 1.2)			
GC1	2.60	AH2527	GCS	A	67	0.01		0.012	7.2				
GC2	2.50	AH2529	GCS	A	53	0.02		0.029	7.5				
GC3	2.00	AH2525	GCS	A	96	0.01		0.007	7.0				
GC4	3.20	AH2526	GCS	A	99	0.03		0.032	7.1				
GC5	3.00	AH2528	GCS	A	84	0.01		0.012	7.2				
GC6+	2.50	AH2524	GCS	A	71	0.02		0.024	7.7				
TEST CODE W = WATER S = SOIL A = AQUEOUS SOIL EXTRACT(2:1)													

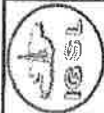
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Appendix 5

Geotechnical Rock Laboratory Test Records

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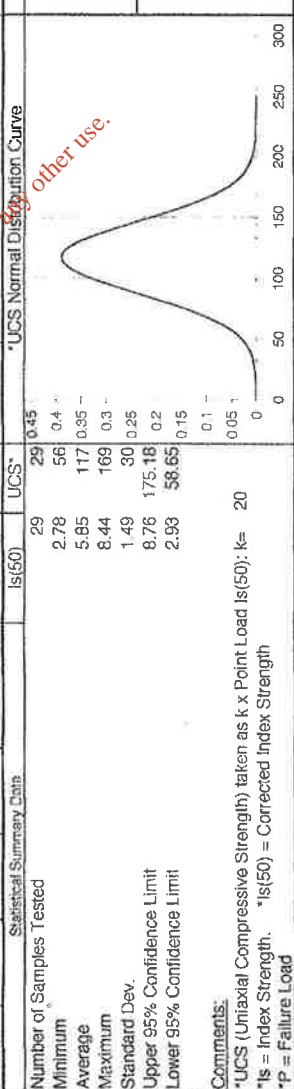




POINT LOAD TEST RESULTS

LIMESTONE										
Sample Type:										
Contract: Indaver Duleek										
Contract no. 14039										
Date of test: 12/03/2009										
Tested by: A. Mahony										
Sample No.	Depth m	Width1 mm	Width2 mm	Diameter mm	*P kN	=	*Is Mpa	*Is(50) Mpa	*UCS MPa	Type
GC1	11.50			102	48.0	1.378	4.61	6.36	127	d
GC1	6.90			102	50.1	1.378	4.81	6.62	132	d
GC1	9.90			102	44.0	1.378	4.23	5.83	117	d
GC1	8.35			102	45.0	1.378	4.33	5.96	119	d
GC2	6.20			102	43.0	1.378	4.13	5.70	114	d
GC2	9.10			102	45.0	1.378	4.33	5.96	119	d
GC2	13.00			102	38.0	1.378	3.65	5.03	101	d
GC2	8.50			102	47.0	1.378	4.52	6.23	125	d
GC2	8.00			102	21.0	1.378	2.02	2.78	56	d
GC2	11.80			102	29.0	1.378	2.79	3.84	77	d
GC3	8.70			102	51.0	1.378	4.90	6.76	135	d
GC3	7.00			102	53.0	1.378	5.09	7.02	140	d
GC3	9.10			102	55.0	1.378	5.29	7.29	146	d
GC3	11.65			102	42.0	1.378	4.04	5.56	111	d
GC3	10.10	89.00		60	28.0	1.086	7.78	8.44	169	d
GC4	11.40			102	57.0	1.378	5.48	7.55	151	d
GC4	6.40			102	45.0	1.378	4.33	5.96	119	d
GC4	6.60			102	48.0	1.378	4.61	6.36	127	d
GC4	7.40			102	32.0	1.378	3.06	4.24	85	d
GC4	10.60			102	53.0	1.378	5.09	7.02	140	d
GC5	5.90			102	57.0	1.378	5.48	7.55	151	d
GC5	8.60			102	21.0	1.378	2.02	2.78	56	d
GC5	11.40			102	52.0	1.378	5.00	6.89	138	d
GC5	10.30			102	46.0	1.378	4.42	6.09	122	d
GC6	10.05			102	32.0	1.378	3.08	4.24	85	d
GC6	11.10			102	37.0	1.378	3.56	4.90	99	d
GC6	13.20			102	22.0	1.378	2.11	2.96	56	d
GC8	8.90			102	46.0	1.378	4.42	6.09	122	d
GC6	8.70			102	57.0	1.378	5.48	7.55	151	d

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Comments:
 *UCS (Uniaxial Compressive Strength) taken as k x Point Load Is(50); k= 20
 *Is = Index Strength. *Is(50) = Corrected Index Strength
 *P = Failure Load

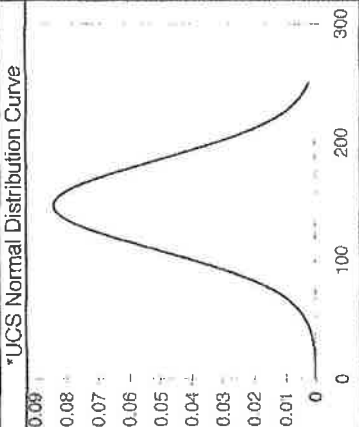
POINT LOAD TEST RESULTS



Contract: Indaver Duleek		Sample Type: LIMESTONE								
Contract no. 14039		Tested by: A. Mahony								
Date of test: 12/03/2009		Date of test: 12/03/2009								
Sample No.	Depth: m	Width1: mm	Width2: mm	Diameter: mm	*P: kN	F	*Is: Mpa	*Is(50) Mpa	*UCS MPa	Type
RP1	8.95			80	31.0	1.236	4.84	5.98	120	d
RP1	10.1			80	35.0	1.236	5.47	6.76	135	d
RP1	7.7			80	58.0	1.236	9.06	11.20	224	d
RP2	9.30			80	24.0	1.236	3.75	4.63	93	d
RP2	8.10			80	36.0	1.236	5.63	6.95	139	d
RP5	10			80	39.0	1.236	6.09	7.53	151	d
RP5	9.6			80	40.0	1.236	6.25	7.72	154	d
RP5	8.80			80	42.0	1.236	6.56	8.11	162	d

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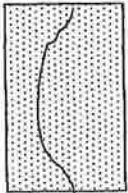
Statistical Summary Data	
Number of Samples Tested	UCS*
8	8
Minimum	4.63
Average	7.36
Maximum	11.20
Standard Dev.	1.90
Upper 95% Confidence Limit	11.09
Lower 95% Confidence Limit	3.63

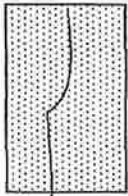


Abbreviations
i
a
b
d

Comments:
 *UCS (Uniaxial Compressive Strength) taken as k x Point Load Is(50): k= 20
 *Is = Index Strength, *Is(50) = Corrected Index Strength
 *P = Failure Load

Handwritten signature

Uniaxial Compression Test Report Sheet		I.G.S.L.
<u>Sample Identification</u>		
Contract Name:	Indaver Duleek	
Job Number:	14039	
Hole No:	RC GC1	
Depth (m):	8.80	
<u>Sample Description</u>		
Colour:	Blue grey	
Grain size:	Medium	
Weathering Grade:	Fresh	
Rock Type:	LIMESTONE	
<u>Weathering Grade Criteria</u>		
I. Fresh:	Unchanged from original state	
II. Slightly weathered:	Slight discolouration, slight weakening	
III. Moderately weathered:	Considerable weakening, penetrative discolouration	
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand	
<u>Sample Measurements</u>		<u>Sketch of Failure Surfaces</u>
Length	251.5	
Diameter (Ø)	102 mm	
<u>Testing</u>		
Load Rate	42	kN/min
Load at Failure (P)	217.9	kN
<u>Strength Calculations</u>		
Uniaxial Compressive Strength =	$\frac{217900}{8167.14}$	
	$= \frac{1000 \times P}{\pi \times (\text{Ø}/2)^2}$	
	$= \frac{217900}{8167.14} = 26.67 \text{ (Mpa)}$	
Bulk Density =	$= 2.66 \text{ (Mg/m}^3\text{)}$	
<u>Notes:</u>		

Uniaxial Compression Test Report Sheet		I.G.S.L.
<u>Sample Identification</u>		
Contract Name:	Indaver Duleek	
Job Number:	14039	
Hole No:	RC GC2	
Depth (m):	6.50	
<u>Sample Description</u>		
Colour:	Blue grey	
Grain size:	Medium	
Weathering Grade:	Fresh	
Rock Type:	LIMESTONE	
<u>Weathering Grade Criteria</u>		
I. Fresh:	Unchanged from original state	
II. Slightly weathered:	Slight discolouration, slight weakening	
III. Moderately weathered:	Considerable weakening, penetrative discolouration	
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand	
<u>Sample Measurements</u>		<u>Sketch of Failure Surfaces</u>
Length	253	
Diameter (Ø)	102 mm	
<u>Testing</u>		
Load Rate	88	kN/min
Load at Failure (P)	589.8	kN
<u>Strength Calculations</u>		
Uniaxial Compressive Strength =	$\frac{589800}{8167.14}$	
	=	$\frac{1000 \times P}{\pi \times (\frac{\text{Ø}}{2})^2}$
	=	$\frac{589800}{\pi \times (\frac{102}{2})^2} = 72.18 \text{ (Mpa)}$
Bulk Density =	$\frac{589.8}{2.16} = 2.68 \text{ (Mg/m}^3\text{)}$	
<u>Notes:</u>		

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Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name: Indaver Duleek
 Job Number: 14039
 Hole No: RC GC4
 Depth (m): 10.30

Sample Description

Colour: Blue grey
 Grain size: Medium
 Weathering Grade: Fresh
 Rock Type: LIMESTONE

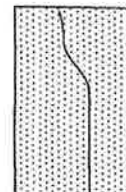
Weathering Grade Criteria

- I. Fresh: Unchanged from original state.
- II. Slightly weathered: Slight discolouration, slight weakening
- III. Moderately weathered: Considerable weakening, penetrative discolouration
- IV. Highly weathered: Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length: 257.6 mm
 Diameter (Ø): 102 mm

Sketch of Failure Surfaces



Testing

Load Rate: 52.5 kN/min
 Load at Failure (P): 293.6 kN

Strength Calculations

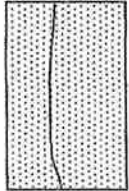
Uniaxial Compressive Strength = $\frac{293600}{8167.14}$

= $\frac{1000 \times P}{\pi \times (\text{Ø}/2)^2}$

= 35.93 (Mpa)

Bulk Density = 2.69 (Mg/m³)

Notes:

Uniaxial Compression Test Report Sheet		I.G.S.L.
<u>Sample Identification</u>		
Contract Name:	Indaver Duleek	
Job Number:	14039	
Hole No:	RC GC5	
Depth (m):	7.90	
<u>Sample Description</u>		
Colour:	Blue grey	
Grain size:	Medium	
Weathering Grade:	Fresh	
Rock Type:	LIMESTONE	
<u>Weathering Grade Criteria</u>		
I. Fresh:	Unchanged from original state	
II. Slightly weathered:	Slight discolouration, slight weakening	
III. Moderately weathered:	Considerable weakening, penetrative discolouration	
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand	
<u>Sample Measurements</u>		<u>Sketch of Failure Surfaces</u>
Length	250	
Diameter (Ø)	102 mm	
<u>Testing</u>		
Load Rate	46.5	kN/min
Load at Failure (P)	310.8	kN
<u>Strength Calculations</u>		
Uniaxial Compressive Strength =	$\frac{310800}{8167.14}$	
	=	$\frac{1000 \times P}{\pi \times (\text{Ø}/2)^2}$
	=	38.04 (Mpa)
Bulk Density	=	2.68 (Mg/m ³)
<u>Notes:</u>		

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Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name: Indaver Duleek
 Job Number: 14039
 Hole No: RC GC6
 Depth (m): 9.20

Sample Description

Colour: Blue grey
 Grain size: Medium
 Weathering Grade: Fresh
 Rock Type: LIMESTONE

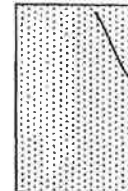
Weathering Grade Criteria

- I. Fresh: Unchanged from original state.
- II. Slightly weathered: Slight discolouration, slight weakening
- III. Moderately weathered: Considerable weakening, penetrative discolouration
- IV. Highly weathered: Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length: 254 mm
 Diameter (Ø): 102 mm

Sketch of Failure Surfaces



Testing

Load Rate: 53 kN/min
 Load at Failure (P): 321.7 kN

Strength Calculations

$$\begin{aligned}
 \text{Uniaxial Compressive Strength} &= \frac{321700}{8167.14} \\
 &= \frac{1000 \times P}{\pi \times (\text{Ø}/2)^2} \\
 &= 39.37 \text{ (Mpa)} \\
 \text{Bulk Density} &= 2.66 \text{ (Mg/m}^3\text{)}
 \end{aligned}$$

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name: Indaver Duleek
 Job Number: 14039
 Hole No: RP1
 Depth (m): 8.10

Sample Description

Colour: Blue grey
 Grain size: Medium
 Weathering Grade: Fresh
 Rock Type: LIMESTONE

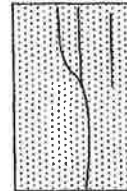
Weathering Grade Criteria

- I. Fresh: Unchanged from original state.
- II. Slightly weathered: Slight discolouration, slight weakening
- III. Moderately weathered: Considerable weakening, penetrative discolouration
- IV. Highly weathered: Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length: 202 mm
 Diameter (Ø): 80 mm

Sketch of Failure Surfaces



Testing

Load Rate: 34.5 kN/min
 Load at Failure (P): 185.2 kN

Strength Calculations

$$\begin{aligned}
 \text{Uniaxial Compressive Strength} &= \frac{185200}{5024} \\
 &= \frac{1000 \times P}{\pi \times (\text{Ø}/2)^2} \\
 &= 36.84 \text{ (Mpa)} \\
 \text{Bulk Density} &= 2.68 \text{ (Mg/m}^3\text{)}
 \end{aligned}$$

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name: Indaver Duleek
 Job Number: 14039
 Hole No: RP2
 Depth (m): 7.70

Sample Description

Colour: Grey
 Grain size: Medium
 Weathering Grade: Fresh
 Rock Type: LIMESTONE

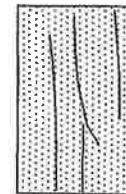
Weathering Grade Criteria

- I. Fresh: Unchanged from original state
- II. Slightly weathered: Slight discolouration, slight weakening
- III. Moderately weathered: Considerable weakening, penetrative discolouration
- IV. Highly weathered: Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length: 112 mm
 Diameter (Ø): 80 mm

Sketch of Failure Surfaces



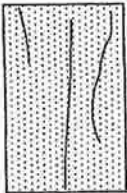
Testing

Load Rate: 46.5 kN/min
 Load at Failure (P): 274 kN

Strength Calculations

$$\begin{aligned}
 \text{Uniaxial Compressive Strength} &= \frac{274000}{5024} \\
 &= \frac{1000 \times P}{\pi \times (\text{Ø}/2)^2} \\
 &= 54.51 \text{ (Mpa)} \\
 \text{Bulk Density} &= 2.68 \text{ (Mg/m}^3\text{)}
 \end{aligned}$$

Notes:

Uniaxial Compression Test Report Sheet		I.G.S.L.
<u>Sample Identification</u>		
Contract Name:	Indaver Duleek	
Job Number:	14039	
Hole No:	RP5	
Depth (m):	10.20	
<u>Sample Description</u>		
Colour:	Grey	
Grain size:	Medium	
Weathering Grade:	Fresh	
Rock Type:	LIMESTONE	
<u>Weathering Grade Criteria</u>		
I. Fresh:	Unchanged from original state	
II. Slightly weathered:	Slight discolouration, slight weakening	
III. Moderately weathered:	Considerable weakening, penetrative discolouration	
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand	
<u>Sample Measurements</u>		<u>Sketch of Failure Surfaces</u>
Length	200	
Diameter (Ø)	80 mm	
<u>Testing</u>		
Load Rate	48.5	kN/min
Load at Failure (P)	299.7	kN
<u>Strength Calculations</u>		
Uniaxial Compressive Strength =	$\frac{299700}{5024}$	
	$= \frac{1000 \times P}{\pi \times (\text{Ø}/2)^2}$	
	$= \boxed{59.62} \text{ (Mpa)}$	
Bulk Density =	$\boxed{2.68} \text{ (Mg/m}^3\text{)}$	
<u>Notes:</u>		

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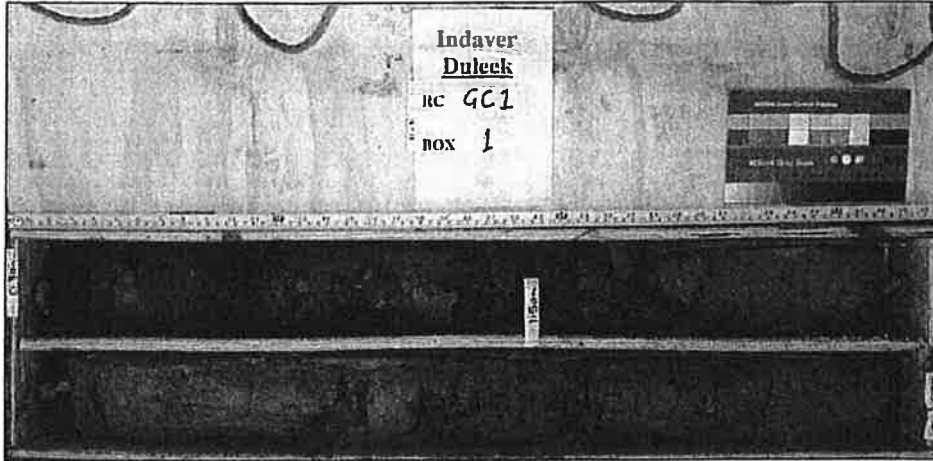
Appendix 6

Core Photographs

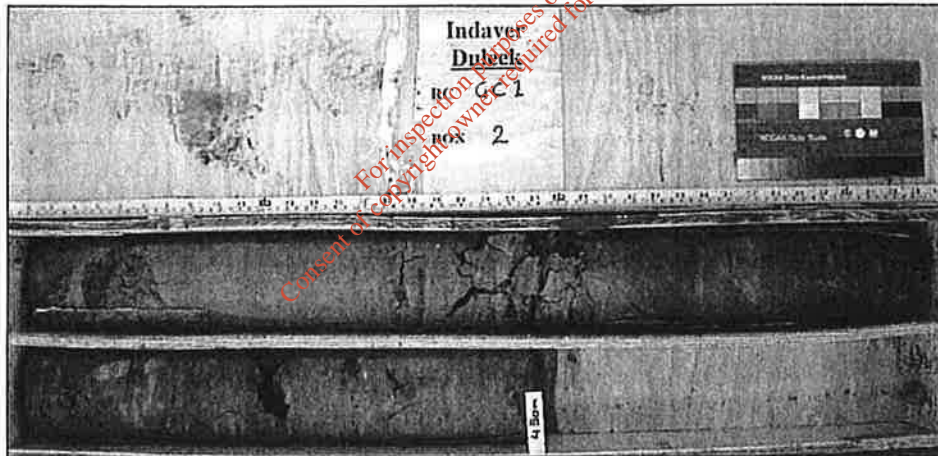
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Core Photography – Indaver Duleek (14039)

RC GC1 BOX 1 OF 7



RC GC1 BOX 2 OF 7

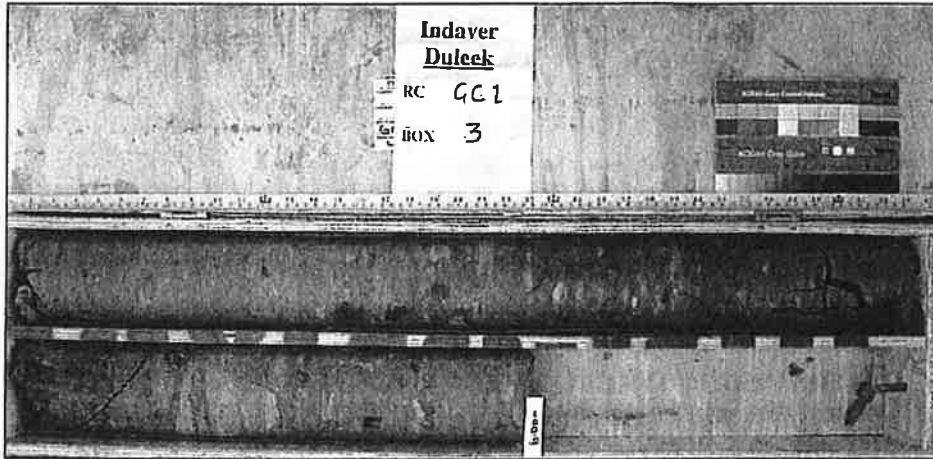


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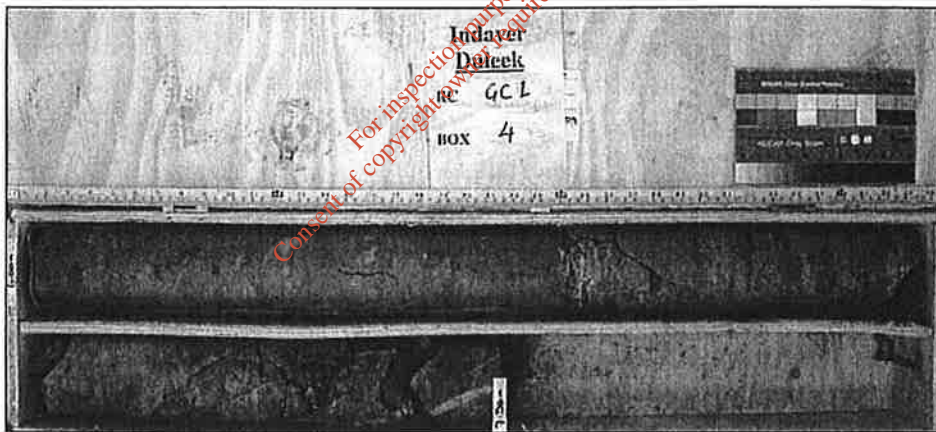
A handwritten signature or set of initials, possibly "Ab", written in black ink.

Core Photography – Indaver Duleek (14039)

RC GC1 BOX 3 OF 7



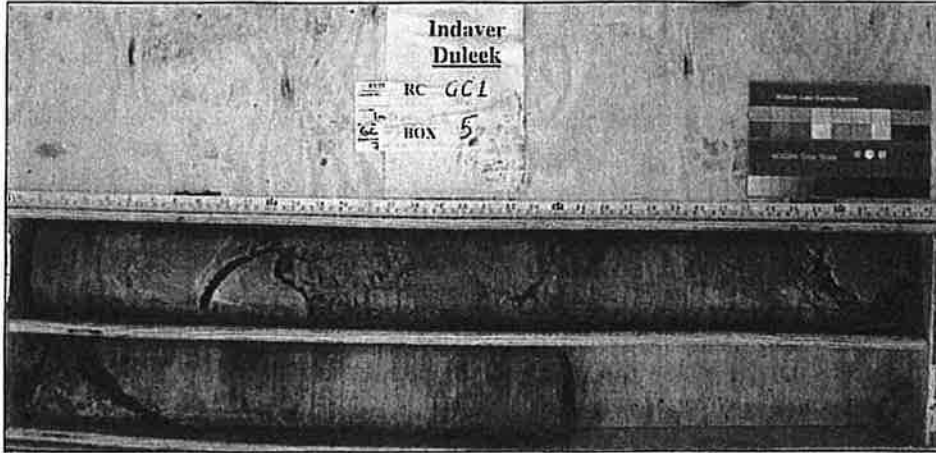
RC GC1 BOX 4 OF 7



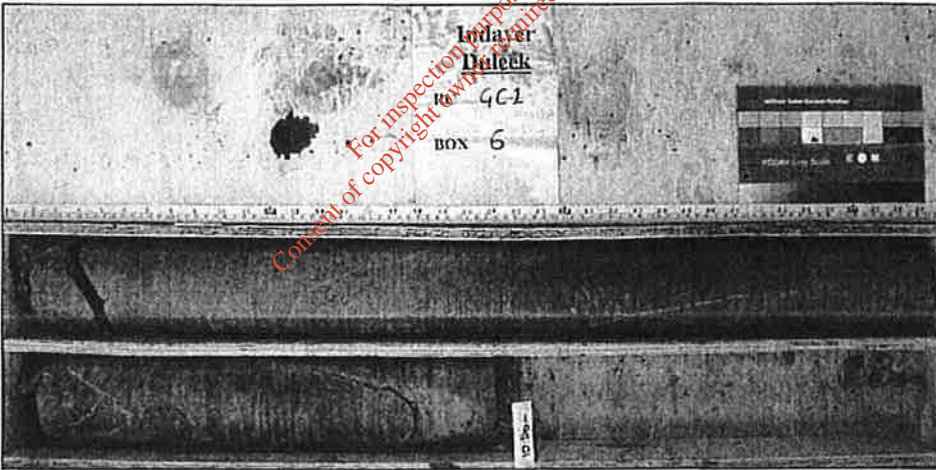
IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC GC1 BOX 5 OF 7



RC GC1 BOX 6 OF 7



IGSL Ltd.

A handwritten signature or set of initials, possibly 'AB', located at the bottom center of the page.

Core Photography – Indaver Duleek (14039)

RC GC1 BOX 7 OF 7

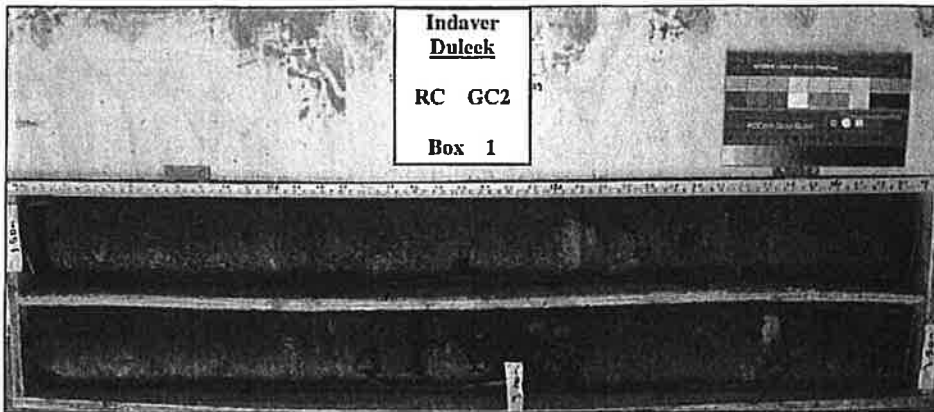


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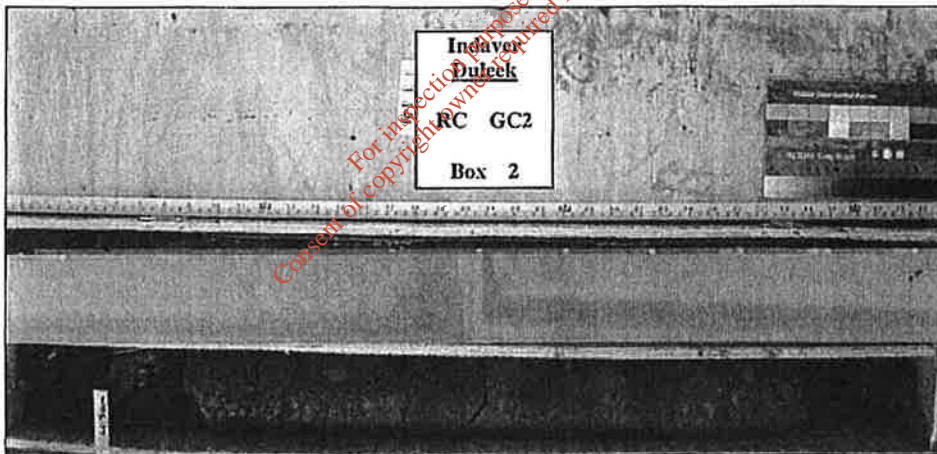
IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC GC2 BOX 1 OF 8



RC GC2 BOX 2 OF 8

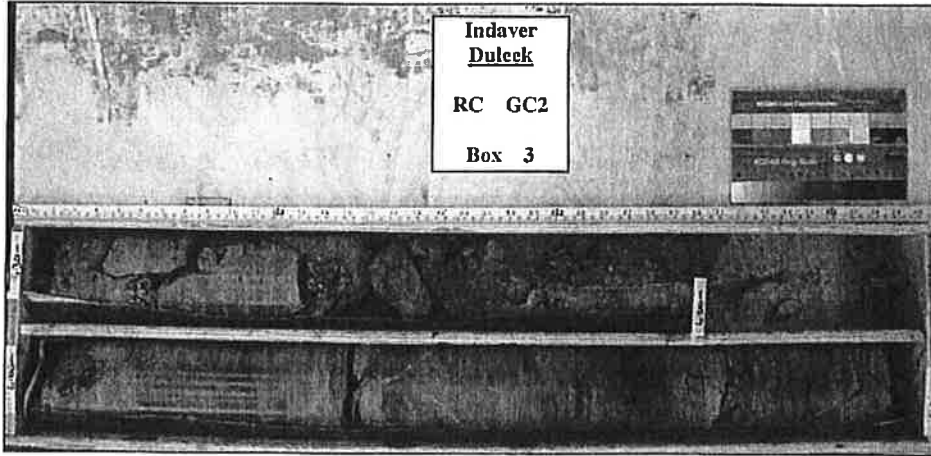


IGSL Ltd.

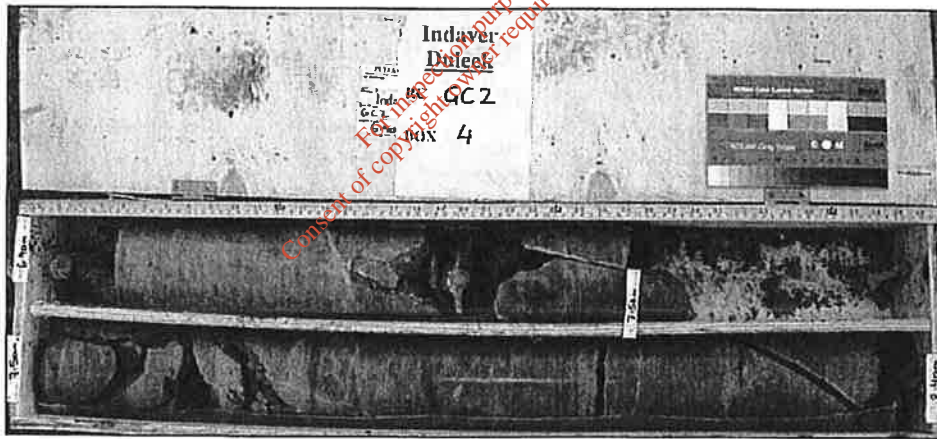
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Core Photography – Indaver Duleek (14039)

RC GC2 BOX 3 OF 8



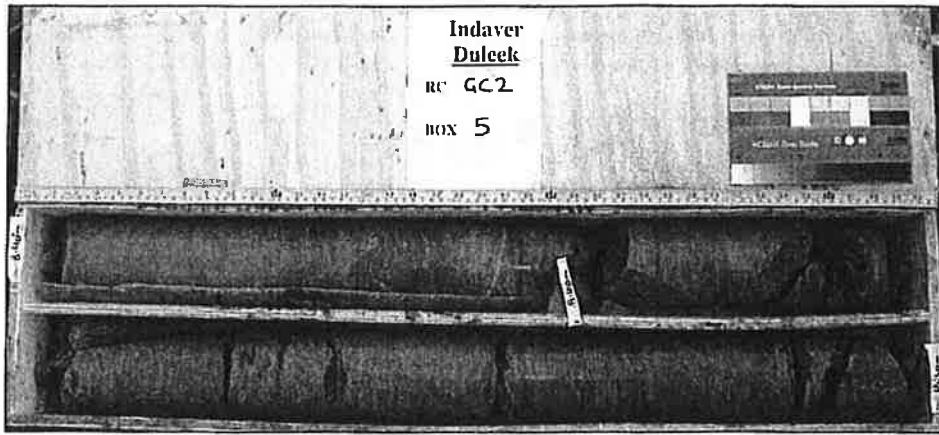
RC GC1 BOX 4 OF 8



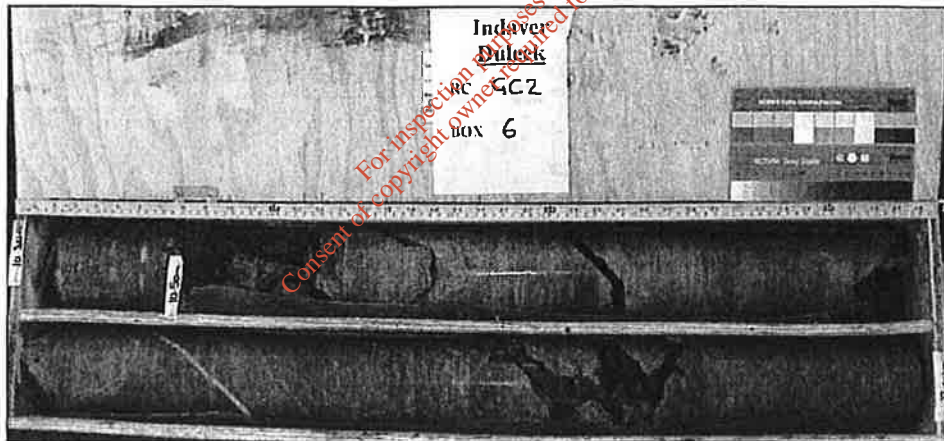
IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC GC2 BOX 5 OF 8



RC GC2 BOX 6 OF 8

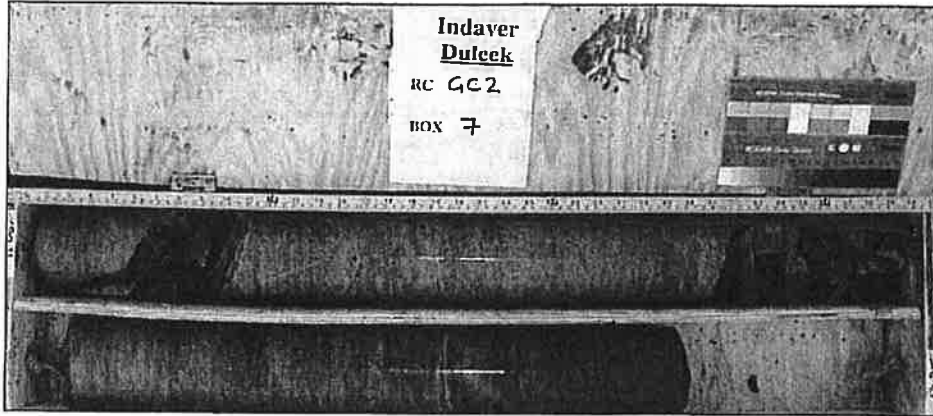


IGSL Ltd.

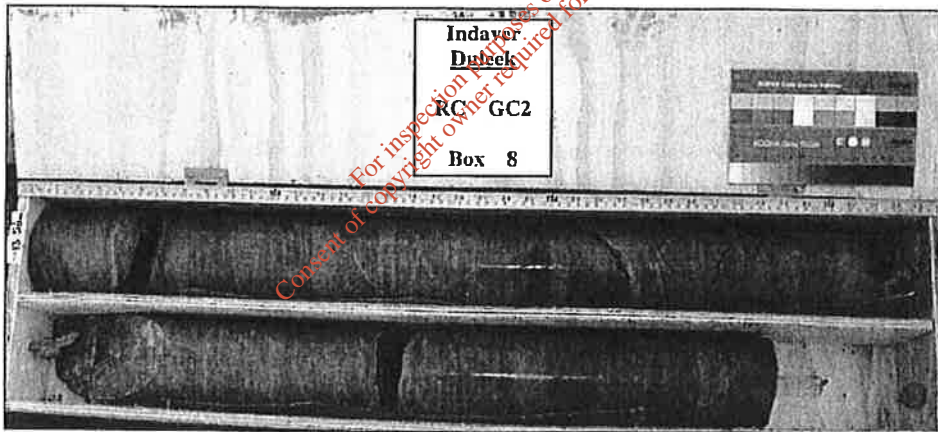
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Core Photography – Indaver Duleek (14039)

RC GC2 BOX 7 OF 8



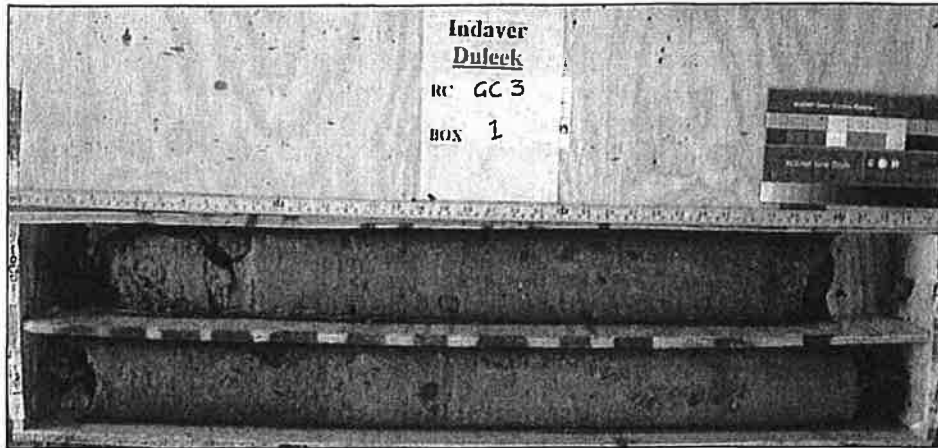
RC GC2 BOX 8 OF 8



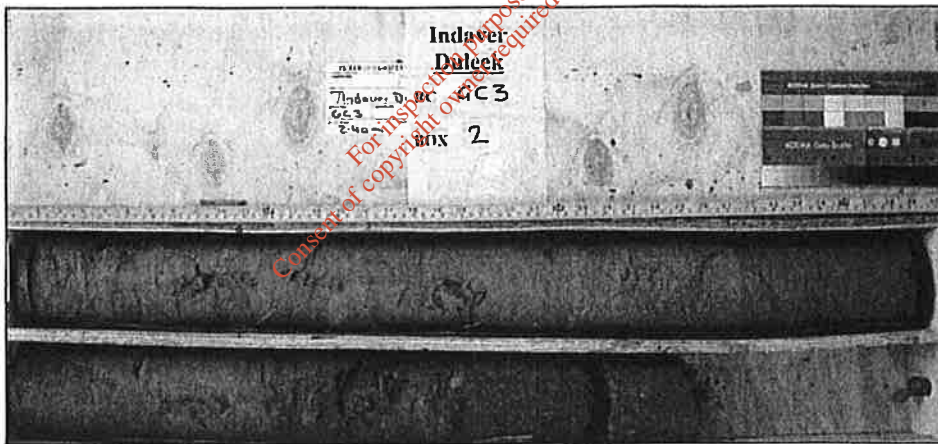
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Core Photography – Indaver Duleek (14039)

RC GC3 BOX 1 OF 7



RC GC3 BOX 2 OF 7

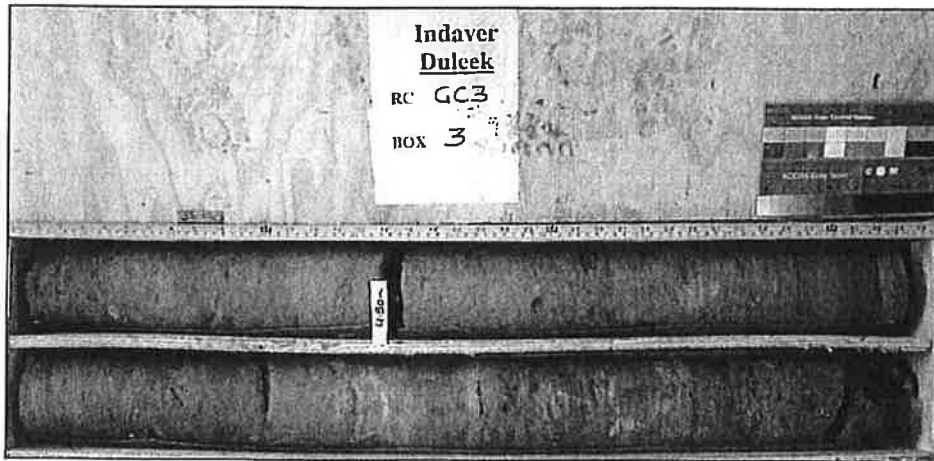


IGSL Ltd.

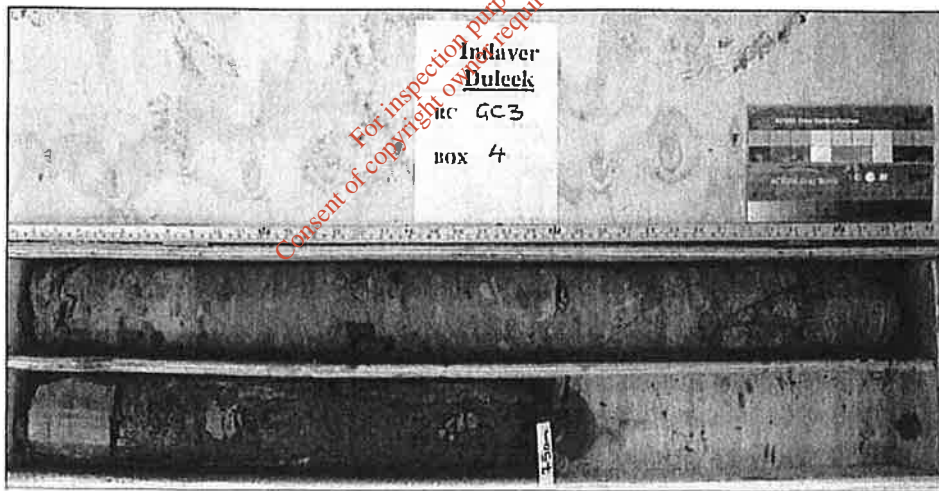
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Core Photography – Indaver Duleek (14039)

RC GC3 BOX 3 OF 7



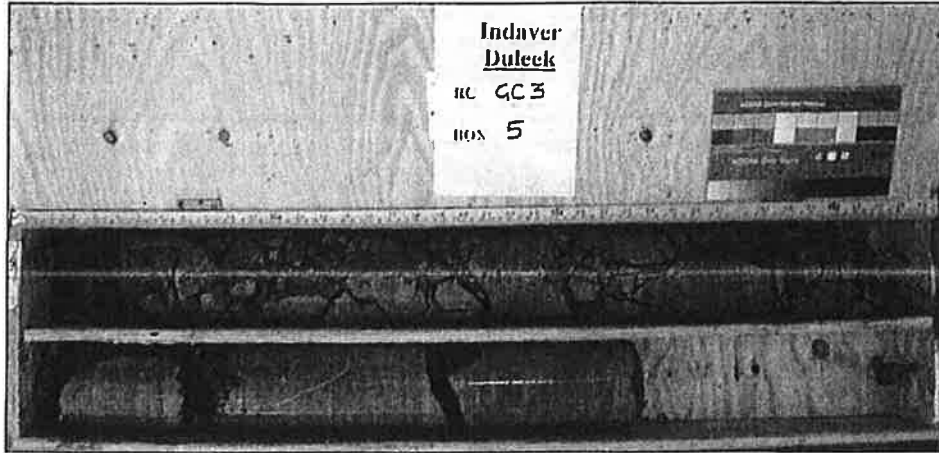
RC GC3 BOX 4 OF 7



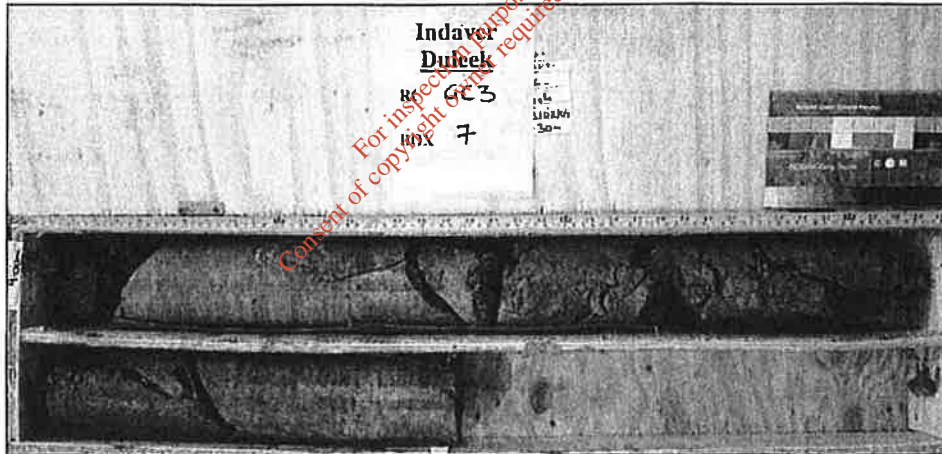
IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC 3 BOX 5 OF 7



RC GC3 BOX 6 OF 7

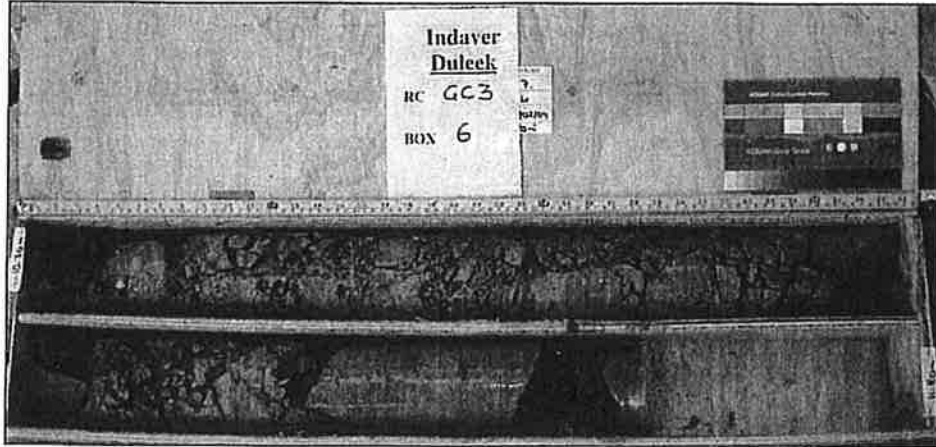


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Core Photography – Indaver Duleek (14039)

RC GC3 BOX 7 OF 7

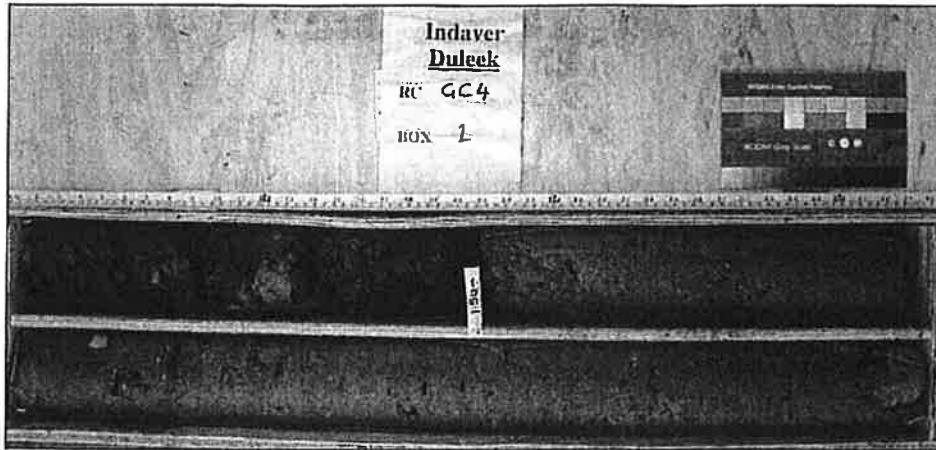


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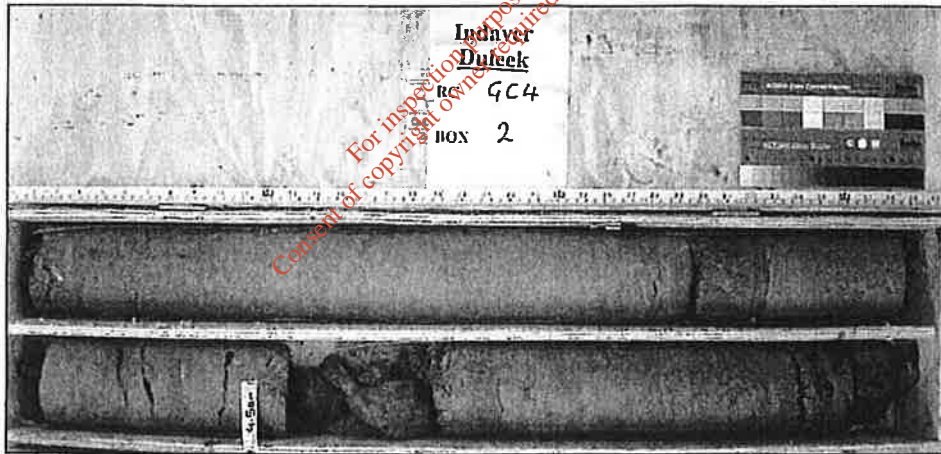
IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC GC4 BOX 1 OF 7



RC GC4 BOX 2 OF 7

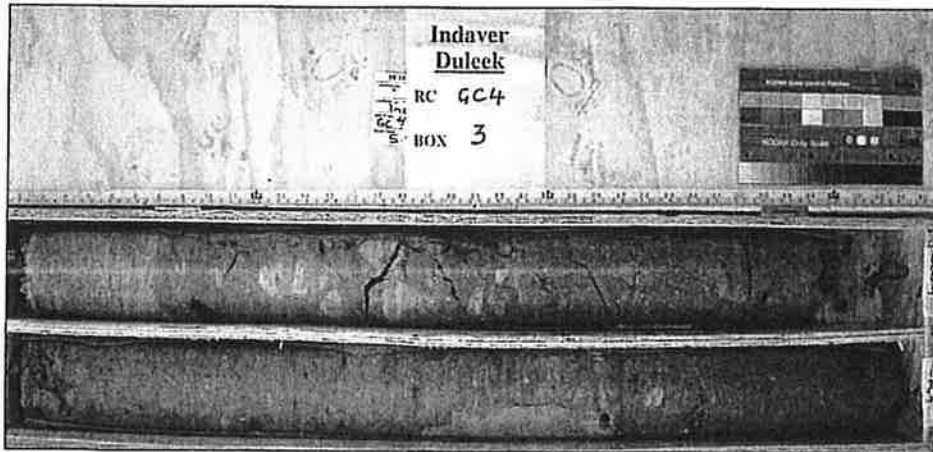


IGSL Ltd.

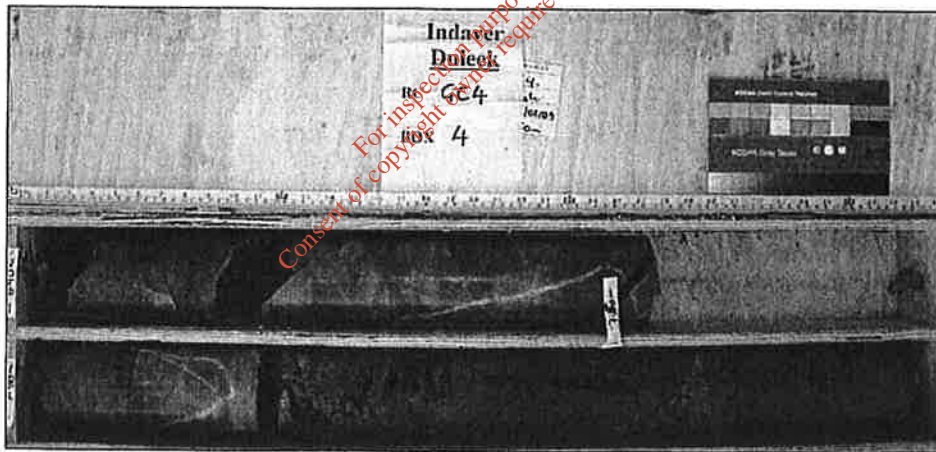
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Core Photography – Indaver Duleek (14039)

RC GC4 BOX 3 OF 7



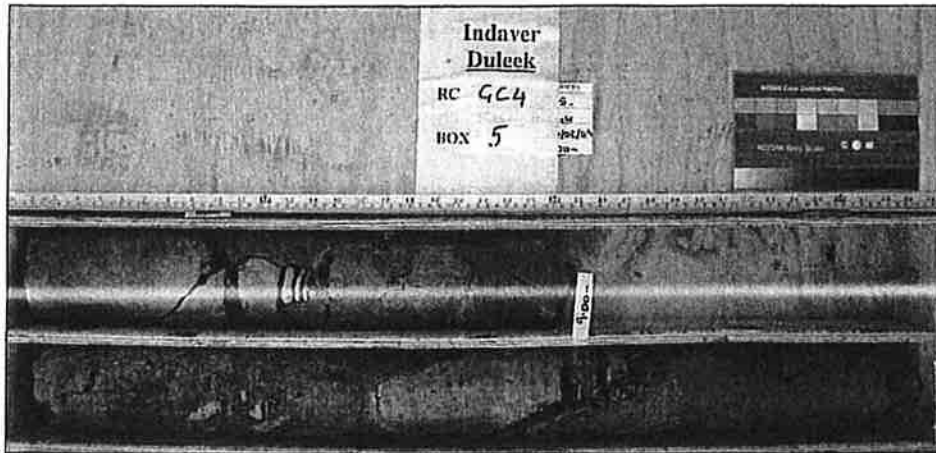
RC GC4 BOX 4 OF 7



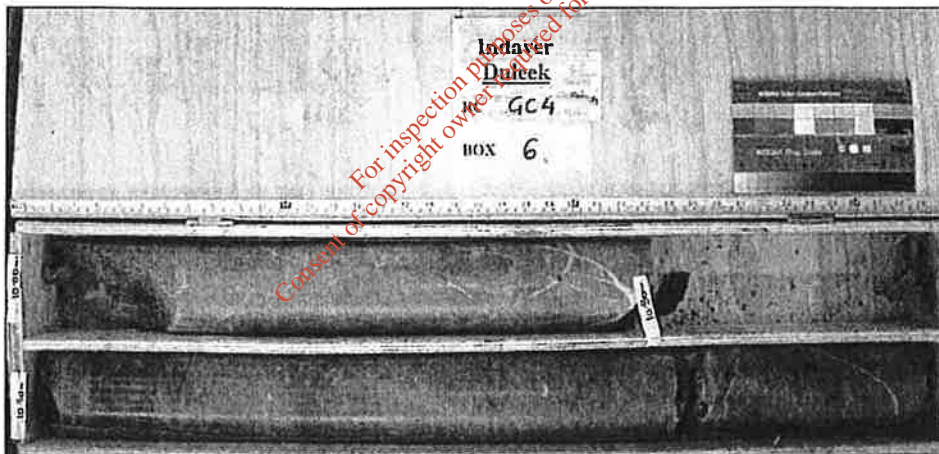
IGSL Ltd.

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RC GC4 BOX 5 OF 7



RC GC4 BOX 6 OF 7

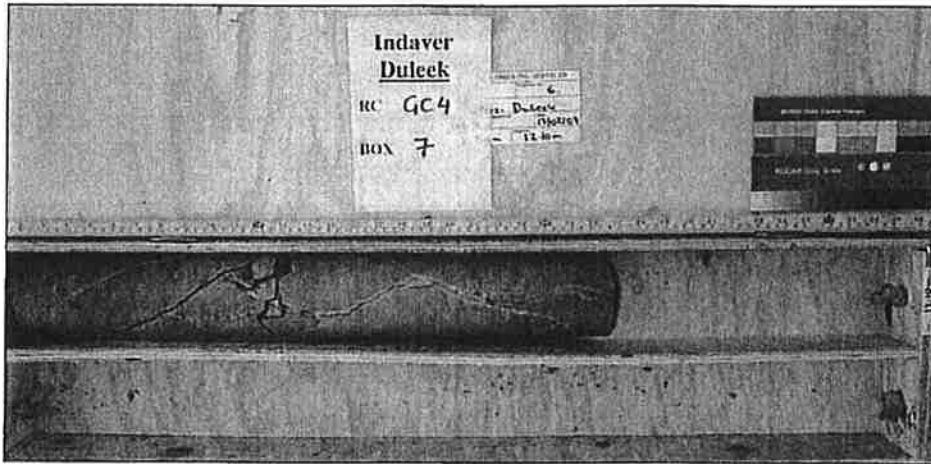


IGSL Ltd.

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Core Photography – Indaver Duleek (14039)

RC GC4 BOX 7 OF 7

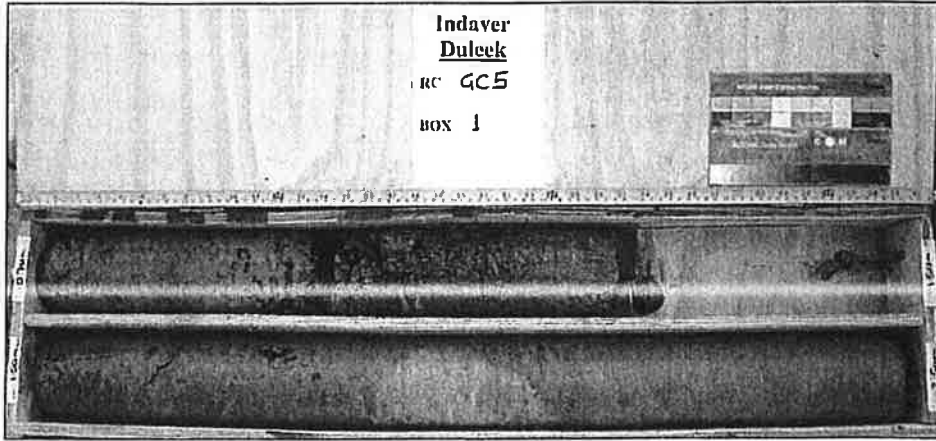


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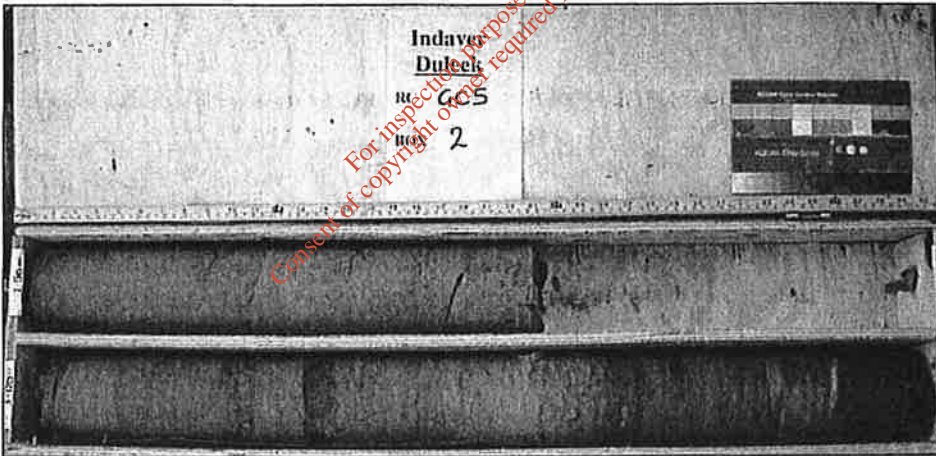
IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC GC5 BOX 1 OF 7



RC GC5 BOX 2 OF 7

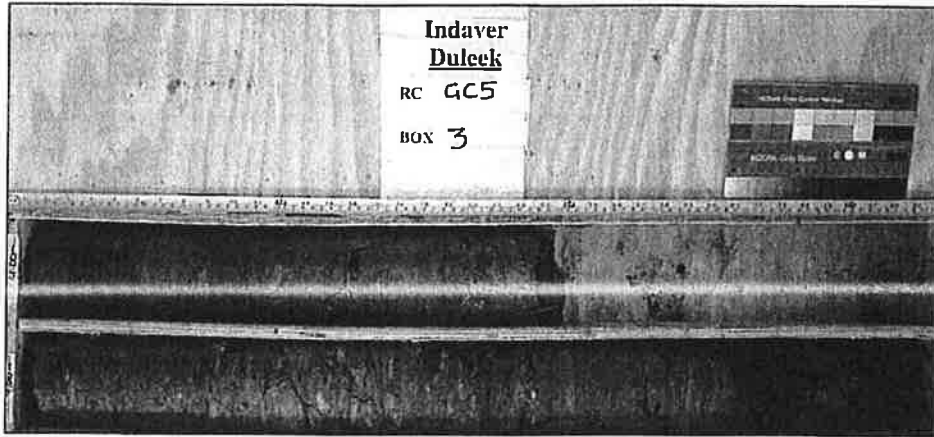


IGSL Ltd.

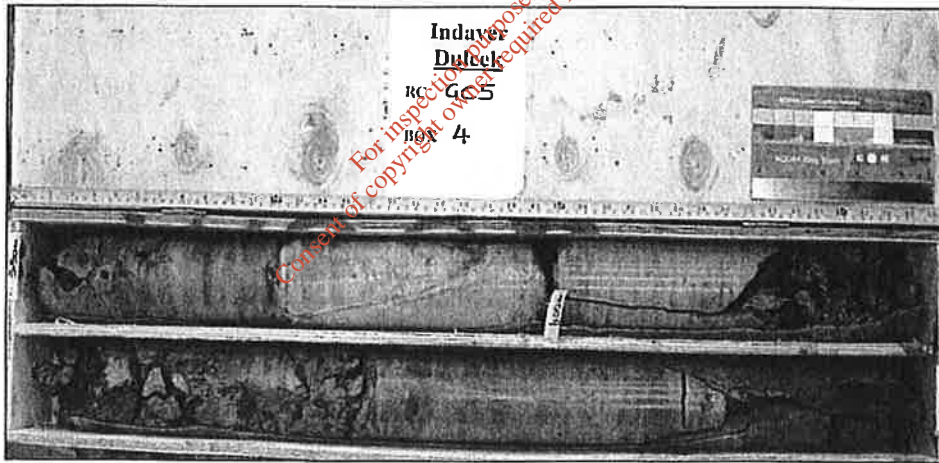
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Core Photography – Indaver Duleek (14039)

RC GC5 BOX 3 OF 7



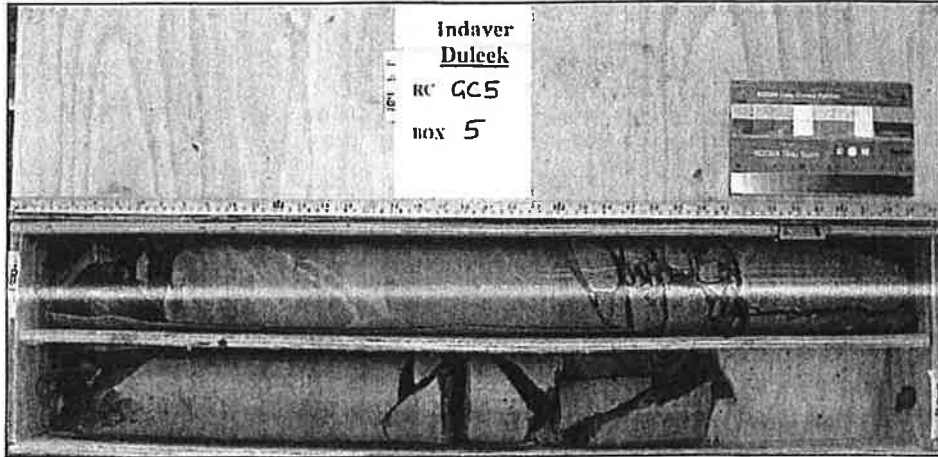
RC GC5 BOX 4 OF 7



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Core Photography – Indaver Duleek (14039)

RC GC5 BOX 5 OF 7



RC GC5 BOX 6 OF 7



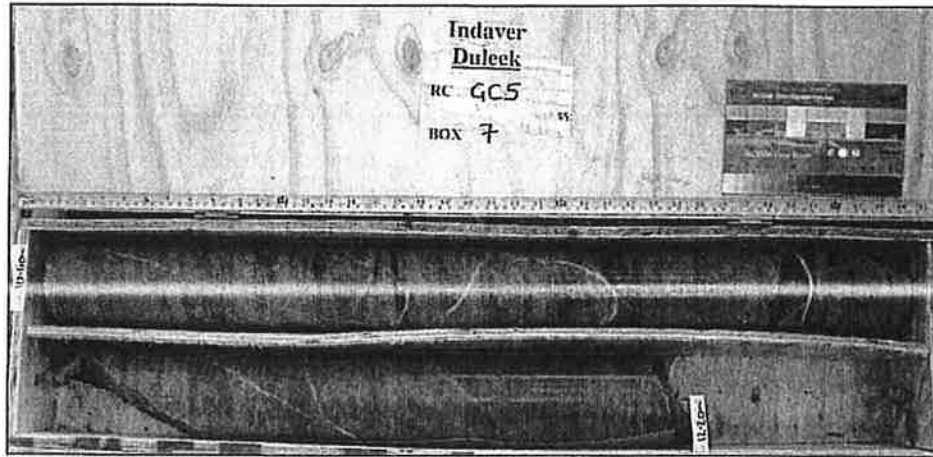
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A handwritten signature or set of initials, possibly "H", written in black ink.

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RC GC5 BOX 7 OF 7

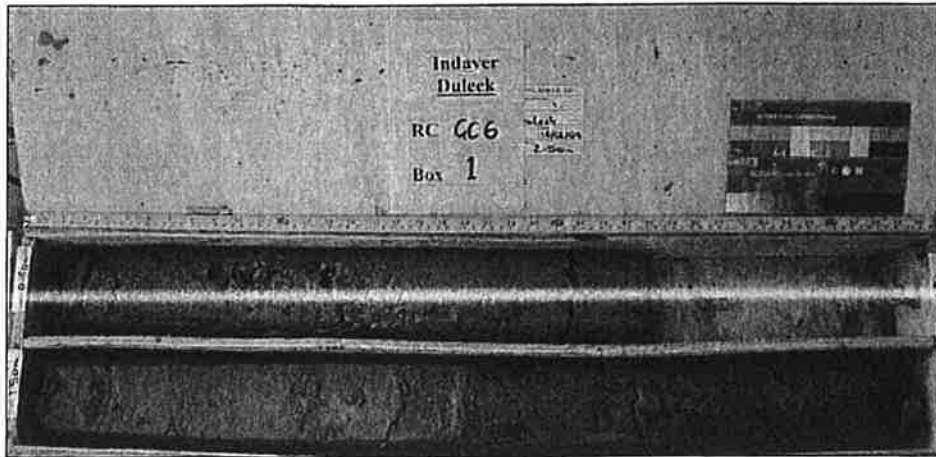


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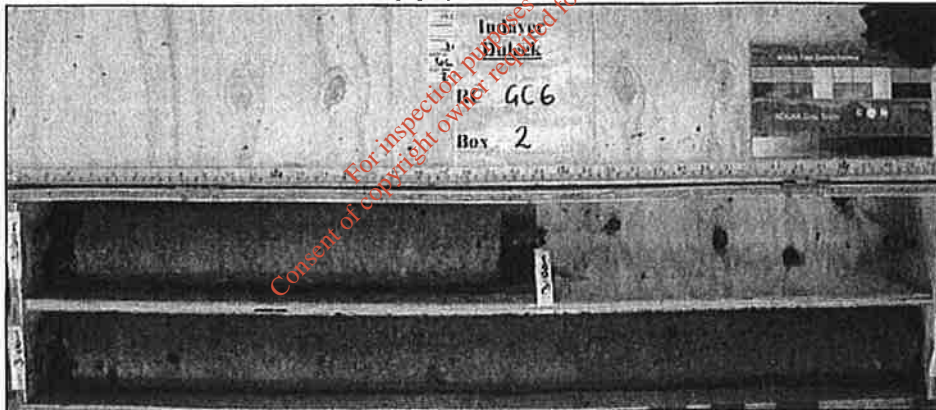
IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC GC6 BOX 1 OF 8



RC GC6 BOX 2 OF 8

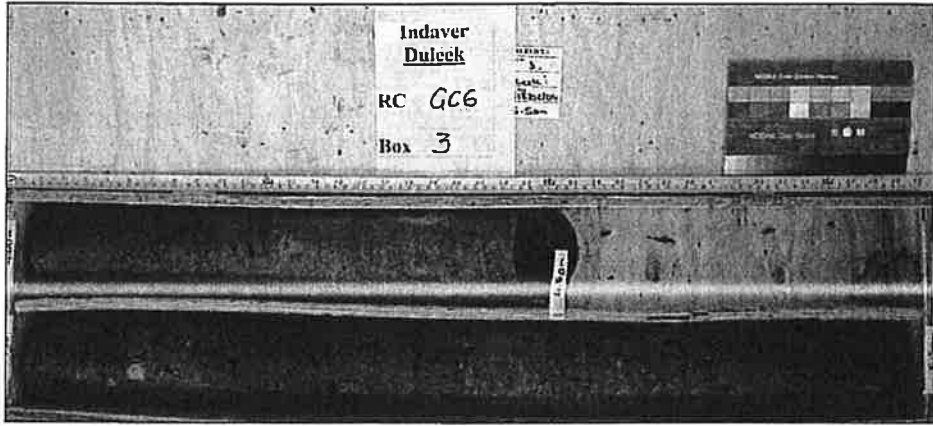


IGSL Ltd.

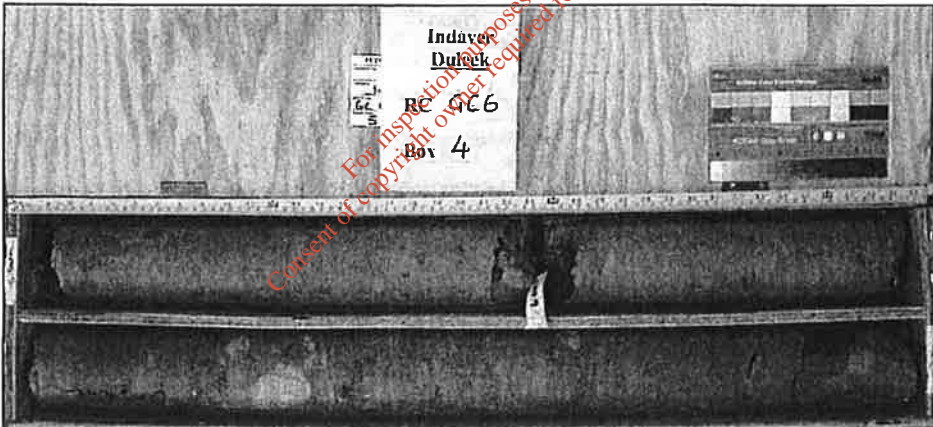
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Core Photography – Indaver Duleek (14039)

RC GC6 BOX 3 OF 8



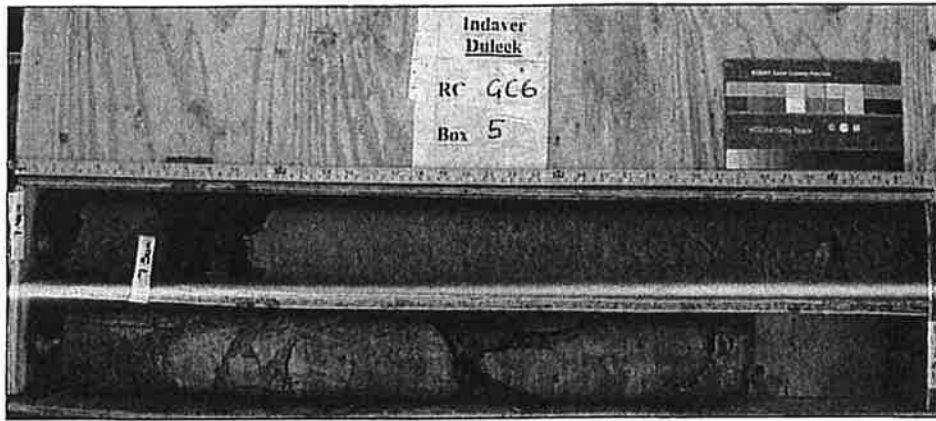
RC GC6 BOX 4 OF 8



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RC GC6 BOX 5 OF 8



RC GC6 BOX 6 OF 8

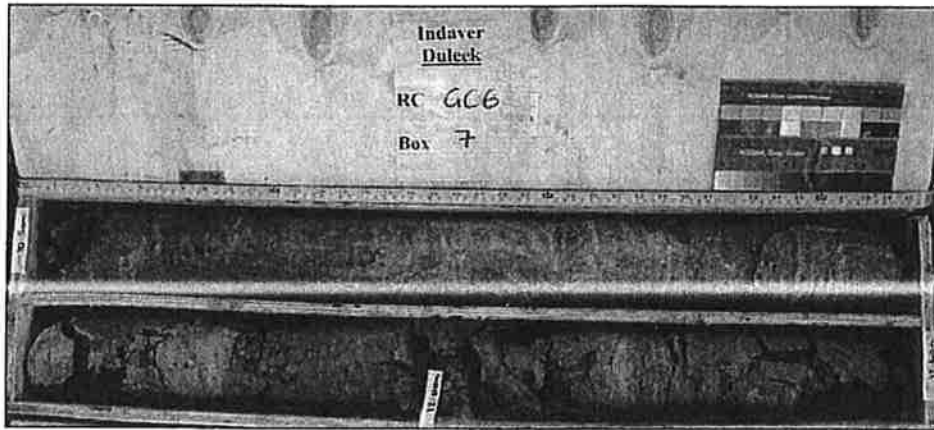


IGSL Ltd.

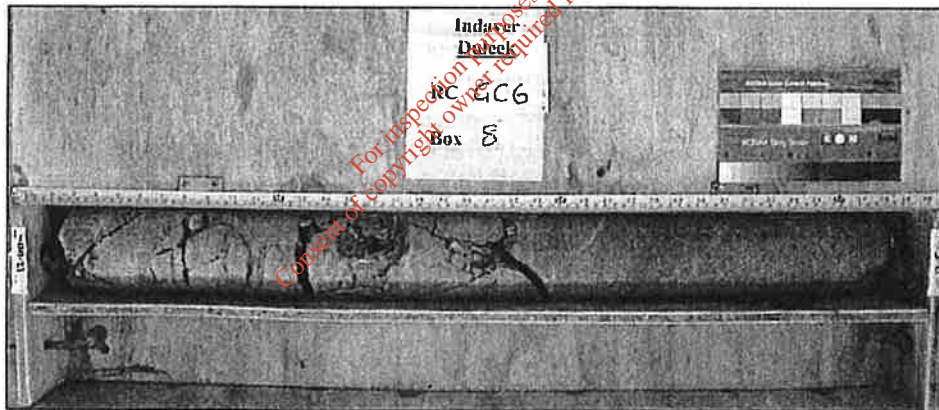
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RC GC6 BOX 7 OF 8



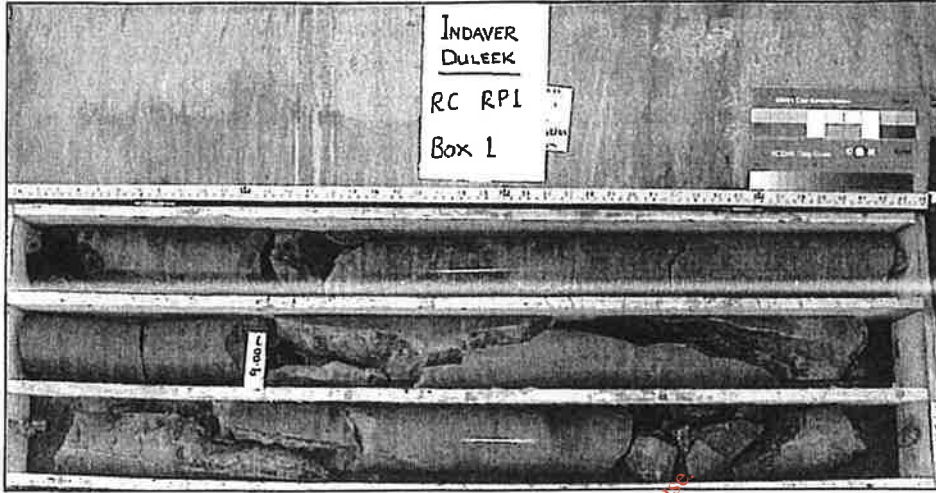
RC GC6 BOX 8 OF 8



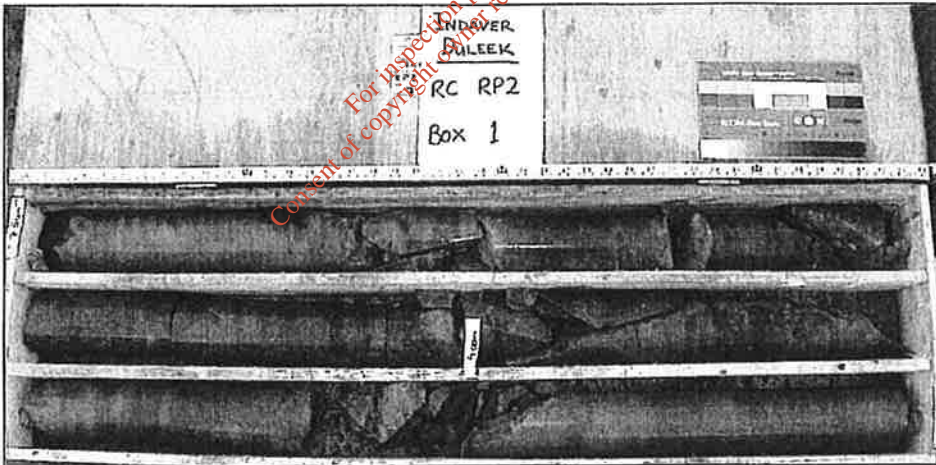
IGSL Ltd.

Core Photography – Indaver Duleek (14039)

RC RP1 BOX 1 OF 1



RC RP2 BOX 1 OF 1

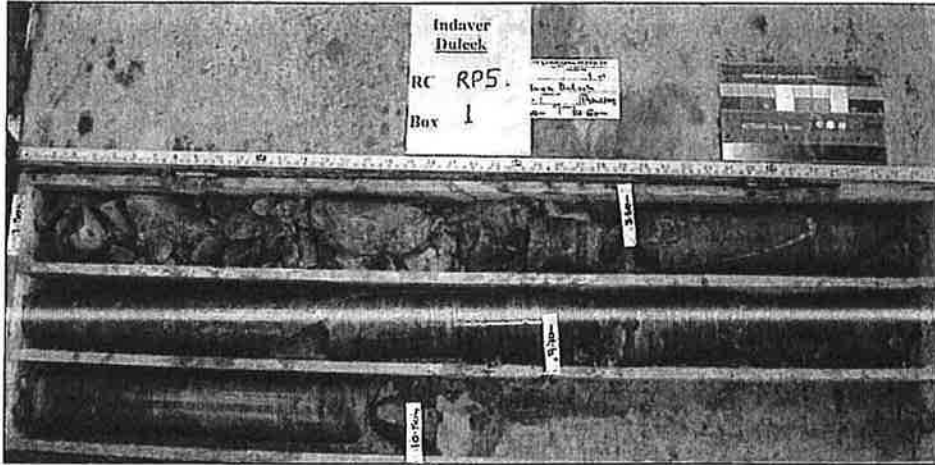


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RC RP5 box 1 of 1



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Appendix 7

Exploratory Site Plan

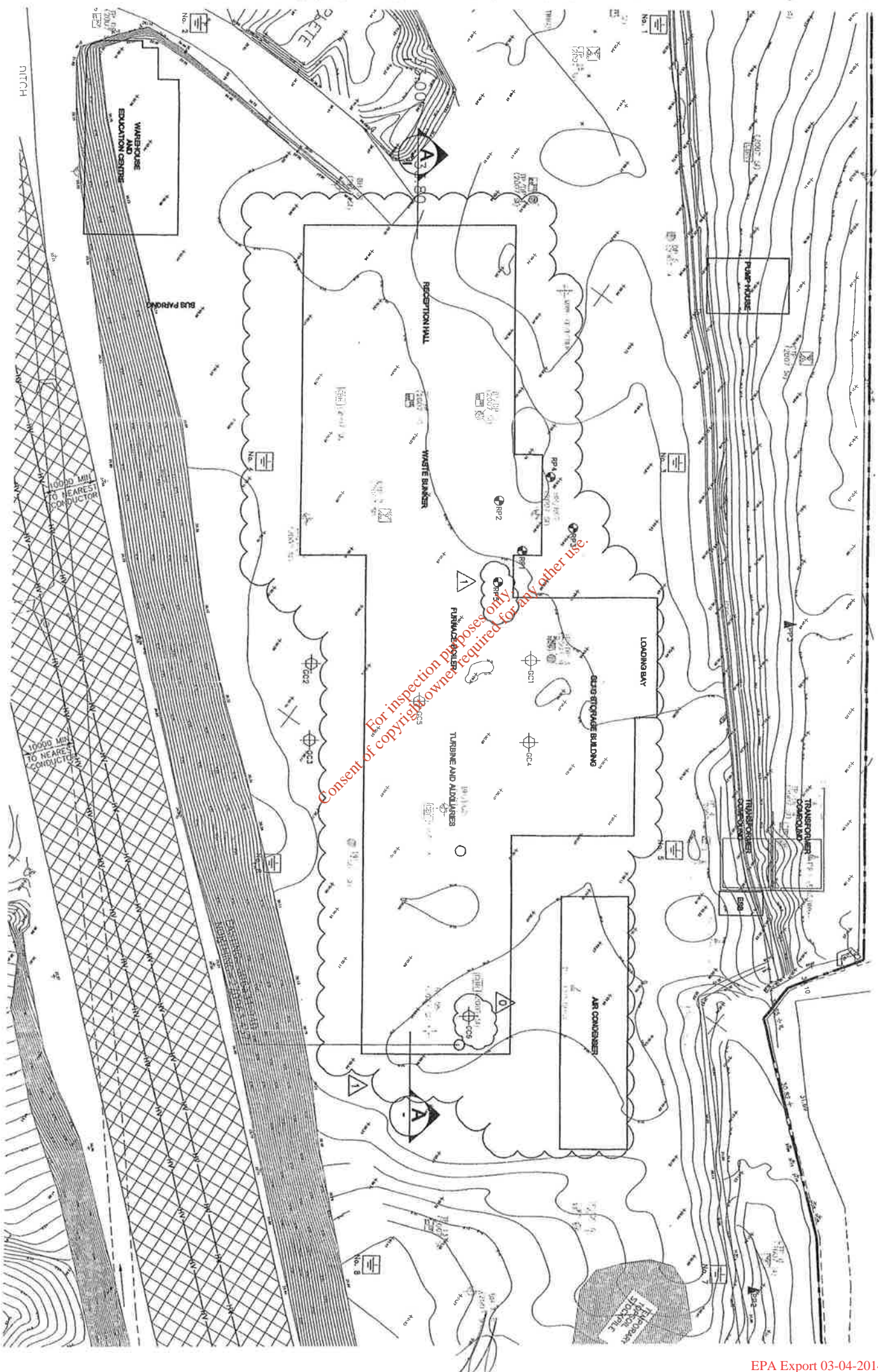
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GPS SURVEY - INDAVER PROJECT

EXPLORATORY NO.	EASTING (m)	NORTHING (m)	HEIGHT (m)
GC1	306263.874	270930.70	30.096
GC2	306286.093	270892.715	30.003
GC3	306299.117	270902.057	30.144
GC4	306275.131	270938.384	30.019
GC5	306280.567	270916.062	30.081
GC6	306325.715	270960.256	30.269
PP2	306334.870	271034.982	30.788
PP3	306229.147	270963.299	29.350
RP1	306246.509	270914.342	29.943
RP2	306241.735	270906.390	30.026
RP5	306255.430	270916.960	30.175

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Appendix 8

Stabilization Test Data

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TRIAL PIT RECORD

REPORT NUMBER

14039

CONTRACT	Indaver Waste Management Facility	TRIAL PIT NO.	TP1
LOGGED BY	D Tallon	SHEET	Sheet 1 of 1
CLIENT	Indaver	DATE STARTED	30/03/2009
ENGINEER	PM Group	DATE COMPLETED	30/03/2009
	CO-ORDINATES(_)	EXCAVATION METHOD	13T Tracked
	GROUND LEVEL (m)		

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Sample Ref	Type	Depth		
0.0	Very firm brown very sandy gravelly CLAY									
1.0						AD1376	LB	1.50-1.50		
2.0	Dense brown clayey gravelly fine to coarse SAND					AD1377	LB	1.50-1.50		
3.0						AD1378	LB	3.00-3.00		
3.30	Dense brown clayey sandy GRAVEL with occasional cobbles		3.30			AD1379	LB	3.00-3.00		
4.0						AD1380	LB	4.00-4.00		
4.0	End of Trial Pit at 4.00m		4.00			AD1381	LB	4.00-4.00		

Groundwater Conditions
Pit dry

Stability
Pit Stable

General Remarks

IGSL TP LOG 14039.GPJ IGSL.GDT 30/03/09

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TRIAL PIT RECORD

REPORT NUMBER

14039

CONTRACT Indaver Waste Management Facility		TRIAL PIT NO. TP2
LOGGED BY D Tallon	CO-ORDINATES(_)	SHEET Sheet 1 of 1
CLIENT Indaver	GROUND LEVEL (m)	DATE STARTED 30/03/2009
ENGINEER PM Group		DATE COMPLETED 30/03/2009
		EXCAVATION METHOD 13T Tracked

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Sample Ref	Type	Depth		
0.0	Loose grey slightly clayey very sandy GRAVEL									
1.0						AD1382	LB	1.50-1.50		
						AD1383	LB	1.50-1.50		
2.0	Medium dense grey/brown very sandy clayey GRAVEL with occasional cobbles									
3.0						AD1384	LB	2.90-3.00		
						AD1385	LB	2.90-3.00		
4.0	End of Trial Pit at 4.00m		4.00			AD1386	LB	3.90-4.00		
						AD1387	LB	3.90-4.00		

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Groundwater Conditions
Pit dry

Stability
Pit Unstable from 1.0m

General Remarks

IGSL TP LOG 14039.GPJ IGSL.GDT 30/3/09

SULPHATE ANALYSIS										IGSL
REPORT NO.										
CONTRACT: Indaver Waste Management Facility										
BH/TP NO.	DEPTH (M)	SAMPLE NO.	SAMPLE TYPE	TEST CODE	% Passing 2mm	SULPHUR TRIOXIDE		CONTRACT NO (so3 X 1.2)	pH VALUE	14039
						2:1WATER SOIL EXTRACT So3 g/L	TOTAL SOIL so3 %			
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	TREATED WITH 1%LIME TESTED AFTER 14	SP1A	S	A	N/A	0.41		0.492	11.9	
	TREATED WITH 2%LIME TESTED AFTER 14	SP1B	S	A	N/A	0.007		0.008	12.8	
	TREATED WITH 1%LIME & 1% CEMENT TESTED	SP1C	S	A	N/A	0.014		0.017	12.6	
COMBINED SAMPLES FROM STOCKPILE 3	TREATED WITH 2% LIME TESTED AFTER 14 DAYS	SP2A	S	A	N/A	0.017		0.020	12.4	
COMBINED SAMPLES FROM TRIAL PIT 1	TREATED WITH 1%LIME TESTED AFTER 14 DAYS	TP1A	S	A	N/A	0.031		0.037	11.7	
COMBINED SAMPLES FROM TRIAL PIT 2	TREATED WITH 1%CEMENT TESTED AFTER 14 DAYS	TP2A	S	A	N/A	0.141		0.169	11.0	
TEST CODE	W = WATER S = SOIL A = AQUEOUS SOIL EXTRACT(2:1)									

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Report No.

MCV SUMMARY

I.G.S.L.

Contract:

Indaver Waste Management Facility

CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
COMBINED SAMPLES FROM TRIAL PIT 1	TP1A		NATURAL	10.5	12.1	93.9	
			NATURAL	9.8	11.7	93.9	
			TREATED WITH 1% LIME TESTED AFTER 3 HRS	13.6	11.5	93.9	
			TREATED WITH 1% LIME TESTED AFTER 3 HRS	12.9	11.6	93.9	

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For inspection purposes only.

Test Code:

Report No. **MCV SUMMARY** I.G.S.L.

Contract: **Indaver Waste Management Facility** CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
COMBINED SAMPLES FROM TRIAL PIT 2	TP2A		NATURAL	9.0	12.0	81.7	
			NATURAL	8.9	12.6	81.7	
			TREATED WITH 1%CEMENT TESTED AFTER 3 HRS	9.7	13.3	81.7	
			TREATED WITH 1%CEMENT TESTED AFTER 3 HRS	10.1	13.2	81.7	

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Test Code:

Report No. **MCV SUMMARY** I.G.S.L.

Contract: **Indaver Waste Management Facility** CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
COMBINED SAMPLES FROM STOCKPILE 3	SP2A		NATURAL	2.9	23.2	92.8	
			NATURAL	3.2	23.9	92.8	
			TREATED WITH 2% LIME TESTED AFTER 3 HRS	5.6	25.9	92.8	
			TREATED WITH 2% LIME TESTED AFTER 3 HRS	5.5	26.5	92.8	

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Test Code:

Report No. **MCV SUMMARY** I.G.S.L.

Contract: **Indaver Waste Management Facility** CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	SP1A		NATURAL	3.0	16.6	91.5	
			NATURAL	2.7	16.8	91.5	
			TREATED WITH 1% LIME TESTED AFTER 3 HRS	6.3	18.3	91.5	
			TREATED WITH 1% LIME TESTED AFTER 3 HRS	7.6	18.6	91.5	

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Test Code:

Report No.

MCV SUMMARY

I.G.S.L.

Contract:

Indaver Waste Management Facility

CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	SP1B		NATURAL	3.0	16.6	91.5	
			NATURAL	2.7	16.8	91.5	
			TREATED WITH 2% LIME TESTED AFTER 3 HRS	7.9	17.8	91.5	
			TREATED WITH 2% LIME TESTED AFTER 3 HRS	8.4	17.3	91.5	

Consent not for inspection purposes only.
Consent not for inspection purposes required for any other use.

Test Code:

Report No. **MCV SUMMARY** I.G.S.L.

Contract: **Indaver Waste Management Facility** CONTRACT No 14039

Location	Sample No.	Depth (m)	Sample Description	MCV	MC %	% Passing 20mm	REMARKS	
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	SP1C		NATURAL	3.0	16.6	91.5		
			NATURAL	2.7	16.8	91.5		
				TREATED WITH 1%LIME & 1% CEMENT TESTED AFTER 3 HF	7.5	17.6	91.5	
				TREATED WITH 1%LIME & 1% CEMENT TESTED AFTER 3 HF	7.5	18.0	91.5	

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Test Code:

Report No.

CALIFORNIA BEARING RATIO**I.G.S.L.**

Contract:

Indaver Waste Management Facility

DATE:

12/05/2009

CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Water Content		Bulk Density Mg/M3	% Passing 20mm	C.B.R.		
						Top %	Bottom %			Top %	Base %	Average %
COMBINED SAMPLES FROM TRIAL PIT 1	TP1A		NATURAL	11.9	NAT	12.0	11.8	2.25	93.9	16.5	18.2	17.4
			NATURAL	11.8	NAT	11.9	11.7	2.25	93.9	18.5	18.2	18.3
		TREATED WITH 1%LIME	11.4	1 DAY	11.3	11.4	2.20	93.9	38.9	36.4	37.6	
		TREATED WITH 1%LIME	11.5	1 DAY	11.5	11.5	2.20	93.9	33.9	38.1	36.0	
		TREATED WITH 1%LIME	11.4	3 DAY	11.5	11.3	2.20	93.9	33.5	30.5	32.0	
		TREATED WITH 1%LIME	11.7	3 DAY	11.8	11.5	2.20	93.9	38.2	38.4	38.3	
		TREATED WITH 1%LIME	11.2	14 DAY	11.3	11.1	2.20	93.9	44.4	54.7	49.6	
		TREATED WITH 1%LIME	11.4	14 DAY	11.6	11.2	2.20	93.9	48.3	53.4	50.9	

Test Code U.-Undisturbed Sample
D.-Dynamic Compaction
St.-Static compaction

L.-2.5Kg. Rammer
H.-4.5Kg. Rammer

A5.-5% Air Voids Ratio
A10.-10% Air Voids Ratio
RN29.- Road Note 29 (St. 95% H.)

V.- Vibrating Hammer
M.- Method Number

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Report No.

CALIFORNIA BEARING RATIO

I.G.S.L.

Contract: Indaver Waste Management Facility

DATE: 12/05/2009

CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Test Code	Water Content		Bulk Density Mg/M3	% Passing 20mm	C.B.R.		
							Top %	Bottom %			Top %	Base %	Average %
COMBINED SAMPLES FROM TRIAL PIT2	TP2A		NATURAL	13.2	NAT	L/St	13.2	13.1	2.24	81.7	23.3	17.6	20.5
			NATURAL	13.3	NAT	L/St	13.0	13.5	2.24	81.7	16.4	17.4	16.9
		TREATED WITH 1% CEMENT	13.4	1 DAY	L/St	13.3	13.5	2.23	81.7	55.5	55.6	55.6	
		TREATED WITH 1% CEMENT	13.4	1 DAY	L/St	13.3	13.4	2.23	81.7	58.7	49.6	54.1	
		TREATED WITH 1% CEMENT	13.5	3 DAY	L/St	13.3	13.6	2.23	81.7	58.1	43.3	50.7	
		TREATED WITH 1% CEMENT	13.1	3 DAY	L/St	13.1	13.0	2.23	81.7	69.2	67.4	68.3	
		TREATED WITH 1% CEMENT	12.4	14 DAY	L/St	12.4	12.4	2.23	81.7	69.0	78.4	73.7	
		TREATED WITH 1% CEMENT	12.9	14 DAY	L/St	12.9	12.8	2.23	81.7	74.1	65.0	69.6	

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Test Code U.-Undisturbed Sample L.-2.5Kg. Rammer A/5.-5% Air Voids Ratio V.- Vibrating Hammer
 D.-Dynamic Compaction H.-4.5Kg. Rammer A10.-10% Air Voids Ratio M.- Method Number
 St.-Static compaction RN29.- Road Note 29 (St. 95% H.)

Report No.

CALIFORNIA BEARING RATIO

I.G.S.I.L.

Contract: Indaver Waste Management Facility

DATE: 12/05/2009

CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Water Content		Bulk Density Mg/M3	% Passing 20mm	C.B.R.		
						Top %	Bottom %			Top %	Base %	Average %
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	SP1A		NATURAL	19.5	NAT	19.5	19.5	2.07	91.5	1.0	0.8	0.9
			NATURAL	19.7	NAT	19.2	20.1	2.07	91.5	1.1	0.6	0.9
		TREATED WITH 1%LIME & 1% CEMENT	18.1	1 DAY	18.1	18.1	2.10	91.5	10.3	10.1	10.2	
		TREATED WITH 1%LIME & 1% CEMENT	18.7	1 DAY	18.4	19.0	2.10	91.5	10.1	10.2	10.1	
		TREATED WITH 1%LIME & 1% CEMENT	18.4	3 DAY	18.4	18.4	2.10	91.5	10.6	10.5	10.6	
		TREATED WITH 1%LIME & 1% CEMENT	18.8	3 DAY	18.8	18.7	2.10	91.5	13.9	14.5	14.2	
		TREATED WITH 1%LIME & 1% CEMENT	18.6	14 DAY	18.7	18.4	2.09	91.5	19.1	12.8	16.0	
		TREATED WITH 1%LIME & 1% CEMENT	18.1	14 DAY	17.8	18.4	2.09	91.5	15.7	16.2	16.0	

Test Code U.-Undisturbed Sample L.-2.5Kg. Rammer A/5.-5% Air Voids Ratio V.- Vibrating Hammer
 D.-Dynamic Compaction H.-4.5Kg. Rammer A10.-10% Air Voids Ratio M.- Method Number
 St.-Static compaction RN29.- Road Note 29 (St. 95% H.)

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Report No.

CALIFORNIA BEARING RATIO

I.G.S.L.

Contract: Indaver Waste Management Facility

DATE: 12/05/2009

CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Water Content		Bulk Density Mg/M3	% Passing 20mm	C.B.R.		
						Top %	Bottom %			Top %	Base %	Average %
COMBINED SAMPLES FROM STOCKPILE 3	SP2A		NATURAL	27.8	NAT	27.0	28.6	1.89	92.8	0.3	0.2	0.3
			NATURAL	26.7	NAT	26.2	27.2	1.89	92.8	0.4	0.3	0.3
		TREATED WITH 2%LIME	26.2	1 DAY	26.3	26.1	1.95	92.8	4.2	4.2	4.2	
		TREATED WITH 2%LIME	26.1	1 DAY	26.8	25.4	1.95	92.8	3.7	4.8	4.2	
		TREATED WITH 2%LIME	26.4	3 DAY	26.3	26.4	1.95	92.8	2.8	2.7	2.7	
		TREATED WITH 2%LIME	26.6	3 DAY	26.5	26.6	1.95	92.8	3.4	3.1	3.3	
		TREATED WITH 2%LIME	25.3	14 DAY	25.0	25.6	1.95	92.8	5.6	5.6	5.6	
		TREATED WITH 2%LIME	25.8	14 DAY	25.2	26.3	1.95	92.8	6.1	6.2	6.1	

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Test Code U.-Undisturbed Sample L.-2.5Kg. Rammer A/5.-5% Air Voids Ratio V.- Vibrating Hammer
 D.-Dynamic Compaction H.-4.5Kg. Rammer A10.-10% Air Voids Ratio M.- Method Number
 St.-Static compaction RN29.- Road Note 29 (St. 95% H.)

CALIFORNIA BEARING RATIO

Report No.

I.G.S.L.

Contract: **Indaver Waste Management Facility**

DATE: **12/05/2009**

CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Test Code	Water Content		Bulk Density Mg/M3	% Passing 20mm	C.B.R.		
							Top %	Bottom %			Top %	Base %	Average %
COMBINED SAMPLES FROM STOCKPILE 1,2 & 4	SP1A		NATURAL	19.5	NAT	L/St	19.5	19.5	2.07	91.5	1.0	0.8	0.9
			NATURAL	19.7	NAT	L/St	19.2	20.1	2.07	91.5	1.1	0.6	0.9
			TREATED WITH 2%LIME	18.9	1 DAY	L/St	18.7	19.0	2.11	91.5	11.1	5.9	8.5
			TREATED WITH 2%LIME	19.0	1 DAY	L/St	19.0	19.0	2.11	91.5	12.7	11.9	12.3
			TREATED WITH 2%LIME	18.1	3 DAY	L/St	18.3	17.8	2.11	91.5	15.1	11.2	13.1
			TREATED WITH 2%LIME	18.5	3 DAY	L/St	18.5	18.5	2.11	91.5	16.9	16.4	16.6
			TREATED WITH 2%LIME	18.0	14 DAY	L/St	18.0	18.0	2.11	91.5	17.3	19.2	18.2
			TREATED WITH 2%LIME	17.6	14 DAY	L/St	17.1	18.0	2.11	91.5	16.5	17.4	16.9

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Test Code U.-Undisturbed Sample	L.-2.5Kg. Rammer	A/5.-5% Air Voids Ratio	V.- Vibrating Hammer
D.-Dynamic Compaction	H.-4.5Kg. Rammer	A10.-10% Air Voids Ratio	M.- Method Number
St.-Static compaction		RN29.- Road Note 29 (St. 95% H.)	

Report No.

CALIFORNIA BEARING RATIO

I.G.S.L.

Contract: Indaver Waste Management Facility

DATE: 12/05/2009

CONTRACT No 14039

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Test Code	Water Content		Bulk Density Mg/M3	% Passing 20mm	C.B.R.		Average %
							Top %	Bottom %			Top %	Base %	
COMBINED SAMPLES FROM STOCKPILE 1, 2 & 4	SP1A		NATURAL	19.5	NAT	L/St	19.5	19.5	2.07	91.5	1.0	0.8	0.9
			NATURAL	19.7	NAT	L/St	19.2	20.1	2.07	91.5	1.1	0.6	0.9
		TREATED WITH 1%LIME	19.3	1 DAY	L/St	19.8	18.7	2.09	91.5	5.4	5.5	5.4	
		TREATED WITH 1%LIME	19.4	1 DAY	L/St	19.0	19.7	2.09	91.5	4.6	6.3	5.4	
		TREATED WITH 1%LIME	19.3	3 DAY	L/St	19.4	19.1	2.09	91.5	5.4	5.8	5.6	
		TREATED WITH 1%LIME	18.8	3 DAY	L/St	18.8	18.7	2.09	91.5	3.4	5.9	4.7	
		TREATED WITH 1%LIME	18.9	14 DAY	L/St	19.1	18.6	2.09	91.5	8.0	6.5	7.2	
		TREATED WITH 1%LIME	17.9	14 DAY	L/St	18.1	17.6	2.09	91.5	8.6	9.7	9.2	

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Test Code U.-Undisturbed Sample
D.-Dynamic Compaction
St.-Static compaction

L.-2.5Kg. Rammer
H.-4.5Kg. Rammer

A/5.-5% Air Voids Ratio
A10.-10% Air Voids Ratio
RN29.- Road Note 29 (St. 95% H.)

V.- Vibrating Hammer
M.- Method Number

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Appendix 9.2

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Table 9.1: Soil Analytical Results - Metals Phenols (28/4/00)

Sample Identity	Depth (m)	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Copper mg/kg	Mercury mg/kg	Nickel mg/kg	Lead mg/kg	Selenium mg/kg	Zinc mg/kg	Total Phenols mg/kg
TP1	0 - 3.3	<1	2	16	37	2	33	10	<1	54	0.01
TP2	0 - 3.4	1	<1	44	48	<1	58	13	<1	72	<0.01
TP3	0 - 3.4	<1	<1	46	26	1	46	9	<1	54	<0.01
TP4	0 - 3.5	<1	<1	49	30	<1	54	12	<1	66	<0.01
TP5	0 - 3.4	19	<1	43	25	<1	43	11	<1	51	<0.01
TP6	0 - 3.1	<1	<1	36	29	3	47	11	<1	59	<0.01
TP7	0 - 3.3	23	<1	39	37	<1	55	13	<1	60	<0.01
TP-7 Duplicate	0 - 3.3	3	<1	42	38	<1	39	9	<1	46	n.a.

Dutch MAC S Values	29	0.8	100	36	0.3	35	85	-	140	-
Dutch MAC I Values	55	12	380	190	10	210	530	-	720	-

Legend

mg/kg: milligrams per kilogram

MAC: Dutch Standard Maximum Admissible Concentration

S Value: Dutch Guideline for normal uncontaminated soil

I Value: Dutch Guideline for Intervention

"-": MAC Guideline not available

n.a. = not analysed

"<" = below detection limit

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Table 9.2: Soil Analytical Results - VOCs (28/4/00)

Trace Organics (VOCs)		TP1	TP2	TP3	TP4	TP5	TP6	TP7	Dutch MACs	
									S-Value	I-Value
Dichlorofluoromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Vinylchloride	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	100
Bromomethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Trichlorofluoromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
trans-1,2-Dichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dichloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	20,000
1,1 Dichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,1 Dichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
cis-1,2-Dichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Bromochloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chloroform	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
2,2-Dichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	4,000
1,1,1-Trichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,1-Dichloropropene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Benzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	1,000
Carbontetrachloride	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dibromomethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Bromodichloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Trichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	1	60,000
cis-1,3-Dichloropropene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
trans-1,3-Dichloropropene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,1,2-Trichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Toluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	130,000
1,3-Dichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dibromochloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dibromoethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Tetrachloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	4,000
1,1,1,2-Tetrachloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Ethylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	50,000
p/m Xylenes	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	25,000
Bromoform	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Styrene	µg/kg	<1	<1	<1	<1	<1	<1	<1	100	100,000
1,1,2,2-Tetrachloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
o - Xylene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,3-Trichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Isopropylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Bromobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
2-Chlorotoluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Propylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4-Chlorotoluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,4-Trimethylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4-Isopropyltoluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,3,5-Trimethylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
1,4-Dichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
sec-Butylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
tert-Butylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,3-Dichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
n-Butylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dibromo-3-Chloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,4-Trichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
Naphthalene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,3-trichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Hexachlorobutadiene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-

LEGEND

µg/kg: micrograms per kilogram
MAC: Maximum Admissible Concentration
Dutch S-Value: Target Value
Dutch I-Value: Intervention Value
-: MAC Guideline Not Available
< = Below current laboratory detection limit

Table 9.3: Soil Analytical Results - Polynuclear Aromatic Hydrocarbons (28/4/00)

Parameters	Depth (m)	TP1	TP2	TP3	TP4	TP5	TP6	TP7	Dutch MAC Values	
									S-Value	I-Value
	Units									
Acenaphthene	µg/kg	<1	12	<1	<1	<1	<1	5	-	-
Acenaphthylene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Benzo(B)fluoranthene	µg/kg	38	25	5	9	5	11	9	-	-
Dibenz(AH)anthracene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Fluorene	µg/kg	5	25	3	12	4	3	3	-	-
Pyrene	µg/kg	12	25	6	7	9	16	4	-	-
PAHs included in 'PAH (Sum of 10)' Dutch S and I MAC values for PAHs in soil										
Anthracene	µg/kg	28	13	9	7	4	9	5	-	-
Benzo(a)anthracene	µg/kg	65	18	5	<1	6	4	10	-	-
Benzo(a)pyrene	µg/kg	21	21	<1	<1	<1	<1	<1	-	-
Benzo(ghi)perylene	µg/kg	<1	<1	<1		<1	<1	<1	-	-
Benzo(k)fluoranthene	µg/kg	22	15	4		2	6	4	-	-
Chrysene	µg/kg	51	28		<1	2	10	7	-	-
Fluoranthene	µg/kg	17	28	8	9	12	14	5	-	-
Indeno(123-cd)pyrene	µg/kg	4	10	1	<1	<1	<1	3	-	-
Naphthalene	µg/kg	67	148	59	94	40	54	34	-	-
Phenanthrene	µg/kg	120	63	13	21	16	18	12	-	-
PAH (Sum of 10)	µg/kg	395	344	105	135	82	115	80	1000	40000
PAH (Total)	µg/kg	449	432	118	162	100	146	100	-	-

Legend
µg/kg: micrograms per kilogram
MAC: Maximum admissible concentration
S-level: Dutch guideline for normal uncontaminated soil
I-Level: Dutch guideline for Intervention
Results awaiting confirmation
"-": MAC not available
< = below laboratory detection limit

Table 9.4: Soil Analytical Results - Polychlorinated Biphenyls (28/4/00)

Parameters	Depth	TP1	TP2	TP3	TP4	TP5	TP6	TP7	Dutch MAC Values	
									S	I
	Units									
PCB Aroclor 1016	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1221	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1232	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1242	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1248	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1254	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1260	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB total	µg/kg	<1	<1	<1	<1	<1	<1	<1	20	1000

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Legend
 µg/kg: micrograms per kilogram
 MAC: Maximum admissible concentration
 S-level: Dutch guideline for normal uncontaminated soil
 I-Level: Dutch guideline for Intervention
 -: MAC not available
 < = below laboratory detection limit

Table 9.5: Soil Analytical Results - Pesticide Analysis (28/4/00)

Pesticide	Units	TP 1	TP 2	TP 3	TP 4	TP 5	TP 6	TP 7
Dichlorvos	µg/kg	<1	<1	<1	<1	<1	<1	<1
Mevinphos	µg/kg	<1	<1	<1	<1	<1	<1	<1
Phorate	µg/kg	<1	<1	<1	<1	<1	<1	<1
Alpha-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1
Beta-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1
Gamma-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1
Diazinon	µg/kg	<1	<1	<1	<1	<1	<1	<1
Disulfoton	µg/kg	<1	<1	<1	<1	<1	<1	<1
Delta-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1
Methyl Parathion	µg/kg	<1	<1	<1	<1	<1	<1	<1
Heptachlor	µg/kg	<1	<1	<1	<1	<1	<1	<1
Fenitrothion	µg/kg	<1	<1	<1	<1	<1	<1	<1
Aldrin	µg/kg	<1	<1	<1	<1	<1	<1	<1
Malathion	µg/kg	<1	<1	<1	<1	<1	<1	<1
Parathion	µg/kg	<1	<1	<1	<1	<1	<1	<1
Heptachlor Epoxide	µg/kg	<1	<1	<1	<1	<1	<1	<1
Endosulfan I	µg/kg	<1	<1	<1	<1	<1	<1	<1
Dieldrin	µg/kg	<1	<1	<1	<1	<1	<1	<1
4,4-DDE	µg/kg	<1	<1	<1	<1	<1	<1	<1
Endrin Ketone	µg/kg	<1	<1	<1	<1	<1	<1	<1
Endosulfan II	µg/kg	<1	<1	<1	<1	<1	<1	<1
4,4-DDD	µg/kg	<1	<1	<1	<1	<1	<1	<1
Ethion	µg/kg	<1	<1	<1	<1	<1	<1	<1
Endrin	µg/kg	<1	<1	<1	<1	<1	<1	<1
Endosulfan Sulphate	µg/kg	<1	<1	<1	<1	<1	<1	<1
4,4-DDT	µg/kg	<1	<1	<1	<1	<1	<1	<1
Methoxychlor	µg/kg	<1	<1	<1	<1	<1	<1	<1
Azinphos Methyl	µg/kg	<1	<1	<1	<1	<1	<1	<1

Dutch Values

S- Value	I Value
-	-
-	-
-	-
2.5	-
1	-
0.05	-
-	-
-	-
-	-
-	-
-	-
2.5	-
-	-
-	-
-	-
0.5	-
2.5	4000
-	-
-	-
2.5	4000
-	-
1	-
-	-
-	-
2.5	4000
-	-
-	-

Legend

- µg/kg: micrograms per kilogram
- MAC: Maximum Admissable Concentration
- S-level: Dutch guideline for normal uncontaminated soil
- I-Level: Dutch guideline for Intervention
- : MAC not available
- < = below laboratory detection limit

Trial Pit Records

Project No. : 2175 Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.1

Geology :

- 0 - 0.25 Dark brown organic-rich TOPSOIL
- 0.25 - 0.9 Medium brown silty CLAY with occasional subrounded pebbles.
- 0.9 - 3.0 Fine grained, homogeneous, brown SAND.
- 3.0 - 3.2 Brown BOULDER CLAY with occasional large limestone boulders
- 3.2 - 3.3 Stiff, black BOULDER CLAY

Depth to Rock : >3.3m

Rock Type :

Water Entry : None

Static Water :

Total Depth : 3.3m

Comments : Composite soil samples taken; Dry deposits. No unusual colours or odours noted.

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Trial Pit Records

Project No. : 2175 Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.2

Geology :

- 0 - 0.2 Brown organic-rich TOPSOIL
- 0.2 - 1.1 Medium brown silty CLAY with occasional subangular pebbles.
- 1.1 - 1.6 Medium brown, silty BOULDER CLAY with large limestone boulders
- 1.6 - 3.4 Extremely coarse, clayey GRAVEL deposits (boulders up to 40 - 45cm), with water.

Depth to Rock : >3.4m

Rock Type :

Water Entry : 3.2m

Static Water : 3.2

Total Depth : 3.4m

Comments : Water seen to be flowing in through the gravels. Composite soil sample taken. No unusual colours or odours noted.

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Trial Pit Records

Project No. : 2175 Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.3

Geology :

- 0 - 0.15 Dark brown organic-rich TOPSOIL
- 0.15 - 1.9 Dark brown, moderately well-sorted , dry, clayey, sandy GRAVEL.
- 1.9 - 3.4 Lighter brown, clayey SAND with occasional pebbles up to 3-4cm in size.

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Depth to Rock : >3.4m

Rock Type :

Water Entry : Seepage into the excavation from approx. 1.9m

Static Water :

Total Depth : 3.4m

Comments : Water was seen to be seeping in through the clayey SAND layer.
Composite soil sample was taken. No unusual colours or odours.

Trial Pit Records

Project No. : 2175

Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.4

Geology :

- 0 - 0.15 Brown organic-rich TOPSOIL
- 0.15 - 0.4 Medium brown subsoil.
- 0.4 - 1.25 Loose, light brown, silty, sandy, CLAY with occasional rounded pebbles.
- 1.25 - 3.45 Poorly sorted, subrounded, brown, clayey, sandy, GRAVEL with some black colouration due to presence of shaley fragments.

Depth to Rock : >3.45m

Rock Type :

Water Entry : Gravels moist- Very small amount of seepage.

Static Water :

Total Depth : 3.45m

Comments : Gravel layer collapsing into the hole. No unusual colours or odours noted. Composite soil samples taken.

Trial Pit Records

Project No. : 2175

Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.5

Geology :

- 0 - 0.12 Medium brown organic-rich TOPSOIL
- 0.12 - 1.3 Loose, light brown, sandy CLAY.
- 1.3 - 2.7 Loose, fine grained, homogeneous brown SAND.
- 2.7 - 3.4 Quite stiff, light brown BOULDER CLAY

Depth to Rock : >3.4m

Rock Type :

Water Entry : Water seeping into the hole at approx 2.7m through the bottom of the sands.

Static Water : Not available. Hole filled up with sand.

Total Depth : 3.4m

Comments : Walls of the excavation very unstable and sand collapsing into the hole. No unusual colours or odours noted. Composite soil samples taken.

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Trial Pit Records

Project No. : 2175 Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.6

Geology :

- 0 - 0.15 Dark brown organic-rich TOPSOIL
- 0.15 - 0.6 Medium brown silty CLAY with only occasional subrounded pebbles.
- 0.6 - 1.85 Grey brown, loose, silty CLAY with boulders up to 25cm in size.
- 1.85 - 3.15 Moderately well sorted, clayey GRAVEL, with occasional large boulders (up to 30cm).

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Depth to Rock : >3.15m

Rock Type :

Water Entry : Spring seen to be flowing into the excavation at approx 1.85m

Static Water : 3.0m and rising

Total Depth : 3.15m

Comments : Spring flowing in from the northern side of the excavation, quite quickly. No unusual colours or odours. Composite soil sample taken.

Trial Pit Records

Project No.: 2175

Location: Duleek, Co. Meath

Date: 28/4/00

Drilling Method: JCB

Supervisor: Amy Brennan

TRIAL PIT NO.7

Geology:

- 0 - 0.3 Dark brown organic-rich TOPSOIL & subsoil
- 0.3 - 0.95 Dark brown, clayey, sandy, SILT with occasional pebbles
- 0.95 - 3.1 Moderately well-sorted, dark brown, sandy, clayey, GRAVEL
- 3.1 - 3.3 Tight, dark brown BOULDER CLAY.

Depth to Rock: >3.3m

Rock Type:

Water Entry: None

Static Water:

Total Depth: 3.3m

Comments: Composite soil samples taken; Dry deposits. No unusual colours or odours noted.

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Appendix 9.3

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Ref: SA/60050 & PL 17.219721 & SA/901467

Indaver Ref: PC012/150310

15th March 2010

Michael Griffin,
Meath County Council
Planning Enforcement
Abbey Mall
Abbey Road
Navan

Re: Waste to Energy Facility Carranstown – Removal of excess soil off site

Dear Michael,

Indaver Ireland wishes to inform Meath County Council regarding the removal of excavated soil off site to a licenced facility. It was the intention of Indaver to reuse all excavated material from the construction phase on site, however the volume of excavated material on site is larger than anticipated and as a result approximately 6,000m³ of excess soil will be transported off site to the following licensed facility: Murphy's Environmental, Gormanstown Facility, Waste Licence Number: W0151-01.

The soil has been sampled by an Independent Environmental company and analysed by an accredited laboratory and has been classified as inert and non hazardous. The soil will be transported off site under EWC Code 17.05 04. All sample result certificates have been retained on site.

The removal of this material from site is due to commence on Tuesday 16 March 2010 and continue for approximately 12 days. The number of days required for this activity is dependent on weather. It is foreseen that on average 800m³ of material will be transported off site on a daily basis which equates to a maximum of 10 trucks per hour for 12 days. Transporting of soil off site will commence on a daily basis at 7.00am and will cease at 18.00 Monday – Friday with potential movement of soil off site also on Saturdays from 07.00am – 14.00.

All vehicles removing the excess soil off site will use a tarpaulin dust cover to cover the soil and this will be checked to be insitu prior to the vehicle leaving site. All vehicles will pass through the wheel wash prior to exiting the site.

Acceptance dockets and weights as issued by the licensed facility accepting the material will be retained on site.

The licenced haulier 'Larry Kiernan Haulage, Ring of Commons (Frank Kiernan Plant Waste Collection Permit No: CPD 462-3) will be made aware of the routing restrictions to and from the site as stipulated in our planning conditions.



Should you have any queries in relation to any of the above, please do not hesitate to contact us.

Yours sincerely

Lynette Creamer

Lynette Creamer
Site Infrastructure Manager
Indaver Ireland

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10 GROUNDWATER / HYDROGEOLOGY

This chapter evaluates the impacts, if any, which the development will have on Groundwater as defined in the Environmental Protection Agency (EPA) 'Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)', 2003 and the Institute of Geologists of Ireland (IGI) Geology in Environmental Impact Statements – A Guide (2002).

This chapter has been prepared based on a number of previous assessments of the site, the most recent of which was completed as part of an EIS and planning application submitted in 2009. It is considered that the primary assessment undertaken at the site in 2005 addressed the primary impacts potentially affecting the Groundwater aspect. This chapter will assess the impact of proposed amendments to the existing planning permission as described in Chapter 1, on the groundwater of the site and environs. The only significant changes with respect to potential impact on groundwater is the installation of an additional domestic effluent treatment system to serve the new office block. Minor construction works will also be required for hardstanding and parking associated with the new buildings. New legislative standards for groundwater quality (SI 9 of 2010) have been considered in determining the impact on the environment.

As the primary facility has now been constructed and is operational, a number of mitigation measures recommended in previous EIS's have now been implemented. This chapter therefore represents an update of the 2009 assessment to include the results of mitigation measures as implemented and any further mitigation measures now required.

10.1 INTRODUCTION

The information regarding the existing hydrogeological environment is based on investigations completed at the site in 2000 and 2001, geotechnical reports based on assessments completed in 2007 and 2008, borehole installation completed in 2011, a desk study and information from the Geological Survey of Ireland database.

10.2 OVERBURDEN HYDROGEOLOGY

The development site is underlain by a thick deposit of low permeability brown silty clays. Some discontinuous lenses of sandy horizons and gravels were also recorded. The vulnerability of the immediate area has been classified by the Geological Survey of Ireland (GSI) as Moderate (Figure 10.1).

The boulder clay varies in thickness across the site, ranging from approximately four metres towards the west of the site, to in excess of 10 metres towards the centre underneath the main building.

With the construction of the main facility now complete, the amendments proposed by this application entail the following

- conversion from temporary to permanent of the office and spare parts facilities
- additional car parking spaces associated with the offices
- paved roadway to the offices
- additional puraflo treatment plant and percolation area for sanitary effluent from the modular office.
- Additional hardstanding areas for shutdowns and maintenance periods

For these works it is anticipated that, only shallow excavations of overburden will be required. The vulnerability in these areas is likely to be of moderate to high rating.

As described further below, the waste bunker has been designed for full containment. The bunker floor has a basal thickness of 1.1m and a wall thickness underground of 800mm. The bunker has a secondary containment system with fully sealed membrane and leak detection system to ensure that the bunker remains water tight all times. Though site conditions required the base of the bunker to be constructed below the surface of bedrock at the site, the protective design measures outlined above ensure the risk of contaminating the aquifer is very low. No changes are proposed to the bunker construction on site.

10.3 BEDROCK AQUIFER

As detailed in Section 9, the limestones found beneath the development site are part of the Platin Formation. The grey limestone which was weathered at the surface was proven by borehole drilling at the site. The limestone is typical of the Lower Carboniferous shallow water limestones. These are typically pale thick-bedded with minor shales, possible dolomitised, with palaeokarstic features (GSI Sheet 16 and Meath Groundwater Protection Scheme). The Platin Formation has been classified by the GSI as; *regionally important, diffuse karst aquifer, good development potential (Rkd)* (Figure 10.2). This classification was determined by the GSI in 2004. This regionally important aquifer displays both karst and fracture flow features.

Since the implementation of the Water Framework Directive (WFD –Directive 2000/60/EC) various initiatives have been underway to lead to its implementation in Ireland. Characterisation of aquifers is one of the first key deliverables in the implementation of the WFD. Eight River Basin districts have been established in Ireland. The development is located in the Eastern River Basin District. The karstified aquifer upon which the site is located has been classified as Rkd, described as a Regionally Important Aquifer Karstified (diffuse). The site is located within the Bettystown Groundwater Body (GWB), coded IE_EA_G_016. The EPA publication *Water Framework Status Update based on Monitoring Results 2007-2009* indicate an overall chemical status of 'Poor Status' and an overall quantitative status of 'Good Status' for the GWB. However, the final classification for the GWB is one of 'Poor Status.'

The karstic nature and productivity of the Platin Formation are demonstrated at the nearby Platin Quarry where a significant dewatering operation is required to maintain dry working conditions at the quarry floor. The development site is located within the local groundwater regime which is now largely determined by the Platin Quarry dewatering programme.

10.4 Aquifer Vulnerability and Resource Protection

On the basis of site specific data, the GSI/EPA/DoEHLG Groundwater Protection Scheme Classification (see table below) ranks the site as having a high (H) to moderate (M) vulnerability due to the thickness and type of overburden cover present at the site. Percolation testing undertaken at the site determined extremely low percolation rates due to the presence of these clays.

Table 10.1 GSI Vulnerability Mapping Guidelines.

Vulnerability Rating	Hydrogeological Requirements (below the point of release of contaminants)				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Recharge Type
	high permeability (sand/gravel)	Moderate permeability (sandy till)	Low permeability (clayey till, clay, peat)	(sand & gravel aquifers only)	
Extreme	0-3.0m	0-3.0 m	0-3.0m	0-3.0m	point (<30 m radius)
High	>3.0	3.0-10.0m	3.0-5.0m	>3.0m	N/A
Moderate	N/A	>10m	5.0-10.0m	N/A	N/A
Low	N/A	N/A	>10.0m	N/A	N/A

Notes: i) N/A =not applicable

ii) Precise permeability values cannot be given at present

iii) Release point of contaminants is assumed to be 1-2 m below ground surface

(from Daly & Warren 1997)

10.4.1 Assessment of Resource Protection Zonation

As the bedrock aquifer is considered Regionally Important, and the soil cover varies in thickness from zero at the base of the waste bunker (post construction) to in excess of 10 metres in thickness in places, the site is assigned a rating of Regionally Important-Extreme to Regionally Important-Moderate (Rk/E to Rk/M) under the GSI classification system for designating resource protection zones. The proposed amendments to the facility will not affect the rating of the site under the GSI classification system.

Response levels have been developed for three polluting activities (septic tanks, landspreading and landfills) using this matrix of resource protection zones. Based on the risk involved in each of these potentially polluting activities, they are either acceptable, acceptable subject to conditions, not acceptable with some exemptions or not acceptable. There is no response level developed for waste-to-energy facilities, however stringent mitigation measures have been incorporated into the facility design and in particular the bunker design to ensure adequate resource protection.

10.5 GROUNDWATER CHARACTERISTICS

10.5.1 Groundwater Flow

Groundwater flow beneath the development site is determined by a cone of depression centred on the Platin excavation. Prior to the quarry development, the groundwater flow beneath the development site would have been towards the River Nanny and in a general south easterly direction.

Today, the groundwater flow beneath the development site has been reversed and is now in a general northwards direction towards the nearby Platin quarry due to the lowering of the water table within the excavation. Current water levels in excess of 30m below ground level (as presented in Appendix 10.1) are well below the level of any excavations completed for the development or required by the proposed amendments.

The groundwater abstracted from the excavation at Platin Quarry is piped directly to the River Nanny and so there is no loss of groundwater to this river. In fact there is a small increase due to the Platin excavation drawing some groundwater from the Boyne River catchment.

10.5.2 Groundwater Quality

Following an assessment of the groundwater monitoring wells present at the site in June 2008, the existing monitoring wells (MW1-MW4) were found to be no longer functioning. All wells were dry. Replacement deeper monitoring boreholes (AGW1-1, AGW1-2 and AGW1-3) were installed in June 2011 at locations as shown on Figure 10.3. As part of the EPA licence for the facility regular groundwater monitoring is required and recent monitoring results are presented in Appendix 10.1

Results have been compared to Groundwater Quality Threshold Values of SI No 9 of 2010 (European Communities Environmental Objectives Groundwater Regulations 2010). Also presented are site specific warning and action trigger levels agreed with the Agency in July 2011. The development of trigger levels for the facility is ongoing. In summary, results indicate groundwater quality is moderate to good at the site. Some breaches of warning trigger (conductivity and Total Organic Carbon (TOC)) levels in both background and downgradient monitoring well have been recorded during late 2011. However, the monitoring record for these wells is not long enough to determine any trends that would indicate any impact from construction/operation. Records for the installation of these monitoring wells (and the installation of the production well) are provided in Appendix 10.2

10.6 GROUNDWATER ABSTRACTIONS

Groundwater is extensively used by the local community as a source of water supply. A GSI well search in 2005 revealed 22 recorded wells within 3km of the site. A table of the available data is presented in Appendix 10.3 It should be noted that the GSI database is not a complete data source for all private water wells.

10.6.1 On Site Groundwater Abstraction

A production well was installed at the site in June 2011 from which the water requirements of the site are supplied. A yield in excess of 600m³/d was identified during installation which comfortably meets the water requirements for the site. The location of the production well is presented on the drawings accompanying the application. The proposed development and increase in capacity will entail only a very minor increase in abstraction requirement (c.300 litres an hour) and will therefore not alter the existing groundwater regime.

10.7 POTENTIAL IMPACTS

The main potential impacts relate to

- Groundwater contamination relating to the storage of chemicals on the site and
- Percolation of treated waste water.

10.7.1 Construction Phase

Potential impacts during the construction phase would be associated with accidental spillage of potentially polluting substances including oils, paints and liquid wastes and any additional substances associated with the construction activities.

All potentially polluting chemicals will be securely stored during the construction phase and refuelling of earth moving machinery will be carried out according to an appropriate Method Statement. Waste water generated during the construction phase will be managed via the existing foul water management network.

10.7.2 Operational Phase

The potential impacts during the operation phase would include;

- Impact on groundwater quality
- Impact due to abstraction on site.

The development site lies within the groundwater regime now established by the Platin dewatering programme. The quarry abstracts sufficient groundwater to maintain the water table just below the working quarry floor. This operation has resulted in a cone of depression in the water table that is centred on the deep excavation. The groundwater abstraction at the site is located within the Platin cone of depression.

Drawdown from this single borehole is minimal when compared to the extent of the Platin cone of depression. Also, as the volume Platin abstracts is varied to maintain the water table level at or just below the quarry floor the small additional abstraction at Indaver does not materially add to the total amount of groundwater abstracted from the aquifer. Rather, the planned abstraction at the development site results in a small net reduction in the amount of groundwater abstracted from

beneath the nearby quarry excavation with the total being abstracted from the aquifer remaining largely unchanged.

In the unlikely event that the facility abstraction is found to impact on groundwater levels in nearby private wells, the Company would remedy the situation by deepening the impacted well(s). No evidence of this has been recorded to date.

In the event that Platin Quarry should cease dewatering, it will take a considerable amount of time for the water table to recover to their pre-quarrying levels. When the water levels have recovered, it is acknowledged that the groundwater flow direction beneath the site will revert to flow in the direction of the River Nanny.

Given the stringent containment measures incorporated into the design of the facility and the bunker, the risk of leakage from the proposed development entering the groundwater system is virtually nil. Therefore even in the event of the dewatering operation ceasing at Platin, there will be no impact on the groundwater quality regime as a result of the groundwater flow direction reverting to its pre dewatering orientation.

The planned disposal of additional treated waste water from the sanitary facility in the modular office block to the ground has the potential to impact on groundwater quality immediately below the percolation area. However in order to ensure adequate protection of the aquifer, the proposed treatment plant and secondary/tertiary treatment system will be designed and constructed in accordance with the EPA's requirements as per the EPA Waste Water Treatment Manual for Small Communities, Business, Leisure Centres and Hotels (1999) and recently published EPA Guidance on the Authorisation of Discharge to Ground (2011). Two other similar treatment plants are already operational on the site at the main process building and security gate house. Both treatment systems have been designed and constructed in compliance with the relevant guidance documents.

In the event of an unmitigated accidental discharge any resulting plume would move in the direction of the Platin excavation and potentially result in the deterioration of the groundwater being pumped from the quarry. Mitigation measures to prevent such an eventuality are described under 10.8 mitigation measures below.

10.8 MITIGATION MEASURES

10.8.1 Construction Phase

Construction works will be completed in accordance with the principles of CIRIA Environmental good practice on site (C692) and the Environmental Management Plan for the site.

All oils, chemicals, paints or other potentially polluting substances used during construction will be stored in designated storage areas which will be bunded to a volume of 110% capacity of the largest tank/container within the bunded area(s). The existing designated storage areas at the site will be used to minimise risks during the construction period.

Filling and draw-off points will be fully located within the bunded area(s).

Drainage for the bunded area(s) will be diverted for collection and safe disposal.

All domestic effluent generated on site during construction works will be discharged via the existing effluent treatment plant systems. It is not proposed to provide portaloos or any other temporary sanitary facilities during construction.

10.8.2 Operational Phase

There are no additional measures/monitoring requirements as a result of the proposed amendments.

The storm water attenuation pond has been constructed with a sealing membrane commonly used for forming secondary containment liners in effluent tanks. The attenuation pond has been tested and demonstrated to be watertight to the satisfaction of the local Authority and EPA as required under the facility licence. The tank is approximately 2.6m deep and surrounded by a 2.4m high chainlink fence. A minimum permanent water level of approximately 300mm is maintained in the tank at all times. A minimum freeboard of 300mm is maintained for any storm occurrence less than 1:100 years.

The only discharge from the site is from the treatment of foul effluent in Puraflo systems and disposal via appropriately sized engineered percolation areas. The system will be designed and constructed in accordance with the EPA requirements and current best practice. All domestic effluent will be treated by an appropriate system prior to its discharge to the percolation area. The Puraflo system proposed will achieve a minimum effluent treatment standard of B.O.D. (Biochemical Oxygen Demand) 20 mg/l and T.S.S. (Total Suspended Solids) 30 mg/l.

All underground piping will be maintained and regularly inspected for integrity.

A petrol interceptor is in place on the surface water drainage outfall line from hardstanding areas to contain any leakages from vehicles on site. Full details of the proposed on site drainage network are presented in Section 11.

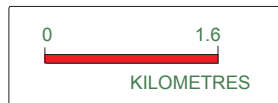
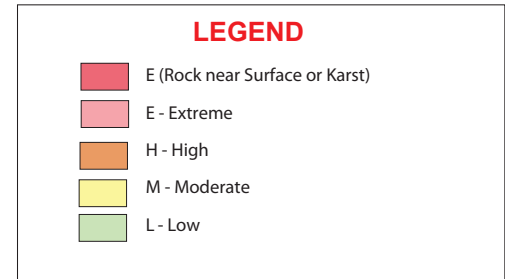
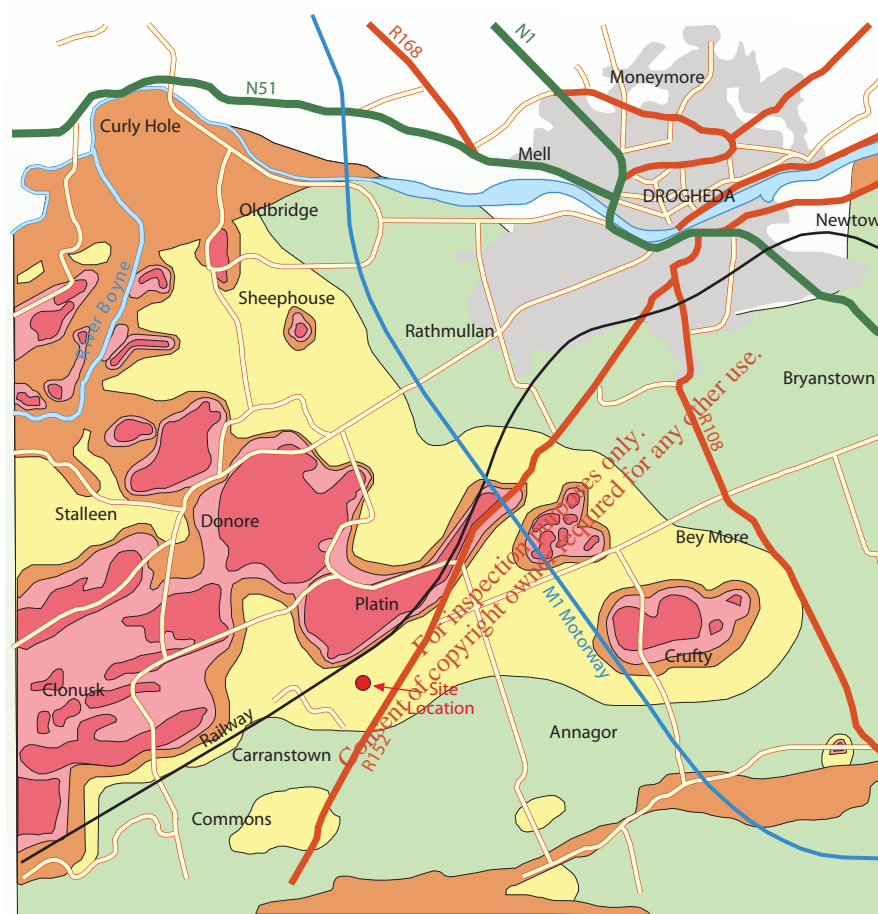
In the event that Platin might cease dewatering or pumping in the future, it is acknowledged that the groundwater flow direction beneath the site will revert to towards the River Nanny. This would take a considerable amount of time to recover. Given the containment measures incorporated into the design

of the facility (and in particular the waste bunker) the risk of leakage to groundwater is virtually nil. The facility will be operated in accordance with an EPA waste licence which will require regular monitoring to detect any potential contamination issues.

10.9 RESIDUAL IMPACTS

The facility as amended will not have a significant impact on the hydrogeology of the development site or beneath the surrounding lands. The proposed development will have no impact on the groundwater regime within this water body. The potential for accidental discharge during construction or operation is low and mitigation measures are in place to minimise any risk to the underlying aquifer.

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Source: www.gsi.ie

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

Indaver

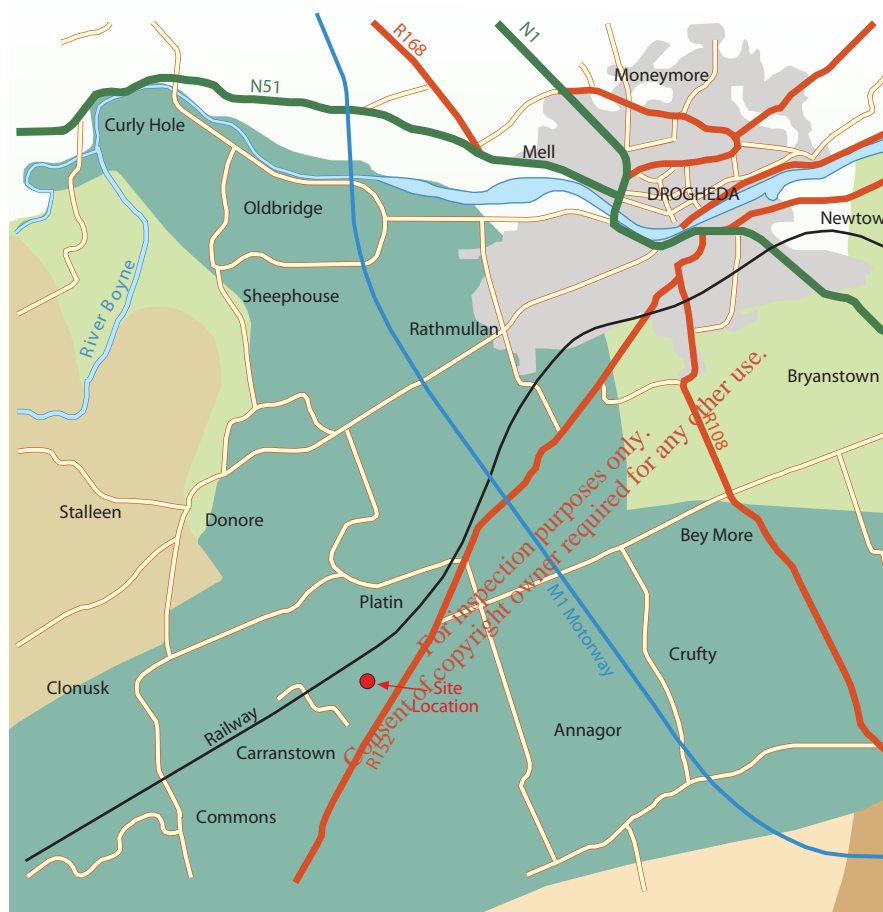
Regional Vulnerability

Figure No. 10.1

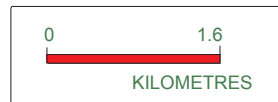
Job No. CE07624	Date. Aug. 2009
Finalised By - DMcD	Office - 1404
Drawn By: J Farrar	CS2, Illustrator



WYG Ireland



Source: www.gsi.ie



LEGEND

- Rkd - Regionally important, diffuse karst aquifer, good development potential
- Lm - Locally important, generally moderately productive
- Ll - Locally important, generally moderate productive in local zones
- Lg - Locally important, sand/gravel aquifers
- Pl - Poor aquifer, generally unproductive except in local zones
- Pu - Poor aquifer, bedrock which is generally unproductive

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

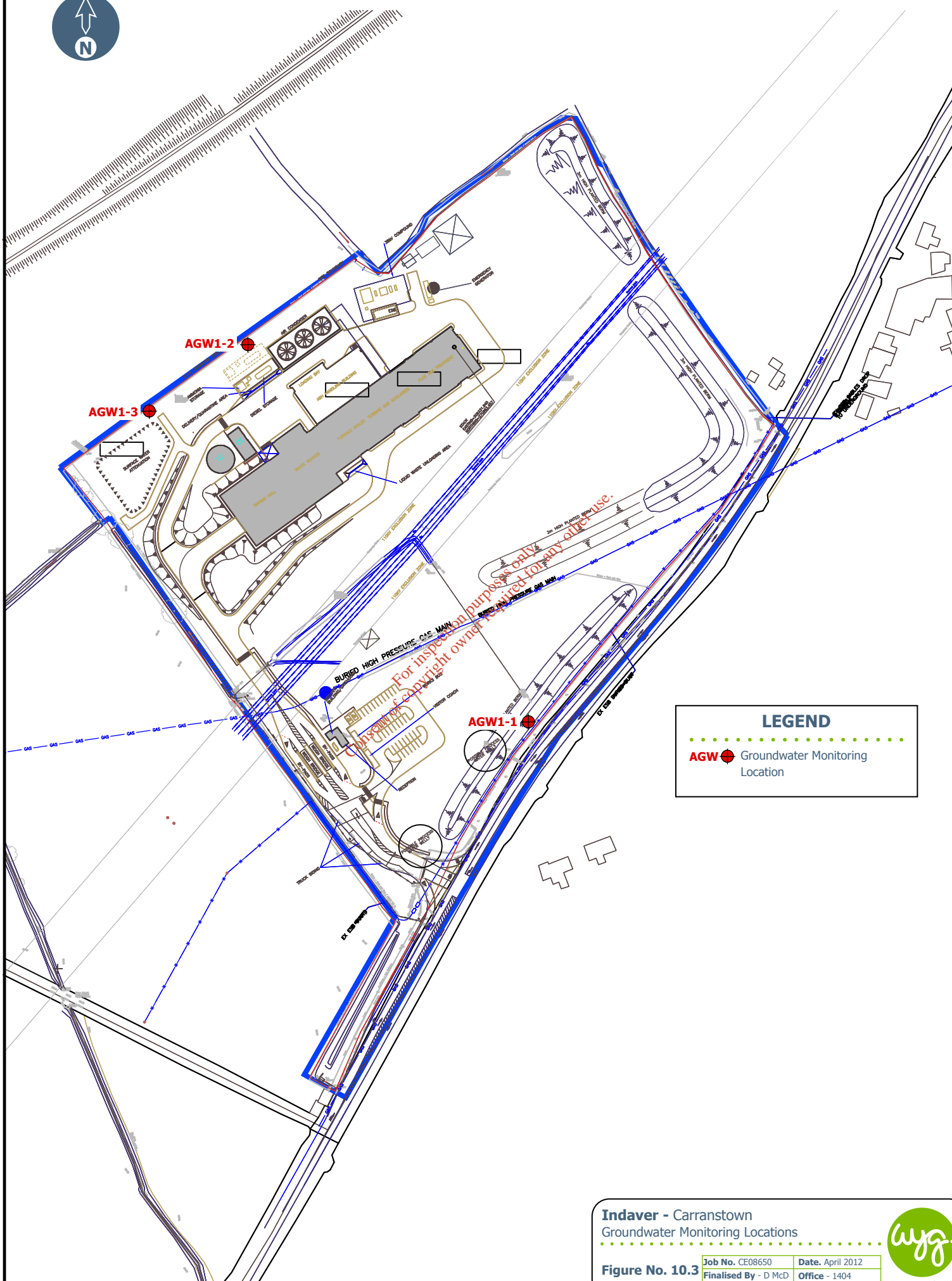
Indaver
Regional Aquifers

Figure No. 10.2

Job No. CE07624	Date. Aug. 2009
Finalised By - DMCD	Office - 1404
Drawn By: J Farrar	CS2, Illustrator



WYG Ireland



LEGEND

..... Groundwater Monitoring Location

Indaver - Carranstown
Groundwater Monitoring Locations

Figure No. 10.3

Job No. CE08650	Date. April 2012
Finalised By - D McD	Office - 1404
Drawn By: J Farrar - CS2, Illustrator	



Appendix 10.1
Groundwater Monitoring Results 2011

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Monitoring Location	AGW1-1 AGW1-2 AGW1-3 AGW1-1 AGW1-2 AGW1-3 AGW1-1 AGW1-2 AGW1-3 AGW1-1 AGW1-2 AGW1-3											
Date of Sampling	Sep-11	Sep-11	Sep-11	Oct-11	Oct-11	Oct-11	Nov-11	Nov-11	Nov-11	Dec-11	Dec-11	Dec-11
Field Data												
Depth of Well	62.7	49	60	62.7	49	60	62.7	49	60	62.7	49	60
Static Water Level	36.1	32.4	41.5	37	32.8	41.2	37.1	33.1	40.8	36.5	32.7	39.8
Monthly Groundwater Monitoring Suite												
Laboratory Parameters												
TOC (mg/l)	0.94	2.78	2.75	6.89	2.97	2.74	2.7	2.56	1.73	6.16	9.49	5.2
Ammonia (NH4) as N mg/l	0.01	0.01	0.023	0.044	0.021	0.01	0.01	0.01	0.01	0.01	0.022	0.01
Conductivity (uS/cm @25 degC)	780	657	643	729	650	642	911	667	669	921	667	697
Biannual Monitoring Suite												
Laboratory Parameters												
pH	-	-	-	-	-	-	7.1	7.4	7.2	-	-	-
Nitrate (mg/l as N)	-	-	-	-	-	-	3.97	10.02	12.61	-	-	-
Nitrite (mg/l as N)	-	-	-	-	-	-	<0.002	<0.002	<0.002	-	-	-
Chloride (mg/l)	-	-	-	-	-	-	83.52	30.9	31.56	-	-	-
Fluoride (mg/l)	-	-	-	-	-	-	0.14	0.12	0.14	-	-	-
Metals_Cd (ug/l)	-	-	-	-	-	-	<0.09	<0.09	<0.09	-	-	-
Metals_Tl (ug/l)	-	-	-	-	-	-	<0.06	<0.06	<0.06	-	-	-
Metals_Hg (ug/l)	-	-	-	-	-	-	<0.04	<0.04	<0.04	-	-	-
Metals_Pb (ug/l)	-	-	-	-	-	-	<0.02	<0.02	<0.02	-	-	-
Metals_Cr (ug/l)	-	-	-	-	-	-	<2.14	<2.14	<2.14	-	-	-
Metals_Cu (ug/l)	-	-	-	-	-	-	<0.11	<0.11	<0.11	-	-	-
Metals_Mn (ug/l)	-	-	-	-	-	-	<0.08	<0.04	<0.04	-	-	-
Metals_Ni (ug/l)	-	-	-	-	-	-	<0.14	<0.14	<0.14	-	-	-
Metals_As (ug/l)	-	-	-	-	-	-	<0.2	<0.1	<0.1	-	-	-
Metals_Co (ug/l)	-	-	-	-	-	-	<0.02	<0.02	<0.02	-	-	-
Metals_V (ug/l)	-	-	-	-	-	-	<0.16	<0.16	<0.16	-	-	-
Metals_Sn (ug/l)	-	-	-	-	-	-	<2.8	<2.8	<2.8	-	-	-
Organo Halogens	-	-	-	-	-	-	<1	<1	<1	-	-	-
Total Coliforms (cfu/100ml)	-	-	-	-	-	-	0	0	0	-	-	-
Faecal Coliforms (cfu/100ml)	-	-	-	-	-	-	0	0	0	-	-	-

SI 9 of 2010 Threshold Value	Trigger Level (Warning)	Trigger Level (Action)
-	-	-
-	-	-
-	-	-
-	5	10
0.175	0.125	0.175
1875	650	800
-	-	-
-	-	-
37.5	-	-
0.375	-	-
187.5	-	-
-	-	-
0.00375	-	-
-	-	-
0.00075	-	-
0.01875	-	-
0.0375	-	-
1.5	-	-
-	-	-
0.015	-	-
0.0075	-	-
-	-	-
-	-	-
Note 1	-	-
-	-	-
-	-	-

Notes:
 SI 9 of 2010 Threshold Values are limit values setout in SI No 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations, 2011
 Trigger Level Warning and Action Values - as agreed with the Agency during 2011
 Note 1- There is no standard under SI 9 of 2010 for general organo halogens though a number of compounds including TCD, VC and others have specific standards which should be compared
 6.89= Shaded values exceed relevant trigger level warning limit value
911= Bold, Underlined and Shaded values exceed relevant trigger level action limit value
 Note Trigger levels are presently under review with the Agency.

Appendix 10.2
Well Installation Records 2011

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MONITORING WELL REPORT

Client: Indaver Ireland **Date:** 20 June 2011.
Duleek
Drogheda
Co Louth

Drillers: Stephen Harte
Stefan Grosko

Drilling commenced on the 16th June and work was completed on 18th June 2011. We used our T4 Ingersoll Rand Drill Rig to construct 2 No Monitoring Wells as per the following Method Statement.

ESTABLISH ALL PLANT & EQUIPMENT AT DRILLING LOCATION

Transport of drilling equipment onto site. Liaise with Indaver personnel and mark location of well. Fence off area and erect safety signs as required. Spoil and water will flow into sediment pit and excess water will be pumped to a safe area.

DRILLING OF 2 NO GROUND WATER MONITORING WELLS

Air hammer drill at open hole diameter 200mm to a depth of 2 metres into bedrock to accommodate 150mm diameter steel casing. Airlift well and check yield of water. Supply and install 150mm diameter steel casing. Airlift well and check yield of water. Drill 150mm diameter through bedrock to target depth. Airlift well and check yield of water every 5 metres. Supply and install 50mm diameter uPVC screen and riser. Supply local pea gravel from bottom of well to above screen section and install 0.5 metres of sand, 2 metre of bentonite and 0.5 metres of sand. Back fill with pea gravel to within 2 mts below ground level. Supply and install 0.5 mts of sand and 1 mtr of bentonite and 0.5 mts of concrete to ground level. Supply and Install lockable cap.

REINSTATEMENT OF SITE

Remove Drill rig from well location. Reports will be completed and sent to you once work is fully completed.



Supplied and installed the following:

Monitoring Well No 1

Materials	Diameter	Total Depth: 50 mts	
		From	To
Steel Casing	150mm	0 mts	17 mts
Bottom Cap on uPVC Riser	50mm		
uPVC Riser	50mm	50 mts	49 mts
uPVC Screen	50mm	49 mts	34 mts
uPVC Riser	50mm	34 mts	00.0 mts
Top Cap on uPVC Riser	50mm		
Pea gravel		50 mts	33 mts
Sand		33 mts	32.5 mts
Bentonite		32.5 mts	30.5 mts
Sand		30.5 mts	30 mts
Pea Gravel		30 mts	3 mts
Sand		3 mts	2.5 mts
Bentonite		2.5 mts	0.5 mts
Sand		0.5 mts	0.0 mts
Lockable Cap		Yes	

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Monitoring Well No 2

Materials	Diameter	Total Depth: 60 mts	
		From	To
Steel Casing	150mm	0 mts	46.7 mts
Bottom Cap on uPVC Riser	50mm		
uPVC Riser	50mm	60 mts	59 mts
uPVC Screen	50mm	59 mts	50 mts
uPVC Riser	50mm	50 mts	00.0 mts
Top Cap on uPVC Riser	50mm		
Pea gravel		60 mts	49 mts
Sand		49 mts	48.5 mts
Bentonite		48.5 mts	46.5 mts
Sand		46.5 mts	46 mts
Pea Gravel		46 mts	3 mts
Sand		3 mts	2.5 mts
Bentonite		2.5 mts	0.5 mts
Sand		0.5 mts	0.0 mts
Lockable cap		Yes	

Monitoring Well of R 152 Road



Ref: AQ/CBC/EPS/BOQ11.02.11

Customer Name: EPS
Site Address: Indaver
 Duleek,
 Co. Louth

DESCRIPTION	DIAMETER	DEPTH
Drill	200mm	0 – 13.1Mts
Supply & Install Steel Casing	150mm	13.1Mts
Drill	150mm	13.1 – 62.8Mts
Supply and install uPVC screen	50mm	Bottom Cap
And Riser from bottom up		62.8 – 59.8Mts Riser
		59.8 – 38.8Mts Screen
		38.8 – 00.0Mts Riser
		Top Cap
Supply and install Pea gravel		62.8 – 37.8Mts
Supply and install Sand		37.8 - 37.3Mts
Supply and install Bentonite		37.3 – 35.3Mts
Supply and install Sand		35.3 – 34.8Mts
Supply and install Pea Gravel		34.8 – 2.5Mts
Supply and install Sand		2.5 - 2.0Mts
Supply and install Bentonite		2.0 - 1.0Mts
Supply and install Sand		1.0 - 0.5Mts
Supply and install Cement		0.5 - 0.0Mts

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Type of Subsoil: 0 – 10.6Mts Boulder Clay
Depth to Bedrock: 10.6Mts
Type of Bedrock: 10.6 – 62.8Mts Limestone
Well Development: 2Hrs
Water Entry: 61Mts – 11m³/Day

Remarks:

No Water in Overburden
 Supply and Install Cast Iron Manhole Cover



Monitoring Well No 1

Ref: AQ/CBC/EPS/Indaverl/MW1

Customer Name: EPS
Site Address: Indaver,
 Duleek,
 Co.Louth.

DESCRIPTION	DIAMETER	DEPTH
Drill	200mm	0 – 17 Mts
Supply and install Steel Casing	150mm	17 Mts
Drill	150mm	17 - 50 Mts
Supply and install uPVC screen and Riser from bottom up	50mm	Bottom Cap 50 – 49Mts Riser 49 – 34Mts Screen 34 - 0Mts Riser
		Top Cap
Supply and install Pea gravel		50 – 33 Mts
Supply and install Sand		33 – 32.5Mts
Supply and install Bentonite		32.5 – 30.5Mts
Supply and install Sand		30.5 – 30 Mts
Supply and install Pea Gravel		30 – 3 Mts
Supply and install Sand		3 – 2.5Mts
Supply and install Bentonite		2.5 – 0.5Mts
Supply and install Sand		0.5 – 0 Mts
Supply and install lockable Lid		Yes

Type of Subsoil: 0 – 3.1Mts Boulder Clay
 3.1 - 7.6Mts Sand and Gravel
 7.6 - 13.7Mts Boulder Clay

Depth to Bedrock: 13.7Mts

Type of Bedrock: 13.7 – 30.5Mts Sandstone
 30.5 – 50 Mts Limestone with clay Crevices

Well Development: 2Hr

Water Entry: 40.0Mts – 4.4m³/hr 50Mts – 10.9m³/hr.



Monitoring Well No 2

Ref: AQ/CBC/EPS/Indaverl/MW 2

Customer Name: EPS
Site Address: Indaver,
 Duleek,
 Co.Louth.

DESCRIPTION	DIAMETER	DEPTH
Drill	200mm	0 – 46.7 Mts
Supply and install Steel Casing	150mm	46.7 Mts
Drill	150mm	46.7 - 60 Mts
Supply and install uPVC screen and Riser from bottom up	50mm	Bottom Cap 60 – 59Mts Riser 59 – 50Mts Screen 50 - 0Mts Riser
		Top Cap
Supply and install Pea gravel		60 – 49 Mts
Supply and install Sand		49 – 48.5Mts
Supply and install Bentonite		48.5 – 46.5Mts
Supply and install Sand		46.5 – 46 Mts
Supply and install Pea Gravel		46 – 3 Mts
Supply and install Sand		3 – 2.5Mts
Supply and install Bentonite		2.5 – 0.5Mts
Supply and install Sand		0.5 – 0 Mts
Supply and install lockable Lid		Yes

Type of Subsoil: 0 – 4.6 Mts Boulder Clay
 4.6 - 46.7Mts Sand

Depth to Bedrock: 46.7Mts

Type of Bedrock: 46.7 – 49.7 Mts White Limestone
 49.7 – 53.4 Mts Weathered Sandstone
 53.4 – 57.9 Mts Limestone
 57.9 – 60 Mts Weathered sandstone

Well Development: 3Hr

Water Entry: 48.8Mts – 43.6m³/hr 60Mts – 65.5m³/hr.



PRODUCTION WELL NO 2

WELL LOG

Ref:AQ/CBC/EPS/Indaver/BOQ11.02.11

Customer Name: EPS
Site Address: Indaver
 Duleek,
 Co. Louth

DEPTH OF WELL: 91.5Mts

DESCRIPTION	DIAMETER	DEPTH
Drill	375mm	0 – 15.6Mts
Supply & Install Steel Casing	300mm	15.6Mts
Drill	300mm	15.6 – 64Mts
Back Fill Well with Pea Gravel		64-58Mts
Supply & Install uPVC Casing	200 x 184.6mm	58Mts
Grout annulus of well with use of Tremmie pipe and Grout Plant 3.30 Tonne		
Airlift Pea gravel		58- 64Mts
Drill	150mm	64 – 91.5Mts

Type of Subsoil: 0 – 13.7Mts Boulder Clay
Depth to Bedrock: 13.7Mts
Type of Bedrock:
 13.7 – 61.0Mts Limestone
 61.0 – 62.5Mts Crevice in Bedrock
 62.5 – 68.6Mts Limestone
 68.6 – 83.8Mts Limestone with Crevices
 83.8 – 91.5Mts Weathered Limestone

Water Entry Levels: 62.0Mts, 76.2Mts, 83.8Mts Onwards
Supply at time of testing 330m³/Day @ 62.0Mts
with drilling rig: 500m³/Day @ 76.2Mts
 600m³/Day @ 83.8Mts

Remarks:
 Cap Well on Completion.
 Developed Well for 2.75Hr

Appendix 10.3
GSI Well Survey Data 2005

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Appendix 10.3 GSI Well search Results (3km radius around 306300, 270900)

DTB	DEPTH	GSI HOLENAME	TYPE	EASTING	NORTHING	TOWNLAND	USAGE	YIELD	YIELD CLASS	AVE DAILY ABSTRACT	WATER STRIKE	MAIN AQUIFER	ABSTR-ACTION
8.2	22.9	2925NWW070	Bored Well	30460	26835	DULEEK		109	Good			Limestone	
7.6	48.2	2925NWW071	Bored Well	30460	26830	DULEEK	Agri/ domestic use	101	Good			Limestone & Drift	
31.5	63.1	2925NWW072	Unknown well	30460	26825	DULEEK		12.5	Poor			Boulder Clay, Sand & Gravel, Limestone	
	18.9	2925NEW070	Bored Well	30855	26910	BEAUMONT		49	Moderate				
0	61	2927SEW047	Bored Well	30605	27150	PLATIN	Industrial	3600	Excellent	3600	41	Limestone with fissures.	137.5
	30	2927SEW048	Bored Well	30590	27135	PLATIN	Industrial	3600	Excellent	3600		Limestone	
	24.4	2925NWW060	Bored Well	30359	26852	DOWNESTOWN	Public supply		Poor	10			
	4.6	2925NEW058	Dug Well	30551	26899	BELLEWSTOWN	Public supply	3.3	Poor				
9.1	42.7	2927SEW036	Bored Well	30665	27210	PLATIN	Public supply	54.5	Moderate				
0	61	2927SEW037	Bored Well	30600	27150	PLATIN, DULEEK	Industrial		Unknown		2.5		
15.2	47.2	2927SEW038	Bored Well	30665	27190	PLATIN	Industrial	872.7	Excellent		28.9		51.12
11.3	34.1	2927SEW039	Bored Well	30665	27185	PLATIN	Industrial	164	Good		14.6		
	21.9	2927SEW041	Bored Well	30630	27335	DROGHEDA		28	Poor				
		2927SEW035	Bored Well	30665	27205	PLATIN			Unknown				
	6.7	2927SEW001	Dug Well	30745	27211	BEYMORE			Unknown				
		2927SEW003	Dug Well	30500	27200	DONORE			Unknown				
	6.1	2927SEW106	Dug Well	30387	27362	OLDBRIDGE							
9.8	10.3	2927SEW107	Dug Well	30380	27363	OLDBRIDGE							

Appendix 10.3 GSI Well search Results (3km radius around 306300, 270900) Contd

DTB	DEPTH	GSI HOLENAME	TYPE	EASTING	NORTHING	TOWNLAND	USAGE	YIELD	YIELD CLASS	AVE DAILY ABSTRACT	WATER STRIKE	MAIN AQUIFER	ABSTR-ACTION
5.1	5.1	2927SEW108	Dug Well	30372	27364	DOWTH							
1.8	1.8	2927SEW109	Dug Well	30367	27365	DOWTH							
0	76.2	2927SEW110	Bored Well	30601	27258	DONORE	Agri/ domestic use	21.8	Poor				
0	42.7	2827SEW111	Bored Well	30602	27251	DONORE	Agri/ domestic use	1091	Excellent		36.5		

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11 SURFACE WATER

This chapter evaluates the impacts, if any, which the development will have on Surface Water as defined in the Environmental Protection Agency (EPA) 'Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)', 2003.

This chapter has been prepared based on a number of previous assessments of the site, the most recent of which was completed as part of an EIS and planning application submitted in 2009. It is considered that the primary assessment undertaken at the site in 2005 addressed the primary impacts potentially affecting the surface water aspect. This chapter will assess the impact of proposed amendments to the existing planning permission as described in Chapter 1, on the surface water of the site and environs. The amendments will entail some additional construction in the form of conversion of two temporary office and maintenance structures respectively to permanent structures, the installation of an additional foul water treatment plant system and associated hardstanding surfaces and parking.

As the facility has now been constructed, a number of mitigation measures recommended in previous EIS's have now been implemented. This chapter therefore represents an update of the 2009 assessment to include the results of mitigation measures as implemented and identify any further mitigation measures now required. New legislative standards for surface water quality (SI 272 of 2009) have been considered in determining the impact on the local surface water environment.

11.1 DRAINAGE NETWORK

Regional

The development site lies in the River Nanny catchment (Figure 11.1). The River Nanny rises in the south-east of Co. Meath and flows through Duleek towards Laytown, where it discharges to the sea.

Data obtained from the EPA indicates an estimated dry weather flow of 0.009 m³/s and a 95 percentile flow of 0.059 m³/s on the nearest hydrological station located on the River Nanny at Duleek.

The River Nanny channel is located approximately 2 km south of the development site. Surface water in the vicinity of the site drains naturally towards the river.

Local

The site lies within the Nanny River Catchment which is part of the Eastern River Basin District (ERBD) as defined under Ireland's programme for the implementation of the Water Framework Directive (WFD) (2000/60/EC). Surface water on and in the vicinity of the site drains through land drains and ditches

towards the local streams that flow to the River Nanny. The drainage ditches are mostly dry in the summer months.

11.2 SURFACE WATER QUALITY

In December 2011, KD Environmental completed an assessment of surface water discharges from the facility and their potential impact on the River Nanny. This study is presented in Appendix 11.1 The study found that the River Nanny is not impacted by surface water discharged from the site when discharged at the permitted flow rate of <130m³/hour.

A limited amount of chemical and biological quality data for the River Nanny is available from the EPA. Results generally indicate moderate quality surface water in the Nanny at the nearest monitoring stations to the site (approximately 2km away). An average Q-value of 3-4 was noted across the various stations on the Nanny from 2010 monitoring. This is consistent with data available for previous monitoring rounds since 2001.

The 2008 ERBD Characterisation Report stated that the River Nanny catchment is considered "At Risk". Agricultural runoff was identified as the dominant cause of poor water quality in the Nanny/Delvin Catchment. The available biological and water quality monitoring records indicated that 16% of monitoring stations are considered unpolluted, 23% of slightly polluted, 52% of moderately polluted and 8% seriously polluted. Overall some improvement in quality has been noted over the last 10 years but pollution levels are considered unacceptably high.

11.3 PROPOSED DRAINAGE NETWORK

11.3.1 Foul Water/Sanitary Management

Construction

During the construction phase, domestic effluent generated on the site will be managed through the existing domestic effluent treatment systems. It is not anticipated that there will be any need for temporary portaloos or other temporary sanitary facilities as there are already sufficient provisions in place at the site.

Operation

Domestic sewage from toilets, changing and kitchen areas currently discharges via the foul drainage system, depending on its location on site, to on site effluent treatment systems which pass through an engineered percolation area to ground. The existing percolation areas have been designed and constructed in accordance with the guidelines in the EPA's Wastewater Treatment Manual (Treatment Systems for Small Communities, Business, Leisure Centres and Hotels, 1999). It is proposed that an

additional system will be installed for the proposed modular office block. The system will be designed and constructed in accordance with the requirements of the recently published EPA Guidance on the Authorisation of Discharges to Groundwater.

11.3.2 Industrial Effluent

Operation

Industrial effluent will be contained within the site and evaporated within the incineration process. There will be no discharge of process effluent to the drainage network. As the flue gas cleaning system is a combination of a semi wet and dry lime injection process, there will be no effluent at all from the flue gas treatment process. All water injected in the semi –wet stage is evaporated in the spray reactor. Some wash waters from cleaning operations will be directed to the spilled water storage tank and will be either evaporated in the spray reactor, or transported off-site for treatment or disposal to an appropriately permitted or licensed facility.

11.3.3 Storm Water Management

Construction

Storm water management during the required construction works will be controlled in accordance with the site Environmental Management Plan (currently being agreed with the Agency) and any planning conditions set down by the planning authority. The facility (ref W0167-02) licence provides for monitoring of such issues as dust generation, noise generation, traffic management and surface water run-off.

Run off generated during construction will be directed to the existing surface water drainage system (including interceptors, attenuation pond, monitoring stations etc) prior to its discharge to the local drainage network. A wheel wash will not be required for the construction phase due to the limited nature of the construction activities associated with the proposed development.

Operation

Process Building

All waters produced from wash down etc. within the waste processing building will be directed to a spill tank located to the east of the bunker building and underground. The spill tanks (2 tanks) have a capacity of 100m³. As described above, water from this spill tank will be used to supplement process water requirements or will be transported off-site for treatment or disposal to an appropriately permitted or licensed facility. There will be no process effluent from the facility.

During shutdowns there may be a need to drain the boiler which is filled with approximately 130m³ of clean de-mineralised water. Some of this water will be pumped to the spilled water tank for re-use in the process and the remainder to the stormwater network where it will pass through two sets of TOC monitoring equipment prior to discharge.

Site Drainage

The site storm water drainage system has been designed in general accordance with Sustainable Drainage Systems (SuDS) principles and will collect rainwater from all roofs, hardstands, roads and grassed areas which fall naturally towards these areas. The proposed amendments will entail some alteration to the existing drainage system but in the main the existing infrastructure will remain. There will be no need for any additional stormwater attenuation capacity. The existing design has been agreed and is in accordance with the requirements of Meath County Council.

Sustainable drainage systems aim to mimic as closely as possible the natural drainage of a site in order to reduce the impact of flooding and water pollution. The subject site is essentially divided into two parts, firstly the northern 6.8 Ha. 'developed' part of the site, and secondly the southern 3.6 Ha. 'undeveloped' part of the site. The southern 'undeveloped' part of the site, is drained naturally. Stormwater will continue to be collected by the existing system of field boundary ditches for ultimate outfall to the River Nanny. Similarly infiltration trenches have been installed to intercept overland stormwater flow from the undeveloped areas before reaching any of the proposed areas of roads and hardstanding. This intercepted flow will be directed to the original field ditch boundary drainage system. Due to the natural south to north slope of the ground, storm waters emanating from the development will not flow naturally to the undeveloped part of the site. Landscaping works have now been completed in this part of the site but will take some time to become fully established. Once established the trees and shrubs planted, will have the beneficial effect of increasing the "residence time" of the storm flows thereby reducing downstream effects.

The design principle for the northern portion of the site is to largely manage runoff flows and pollutants on the site rather than directing them to the nearest receiving waters. In addition good housekeeping practices, retention and regular monitoring (i.e. testing) will ensure the potential for contamination is minimised. Good housekeeping measures include reusing waste contaminated water in the process itself, as detailed above. Waste contaminated water that is not required in the process will be diverted to the spilled water tank and sent for disposal or treatment at an appropriately licensed facility. It is therefore highly unlikely for such waste contaminated water to pollute any receiving waters.

In accordance with SuDS, consideration was given to surfacing roads and hard standings with pervious paving. However given the risk of spillage onto these areas from attending refuse lorries, with subsequent possible contaminated runoff, the existing surface water drainage system routes the surface water from roads and hardstanding to a monitoring station and from there to the firewater retention tank if contaminated, or to the natural watercourse via a petrol interceptor if uncontaminated. The proposed amendments require the conversion of two temporary structures to permanent use; a 375sq m maintenance building and a 396sq m office block. The maintenance building is accompanied by a hardcored laydown area (to be used during annual maintenance shutdown). The office building requires

the development of a paved access road and hardstand outside of the building. 22 Nr additional parking spaces are also to be provided at the main car park. In the case of the Buildings and the additional carparking it is proposed that the run-off from these areas will drain in to the site storm water drainage system.

In order to prevent flooding of the ditches downstream of the facility a discharge rate from the site based on the Dublin City Council Storm Water Management Policy and by agreement with Meath County Council of 59.8 litres/second has been incorporated into the existing drainage design. Attenuation for a 1 in 30 year storm will be provided by the storm water attenuation pond which discharges via a pump to an external drainage ditch. Attenuation of 1 in 100 year storm occurrences will also be contained within the attenuation pond (see Appendix 11.2 for calculations- revised to account for the new structures and additional surfaces). Based on these calculations it is confirmed that the system has the capacity to accommodate the discharges from the additional areas. In the event of a greater than 1:100 year storm occurrence, the paving has been designed sloping away from the building meaning any flooding that may occur will flow away from the building towards proposed and existing land drains. The provision of the above system allows the maintenance of the current discharge characteristics to the ditches serving the site i.e. flows similar to that generated from agricultural land. This will prevent downstream flooding due to "flash flooding" from the site.

See Figure 11.2 for a flow diagram of the proposed storm water management system.

11.4 POTENTIAL IMPACTS

Construction Phase

The construction phase will consist of construction of roads, hardstanding areas, car parks and other ancillary structures as specified earlier in this EIS and as detailed in Chapter 18, Construction.

The main potential impacts arising out of these works will consist of the following:

- Run-off from bare earth surfaces will contain silt and clay particles. Excessive amounts of silt entering the surface water system could clog the stream beds.
- Hydrocarbon contaminated water entering the drainage network has the potential to contaminate the surface water.
- Sewage or canteen effluent entering the surface water system has the potential to contaminate the surface waters.

Operational Phase

The main potential impacts associated with the operational phase will comprise the following:

- Run-off from the site has the potential to impact on surface water quality.
- Fire water run-off generated by a fire occurring in any of the buildings causing uncontrolled flows to the storm water drainage system have the potential to impact on surface water quality.

11.5 MITIGATION MEASURES

Construction Phase

The following mitigation measures will be implemented during the construction phase:

It is anticipated that the existing storm water management system will be used to manage any potentially silt laden run off during construction works. In the event that temporary settlement tanks are required, written agreement will be sought from the planning authority for details of temporary settlement tanks/silt traps/oil interceptors to control discharges of site surface water run-off during the construction period. The concentration of suspended solids (SS) of the surface water run-off from the site construction works, for discharge to surface waters, will not exceed 30 mg/litre.

During the construction phase of the development, oil and fuel storage tanks, chemicals and all other materials that pose a risk to waters if spilled, will be stored in designated storage areas, which are bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s). The existing designated storage areas at the facility will be used to minimise risks of spillages during the construction period. Filling and draw-off points will be located entirely within the bunded area(s). Drainage from the bunded area(s) will be diverted for collection and safe disposal. Bunded pallets will be used for storage of drums.

During the construction phase all domestic effluent generated on site will discharge to existing sewage treatment facilities. It is not proposed to provide portaloo or other additional sanitary facilities.

During the earthmoving/excavation phase of the proposed construction works site construction roads will be sprayed with water during dry periods to mitigate against the formation of dry dust particles and road sweepers will be operated as required to keep public roads clean.

Operational Phase

There will be no discharge of process effluent to the drainage network.

Fuels and oils used on site during the operational phase will be stored in tanks located in concrete containment bunds. Fuel oil and bulk ammonia tanks are located outside in double skinned tanks.

Domestic effluent will be treated depending on its location at one of three foul water treatment systems and discharged to the relevant percolation area.

Chemicals or other potentially polluting substances will be stored in the designated storage areas within the main process building which is bunded.

Run-off from clean hard surfaces on site including the roofs of the buildings, site roads, car parks, hardstanding areas and ancillary buildings will be collected into the surface water drainage system as detailed in Section 11.3.3 above.

All drainage arrangements will comply with the requirements of the planning authority for such works and services.

All sludge from the drainage system, bunds, silt traps and oil interceptors will be regularly collected for safe disposal.

An adequate supply of containment booms and/or suitable absorbent material to control, contain and absorb any potential spillages will be maintained at the facility.

Firefighting and Firewater Retention

Fire suppression is provided by an on site dual purpose water storage tank. This tank has an overall capacity of 2,185m³ with an effective fire-fighting storage volume of 1855m³ and a process water storage capacity of 330m³. The fire fighting effort is supported by 2 diesel fire pumps connected to a fire main and hydrant system throughout both the site and buildings. This will be further augmented by Local Fire Service capabilities. In the event of a fire, the process water requirement will not be needed and potentially all 2,185m³ will be available for fire fighting. All staff are trained in Emergency Response techniques in order to deal with emergencies including fire fighting.

The facility has achieved compliance with the Building Regulations with particular reference to Part B (Fire), i.e. a Fire Safety Certificate has been obtained; and will continue insofar as practicable follow the recommendations in the Code of Practice for Fire Safety in Buildings – BS5588 which is referred to in Technical Guidance Document B (Fire) to the Building Regulations. The modular offices and the warehouse will be submitted to the Local Authority for certification purposes.

The greatest potential for fire at the facility arises within the waste bunker where localised heating can occur due to decomposition of organic material. As detailed in Section 5, localised fires within the waste bunker are lifted using the grab crane, into the hoppers which transfer the waste directly to the furnace. Up to the level of the tipping hall, the bunker has a capacity of 5,670m³ approximately. If a 50% voidage ratio is assumed for the waste, then there would be a retention capacity of 2,835m³

within the waste bunker. With 2,185m³ of water available for fire fighting, this demonstrates that all of the water will be retained within the bunker even in the most extreme fire event.

If a fire occurred in the turbine area, the fire fighting water would be collected in the cellar beneath the turbine which has a capacity of circa 1,000 m³. As outlined in Chapter 9, the waste bunker has been designed conservatively with 1.1m thick walls and 800mm base and secondary containment system. It will therefore retain any fire water generated within the bunker.

With respect to fire occurring elsewhere in the process building or other buildings on site, the design philosophy as outlined in the 2009 EIS and as represented in Figure 11.2 remains unchanged.

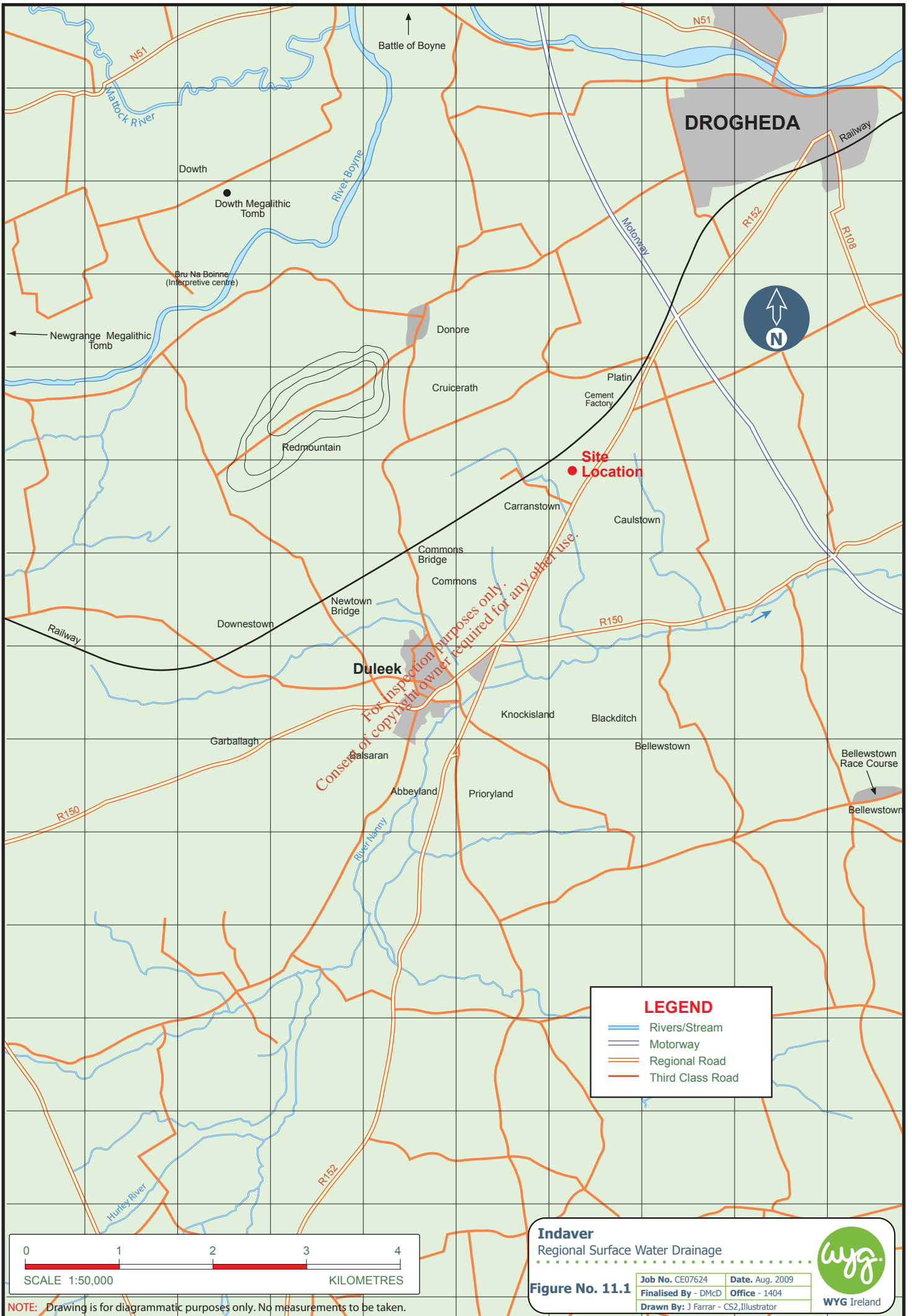
The firewater retention tank volume of 300m³ remains unchanged and has been calculated using the German LÖRÜRL Methodology for the calculation of retention volume.

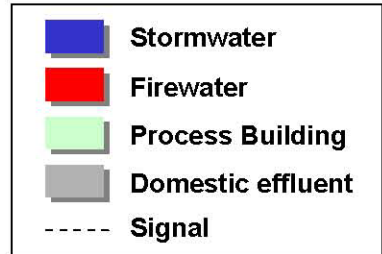
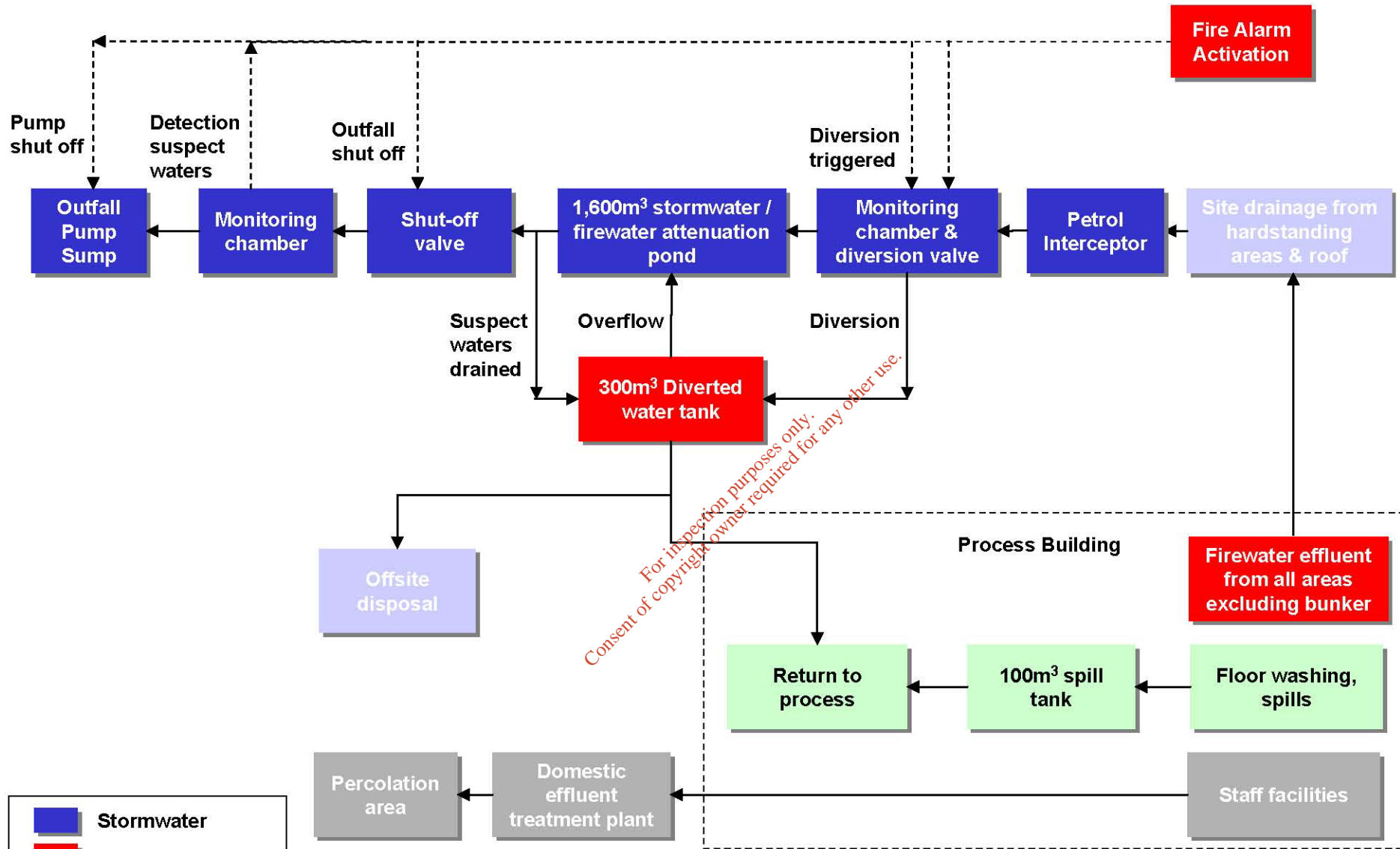
A Fire Water Risk Management Programme was prepared in July 2011 to comply with Condition 3.7 of Indaver's Waste Licence W 0167-02 and has been attached in Appendix 11.3.

A schematic of the effluent streams and their management is presented in Figure 11.2.

11.6 RESIDUAL IMPACTS

The existing surface water management system is adequately designed to prevent uncontrolled discharges to the outfall ditch by the provision of two layers of monitoring and a controlled discharge system. As a result of the proposed amendments there will be no significant negative impacts on the existing surface water environment.






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Indaver
Proposed Drainage

Figure No. 11.2

Job No. CE07629	Date. Aug. 2009
Finalised By - DMcD	Office - 1404
Drawn By: J Farrar - CS2, Illustrator	



WYG Ireland

Appendix 11.1

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Indaver Ireland Ltd.
Carranstown, Duleek, Co. Meath

Surface Water Assimilation Capacity Study

Report Date:
5th January 2012

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KD Environmental

17 Eastham Court, Bettystown, Co. Meath

Report No 2011/49/03

1.0 Introduction

KD Environmental were commissioned by Grace McCormack of Indaver Ireland to perform an assimilation capacity study of surfacewater discharged from the Indaver waste facility to the River Nanny.

The Indaver Ireland waste facility is situated at Carranstown, Co. Meath approximately 1.5km from the town of Duleek. Surrounding land use is agricultural with some private residences in the immediate vicinity of the Indaver facility.

Surface water runoff from roofs, yards and hardstand areas is held on site within a surfacewater lagoon and is continually monitored for discharge parameters of conductivity, pH and Total Organic Carbon as per schedule C.6.2 of EPA waste license W0167-02. Surface water is only discharged if parametric trigger limits set for these parameters is met and should any parameter exceed these limits, the surface water is retained in the lagoon pending investigation and treatment if required. Parametric trigger limits were set by Indaver and are included in section 8 of this report.

In recent cold and icy weather, salt has been applied to some hardstand walkways to prevent slipping of employees on icy surfaces. This has resulted in the elevation of conductivity levels in site surface water and consequentially the surface water, SW1, has not been discharged.

This report performs an assimilation capacity study to determine whether the River Nanny which receives the Indaver surface water, will experience a significant rise in conductivity level as a result of discharging the Indaver surface water with the increased conductivity. An assimilation capacity study to determine the capacity of the Nanny to receive Total Organic Carbon (TOC) in the Indaver SW1 is also made and compared to current TOC trigger limits set by Indaver for the SW1 discharge.

2.0 Receiving Water

The surface water, SW1, is pumped from the holding lagoon into a drainage ditch. This ditch crosses neighbouring farm land for approx. 1.5km. The drainage ditch forms part of the River Nanny catchment area and surface water will enter the Nanny in the vicinity of the town of Duleek along with other land drains in the area.

The River Nanny enters the sea at Laytown, Co. Meath approx. 13km from the Indaver site and the Nanny estuary and shoreline is a designated Special Protected Area (Site Code 004158). The monitoring location on the Nanny for the purposes of this report was approx. 10km upstream from the SPA.

The OPW have in the past performed flow monitoring on the River Nanny both upstream and downstream of Duleek. The OPW flow readings downstream of Duleek are used to calculate the assimilation capacity of the River Nanny to receive the surfacewater from the Indaver site. OPW flow data is included as Appendix 1 of this report.

3.0 Methodology

Samples of both the River Nanny and the SW1 surface water were taken on 3 separate days and analysed in-situ for Conductivity. In-situ analysis of pH, Total Dissolved Solids, Dissolved Oxygen and Temperature was also performed. A 1L sample was also taken and sent to Fitz Scientific Laboratories in Drogheda, Co. Louth for analysis of Total Organic Carbon. Laboratory certificates of analysis are included as Appendix 3 of this report.

The sampling point on the river Nanny was approx. 1.5km downstream of Duleek and approx. 3km from the Indaver site.

In situ analysis was performed by KD Environmental. pH, TDS and Conductivity were measured using a Hanna HI 98129 'Combometer' which was calibrated using known buffers before use on each monitoring day. The meter was checked using a pH 4.01 buffer and a 500uS/cm buffer and all readings were within a 2% acceptance range. Dissolved oxygen and temperature were measured using a Hanna HI9146 DO meter. The DO meter was air calibrated before use.

The results for Conductivity, TOC and the OPW flow data were used to calculate the predicted changes in conductivity and TOC of the River Nanny water as a result of receiving the Indaver discharge. Predicted conductivity levels are compared to the 1989 Surface Water Regulations, SI 294 of 1989, limit for conductivity in Class A1 surface waters. Predicted TOC levels are compared to the 1989 Surface Water Regulations, SI 294 of 1989, limit for COD in Class A3 surface waters.

50%ile and 95%ile river flow data was used to illustrate effect of rainfall variations on the assimilation capacity of the River Nanny.

4.0 Analysis Results

Table 1: Indaver Surface water SW1

Date	Conductivity (uS/cm)	TOC (mg/L)	pH (pH units)	TDS (mg/L)	D.O (mg/L)	Temp (°C)
15/12/11	1268	4.10	8.20	634	9.56	4.2
16/12/11	1266	4.04	8.09	633	10.68	3.1
19/12/11	853	3.73	8.32	418	10.15	7.8
Average	1129	3.96	8.20	562	10.13	5.0

Table 2: River Nanny Water

Date	Conductivity (uS/cm)	TOC (mg/L)	pH (pH units)	TDS (mg/L)	D.O (mg/L)	Temp (°C)
15/12/11	684	6.02	8.09	342	10.76	4.6
16/12/11	690	5.32	8.24	350	11.20	3.9
19/12/11	710	4.85	8.21	359	10.77	7.4
Average	695	5.39	8.18	350	10.91	5.3

5.0 Conductivity Assimilation Capacity Calculations

Formula:

$$C_{\text{final}} = (C_{\text{back}} * F_{\text{river}}) + (C_{\text{discharge}} * F_{\text{discharge}}) / (F_{\text{river}} + F_{\text{discharge}})$$

C final=Resultant concentration after discharge (uS/cm)

C back=Background Conductivity in river (uS/cm)

F river=Flow in river (m3/s)

C discharge =Average Conductivity in discharge (uS/cm)

F discharge=Flow of discharge (m3/s)

5.1 Using 50%ile flow data

$$C_{\text{final}} = (C_{\text{back}} * F_{\text{river}}) + (C_{\text{discharge}} * F_{\text{discharge}}) / (F_{\text{river}} + F_{\text{discharge}})$$

C final = 708 uS/cm

Change in River Nanny conductivity 13 uS/cm

5.2 Using 95%ile flow data

$$C_{\text{final}} = (C_{\text{back}} * F_{\text{river}}) + (C_{\text{discharge}} * F_{\text{discharge}}) / (F_{\text{river}} + F_{\text{discharge}})$$

C final = 810 uS/cm

Change in River Nanny conductivity 115 uS/cm

6.0 TOC Assimilation Capacity Calculations

Formula:

$$C_{\text{final}} = (C_{\text{back}} * F_{\text{river}}) + (C_{\text{discharge}} * F_{\text{discharge}}) / (F_{\text{river}} + F_{\text{discharge}})$$

C final=Resultant concentration after discharge (mg/L)

C back=Background TOC in river (mg/L)

F river=Flow in river (m3/s)

C discharge =Average TOC in discharge (mg/L)

F discharge=Flow of discharge (m3/s)

6.1 Using 50%ile flow data

$$C_{\text{final}} = (C_{\text{back}} * F_{\text{river}}) + (C_{\text{discharge}} * F_{\text{discharge}}) / (F_{\text{river}} + F_{\text{discharge}})$$

C final = 5.35 mg/L

Change in River Nanny TOC: None, -0.04 mg/L

6.2 Using 95%ile flow data

$$C_{\text{final}} = (C_{\text{back}} * F_{\text{river}}) + (C_{\text{discharge}} * F_{\text{discharge}}) / (F_{\text{river}} + F_{\text{discharge}})$$

C final = 5.01 mg/L

Change in River Nanny TOC: None, - 0.38 mg/L

Note: The SW1 discharge applies a slight dilution factor to the Nanny TOC levels as the discharge has a lower TOC concentration than the analysed TOC levels in the River Nanny water. This results in a slight reduction in TOC levels in the Nanny.

7.0 Assimilation Capacity Results

Table 3 below compares predicted conductivity levels in the River Nanny downstream to conductivity limits for Class A1 waters under the 1989 EC (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, SI No. 294 of 1989.

As there are no limits for TOC specified under the 1989 Surface Water Regulations, Table 4 compares the predicted TOC levels in the River Nanny downstream to COD limits for Class A3 waters under the 1989 EC (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, SI No. 294 of 1989. There is a direct relationship between COD and TOC levels in surface water.

Table 3: Conductivity Results vs. Class A1 water status

	Predicted Conductivity uS/cm	1989 Surface Water Regulations Class A1 Water
50%ile	708	1000
95%ile	810	1000

Table 4: TOC Results vs. COD Class A3 water status

	Predicted TOC mg/L	1989 Surface Water Regulations Class A3 Water
50%ile	5.35	40
95%ile	5.01	40

8.0 Trigger Limits

Trigger limits have been set by Indaver for conductivity and TOC levels in the SW1 to prevent pollution in the receiving water body being caused by the discharge.

A warning limit of 650 uS/cm and a control limit of 800 uS/cm have been set for Conductivity. A warning limit of 15 mg/L and a control limit of 20 mg/L have been set for TOC.

Assimilation capacity calculations in this report show that conductivity levels exceeding these trigger limits would not affect the quality of the River Nanny water following discharge of SW1.

It is suggested that a review of these trigger limits is made by Indaver as use of salt to prevent slipping on hardstand walkways will cause a breach of these conductivity trigger limits in the future.

TOC discharged at the warning limit of 15 mg/L or the control limit of 20 mg/L would not exceed the COD limit for class A3 waters under the 1989 Surface Water regulations. SW1 analysis results are significantly lower than the TOC warning limit. However, there may be scope to increase TOC warning and control limits if required and this is outlined in the conclusion section of this report.

9.0 Conclusions

The discharge of the SW1 surface water to the River Nanny will not cause a significant increase in conductivity of the river when discharged at the concentrations averaged in table 1 of this report and at a rate of 130m³/hour. The fact that the Nanny has a much larger flow than the discharge rate of the Indaver surface water and that the Nanny has relatively low conductivity levels, allows for the current surface water held in the lagoon to be assimilated into the river water without causing significantly high conductivity levels in the river water.

Using the assimilation calculations, the OPW flow data and the analysis on the River Nanny conductivity levels, a surface water discharge with higher conductivity levels or a discharge at a greater rate could be accommodated by the Nanny. The Indaver discharge is set at 130m³/hour or 0.036m³/sec. At this discharge rate it is predicted that a conductivity level in the discharge of 1800uS/cm would have no detrimental effects on the R. Nanny conductivity levels.

However, the Indaver surface water discharge travels to the River Nanny via land drainage ditches that cross private agricultural land and respect to this must be taken into account. There are also unaccounted for sources of conductivity and TOC that may enter the River Nanny such as agricultural discharges and surface waters from other premises in the area.

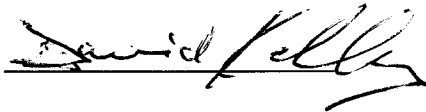
Electric Conductivity is directly dependent on total ion concentration or dissolved solids present. A conductivity measurement alone does not determine whether a discharge has polluting potential or not. A discharge with a low conductivity may still contain polluting substances that at low concentrations can be significantly detrimental to the water quality of the receiving waterbody.

Changes in TOC concentration are compared to 1989 Surface Water regulation Class A3 water COD limits. COD is not a direct comparison to TOC but levels are generally similar. Also Class A3 waters are not of good quality and would require intensive physical and chemical treatment to render them safe as drinking water. For these reasons the current TOC trigger limits could be increased but it is recommended that they are only increased to 25mg/L for warning limits and 30mg/L for control limits even though assimilation capacity calculations suggest that higher TOC discharge concentrations could be accommodated by the River Nanny.

In summary, the discharge of surface water analysed from the holding lagoon at the Indaver site will not have a significant impact on the conductivity levels of the River Nanny water when discharged at 130 m³/hour.

The increased conductivity levels in the surfacewater discharge are due to presence of sodium chloride or salt used to prevent slipping on icy hard stand areas. This will not pose significant environmental hazards to the River Nanny.

The River Nanny has the capacity to assimilate Indaver surface water discharges with higher conductivity and TOC levels than the current trigger limits set for the SW1 discharge.



David Kelly
Technical Manager
KD Environmental

5th January 2012

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Appendix 1

OPW River Nanny Flow Data

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- [Hydro-Data Home](#) • [Contact Us](#) • [Search Query](#) • [Search Results](#) • [Map-Finder](#) • [Online Questionnaire](#)

Summary Statistics Data

- [Daily Mean Flow Data](#) • [Daily Mean Level Data](#) • [Annual Maxima Data](#)

GENERAL STATION DETAILS			
Station Name: Duleek D/S	Station No: 08011	Watercourse: Nanny	NGR: O 053 685
Catchment Area (km ²): 181	Catchment: Nanny.	Gauge Type: L/AR	Datum: Poolbeg

SUMMARY HYDROMETRIC STATISTICS
Annual Average Rainfall (mm) ¹ : 850
Est'd Annual Losses (mm) ¹ : 456
Mean Annual Flow (m ³ /s): 2.2713 (Data derived for the period 1979 to 2005)

STATION HISTORY
Period of Continuous Hardcopy Records: 1979 to 2005
Period of Digitised Record: 1979 to 2005

Note 1 : Data extracted from the Environmental Protection Agency publication 'Hydrological Data', July 1997

DURATION PERCENTILES								
Flows equalled or exceeded for the given percentage of time (m ³ /s) (Data derived for the period 1979 to 2005)								
1%	5%	10%	50%	80%	90%	95%	99%	
16.0	7.56	5.56	1.17	0.33	0.17	0.10	0.04	
Levels equalled or exceeded for the given percentage of time (mAOD Poolbeg) (Data derived for the period 1979 to 2005)								
1%	5%	10%	50%	80%	90%	95%	99%	
21.06	20.45	20.28	19.96	19.84	19.80	19.75	19.46	

COMMENTS / NOTES
Poor quality low flow data - to be used for indicative purposes only.

Appendix 2

Assimilation Capacity Calculations

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Formula:

$$C \text{ final} = (C \text{ back} * F \text{ river}) + (C \text{ discharge} * F \text{ discharge}) / (F \text{ river} + F \text{ discharge})$$

C final=Resultant concentration after discharge (uS/cm)

C back=Background Conductivity in river(uS/cm)

F river=Flow in river (m3/s)

C discharge =Average Conductivity in discharge (uS/cm)

F discharge=Flow of discharge (m3/s)

	Units	Avr Nanny Result (uS/cm)	River Flow m3/s	Avr SW1 Result (uS/cm)	SW1 Flow	C Final (uS/cm)
50%ile	uS/cm	695	1.17	1129	0.036	707.95
95%ile	uS/cm	695	0.1	1129	0.036	809.85

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Formula:

$$C_{\text{final}} = (C_{\text{back}} * F_{\text{river}}) + (C_{\text{discharge}} * F_{\text{discharge}}) / (F_{\text{river}} + F_{\text{discharge}})$$

C final=Resultant concentration after discharge (mg/L)

C back=Background TOC in river (mg/L)

F river=Flow in river (m3/s)

C discharge =Average TOC in discharge (mg/L)

F discharge=Flow of discharge (m3/s)

	Units	Avr Nanny Result (mg/L)	River Flow (B) m3/s	Avr SW1 Result (mg/L)	SW1 Flow	C Final (mg/l)
50%ile	mg/L	5.39	1.17	3.96	0.036	5.35
95%ile	mg/L	5.39	0.1	3.96	0.036	5.01

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Appendix 3

Laboratory Certificates of Analysis

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Fax: +353 41 9846171
Web: www.fitzsci.ie
email: info@fitzsci.ie

Customer	David Kelly KD Environmental Consultancy & Service 17 Eastham Court Bettystown Co. Meath	Lab Report Ref. No.	4315/007/02
Customer PO		Date of Receipt	16/12/2011
Customer Ref	Indaver SW - 15/12/11	Sampled On	15/12/2011
		Date Testing Commenced	16/12/2011
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
		Date of Report	20/12/2011
		Sample Type	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Total Organic Carbon	316	TOC analyser (NPOC)	4.10	mg/L	

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Signed: A Harmon
Aoife Harmon - Technical Supervisor

Date: 20/12/11

Acc.: Accredited Parameters by ISO 17025:2005

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Results contained in this report relate only to the samples tested

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Customer PO		Date of Receipt	16/12/2011
Customer Ref	Indaver SW - 16/12/11	Sampled On	16/12/2011
		Date Testing Commenced	16/12/2011
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
		Date of Report	20/12/2011
		Sample Type	Surface Water

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Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Total Organic Carbon	316	TOC analyser (NPOC)	4.04	mg/L	

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Customer	David Kelly KD Environmental Consultancy & Service 17 Eastham Court Betystown Co. Meath	Lab Report Ref. No.	4315/008/02
Customer PO		Date of Receipt	19/12/2011
Customer Ref	Indaver S.W - 19/12/11	Sampled On	19/12/2011
		Date Testing Commenced	19/12/2011
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
		Date of Report	22/12/2011
		Sample Type	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Total Organic Carbon	316	TOC analyser (NPOC)	3.73	mg/L	

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Customer	David Kelly KD Environmental Consultancy & Service 17 Eastham Court Bettystown Co. Meath	Lab Report Ref. No.	4315/007/01
Customer PO		Date of Receipt	16/12/2011
Customer Ref	Nanny - 15/12/11	Sampled On	15/12/2011
		Date Testing Commenced	16/12/2011
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
		Date of Report	20/12/2011
		Sample Type	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Total Organic Carbon	316	TOC analyser (NPOC)	6.02	mg/L	

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Customer	David Kelly KD Environmental Consultancy & Service 17 Eastham Court Bettystown Co. Meath	Lab Report Ref. No.	4315/007/03
Customer PO		Date of Receipt	16/12/2011
Customer Ref	Nanny - 16/12/11	Sampled On	16/12/2011
		Date Testing Commenced	16/12/2011
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
		Date of Report	20/12/2011
		Sample Type	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Total Organic Carbon	316	TOC analyser (NPOC)	5.32	mg/L	

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Customer	David Kelly KD Environmental Consultancy & Service 17 Eastham Court Bettystown Co. Meath	Lab Report Ref. No.	4315/008/01
		Date of Receipt	19/12/2011
		Sampled On	19/12/2011
		Date Testing Commenced	19/12/2011
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		Date of Report	22/12/2011
Customer Ref	Nanny - 19/12/11	Sample Type	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Total Organic Carbon	316	TOC analyser (NPOC)	4.85	mg/L	

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Date : 22/12/11

All organic results are analysed as received and all results are corrected for dry weight at 104 C
Results shall not be reproduced, except in full, without the approval of Fitz Scientific
Results contained in this report relate only to the samples tested

**The analytical result for this parameter may not be reflective of the concentration present at the time of sampling. The maximum recommended preservation time for this parameter has been exceeded.

Page 1 of 1

Appendix 11.2

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Summary Wizard of "CRITICAL"(Rank 1 by Max Level)
Results for Design Storms

PN	Storm	Return Period	Climate Change	Rank	First X Surchage	First Y Flood	First Z Overflow	O/F Act
6.001	15 Summer	30	10%	1				
7.000	15 Summer	30	10%	1				
6.002	15 Summer	30	10%	1				
8.000	15 Summer	30	10%	1				
3.006	15 Winter	30	10%	1	30/15 Summer			
1.008	15 Winter	30	10%	1	30/15 Summer			
9.000	15 Winter	30	10%	1	30/15 Summer			
9.001	15 Winter	30	10%	1	30/15 Summer			
10.000	15 Winter	30	10%	1	30/15 Summer			
9.002	15 Winter	30	10%	1	30/15 Summer			
9.003	15 Winter	30	10%	1	30/15 Summer			
11.000	15 Winter	30	10%	1	30/15 Summer			
9.004	15 Winter	30	10%	1	30/15 Summer			
9.005	15 Winter	30	10%	1	30/15 Summer			
12.000	15 Winter	30	10%	1	30/15 Winter			
9.006	15 Winter	30	10%	1	30/15 Summer			
13.000	15 Winter	30	10%	1				
13.001	15 Winter	30	10%	1	30/15 Summer			
9.007	15 Winter	30	10%	1	30/15 Summer			
14.000	15 Summer	30	10%	1				
9.008	15 Winter	30	10%	1	30/15 Summer			
1.009	15 Winter	30	10%	1	30/15 Summer			
1.010	15 Winter	30	10%	1	30/15 Summer			
1.011	15 Winter	30	10%	1	30/15 Summer			

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Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
	6.001	32.450	-0.050	0.000	0.92	0.0	34.6	O K
	7.000	32.501	-0.099	0.000	0.61	0.0	24.3	O K
	6.002	32.116	-0.134	0.000	0.33	0.0	67.9	O K
	8.000	31.052	-0.148	0.000	0.26	0.0	21.1	O K
	3.006	28.932	0.522	0.000	1.07	0.0	139.8	SURCH'ED
	1.008	28.810	0.310	0.000	0.81	0.0	246.4	SURCH'ED
	9.000	29.662	0.177	0.000	0.36	0.0	16.8	SURCH'ED
	9.001	29.640	0.355	0.000	0.79	0.0	25.5	SURCH'ED
	10.000	29.610	0.325	0.000	0.28	0.0	8.7	SURCH'ED
	9.002	29.594	0.414	0.000	1.10	0.0	32.7	SURCH'ED
	9.003	29.484	0.394	0.000	1.16	0.0	37.5	SURCH'ED
	11.000	29.347	0.122	0.000	0.36	0.0	18.8	SURCH'ED
	9.004	29.336	0.356	0.000	1.65	0.0	51.8	SURCH'ED
	9.005	29.214	0.284	0.000	1.00	0.0	63.8	SURCH'ED
	12.000	29.153	0.053	0.000	0.69	0.0	30.7	SURCH'ED
	9.006	29.144	0.294	0.000	1.04	0.0	112.4	SURCH'ED
	13.000	29.084	-0.016	0.000	0.27	0.0	15.1	O K
	13.001	29.072	0.227	0.000	0.52	0.0	24.3	SURCH'ED
	9.007	29.058	0.323	0.000	1.39	0.0	152.8	SURCH'ED
	14.000	29.214	-0.186	0.000	0.07	0.0	4.1	O K
	9.008	28.825	0.270	0.000	0.97	0.0	151.1	SURCH'ED
	1.009	28.777	0.327	0.000	1.86	0.0	391.6	SURCH'ED
	1.010	28.628	0.298	0.000	1.69	0.0	388.9	SURCH'ED
	1.011	28.477	0.172	0.000	1.68	0.0	387.4	SURCH'ED

Killakee House
 Belgard Square
 Tallaght Dublin 24

Indaver Duleek
 Phase 2



Date 21 February 2012 10:04
 File PHASE 2 30YR.SUM

Designed By WH
 Checked By

Micro Drainage

Simulation W.11.3

Summary Wizard of "CRITICAL"(Rank 1 by Max Level)
Results for Design Storms

PN	Storm	Return Period	Climate Change	Rank	First X Surchage	First Y Flood	First Z Overflow	O/F Act
1.012	15 Winter	30	10%	1	30/15 Summer			
1.013	120 Winter	30	10%	1	30/30 Summer			
1.014	15 Summer	30	10%	1				

Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
	1.012	28.324	0.049	0.000	1.42	0.0	386.5	SURCH'ED
	1.013	28.077	0.177	0.000	2.34	0.0	60.0	SURCH'ED
	1.014	29.786	-0.064	0.000	0.98	0.0	60.0	O K

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Global Variables

Region	FSR - Scotland & Ireland
Return Period (yrs)	5
M5-60 (mm)	15.300
Ratio R	0.270
Volumetric Runoff Coef	0.750
Profile Type	Summer
PIMP (%)	100
Areal Reduction Factor	1.000
Storm Duration (mins)	15
Hot Start (mins)	0
Hot Start Level (mm)	0
Manhole Headloss Coefficient	0.500
MADD Factor * 10m ³ /ha Storage	2.000
Foul Sewage/Hectare (l/s)	0.00
Additional Flow - % of Total Flow	0
Number of Input Hydrographs	0
Number of Time/Area Diagrams	0
Number of Bifurcations	0
Number of Overflows	0
Number of Off-Line Controls	0
Number of On-Line Controls	1

Starting Storm file name

M:\011838\MICROD\PHASE 2\PHASE 2.SWS

Freely Discharging Outfalls

Outfall Pipe Number	Outfall MH/No	C.Level (m)	I.Level (m)	D, L (mm)	B (mm)
1.014	S1.13	30.200	29.500	1500	0

Killakee House
 Belgard Square
 Tallaght Dublin 24

Indaver Duleek
 Phase 2



Date 21 February 2012 15:39
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On-Line Controls (Pump)

US/PN	Volume (m ³)	Ctrl MH Name	Invert (m)	Headloss (m)	Flow (l/s)
1.012	8.624	S1.11	27.600	0.2	60.0
				0.4	60.0
				0.6	60.0
				0.8	60.0
				1.0	60.0
				1.4	60.0
				1.8	60.0
				2.2	60.0
				2.6	60.0

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Network Details

* - Indicates pipe has been modified outside of WinDes's Storm/Foul & Schedules

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
1.000	33.60	0.140	240.0	0.107	4.00	1	0.600	o	300
1.001	39.20	0.290	135.2	0.114	0.00	1	0.600	o	300
1.002	21.50	0.100	215.0	0.038	0.00	1	0.600	o	300
2.000	29.00	0.290	100.0	0.254	4.00	1	0.600	o	225
1.003	30.10	0.175	172.0	0.018	0.00	1	0.600	o	300
1.004	13.20	0.087	151.7	0.030	0.00	1	0.600	o	300
1.005	64.16	1.580	40.6	0.068	0.00	1	0.600	o	300
1.006	42.34	0.200	211.7	0.049	0.00	1	0.600	o	375
1.007	53.63	0.200	268.1	0.015	0.00	1	0.600	o	375
3.000	20.00	0.200	100.0	0.049	4.00	1	0.600	o	225
3.001	54.00	0.260	207.7	0.094	0.00	1	0.600	o	225
3.002	41.00	0.150	273.3	0.052	0.00	1	0.600	o	225
4.000	57.60	0.445	129.4	0.156	4.00	1	0.600	o	225
3.003	13.00	0.070	185.7	0.006	0.00	1	0.600	o	300
3.004	74.25	0.285	260.5	0.007	0.00	1	0.600	o	300
5.000	13.32	0.200	66.6	0.030	4.00	1	0.600	o	225
3.005	52.03	0.165	315.3	0.053	0.00	1	0.600	o	375

PN	USMH No.	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl No.	US/MH (mm)
1.000	S1.00	32.700	31.700	0.700	32.360	31.560	0.500		1200
1.001	S1.01	32.360	31.560	0.500	32.450	31.270	0.880		1200
1.002	S1.02	32.450	31.270	0.880	32.200	31.170	0.730		1200
2.000	S8.00	32.500	31.620	0.655	32.200	31.330	0.645		1200
1.003	S1.03	32.200	31.170	0.730	31.915	30.995	0.620		1200
1.004	S1.03a	31.915	30.267	1.348	31.850	30.180	1.370		1200
1.005	S1.04	31.850	30.180	1.370	32.415	28.600	3.515		1200
1.006	S1.05	32.415	28.525	3.515	31.950	28.325	3.250		1200
1.007	S1.06	31.950	28.325	3.250	30.750	28.125	2.250		1200
3.000	S20.00	30.150	29.315	0.610	30.300	29.115	0.960		1200
3.001	S3.00	30.300	29.115	0.960	30.300	28.855	1.220		1200
3.002	S3.01	30.300	28.855	1.220	30.250	28.705	1.320		1200
4.000	S3.01A	30.090	29.300	0.565	30.250	28.855	1.170		1200
3.003	S3.02	30.250	28.630	1.320	30.370	28.560	1.510		1200
3.004	S3.03	30.370	28.560	1.510	31.000	28.275	2.425		1200
5.000	S4.00	31.320	29.175	1.920	31.000	28.975	1.800		1200
3.005	S3.04	31.000	28.200	2.425	31.200	28.035	2.790		1200

Network Details

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
6.000	18.60	0.100	186.0	0.090	4.00	1	0.600	o	225
6.001	43.00	0.250	172.0	0.045	0.00	1	0.600	o	225
7.000	19.00	0.140	135.7	0.090	4.00	1	0.600	o	225
6.002	9.60	2.150	4.5	0.045	0.00	1	0.600	o	225
8.000	28.52	0.800	35.6	0.078	4.00	1	0.600	o	225
3.006	23.01	0.135	170.4	0.000	0.00	1	0.600	o	375
1.008	9.97	0.050	199.4	0.009	0.00	1	0.600	o	600
9.000	20.00	0.200	100.0	0.067	4.00	1	0.600	o	225
9.001	22.65	0.105	215.7	0.068	0.00	1	0.600	o	225
10.000	24.50	0.105	233.3	0.047	4.00	1	0.600	o	225
9.002	22.60	0.090	251.1	0.027	0.00	1	0.600	o	225
9.003	23.72	0.110	215.7	0.035	0.00	1	0.600	o	225
11.000	8.25	0.140	58.9	0.074	4.00	1	0.600	o	225
9.004	8.75	0.050	175.0	0.013	0.00	1	0.600	o	225

PN	USMH No.	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl No.	US/MH (mm)
6.000	S5.00	33.800	32.375	1.200	33.800	32.275	1.300		1200
6.001	S5.01	33.800	32.275	1.300	33.800	32.025	1.550		1200
7.000	S6.00	33.800	32.375	1.200	33.800	32.235	1.340		1200
6.002	S5.02	33.800	32.025	1.550	31.200	29.875	1.100		1200
8.000	S3.05a	32.850	30.975	1.650	31.200	30.175	0.800		1200
3.006	S3.05	31.200	28.035	2.790	30.750	27.900	2.475		1200
1.008	S1.07	30.750	27.900	2.250	30.510	27.850	2.060		1500
9.000	S20.01	30.150	29.260	0.665	30.275	29.060	0.990		1200
9.001	S7.00	30.275	29.060	0.990	30.325	28.955	1.145		1200
10.000	S7.00a	30.320	29.060	1.035	30.325	28.955	1.145		1200
9.002	S7.00b	30.325	28.955	1.145	30.375	28.865	1.285		1200
9.003	S7.01	30.375	28.865	1.285	30.045	28.755	1.065		1200
11.000	S9.00	30.350	29.000	1.125	30.045	28.860	0.960		1200
9.004	S7.02	30.045	28.755	1.065	30.200	28.705	1.270		1200

Network Details

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
9.005	17.57	0.080	219.6	0.070	0.00	1	0.600	o	300
12.000	3.50	0.100	35.0	0.119	4.00	1	0.600	o	225
9.006	30.70	0.115	267.0	0.116	0.00	1	0.600	o	375
13.000	17.39	0.255	68.2	0.058	4.00	1	0.600	o	225
13.001	7.43	0.110	67.5	0.059	0.00	1	0.600	o	225
9.007	50.79	0.180	282.2	0.111	0.00	1	0.600	o	375
14.000	12.30	0.200	61.5	0.015	4.00	1	0.600	o	225
9.008	14.93	0.060	248.8	0.066	0.00	1	0.600	o	450
1.009	6.00	0.020	300.0	0.000	0.00	1	0.600	o	600
1.010	7.00	0.025	280.0	0.000	0.00	1	0.600	o	600
1.011	9.60	0.030	320.0	0.000	0.00	1	0.600	o	600
1.012	32.00	0.075	426.7	0.000	0.00	1	0.600	o	600
1.013	12.00	-2.000	-6.0	0.080	0.00	1	0.600	o	300
1.014	7.00	0.050	140.0	0.000	0.00	1	0.600	o	300

PN	USMH No.	US/CL (m)	US/IL (m)	US C. Depth (m)	DS/CL (m)	DS/IL (m)	DS C. Depth (m)	Ctrl No.	US/MH (mm)
9.005	S7.03	30.200	28.630	1.270	30.290	28.550	1.440		1200
12.000	S10.00	30.300	28.875	1.200	30.290	28.775	1.290		1200
9.006	S7.04	30.290	28.475	1.440	30.300	28.360	1.565		1200
13.000	S11.00	30.325	28.875	1.225	30.400	28.620	1.555		1200
13.001	S11.01	30.400	28.620	1.555	30.300	28.510	1.565		1200
9.007	S7.05	30.300	28.360	1.565	30.530	28.180	1.975		1200
14.000	S7.06a	30.600	29.175	1.200	30.530	28.975	1.330		1200
9.008	S7.06	30.530	28.105	1.975	30.510	28.045	2.015		1350
1.009	S1.08	30.510	27.850	2.060	29.500	27.830	1.070		1500
1.010	S1.09	29.500	27.730	1.170	29.500	27.705	1.195		1500
1.011	S1.10	29.500	27.705	1.195	29.500	27.675	1.225		1500
1.012	S1.10a	29.500	27.675	1.225	29.500	27.600	1.300		1500
1.013	S1.11	29.500	27.600	1.600	30.151	29.600	0.251	5	1500
1.014	S1.12	30.151	29.550	0.301	30.200	29.500	0.400		1500

Killakee House
Belgard Square
Tallaght Dublin 24Indaver Duleek
Phase 2Date 21 February 2012 15:39
File PHASE 2 5YR.SUMDesigned By WH
Checked By

Micro Drainage

Simulation W.11.3

PIPELINE SCHEDULESUpstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
1.000	o	300	S1.00	32.700	31.700	0.700		1200
1.001	o	300	S1.01	32.360	31.560	0.500		1200
1.002	o	300	S1.02	32.450	31.270	0.880		1200
2.000	o	225	S8.00	32.500	31.620	0.655		1200
1.003	o	300	S1.03	32.200	31.170	0.730		1200
1.004	o	300	S1.03a	31.915	30.267	1.348		1200
1.005	o	300	S1.04	31.850	30.180	1.370		1200
1.006	o	375	S1.05	32.415	28.525	3.515		1200
1.007	o	375	S1.06	31.950	28.325	3.250		1200
3.000	o	225	S20.00	30.150	29.315	0.610		1200
3.001	o	225	S3.00	30.300	29.115	0.960		1200
3.002	o	225	S3.01	30.300	28.855	1.220		1200
4.000	o	225	S3.01A	30.090	29.000	0.565		1200
3.003	o	300	S3.02	30.250	28.630	1.320		1200
3.004	o	300	S3.03	30.300	28.560	1.510		1200
5.000	o	225	S4.00	32.020	29.175	1.920		1200

Downstream Manhole

PN	Length (m)	Slope (1:x)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
1.000	33.60	240.0	S1.01	32.360	31.560	0.500		1200
1.001	39.20	135.2	S1.02	32.450	31.270	0.880		1200
1.002	21.50	215.0	S1.03	32.200	31.170	0.730		1200
2.000	29.00	100.0	S1.03	32.200	31.330	0.645		1200
1.003	30.10	172.0	S1.03a	31.915	30.995	0.620		1200
1.004	13.20	151.7	S1.04	31.850	30.180	1.370		1200
1.005	64.16	40.6	S1.05	32.415	28.600	3.515		1200
1.006	42.34	211.7	S1.06	31.950	28.325	3.250		1200
1.007	53.63	268.1	S1.07	30.750	28.125	2.250		1500
3.000	20.00	100.0	S3.00	30.300	29.115	0.960		1200
3.001	54.00	207.7	S3.01	30.300	28.855	1.220		1200
3.002	41.00	273.3	S3.02	30.250	28.705	1.320		1200
4.000	57.60	129.4	S3.02	30.250	28.855	1.170		1200
3.003	13.00	185.7	S3.03	30.370	28.560	1.510		1200
3.004	74.25	260.5	S3.04	31.000	28.275	2.425		1200
5.000	13.32	66.6	S3.04	31.000	28.975	1.800		1200

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
3.005	o	375	S3.04	31.000	28.200	2.425		1200
6.000	o	225	S5.00	33.800	32.375	1.200		1200
6.001	o	225	S5.01	33.800	32.275	1.300		1200
7.000	o	225	S6.00	33.800	32.375	1.200		1200
6.002	o	225	S5.02	33.800	32.025	1.550		1200
8.000	o	225	S3.05a	32.850	30.975	1.650		1200
3.006	o	375	S3.05	31.200	28.035	2.790		1200
1.008	o	600	S1.07	30.750	27.900	2.250		1500
9.000	o	225	S20.01	30.150	29.260	0.665		1200
9.001	o	225	S7.00	30.275	29.060	0.990		1200
10.000	o	225	S7.00a	30.320	29.060	1.035		1200
9.002	o	225	S7.00b	30.325	28.955	1.145		1200
9.003	o	225	S7.01	30.75	28.865	1.285		1200

Downstream Manhole

PN	Length (m)	Slope (1:x)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
3.005	52.03	315.3	S3.05	31.200	28.035	2.790		1200
6.000	18.60	186.0	S5.01	33.800	32.275	1.300		1200
6.001	43.00	172.0	S5.02	33.800	32.025	1.550		1200
7.000	19.00	135.7	S5.02	33.800	32.235	1.340		1200
6.002	9.60	4.5	S3.05	31.200	29.875	1.100		1200
8.000	28.52	35.6	S3.05	31.200	30.175	0.800		1200
3.006	23.01	170.4	S1.07	30.750	27.900	2.475		1500
1.008	9.97	199.4	S1.08	30.510	27.850	2.060		1500
9.000	20.00	100.0	S7.00	30.275	29.060	0.990		1200
9.001	22.65	215.7	S7.00b	30.325	28.955	1.145		1200
10.000	24.50	233.3	S7.00b	30.325	28.955	1.145		1200
9.002	22.60	251.1	S7.01	30.375	28.865	1.285		1200
9.003	23.72	215.7	S7.02	30.045	28.755	1.065		1200

Killakee House
Belgard Square
Tallaght Dublin 24Indaver Duleek
Phase 2Date 21 February 2012 15:39
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Micro Drainage

Simulation W.11.3

PIPELINE SCHEDULESUpstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
11.000	o	225	S9.00	30.350	29.000	1.125		1200
9.004	o	225	S7.02	30.045	28.755	1.065		1200
9.005	o	300	S7.03	30.200	28.630	1.270		1200
12.000	o	225	S10.00	30.300	28.875	1.200		1200
9.006	o	375	S7.04	30.290	28.475	1.440		1200
13.000	o	225	S11.00	30.325	28.875	1.225		1200
13.001	o	225	S11.01	30.400	28.620	1.555		1200
9.007	o	375	S7.05	30.300	28.360	1.565		1200
14.000	o	225	S7.06a	30.600	29.175	1.200		1200
9.008	o	450	S7.06	30.530	28.105	1.975		1350
1.009	o	600	S1.08	30.510	27.850	2.060		1500
1.010	o	600	S1.09	29.500	27.730	1.170		1500
1.011	o	600	S1.10	29.500	27.705	1.195		1500
1.012	o	600	S1.10a	29.500	27.675	1.225		1500
1.013	o	300	S1.11	29.500	27.600	1.600		1500

Downstream Manhole

PN	Length (m)	Slope (1:x)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., (mm)	L*W
11.000	8.25	58.9	S7.02	30.045	28.860	0.960		1200
9.004	8.75	175.0	S7.03	30.200	28.705	1.270		1200
9.005	17.57	219.6	S7.04	30.290	28.550	1.440		1200
12.000	3.50	35.0	S7.04	30.290	28.775	1.290		1200
9.006	30.70	267.0	S7.05	30.300	28.360	1.565		1200
13.000	17.39	68.2	S11.01	30.400	28.620	1.555		1200
13.001	7.43	67.5	S7.05	30.300	28.510	1.565		1200
9.007	50.79	282.2	S7.06	30.530	28.180	1.975		1350
14.000	12.30	61.5	S7.06	30.530	28.975	1.330		1350
9.008	14.93	248.8	S1.08	30.510	28.045	2.015		1500
1.009	6.00	300.0	S1.09	29.500	27.830	1.070		1500
1.010	7.00	280.0	S1.10	29.500	27.705	1.195		1500
1.011	9.60	320.0	S1.10a	29.500	27.675	1.225		1500
1.012	32.00	426.7	S1.11	29.500	27.600	1.300		1500
1.013	12.00	-6.0	S1.12	30.151	29.600	0.251		1500

Killakee House
Belgard Square
Tallaght Dublin 24Indaver Duleek
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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.014	o	300	S1.12	30.151	29.550	0.301	1500

Downstream Manhole

PN	Length (m)	Slope (1:x)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.014	7.00	140.0	S1.13	30.200	29.500	0.400	1500

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Summary Wizard of "CRITICAL"(Rank 1 by Max Level)
Results for Design Storms

Margin for Flood Risk warning (mm) 300 Inertia Status OFF
DTS Status ON Analysis Time Step Fine
DVD Status OFF

Profile(s) Summer and Winter
 15, 30, 60, 120, 240, 360, 480, 960,
Duration(s) (mins) 1440, 2160, 2880, 4320, 5760, 7200,
 8640, 10080
Return Period(s) (years) 5
Climate Change (%) 10

PN	Storm	Return Period	Climate Change	Rank	First X Surcharge	First Y Flood	First Z Overflow	O/F Act
1.000	15 Summer	5	10%	1				
1.001	15 Winter	5	10%	1				
1.002	15 Winter	5	10%	1				
2.000	15 Summer	5	10%	1				
1.003	15 Winter	5	10%	1				
1.004	15 Winter	5	10%	1				
1.005	15 Winter	5	10%	1				
1.006	15 Winter	5	10%	1				
1.007	15 Winter	5	10%	1				
3.000	15 Summer	5	10%	1				
3.001	15 Winter	5	10%	1				
3.002	15 Winter	5	10%	1				
4.000	15 Summer	5	10%	1				
3.003	15 Winter	5	10%	1				
3.004	15 Winter	5	10%	1				
5.000	15 Summer	5	10%	1				
3.005	15 Winter	5	10%	1				5/15 Summer
6.000	15 Summer	5	10%	1				

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Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
	1.000	31.812	-0.188	0.000	0.29	0.0	19.2	O K
	1.001	31.693	-0.167	0.000	0.40	0.0	35.3	O K
	1.002	31.509	-0.061	0.000	0.61	0.0	40.6	O K
	2.000	31.795	-0.050	0.000	0.94	0.0	45.7	O K
	1.003	31.470	0.000	0.000	1.02	0.0	78.1	O K
	1.004	30.575	0.008	0.000	1.11	0.0	81.8	SURCH'ED
	1.005	30.339	-0.141	0.000	0.54	0.0	90.2	O K
	1.006	28.774	-0.126	0.000	0.77	0.0	96.0	O K
	1.007	28.618	-0.082	0.000	0.84	0.0	94.5	O K
	3.000	29.381	-0.159	0.000	0.19	0.0	9.0	O K
	3.001	29.249	-0.091	0.000	0.62	0.0	21.5	O K
	3.002	29.030	-0.050	0.000	0.93	0.0	27.5	O K
	4.000	29.433	-0.092	0.000	0.65	0.0	28.6	O K
	3.003	28.857	-0.073	0.000	0.78	0.0	51.5	O K
	3.004	28.820	-0.040	0.000	0.90	0.0	59.4	O K
	5.000	29.222	-0.178	0.000	0.10	0.0	5.5	O K
	3.005	28.607	0.032	0.000	0.61	0.0	64.0	SURCH'ED
	6.000	32.485	-0.115	0.000	0.48	0.0	16.5	O K

Summary Wizard of "CRITICAL"(Rank 1 by Max Level)
Results for Design Storms

PN	Storm	Return Period	Climate Change	Rank	First X Surcharge	First Y Flood	First Z Overflow	O/F Act
6.001	15 Winter	5	10%	1				
7.000	15 Summer	5	10%	1				
6.002	15 Summer	5	10%	1				
8.000	15 Summer	5	10%	1				
3.006	30 Winter	5	10%	1	5/15 Summer			
1.008	15 Winter	5	10%	1				
9.000	15 Summer	5	10%	1				
9.001	15 Winter	5	10%	1				
10.000	15 Winter	5	10%	1				
9.002	15 Winter	5	10%	1	5/15 Winter			
9.003	15 Winter	5	10%	1	5/15 Summer			
11.000	15 Summer	5	10%	1				
9.004	15 Winter	5	10%	1	5/15 Summer			
9.005	15 Winter	5	10%	1				
12.000	15 Summer	5	10%	1				
9.006	15 Winter	5	10%	1				
13.000	15 Summer	5	10%	1				
13.001	15 Winter	5	10%	1				
9.007	15 Winter	5	10%	1				
14.000	15 Summer	5	10%	1				
9.008	15 Winter	5	10%	1				
1.009	15 Summer	5	10%	1				
1.010	15 Winter	5	10%	1	5/15 Summer			
1.011	15 Winter	5	10%	1	5/30 Summer			

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Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
	6.001	32.403	-0.097	0.000	0.59	0.0	22.4	O K
	7.000	32.475	-0.125	0.000	0.41	0.0	16.6	O K
	6.002	32.096	-0.154	0.000	0.21	0.0	43.4	O K
	8.000	31.038	-0.162	0.000	0.18	0.0	14.4	O K
	3.006	28.544	0.134	0.000	0.71	0.0	93.5	SURCH'ED
	1.008	28.475	-0.025	0.000	0.61	0.0	185.8	O K
	9.000	29.338	-0.147	0.000	0.26	0.0	12.3	O K
	9.001	29.226	-0.059	0.000	0.66	0.0	21.1	O K
	10.000	29.201	-0.084	0.000	0.26	0.0	8.1	O K
	9.002	29.188	0.008	0.000	0.92	0.0	27.4	SURCH'ED
	9.003	29.112	0.022	0.000	0.98	0.0	31.6	SURCH'ED
	11.000	29.077	-0.148	0.000	0.26	0.0	13.6	O K
	9.004	29.010	0.030	0.000	1.34	0.0	42.2	SURCH'ED
	9.005	28.835	-0.095	0.000	0.80	0.0	51.4	O K
	12.000	28.987	-0.113	0.000	0.49	0.0	22.0	O K
	9.006	28.757	-0.093	0.000	0.76	0.0	81.7	O K
	13.000	28.941	-0.159	0.000	0.19	0.0	10.7	O K
	13.001	28.721	-0.124	0.000	0.41	0.0	19.3	O K
	9.007	28.693	-0.042	0.000	0.99	0.0	109.3	O K
	14.000	29.207	-0.193	0.000	0.05	0.0	2.8	O K
	9.008	28.494	-0.061	0.000	0.75	0.0	117.9	O K
	1.009	28.450	0.000	0.000	1.31	0.0	276.0	O K
	1.010	28.367	0.037	0.000	1.31	0.0	300.7	SURCH'ED
	1.011	28.323	0.018	0.000	1.30	0.0	299.4	SURCH'ED

Killakee House
 Belgard Square
 Tallaght Dublin 24

Indaver Duleek
 Phase 2



Date 21 February 2012 15:39
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Micro Drainage

Simulation W.11.3

Summary Wizard of "CRITICAL"(Rank 1 by Max Level)
Results for Design Storms

PN	Storm	Return Period	Climate Change	Rank	First X Surcharge	First Y Flood	First Z Overflow	O/F Act
1.012	30 Summer	5	10%	1				
1.013	60 Winter	5	10%	1				
1.014	15 Summer	5	10%	1				

Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
	1.012	28.275	0.000	0.000	1.02	0.0	279.7	O K
	1.013	27.881	-0.019	0.000	2.34	0.0	60.0	O K
	1.014	29.786	-0.064	0.000	0.98	0.0	60.0	O K

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Network Details

* - Indicates pipe has been modified outside of WinDes's Storm/Foul & Schedules

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
1.000	33.60	0.140	240.0	0.107	4.00	1	0.600	o	300
1.001	39.20	0.290	135.2	0.114	0.00	1	0.600	o	300
1.002	21.50	0.100	215.0	0.038	0.00	1	0.600	o	300
2.000	29.00	0.290	100.0	0.254	4.00	1	0.600	o	225
1.003	30.10	0.175	172.0	0.018	0.00	1	0.600	o	300
1.004	13.20	0.087	151.7	0.030	0.00	1	0.600	o	300
1.005	64.16	1.580	40.6	0.068	0.00	1	0.600	o	300
1.006	42.34	0.200	211.7	0.049	0.00	1	0.600	o	375
1.007	53.63	0.200	268.1	0.015	0.00	1	0.600	o	375
3.000	20.00	0.200	100.0	0.049	4.00	1	0.600	o	225
3.001	54.00	0.260	207.7	0.094	0.00	1	0.600	o	225
3.002	41.00	0.150	273.3	0.052	0.00	1	0.600	o	225
4.000	57.60	0.445	129.4	0.156	4.00	1	0.600	o	225
3.003	13.00	0.070	185.7	0.006	0.00	1	0.600	o	300
3.004	74.25	0.285	260.5	0.007	0.00	1	0.600	o	300
5.000	13.32	0.200	66.6	0.030	4.00	1	0.600	o	225
3.005	52.03	0.165	315.3	0.053	0.00	1	0.600	o	375

PN	USMH No.	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl No.	US/MH (mm)
1.000	S1.00	32.700	31.700	0.700	32.360	31.560	0.500		1200
1.001	S1.01	32.360	31.560	0.500	32.450	31.270	0.880		1200
1.002	S1.02	32.450	31.270	0.880	32.200	31.170	0.730		1200
2.000	S8.00	32.500	31.620	0.655	32.200	31.330	0.645		1200
1.003	S1.03	32.200	31.170	0.730	31.915	30.995	0.620		1200
1.004	S1.03a	31.915	30.267	1.348	31.850	30.180	1.370		1200
1.005	S1.04	31.850	30.180	1.370	32.415	28.600	3.515		1200
1.006	S1.05	32.415	28.525	3.515	31.950	28.325	3.250		1200
1.007	S1.06	31.950	28.325	3.250	30.750	28.125	2.250		1200
3.000	S20.00	30.150	29.315	0.610	30.300	29.115	0.960		1200
3.001	S3.00	30.300	29.115	0.960	30.300	28.855	1.220		1200
3.002	S3.01	30.300	28.855	1.220	30.250	28.705	1.320		1200
4.000	S3.01A	30.090	29.300	0.565	30.250	28.855	1.170		1200
3.003	S3.02	30.250	28.630	1.320	30.370	28.560	1.510		1200
3.004	S3.03	30.370	28.560	1.510	31.000	28.275	2.425		1200
5.000	S4.00	31.320	29.175	1.920	31.000	28.975	1.800		1200
3.005	S3.04	31.000	28.200	2.425	31.200	28.035	2.790		1200

Network Details

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
6.000	18.60	0.100	186.0	0.090	4.00	1	0.600	o	225
6.001	43.00	0.250	172.0	0.045	0.00	1	0.600	o	225
7.000	19.00	0.140	135.7	0.090	4.00	1	0.600	o	225
6.002	9.60	2.150	4.5	0.045	0.00	1	0.600	o	225
8.000	28.52	0.800	35.6	0.078	4.00	1	0.600	o	225
3.006	23.01	0.135	170.4	0.000	0.00	1	0.600	o	375
1.008	9.97	0.050	199.4	0.009	0.00	1	0.600	o	600
9.000	20.00	0.200	100.0	0.067	4.00	1	0.600	o	225
9.001	22.65	0.105	215.7	0.068	0.00	1	0.600	o	225
10.000	24.50	0.105	233.3	0.047	4.00	1	0.600	o	225
9.002	22.60	0.090	251.1	0.027	0.00	1	0.600	o	225
9.003	23.72	0.110	215.7	0.035	0.00	1	0.600	o	225
11.000	8.25	0.140	58.9	0.074	4.00	1	0.600	o	225
9.004	8.75	0.050	175.0	0.013	0.00	1	0.600	o	225

PN	USMH No.	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl No.	US/MH (mm)
6.000	S5.00	33.800	32.375	1.200	33.800	32.275	1.300		1200
6.001	S5.01	33.800	32.275	1.300	33.800	32.025	1.550		1200
7.000	S6.00	33.800	32.375	1.200	33.800	32.235	1.340		1200
6.002	S5.02	33.800	32.025	1.550	31.200	29.875	1.100		1200
8.000	S3.05a	32.850	30.975	1.650	31.200	30.175	0.800		1200
3.006	S3.05	31.200	28.035	2.790	30.750	27.900	2.475		1200
1.008	S1.07	30.750	27.900	2.250	30.510	27.850	2.060		1500
9.000	S20.01	30.150	29.260	0.665	30.275	29.060	0.990		1200
9.001	S7.00	30.275	29.060	0.990	30.325	28.955	1.145		1200
10.000	S7.00a	30.320	29.060	1.035	30.325	28.955	1.145		1200
9.002	S7.00b	30.325	28.955	1.145	30.375	28.865	1.285		1200
9.003	S7.01	30.375	28.865	1.285	30.045	28.755	1.065		1200
11.000	S9.00	30.350	29.000	1.125	30.045	28.860	0.960		1200
9.004	S7.02	30.045	28.755	1.065	30.200	28.705	1.270		1200

Network Details

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
9.005	17.57	0.080	219.6	0.070	0.00	1	0.600	o	300
12.000	3.50	0.100	35.0	0.119	4.00	1	0.600	o	225
9.006	30.70	0.115	267.0	0.116	0.00	1	0.600	o	375
13.000	17.39	0.255	68.2	0.058	4.00	1	0.600	o	225
13.001	7.43	0.110	67.5	0.059	0.00	1	0.600	o	225
9.007	50.79	0.180	282.2	0.111	0.00	1	0.600	o	375
14.000	12.30	0.200	61.5	0.015	4.00	1	0.600	o	225
9.008	14.93	0.060	248.8	0.066	0.00	1	0.600	o	450
1.009	6.00	0.020	300.0	0.000	0.00	1	0.600	o	600
1.010	7.00	0.025	280.0	0.000	0.00	1	0.600	o	600
1.011	9.60	0.030	320.0	0.000	0.00	1	0.600	o	600
1.012	32.00	0.075	426.7	0.000	0.00	1	0.600	o	600
1.013	12.00	-2.000	-6.0	0.080	0.00	1	0.600	o	300
1.014	7.00	0.050	140.0	0.000	0.00	1	0.600	o	300

PN	USMH No.	US/CL (m)	US/IL (m)	US C. Depth (m)	DS/CL (m)	DS/IL (m)	DS C. Depth (m)	Ctrl No.	US/MH (mm)
9.005	S7.03	30.200	28.630	1.270	30.290	28.550	1.440		1200
12.000	S10.00	30.300	28.875	1.200	30.290	28.775	1.290		1200
9.006	S7.04	30.290	28.475	1.440	30.300	28.360	1.565		1200
13.000	S11.00	30.325	28.875	1.225	30.400	28.620	1.555		1200
13.001	S11.01	30.400	28.620	1.555	30.300	28.510	1.565		1200
9.007	S7.05	30.300	28.360	1.565	30.530	28.180	1.975		1200
14.000	S7.06a	30.600	29.175	1.200	30.530	28.975	1.330		1200
9.008	S7.06	30.530	28.105	1.975	30.510	28.045	2.015		1350
1.009	S1.08	30.510	27.850	2.060	29.500	27.830	1.070		1500
1.010	S1.09	29.500	27.730	1.170	29.500	27.705	1.195		1500
1.011	S1.10	29.500	27.705	1.195	29.500	27.675	1.225		1500
1.012	S1.10a	29.500	27.675	1.225	29.500	27.600	1.300		1500
1.013	S1.11	29.500	27.600	1.600	30.151	29.600	0.251	5	1500
1.014	S1.12	30.151	29.550	0.301	30.200	29.500	0.400		1500

Killakee House
Belgard Square
Tallaght Dublin 24Indaver Duleek
Phase 2Date 21 February 2012 10:03
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Micro Drainage

Simulation W.11.3

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	300	S1.00	32.700	31.700	0.700	1200
1.001	o	300	S1.01	32.360	31.560	0.500	1200
1.002	o	300	S1.02	32.450	31.270	0.880	1200
2.000	o	225	S8.00	32.500	31.620	0.655	1200
1.003	o	300	S1.03	32.200	31.170	0.730	1200
1.004	o	300	S1.03a	31.915	30.267	1.348	1200
1.005	o	300	S1.04	31.850	30.180	1.370	1200
1.006	o	375	S1.05	32.415	28.525	3.515	1200
1.007	o	375	S1.06	31.950	28.325	3.250	1200
3.000	o	225	S20.00	30.150	29.315	0.610	1200
3.001	o	225	S3.00	30.300	29.115	0.960	1200
3.002	o	225	S3.01	30.300	28.855	1.220	1200
4.000	o	225	S3.01A	30.090	29.000	0.565	1200
3.003	o	300	S3.02	30.250	28.630	1.320	1200
3.004	o	300	S3.03	30.300	28.560	1.510	1200
5.000	o	225	S4.00	32.020	29.175	1.920	1200

Downstream Manhole

PN	Length (m)	Slope (1:x)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	33.60	240.0	S1.01	32.360	31.560	0.500	1200
1.001	39.20	135.2	S1.02	32.450	31.270	0.880	1200
1.002	21.50	215.0	S1.03	32.200	31.170	0.730	1200
2.000	29.00	100.0	S1.03	32.200	31.330	0.645	1200
1.003	30.10	172.0	S1.03a	31.915	30.995	0.620	1200
1.004	13.20	151.7	S1.04	31.850	30.180	1.370	1200
1.005	64.16	40.6	S1.05	32.415	28.600	3.515	1200
1.006	42.34	211.7	S1.06	31.950	28.325	3.250	1200
1.007	53.63	268.1	S1.07	30.750	28.125	2.250	1500
3.000	20.00	100.0	S3.00	30.300	29.115	0.960	1200
3.001	54.00	207.7	S3.01	30.300	28.855	1.220	1200
3.002	41.00	273.3	S3.02	30.250	28.705	1.320	1200
4.000	57.60	129.4	S3.02	30.250	28.855	1.170	1200
3.003	13.00	185.7	S3.03	30.370	28.560	1.510	1200
3.004	74.25	260.5	S3.04	31.000	28.275	2.425	1200
5.000	13.32	66.6	S3.04	31.000	28.975	1.800	1200

Killakee House
Belgard Square
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PIPELINE SCHEDULESUpstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
3.005	o	375	S3.04	31.000	28.200	2.425	1200
6.000	o	225	S5.00	33.800	32.375	1.200	1200
6.001	o	225	S5.01	33.800	32.275	1.300	1200
7.000	o	225	S6.00	33.800	32.375	1.200	1200
6.002	o	225	S5.02	33.800	32.025	1.550	1200
8.000	o	225	S3.05a	32.850	30.975	1.650	1200
3.006	o	375	S3.05	31.200	28.035	2.790	1200
1.008	o	600	S1.07	30.750	27.900	2.250	1500
9.000	o	225	S20.01	30.150	29.260	0.665	1200
9.001	o	225	S7.00	30.275	29.060	0.990	1200
10.000	o	225	S7.00a	30.320	29.060	1.035	1200
9.002	o	225	S7.00b	30.325	28.955	1.145	1200
9.003	o	225	S7.01	30.75	28.865	1.285	1200

Downstream Manhole

PN	Length (m)	Slope (1:x)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
3.005	52.03	315.3	S3.05	31.200	28.035	2.790	1200
6.000	18.60	186.0	S5.01	33.800	32.275	1.300	1200
6.001	43.00	172.0	S5.02	33.800	32.025	1.550	1200
7.000	19.00	135.7	S5.02	33.800	32.235	1.340	1200
6.002	9.60	4.5	S3.05	31.200	29.875	1.100	1200
8.000	28.52	35.6	S3.05	31.200	30.175	0.800	1200
3.006	23.01	170.4	S1.07	30.750	27.900	2.475	1500
1.008	9.97	199.4	S1.08	30.510	27.850	2.060	1500
9.000	20.00	100.0	S7.00	30.275	29.060	0.990	1200
9.001	22.65	215.7	S7.00b	30.325	28.955	1.145	1200
10.000	24.50	233.3	S7.00b	30.325	28.955	1.145	1200
9.002	22.60	251.1	S7.01	30.375	28.865	1.285	1200
9.003	23.72	215.7	S7.02	30.045	28.755	1.065	1200

Killakee House
Belgard Square
Tallaght Dublin 24Indaver Duleek
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PIPELINE SCHEDULESUpstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
11.000	o	225	S9.00	30.350	29.000	1.125	1200
9.004	o	225	S7.02	30.045	28.755	1.065	1200
9.005	o	300	S7.03	30.200	28.630	1.270	1200
12.000	o	225	S10.00	30.300	28.875	1.200	1200
9.006	o	375	S7.04	30.290	28.475	1.440	1200
13.000	o	225	S11.00	30.325	28.875	1.225	1200
13.001	o	225	S11.01	30.400	28.620	1.555	1200
9.007	o	375	S7.05	30.300	28.360	1.565	1200
14.000	o	225	S7.06a	30.600	29.175	1.200	1200
9.008	o	450	S7.06	30.530	28.105	1.975	1350
1.009	o	600	S1.08	30.510	27.850	2.060	1500
1.010	o	600	S1.09	29.500	27.730	1.170	1500
1.011	o	600	S1.10	29.500	27.705	1.195	1500
1.012	o	600	S1.10a	29.500	27.675	1.225	1500
1.013	o	300	S1.11	29.500	27.600	1.600	1500

Downstream Manhole

PN	Length (m)	Slope (1:x)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
11.000	8.25	58.9	S7.02	30.045	28.860	0.960	1200
9.004	8.75	175.0	S7.03	30.200	28.705	1.270	1200
9.005	17.57	219.6	S7.04	30.290	28.550	1.440	1200
12.000	3.50	35.0	S7.04	30.290	28.775	1.290	1200
9.006	30.70	267.0	S7.05	30.300	28.360	1.565	1200
13.000	17.39	68.2	S11.01	30.400	28.620	1.555	1200
13.001	7.43	67.5	S7.05	30.300	28.510	1.565	1200
9.007	50.79	282.2	S7.06	30.530	28.180	1.975	1350
14.000	12.30	61.5	S7.06	30.530	28.975	1.330	1350
9.008	14.93	248.8	S1.08	30.510	28.045	2.015	1500
1.009	6.00	300.0	S1.09	29.500	27.830	1.070	1500
1.010	7.00	280.0	S1.10	29.500	27.705	1.195	1500
1.011	9.60	320.0	S1.10a	29.500	27.675	1.225	1500
1.012	32.00	426.7	S1.11	29.500	27.600	1.300	1500
1.013	12.00	-6.0	S1.12	30.151	29.600	0.251	1500

Killakee House
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Tallaght Dublin 24Indaver Duleek
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PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.014	o	300	S1.12	30.151	29.550	0.301	1500

Downstream Manhole

PN	Length (m)	Slope (1:x)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.014	7.00	140.0	S1.13	30.200	29.500	0.400	1500

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Summary Wizard of "CRITICAL"(Rank 1 by Max Level)
Results for Design Storms

Margin for Flood Risk warning (mm) 300 Inertia Status OFF
DTS Status ON Analysis Time Step Fine
DVD Status OFF

Profile(s) Summer and Winter
 15, 30, 60, 120, 240, 360, 480, 960,
Duration(s) (mins) 1440, 2160, 2880, 4320, 5760, 7200,
 8640, 10080
Return Period(s) (years) 5
Climate Change (%) 10

PN	Storm	Return Period	Climate Change	Rank	First X Surcharge	First Y Flood	First Z Overflow	O/F Act
1.000	15 Summer	5	10%	1				
1.001	15 Winter	5	10%	1				
1.002	15 Winter	5	10%	1				
2.000	15 Summer	5	10%	1				
1.003	15 Winter	5	10%	1				
1.004	15 Winter	5	10%	1				
1.005	15 Winter	5	10%	1				
1.006	15 Winter	5	10%	1				
1.007	15 Winter	5	10%	1				
3.000	15 Summer	5	10%	1				
3.001	15 Winter	5	10%	1				
3.002	15 Winter	5	10%	1				
4.000	15 Summer	5	10%	1				
3.003	15 Winter	5	10%	1				
3.004	15 Winter	5	10%	1				
5.000	15 Summer	5	10%	1				
3.005	15 Winter	5	10%	1				5/15 Summer
6.000	15 Summer	5	10%	1				

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Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
	1.000	31.812	-0.188	0.000	0.29	0.0	19.2	O K
	1.001	31.693	-0.167	0.000	0.40	0.0	35.3	O K
	1.002	31.509	-0.061	0.000	0.61	0.0	40.6	O K
	2.000	31.795	-0.050	0.000	0.94	0.0	45.7	O K
	1.003	31.470	0.000	0.000	1.02	0.0	78.1	O K
	1.004	30.575	0.008	0.000	1.11	0.0	81.8	SURCH'ED
	1.005	30.339	-0.141	0.000	0.54	0.0	90.2	O K
	1.006	28.774	-0.126	0.000	0.77	0.0	96.0	O K
	1.007	28.618	-0.082	0.000	0.84	0.0	94.5	O K
	3.000	29.381	-0.159	0.000	0.19	0.0	9.0	O K
	3.001	29.249	-0.091	0.000	0.62	0.0	21.5	O K
	3.002	29.030	-0.050	0.000	0.93	0.0	27.5	O K
	4.000	29.433	-0.092	0.000	0.65	0.0	28.6	O K
	3.003	28.857	-0.073	0.000	0.78	0.0	51.5	O K
	3.004	28.820	-0.040	0.000	0.90	0.0	59.4	O K
	5.000	29.222	-0.178	0.000	0.10	0.0	5.5	O K
	3.005	28.607	0.032	0.000	0.61	0.0	64.0	SURCH'ED
	6.000	32.485	-0.115	0.000	0.48	0.0	16.5	O K

Summary Wizard of "CRITICAL"(Rank 1 by Max Level)
Results for Design Storms

PN	Storm	Return Period	Climate Change	Rank	First X Surcharge	First Y Flood	First Z Overflow	O/F Act
6.001	15 Winter	5	10%	1				
7.000	15 Summer	5	10%	1				
6.002	15 Summer	5	10%	1				
8.000	15 Summer	5	10%	1				
3.006	30 Winter	5	10%	1	5/15 Summer			
1.008	15 Winter	5	10%	1				
9.000	15 Summer	5	10%	1				
9.001	15 Winter	5	10%	1				
10.000	15 Winter	5	10%	1				
9.002	15 Winter	5	10%	1	5/15 Winter			
9.003	15 Winter	5	10%	1	5/15 Summer			
11.000	15 Summer	5	10%	1				
9.004	15 Winter	5	10%	1	5/15 Summer			
9.005	15 Winter	5	10%	1				
12.000	15 Summer	5	10%	1				
9.006	15 Winter	5	10%	1				
13.000	15 Summer	5	10%	1				
13.001	15 Winter	5	10%	1				
9.007	15 Winter	5	10%	1				
14.000	15 Summer	5	10%	1				
9.008	15 Winter	5	10%	1				
1.009	15 Summer	5	10%	1				
1.010	15 Winter	5	10%	1	5/15 Summer			
1.011	15 Winter	5	10%	1	5/30 Summer			

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Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
	6.001	32.403	-0.097	0.000	0.59	0.0	22.4	O K
	7.000	32.475	-0.125	0.000	0.41	0.0	16.6	O K
	6.002	32.096	-0.154	0.000	0.21	0.0	43.4	O K
	8.000	31.038	-0.162	0.000	0.18	0.0	14.4	O K
	3.006	28.544	0.134	0.000	0.71	0.0	93.5	SURCH'ED
	1.008	28.475	-0.025	0.000	0.61	0.0	185.8	O K
	9.000	29.338	-0.147	0.000	0.26	0.0	12.3	O K
	9.001	29.226	-0.059	0.000	0.66	0.0	21.1	O K
	10.000	29.201	-0.084	0.000	0.26	0.0	8.1	O K
	9.002	29.188	0.008	0.000	0.92	0.0	27.4	SURCH'ED
	9.003	29.112	0.022	0.000	0.98	0.0	31.6	SURCH'ED
	11.000	29.077	-0.148	0.000	0.26	0.0	13.6	O K
	9.004	29.010	0.030	0.000	1.34	0.0	42.2	SURCH'ED
	9.005	28.835	-0.095	0.000	0.80	0.0	51.4	O K
	12.000	28.987	-0.113	0.000	0.49	0.0	22.0	O K
	9.006	28.757	-0.093	0.000	0.76	0.0	81.7	O K
	13.000	28.941	-0.159	0.000	0.19	0.0	10.7	O K
	13.001	28.721	-0.124	0.000	0.41	0.0	19.3	O K
	9.007	28.693	-0.042	0.000	0.99	0.0	109.3	O K
	14.000	29.207	-0.193	0.000	0.05	0.0	2.8	O K
	9.008	28.494	-0.061	0.000	0.75	0.0	117.9	O K
	1.009	28.450	0.000	0.000	1.31	0.0	276.0	O K
	1.010	28.367	0.037	0.000	1.31	0.0	300.7	SURCH'ED
	1.011	28.323	0.018	0.000	1.30	0.0	299.4	SURCH'ED

Killakee House
 Belgard Square
 Tallaght Dublin 24

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 Phase 2



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Summary Wizard of "CRITICAL"(Rank 1 by Max Level)
Results for Design Storms

PN	Storm	Return Period	Climate Change	Rank	First X Surcharge	First Y Flood	First Z Overflow	O/F Act
1.012	30 Summer	5	10%	1				
1.013	60 Winter	5	10%	1				
1.014	15 Summer	5	10%	1				

Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m ³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
	1.012	28.275	0.000	0.000	1.02	0.0	279.7	O K
	1.013	27.881	-0.019	0.000	2.34	0.0	60.0	O K
	1.014	29.786	-0.064	0.000	0.98	0.0	60.0	O K

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Appendix 11.3

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Indaver Meath Waste-to-Energy Facility

FIRE WATER RISK MANAGEMENT PROGRAMME

(Prepared in Compliance with Condition 3.7 of Waste Licence

Register No. W 0167-02)

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1 INTRODUCTION

At the request of Indaver Ireland, this report sets the Firewater Risk Management Programme for the Meath Waste-to-Energy (WtE) facility at Carranstown, Duleek, Co. Meath, which was prepared in accordance with Indaver's Waste Licence (Reg. No. W0167-02). Condition 3.7 of the Licence states the following:

3.7.1 - The licensee shall, to the satisfaction of the Agency, establish and maintain a suitable firewater risk management programme. The risk management programme shall be fully implemented in advance of acceptance of waste at the facility.

3.7.2 - In the event of a fire or spillage to storm water, the site storm water shall be diverted to suitable containment. The licensee shall have regard to any guidelines issued by the Agency with regard to firewater retention.

This report builds on Indaver's Fire Water Risk Assessment Report – Ref: PMG-MEATH-HSE-REP-000-1505 and the site's Emergency Response Procedure (ERP).

2 SITE DESCRIPTION

The Meath WtE Facility is situated on the R152 Drogheda to Duleek road and is located in the townland of Carranstown, approximately 3 km north east of Duleek in Co. Meath. The facility consists of a 70 Megawatt (MW) WtE plant for the acceptance of up to 200,000 tonnes per annum (tpa) of household, commercial and industrial non-hazardous waste.

On completion of the construction works, the facility will comprise of the following main elements:

- The main process building (comprising of tipping hall, waste bunker, furnace boiler, steam turbine, flue gas treatment and ash storage)
- An air cooled condensers building
- A contractors' compound / building with workshop
- A transformer compound and ESB substation with emergency generator
- A security building with weighbridge at facility entrance
- A water storage tank and pump house
- A surface water attenuation pond and fire water retention tank

When waste treatment operations commence, waste will be transported to the site on a daily basis by waste contractors. On entering the site, waste contractors will follow a two-way route to the tipping hall where inspections on the waste will be conducted by Indaver on a routine basis. In the tipping hall, waste will be deposited into the waste bunker where it will be mixed by the grab before being placed in the hopper that feeds the furnace. In the furnace, the waste will be incinerated at temperatures in excess of 850°C. The ash collected from the bottom of the furnace will pass through a wet bath before being stored for collection and removal from the site. The combustion gases from the incineration process will pass through a number of treatment stages. These

include two stages of dosing (lime milk and lime) for acid removal and two stages of dosing (expanded clay and activated carbon) for dioxin removal, before passing through filter bags and being discharged to atmosphere via the stack. The emissions to air will be monitored continuously and the results will be fed back to the control room for the facility where the levels of dosing can be adjusted accordingly.

The fire scenarios that are included in this programme were identified on the basis of the potentially hazardous materials and/or operating conditions at the site.

2.1 Hazards

The facility will be used for the treatment of household, commercial and non-hazardous industrial waste, sewage sludges and industrial sludges. Although they are not classed as hazardous, there is a potential fire risk due to the combustible nature of the waste stream. However this risk is mitigated to some extent as the waste has a high moisture content and a slow natural burn rate. Further risk mitigation is provided by good operating practices and by the provision of fire fighting equipment at the site.

The wastes do not fit into any of the categories of potentially environmentally damaging materials identified in the EPA's guidance document on the storage and transfer of materials for scheduled activities¹.

- They are not included in the list of Priority Substances established under the Water Framework Directive (2000/60/EC);
- They are not classed as Dangerous for the Environment;
- They do not exhibit any of the toxicological properties identified in the guidance document;
- They are not classified under the German WGK system (water hazard classification system).

However, as the EPA's guidance document notes, substances may exhibit low toxicity or be non-hazardous to waters yet elicit a pollution response due to their Biological Oxygen Demand (BOD). As such, Indaver provided firewater retention facilities in order to protect against any potential damage from contaminated run-off.

Other hazards considered as part of this study include the potential sources of fires involving combustible materials stored on site and other materials which may adversely affect water quality if released in firewater run-off from the site.

2.2 Fire Safety Management Systems

2.2.1 Fire Prevention

The facility has been designed in accordance with internationally recognised health and safety standards, design codes, legislation, good practice and experience. The

¹ EPA IPC Guidance Note on Storage and Transfer of Materials for Scheduled Activities (2004)

facility is provided with manual and automatic controls, and there is a comprehensive interlock system in place which can automatically shut down the plant in a safe manner in the event of equipment failure or dangerous situations arising. In addition, the facility will operate a permit-to-work system (including hot work permits) for all maintenance work, which could give rise to the potential for fire and all contractors on site will undergo induction safety training.

2.2.2 Fire Detection

In addition to the controls to reduce the risk of a fire occurring in the first place, Indaver have also installed a fire detection / alarm system throughout the site. The devices on the system include:

- Optical smoke detectors, heat detectors and UV/IR flame detectors located throughout the plant;
- VESDA aspirating smoke detectors in MCC Room cabinets, VSD room, technical galleries and turbine hall;
- CCTV monitoring of key process operations (hopper /bunker);
- Fire alarm break glass units located throughout the plant;
- Local alarms in individual areas and site wide klaxon evacuation alarm;
- Master fire alarm panel located in MCC room and boiler area and a Repeater Panel located in the Control Room.

These systems would assist Indaver in developing a rapid response to any fire scenario, which can help to bring a fire under control more quickly, thereby reducing the quantities of fire fighting water required.

2.2.3 Fire Protection

The facility has been designed in accordance with internationally recognised health and safety standards, design codes, legislation, good practice and experience. Fire protection measures include fire doors with a minimum rating of one hour located through the facility and fire walls (locations shown in Figure 1) providing two hour fire protection with the exception of the viewing platform glazing between the Waste Bunker and the Administration Building control room, which will provide one hour protection.

2.2.4 Fire Suppression

Fire suppression is provided by an on-site water storage tank of 2,185 m³ capacity. This water can be distributed around the site via a 250 mm diameter fire main and hydrant system. Of this capacity, 1,855 m³ is set aside for fire fighting purposes, while the remaining volume is provided for process water requirements. However in the event of a fire, the process water requirement will not be needed and so potentially up to 2,185 m³ could be available for fire-fighting purposes.

The firewater pump house is equipped with three diesel pumps (two duty and one standby), and an electrical jockey pump to maintain the pressure in the line. These pumps can distribute water around the mains at a flow rate of 900 m³ per hour. For fires inside the process building, the internal fire main has fixed hose reels, water cannons, sprinkler heads and foam deluge systems. For fires in outdoor areas, the external fire main has a network of hydrants.

The mains system delivers firewater to the following systems:

- Fire hydrants and fixed hose reels, located throughout the site;
- Automatic/manual dry and wet sprinkler systems (see Table 1 for more details);
- Automatic/manual foam deluge systems (see Table 1 for more details);
- Four water cannons in the Bunker Area.

A breakdown of the sprinkler systems at the site is provided in Table 1.

Table 1: Summary of Sprinkler Systems at Indaver

Area	Design Density	Design Area	System Type	Rate (l/min)
Shredder Unit	8 mm/min/m ²	45 m ²	Deluge system	360
Tipping Hall Waste Laydown Area	32 mm/min/m ²	165 m ²	Dry sprinkler	5,280
Sprinkler Pump House	8.1 mm/min/m ²	157 m ²	Wet sprinkler	1,223
Turbine Hall	8 mm/min/m ²	70 m ²	Deluge	560
Turbine Cellar	8 mm/min/m ²	23 m ²	Foam system	984
VSD Room*	n.a.	n.a.	Gaseous suppression	n.a.
Feeding Hopper	32 mm/min/m ²	60 m ²	Deluge	1,920
Crane Laydown Room	32 mm/min/m ²	330 m ²	Dry sprinkler	10,560
Burner x 2	8mm/min/m ²	6m ²	Wet	48
Cannons x 4		-	-	2,500

*The sprinkler system at the Variable Speed Drive (VSD) Room is a gaseous suppression system and so there is no firewater implications associated with its use.

Sprinkler systems provide the advantage that they allow water to be applied directly to the fire, allowing extinguishment to be achieved with lower flow rates than would be required using mobile systems, e.g. application from a fire tender. This means that smaller quantities of fire fighting water runoff would be generated for fires in these areas.

Indaver also maintain a stock of AFFF foam in a 1.5 m³ foam tank, which feeds the foam deluge system.

For fires in the Bunker Area, there are four cannons in place, each capable of applying water at a rate of 2,500 l/min. In the event of a fire in this area, up to two cannons could be deployed.

For fires in outdoor areas, water would be applied by connecting to the network of hydrants on the external mains.

The layout of these facilities is illustrated in Figure 1.

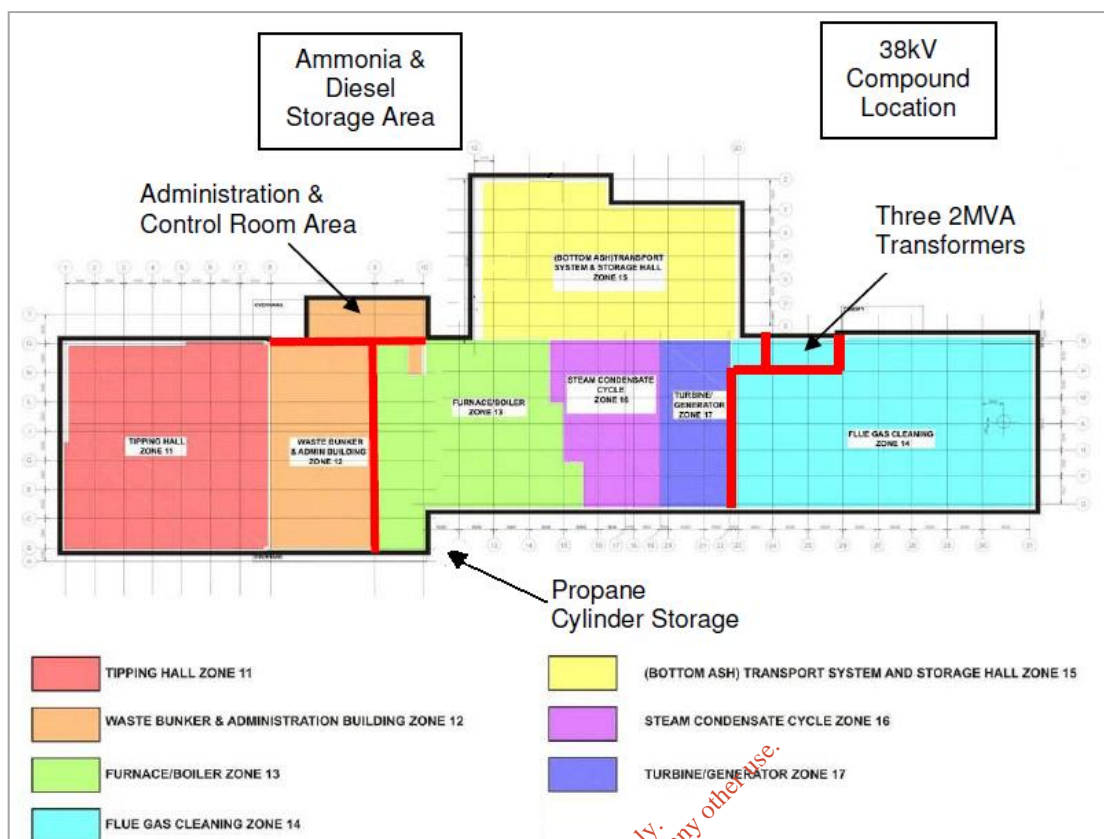


Figure 1: Indaver Ireland Facility Layout (Firewalls highlighted in red)

2.3 Drainage System

The site's outdoor surface drainage system has been designed in general accordance with Sustainable Drainage Systems (SuDS) principles. The system collects all rainwater from roofs, hardstanding areas, roads etc. and routes it to:

- A Class I bypass petrol interceptor, designed to retain oil/hydrocarbons present in the surface water runoff;
- A continuous online monitoring chamber (TOC, pH and conductivity) with diversion valve located between the interceptor and the surface water attenuation pond;
- A surface water attenuation pond with a capacity of 1,600 m³;
- Another continuous online monitoring chamber (TOC, pH and conductivity), this one on the outfall from the attenuation pond;
- Local surface water drainage network and River Nanny.

The pre-attenuation pond monitoring chamber would divert any contaminated run-off to an underground diverted fire water retention tank with a capacity of 300 m³. Should this tank be filled, the monitoring chamber would go into overflow mode, allowing runoff to pass into the attenuation pond.

The post-attenuation pond monitoring chamber would shut off the discharge pumps from the pond if contamination is detected in the outfall.

In addition, the delivery area for the ammonia solution and diesel storage area drains to a 10,000 litre forecourt separator before joining the surface water drainage system upstream of the petrol interceptor. There is also a diversion valve located before the separator which leads to a 2.5m³ holding tank to be used during filling operations in delivery area which will prevent small spills entering the surface water system. This will be included as part of the written procedure for these filling operations. After filling is successfully completed the diversion valve will remain open to the separator.

The internal surface drainage in the process building all drains to the 2 × 50 m³ recovery tanks and is discussed in detail in Section 4.2.

3 DESCRIPTION OF METHODOLOGY

3.1 Review of Firewater Scenarios

The first step in the Fire Water Risk Management Programme is to identify the scenarios which can result in large quantities of fire fighting water being generated. The specific fire fighting scenarios are discussed in Section 4.1 of this report, but from a firewater retention viewpoint they can be broken down into the following categories:

- Fires in the Bunker Area
- Fires in Turbine Area
- Fires at the three 2MVA Transformers inside Process Building
- Fires in other locations inside Process Building
- Fires in outdoors location

In the first instances, any fire-fighting water would be collected in the Bunker itself, which is designed as a watertight structure, in accordance with BS8007, “Design of Aqueous Liquid Retaining Concrete Structures”.

For fires in the Turbine area, any fire-fighting water would be retained within the cellar beneath the turbine which is also designed as a watertight structure, in accordance with BS8007.

For fires at the three 2MVA Transformers, fires would be either allowed to burn down or fought using CO₂/powder extinguishers.

For any other fire scenarios inside the Process Building, the fire water run-off would be collected in dedicated Recovery tanks (designed as a watertight structure, in accordance with BS8007), with any overflow leading to the external surface water drainage network.

For fires in outdoor areas, the fire water run-off would be collected in the surface water drainage system.

These drainage / catchment systems are described in more detail in the following section.

3.2 Firewater Catchment Systems

As discussed in Section 2.3, there are arrangements in place to prevent contaminated surface water run-off from being discharged off site. However, for fires inside the process building, there are separate provisions to retain the fire-fighting water, rather than allowing it to run-off to the surface water drains.

The greatest potential for fire at the facility arises within the waste bunker, where localised heating could occur due to decomposition of organic material in the waste. The bunker is water-tight (BS8007) and, up to the level of the tipping hall, it has a capacity of c.5,670 m³. If a 50% voidage ratio is assumed for the waste, then there would be a retention capacity of 2,835 m³ within the bunker. This is greater than the total quantity of fire-fighting water available on site, and so for a fire in this area all water would be retained within the bunker, even in the most extreme fire event. All firewater used in the Tipping Hall also drains to the waste bunker.

If a fire occurred in the Turbine area, the fire-fighting water would be collected in the cellar beneath the turbine. The cellar is of water-tight construction (BS8007 - Code of practice for design of concrete structures for retaining aqueous liquids), and has the capacity to retain c.1,000 m³ of water.

If a fire occurred elsewhere in the process building, the firewater run-off would drain to the 2 × 50 m³ recovery tanks.

For any scenarios outside of the process building, the fire-fighting water would be collected in the surface water drainage system, which incorporates a 300 m³ diverted fire water retention tank (designed as a watertight structure, in accordance with BS8007) and a 1,600 m³ surface water attenuation pond (described in Section 2.4). In addition, there is additional storage provided for runoff from the diesel delivery area with the forecourt separator providing up to 10 m³ of additional storage.

3.3 Environmental Receptors

The main environmental receptor for firewater run-off from the site would be the River Nanny.

An ecological survey, carried out as part of the EIS, found that no parts of the site or in the immediate surroundings are covered by a scientific or conservation designation or proposed designation as recognised by the National Parks and Wildlife Service (NPWS). The survey identified that there were four such designated sites within approximately 5 km of the site and these are listed below:

- Duleek Commons (pNHA)
- Thomastown Bog
- Boyne River Island

- Dowth Wetland

These are described in more detail in the EIS. None of these areas would be exposed to any risk due to firewater run-off from the site. However, the EIS also noted that the River Nanny reaches the Irish Sea at Laytown, where the estuary is a pNHA and a pSAC (site code: 000554, Laytown Dunes / Nanny Estuary). However, as the site is at a distance of c.10 km from the coast, if any firewater did enter the river, any contamination would be diluted to insignificant levels long before it reached the estuary.

Another potential receptor for contaminated firewater run-off would be groundwater. The limestones found beneath the site are part of the Platin Formation which has been classified by the GSI as a regionally important, diffuse karst aquifer with good development potential. The GSI/EPA/DoEHLG Groundwater Protection Scheme Classification ranks the site as having a moderate vulnerability due to the thickness and type of overburden cover present at the site. However there are no pathways by which contaminated firewater would enter the groundwater. Any fire-fighting water applied inside the process area would be retained there, while any fire-fighting water applied outdoors would be collected and retained in the surface water drainage system.

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4 RISK MANAGEMENT PROGRAMME

4.1 Fire Scenarios

The fire scenarios identified during the risk assessment conducted by Indaver are summarised in Table 2. For reference, we include details of the environmental fate of any firewater applied in these scenarios.

Table 2: Fire Scenarios at Indaver

Scenario	Corresponding Retention / Drainage System
Fire in Diesel Tank unloading area	Water applied in outdoor locations would be collected in the surface water drainage system
Ignition of Activated Carbon	Water applied in the Flue Gas Cleaning area would be collected in the Recovery Tanks
Fire in proposed Shredder Unit	Water applied in Tipping Hall area would be collected in the Waste Bunker
Waste truck fire in Tipping Hall	Water applied in Tipping Hall area would be collected in the Waste Bunker
Fire in Bunker	Water applied to the Bunker would also be retained within the Bunker
Fire in Feed Hopper	Water applied to the Bunker would also be retained within the Bunker
Fire in Furnace / Boiler Area	Water applied in this area would be collected in the Recovery Tanks
Fire in Turbine Area	Water applied in the Turbine area would be collected in the Cellar
Fire in Bag House Filter	Water applied in the Flue Gas Cleaning area would be collected in the Recovery Tanks
Fire in Variable Speed Drive (VSD) Room	Gaseous suppression system in this area – no firewater runoff implications
Fire in 2 MVA Transformers	CO2 and Powder fire extinguishers in areas – no firewater runoff implications
Fire in Office and/or Administration areas	Water applied in this area would be collected in the Recovery Tanks

4.2 Fire Fighting & Fire Water Retention Systems

4.2.1 Fire in Bunker Area (including Tipping Hall)

For a fire within the main bunker, water would be applied using $2 \times 2,500$ l/min water cannons. A typical fire-fighting scenario would involve application of water for 10 – 30 mins, however it is conservatively assumed that each scenario could potentially last for up to 2 hours. With a total available fire-fighting water stock of between $1,855 \text{ m}^3$ and $2,185 \text{ m}^3$, there is the capacity to continue fire-fighting beyond this time, and water could be applied to the bunker for c.6 hours in an extreme case. Even if the full inventory of water available on site was applied to combat a fire in this area, the bunker would have the capacity to store $2,835 \text{ m}^3$ of water even if it was full of

waste, which means that it has more than sufficient capacity to retain the full volume of water that could be applied in any scenario.

Part of the bunker area is also protected by fixed sprinkler systems, as shown in Table 1. In these cases the water application rate would be comparable to or less than the amount of water that would be applied using the water cannons. Again, even if all the water on site was applied to the bunker as part of the emergency response, there would be sufficient capacity in the Bunker to retain it all.

4.2.2 Fire in Turbine Area

The fire-fighting measures in the Turbine Area are provided by fixed sprinkler systems, as described in Table 1. There are two such systems, one to apply water at the Turbine Hall (which covers the turbine bearing, valves, flanges etc.), and one to apply water to equipment in the Turbine Cellar (including the lube oil tank and pipe rack).

Based on the figures in Table 1, the Turbine Hall sprinkler system would apply water at a flow rate of 560 litres per minute, while the Turbine Cellar sprinkler system would apply foam at a flow rate of 984 litres per minute.

For a conservative fire fighting scenario of 2 hours (a typical fire-fighting scenario is estimated to only last 30mins, as explained above), this means that a total volume of up to 67 m³ of water would be applied using the Turbine Hall sprinkler system, which is significantly less than the capacity of the Cellar. Even if the fire was to continue beyond this duration, it would take c. 30 hours of continuous water application using these sprinklers to fill the Cellar to capacity. As such it is not credible that these sprinklers would be deployed for this length of time. As such there is no run-off risk association with these scenarios.

The sprinkler system in the Turbine cellar is a foam-based system. AFFF foam is stored in a 1.5 m³ tank to supply foam to the deluge system. This foam is mixed with water in a ratio of 97:3 to give a 3% foam solution. This means that a stock of 1.5 m³ of foam can be used to generate up to 48.5 m³ of foam/water solution. AFFF is categorised as a Low-Expansion foam and has an expansion ratio of less than 20:1. This means that the maximum volume of expanded foam solution that could be applied within the cellar is less than 970 m³, assuming that the full inventory of foam was applied in this area. This volume is less than the capacity of the cellar and so there would be no firewater or foam run-off from this scenario.

4.2.3 Fire at the 2MVA Transformers

There are three 2MVA transformers located adjacent to the Flue Gas Cleaning area (as shown in Figure 1). These transformers are each partitioned from the Flue Gas Cleaning area and from each other by 2-hour fire walls. Each transformer contains 635 kg of transformer oil (PCB free) and is separately banded. The transformer oil is combustible but is isolated from ignition sources by proven design. In the event of a fire in a transformer the Control Room will initiate electrical disconnection/isolation of transformer and a decision will be made on whether to tackle the fire or allow fire

to burn out. CO₂ and powder fire extinguishers in the area can be used to fight the fire so there would be no firewater or foam run-off from this scenario.

4.2.4 Fire in Flue Gas Cleaning Area and Other Process Areas

For fires in the flue gas cleaning area and other process areas, the fire-fighting water would be applied by the fixed sprinkler systems, described in Table 1. The water would then be collected in the 2 × 50 m³ recovery tanks.

The two Recovery tanks have a total combined capacity of 100 m³. Water from floor washing *etc.* will also drain to these tanks, but Indaver will ensure that the water level in these tanks is kept to a minimal level. At all times one tank will be empty, and the other will be filled to no more than 25% capacity. This means that in the event of a fire in this area the actual available capacity in these tanks will be at least 87.5 m³. If a major scenario occurred which resulted in greater quantities of water being applied than could be retained in these tanks, then any overflow would be directed to the surface water drainage system where it can be contained.

4.2.5 Fire Outside the Main Process Building Area (including the Contractors Compound)

A fire in the contractors compound, 38kV compound & generator, diesel storage area or other outdoor areas, would be fought using hose reels and hydrants connected to the outdoor firewater ring main and, potentially, local fire brigade equipment. There will also be fire fighting equipment, such as hand held fire extinguishers, located in the contractors building.

All fire water generated from hardstanding areas on the site will be collected in the surface drainage system which passes through a Class 1 by-pass petrol interceptor (designed for a min. 1 in 100 year storm) before entering the surface water attenuation pond or, in the case of an emergency, the firewater retention tank. The monitoring points in the surface water drainage system are located after the petrol interceptor and at the outfall pump sump from the site where runoff is released to the hydrobrake leading to the drainage ditch beside the site. The monitoring points are automated and monitor Total Organic Carbon (TOC), conductivity and pH in the surface water.

If, after passing through the petrol interceptor, the surface water TOC is outside the set parameters, the diversion valve will close and redirect the surface water runoff to the firewater retention tank where it can be stored and tested for reuse in the flue gas cleaning process or removed from site for treatment or disposal by an appropriately licensed facility. The outfall pump for delivering the water from the surface water attenuation pond to the drainage ditch can also be de-activated remotely from the control room if the fire alarm is triggered.

The firewater retention tank has a capacity of 300 m³. Should the capacity of this tank be reached, the system will automatically overflow to the surface water attenuation pond (capacity of 1,600 m³) and can be contained there until testing on the water quality has been carried out. Meath County Council and the EPA were consulted on the proposed design of the continuous monitoring and discharge system as part of the planning and licensing process for the site.

The drainage channel in the ammonia solution and diesel tank delivery area runs to a 10,000 litre forecourt separator where spills can be contained. When the capacity of the separator is reached, the flow will enter the surface water drainage system upstream of the petrol interceptor. As previously described, the 2.5m³ holding tank will only be utilised during filling operations at the tanks.

Another potential fire scenario could arise in the event of a grassland fire in the surrounding area. In this case the response at Indaver would be to assess the scale of the fire and, if necessary, apply protective cooling water to items of plant or equipment judged to be in danger of overheating. In this case there is no contamination issue associated with the water used, as there is no loss of containment event on site. Even so any cooling water applied in this scenario would still be retained in the site drainage system.

4.3 Risk Assessment

4.3.1 Fires inside Process Buildings

Based on this analysis, many of the fire scenarios identified present no inherent environmental risk from firewater run-off. For any fires in the bunker area or in the turbine area, the capacity within the building would be more than sufficient to retain all fire-fighting water that could be applied. For scenarios in other locations inside the process building, any fire-fighting water would be collected in the Recovery tanks provided. If the Recovery tanks reach their capacity, the firewater will enter the surface water drainage network, where it will be contained (see section 4.3.2).

4.3.2 Fires at Outdoor Locations

For fires at outdoor locations, the capacity of the drainage system is more than sufficient to accommodate the volumes of water that would be applied and so there would be no environmental risk due to run-off from these fire scenarios under normal conditions.

However, the EPA guidance document on firewater retention advises that consideration should also be given to the amount of rainfall that could be collected in the retention system. This is not applicable for the scenarios in which the firewater would be retained within the building (in the Bunker, Cellar or Recovery Tanks), but it is relevant for those scenarios where the surface water drainage system is required to provide retention. The EPA's guidance on this matter is to allow for 50 mm rainfall or, if the figure is significantly different, to allow for the 20-year, 24-hour rainfall event.

We note that the surface water drainage and firewater retention system is not designed to the EPA's guidance but is instead designed using the German LÖRÜRL methodology. The methodology is based on the practical experience of German fire

fighting authorities, technical universities, industry federations and the insurance industry. Under this methodology, the system is designed to retain water from a 2-hour fire event, plus rainwater from a 1-in-20 year storm for a total of four hours. The LÖRÜRL methodology considers that a large storm occurring simultaneously with a fire is an unrealistic scenario and so the approach used is that the storm could occur for the duration of the fire plus another two hours afterwards.

This means that in the highly unlikely event of a major fire scenario in an outdoor area, combined with a major rainfall event, a situation could arise in which the retention capacity of the site would not be sufficient for all of the water being collected in it. However, it should also be noted that in addition to the remote probability of such a combined event, this scenario would also have reduced environmental impact, due to the high level of dilution that would be provided by the high levels of rainfall to the site and to the surrounding catchment area.

There are no stormwater implications associated with the scenario involving a grassland fire off-site. The circumstances for grassland or forest fires to occur involve a period of dry weather so that the grass becomes dried out. It is not considered credible therefore that an external grassland fire could occur simultaneous with a major rainfall event.

4.4 Programme

According to the EPA guidelines, the risk management programme should outline actions to be taken to reduce the risk associated with contaminated firewater run-off (this may include the construction of a firewater retention facility, depending on the level of pollution risk).

Appendix C of the EPA's guidance includes a number of recommendations for a firewater risk management programme. Table 3 shows how these elements have been covered by the arrangements at Indaver.

Table 3: EPA Recommendations for Firewater Management Programmes

Recommendation	Status at Indaver
Construction of a fire retention facility	Retention facilities are in place, as discussed in this report
Alteration, where possible, to the process or the facility (cleaner technologies, waste minimisation, increased cleaning and maintenance)	Facility is new-build, incorporating best practice for the treatment of waste
Substitution of a potentially polluting raw material	Not applicable, the site is used for the treatment of waste. All transformer oil used onsite is PCB free.
Installation of pollution control equipment, structures or procedures	These are in place, as described in this report. These are described in greater detail in the EIS

Recommendation	Status at Indaver
Alteration of storage arrangements for potential pollutants	Storage arrangements are in line with best practice (e.g. water impermeable bunker for wastes, recovery tanks for spills inside the process building, double skinned ammonia solution/diesel tank etc). Again, these are described in this report, and in more detail in the EIS
Implementation of a new or revised fire safety system	The facilities at the site are new-built and in accordance with best practice for fire safety
Implementation of emergency response procedures	There is an emergency response plan in place at the site
Establishment of emergency management structures, delegation of staff responsibilities and provision of fire awareness and response training	Roles and responsibilities are set out in detail in the emergency response plan
Development of a review/audit process to regularly monitor the implementation of risk management measures and ensure their continuing effectiveness	Indaver will draw up a programme to review and audit the firewater risk management programme

4.4.1 Indoor Scenarios

Indaver have provided firewater retention facilities at the site. For any fire inside the process area, water and/or foam would be applied as required, as set out in the Emergency Response Procedures for the facility. In addition, the valve on the effluent outfall from the site would be closed on activation of a fire alarm.

Any fire-fighting water applied in these areas would be retained on-site in the Bunker, the Turbine Cellar or the Recovery Tanks. As such the engineering controls are already in place to eliminate the potential pollution hazards associated with these scenarios.

In order to ensure the continued effectiveness of the retention facilities in these areas, Indaver will conduct periodic inspections of these systems. All maintenance will be performed in accordance with the recommendations of the manufacturer or supplier of the equipment. This will be recorded and documented in the SAP system that is in place at the site.

The only response measures after the event would be to assess the retained firewater for contamination to determine whether it could be disposed of as effluent or whether it should be collected for removal off site by a licensed undertaker. Any decision of this type would be made in consultation with the EPA.

4.4.2 Outdoor Scenarios

Indaver have also provided firewater retention facilities for fires at outdoor areas of the site. In this case the facilities have enough capacity to deal with any fire-fighting scenario. They do not have sufficient capacity to meet the EPA guidelines for storm water during a fire scenario, as they are designed using the German LÖRÜRL

methodology. As such, the risk management programme includes a number of steps to further reduce the risk to the environment from a fire in these areas.

Fire in Contractors Compound

This scenario involves a fire in the contractors' compound. In this case any fire-fighting water applied would be collected in the general surface water drainage system, described earlier. The valve on the effluent discharge outlet from the site would be closed as part of the response procedure in order to ensure that any fire-fighting water would be retained on site.

The capacity of the retention systems would be sufficient to accommodate the fire-fighting water that would be applied in this scenario according to the German LÖRÜRL methodology, but it would not be sufficient to provide capacity for the 24-hour 20-year storm water event from the EPA's guidance document. This is because the fire-fighting water would enter the same drainage system as the surface water falling across the entire site.

However, this scenario does not present a significant environmental risk due to the lack of potential for contamination in the run-off and also the degree of additional dilution that would be provided if this quantity of rainfall occurred. Also, all surface runoff passes through the petrol interceptor before entering the surface water attenuation pond. The contractors' compound area is not used for storing any significant quantities of dangerous substances and so the environmental hazards associated with a fire here are similar to those at any typical commercial or office building. Furthermore, the circumstances of any scenario which would result in the capacity of the retention facilities being exceeded (i.e. a fire in an outdoor area simultaneous with a major rainfall event), would also result in a large dilution factor as large volumes of rainwater run-off, from the site and from the greater catchment area surrounding it, would enter the river at the same time.

If a situation arose in which a fire occurred in an outdoor area at the same time as a major storm event, Indaver would monitor the water levels in the retention lagoon to ensure that it did not overflow. If the levels in the pond approach overflow levels, then some of the water would be required to be discharged off site in a controlled manner. As mentioned already, the system is designed to an internationally recognised standard and has more than sufficient capacity for fire-fighting water. If a scenario arose in which a fire in an outdoor area coincided with a major rainfall event, only the excess water volumes would be discharged off-site in this manner and so the bulk of the water would still be retained on-site. By its very nature, the large volumes of rainfall involved in this scenario would also provide a great deal of dilution to the firewater run-off. Furthermore, as discussed previously, the run-off from a fire of this type presents a low environmental hazard in the first place.

Fire at the ammonia solution/diesel tank unloading area

This scenario involves a release of Diesel fuel, which is classed as Dangerous for the Environment. This material is not classed as Flammable, and has a flash point of 66°C which is well above ambient temperatures, and so this scenario presents a very

low fire risk. The ammonia solution used is non-flammable under ambient temperature and pressure conditions.

In the event of a fire in this area some ammonia gas fumes may be released due to an increase in ambient temperatures in the area and thermal radiation to the ammonia tank. Ammonia gas is only explosive over a very narrow concentration range (16-23% in air), and due to the fact that it is stored on site as a dilute solution (25% in water) it would not be credible that the necessary airborne concentrations could be reached. Furthermore as the ammonia solution tank is stored in an external area, any vapour formed would rapidly disperse to atmosphere, further reducing the potential for any build up of vapour, even if the tank were to be fully engulfed in a fire. The double-skinned ammonia and diesel tanks are also located in an external area away from facility processes and potential ignition sources.

During normal operations, storm water run-off from this area would be routed through the separator before joining the main surface water drainage system. However, when a delivery of fuel/ammonia solution is made, standard operating procedure is that the valve on the local drainage system will be closed and so that any spills would be routed to a 2.5 m³ capacity underground holding tank. This tank is of sufficient capacity to retain a typical spill scenario in this area (e.g. leak from a transfer hose).

Fuel transfer operations will be continuously manned and monitored in order to allow a quick response to be put in place if a loss of containment did arise. In the event of a larger release scenario (e.g. damage to the road tanker resulting in a full compartment comprising c.6 m³ of fuel leaking), any excess material will enter the local drainage system and be retained in the underground separator tank. These measures ensure that any spill scenario (and also any fire scenario) in this area would not impact the surface water drainage at the site.

Fire at the 38kV compound & generator

This scenario involves a fire at the 38 kV compound or the generator, leading to a release of transformer oil or diesel with firewater, which are both classed as Dangerous for the Environment. These materials are not classed as Flammable so this scenario presents a very low fire risk.

In this case any fire-fighting water applied would be collected and retained in the bunding and the general surface water drainage system, described above in 'Fire in Contractors Compound'.

4.4.3 Arrangements for Disposal of Firewater Run-off

After a fire event, the safe disposal of firewater from the site will include testing of water retained in the fire water retention tank and the surface water retention pond to see if it can be released safely, with the agreement of the Agency. If not, then arrangements are in place for it to be disposed of by other means (e.g. treatment in situ, if practicable, or arranging for a third-party to remove it).

If water must be removed for treatment at an offsite facility the waste water will be classified by the technical department in accordance with operations procedure 4.2 Classification and Identification of Waste. Once the EWC has been assigned a suitable facility will be chosen to send the waste to and Indaver have a list of potential vendors who can accept these wastes. Only approved vendors under the internal vendor control procedure will be used.

5 CONCLUSIONS

Indaver's Meath Waste-to-Energy (WtE) facility at Carranstown, Duleek, Co. Meath, has been designed in accordance with internationally recognised health and safety standards, design codes, legislation, good practice and experience. The facility is provided with manual and automatic controls, and there is a comprehensive interlock system in place which can automatically shut down the plant in a safe manner in the event of equipment failure or dangerous situations arising. In addition, the facility will operate a permit-to-work system (including hot work permits) for all maintenance work, which could give rise to the potential for fire and all contractors on site will undergo induction safety training.

The firewater risk management programme for the site covers all the major fire scenarios identified for the site and the runoffs generated by the fire fighting responses including any releases of materials to the drainage systems that may be hazardous to the environment. The programme includes retention facilities, spill containment facilities and equipment, best practice process design, operational controls and procedures, fire fighting systems and other fire fighting equipment. These are described in details in each of the relevant sections.

The surface water drainage and firewater retention system is not designed to fully meet the EPA's guidance but is instead designed using the German LÖRÜRL methodology. This methodology is based on the practical experience of German fire fighting authorities, technical universities, industry federations and the insurance industry. The methodology does not meet the retention volumes required for the worst case 24 hour rainfall scenario given in the EPA's guidance. However, this does not present a significant environmental risk to offsite receptors due to the lack of potential for contamination in the run-off for the scenarios affected and also the degree of additional dilution that would be provided if this quantity of rainfall occurred.

This firewater risk management programme will be reviewed on a regular basis and, where necessary, updated as part of the Annual Environmental Report.

12 ECOLOGY

12.1 INTRODUCTION

This chapter evaluates the impacts, if any, which the development will have on Ecology i.e. Flora and Fauna as defined in the Environmental Protection Agency (EPA) 'Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)', 2003.

This chapter has been prepared based on a review of previous ecological assessments of the site, the most recent of which was completed as part of an EIS and planning application submitted in 2009. This chapter will assess the impact of proposed amendments to the existing planning permission as described in Chapter 1, on the flora and fauna of the site and environs.

As the primary facility has now been constructed, a number of ecological mitigation measures recommended in previous EIS's have now been implemented. The primary ecological assessment for the development was undertaken in 2005 and addressed the potential impacts of the proposed development on the flora and fauna of the site and its environs. This chapter provides an update of the 2009 assessment including the results of mitigation measures as implemented and any further mitigation measures now required due to the proposed amendments.

12.2 NATURE CONSERVATION DESIGNATIONS

A review of the National Parks and Wildlife Service datasets (www.npws.ie) indicates that there are no parts of the site or the immediate surroundings covered by a scientific or conservation designation or proposed designation as recognised by the NPWS. Four designated pNHAs and one SAC occur within approximately 5km of the site and are detailed below (see Figure 12.1).

Table.12.1. Designated sites within approximately 5 km of the study area.

Site	Designation	Site Code	Description	Approx. distance to study area
01578	Duleek Commons	pNHA	Calcareous marsh and fen system	2 km
01593	Thomastown Bog	pNHA	Raised bog surrounded by wet woodland and wet grassland	5 km
01862	Boyne River Islands	pNHA	Alluvial wet woodland	5 km
01861	Dowth Wetland	pNHA	floodplain marsh with an associated area of deciduous woodland	4 km
002299	River Boyne & River Blackwater	SAC	Fresh water river with alkaline fen and alluvial woodlands	3km

12.3 CONSULTATION

In advance of the preparation of this ecological assessment, consultation was undertaken with the National Parks and Wildlife Service (NPWS). On 18th November 2011, WYG discussed the proposed amendments to the development with Maurice Eakin (Regional Officer for the NPWS). He indicated that given the nature of the proposed amendments it would be unlikely to require an Appropriate Assessment in accordance with Article 6(3) and Article 6(4) of the requirements of the Habitats Directive. Subsequently WYG have completed a screening assessment of the proposed development which concludes that an AA is not required.

Previous consultation with the DOEHLG in 2006, considered the area to be largely intensive agricultural land use and that the existing Indaver facility would have no ecological issues. The ERFB highlighted the populations of brown trout in the Nanny. The Environmental Officer stated that it was imperative that preventative measures were taken to ensure non negative impact to water courses. These measures are discussed elsewhere in the EIS including Chapter 11 Surface Water.

12.4 FIELD INSPECTIONS

Comprehensive flora, mammal and bird assessments were conducted at the site as part of the EIS submitted with the planning application in 2006. No designated habitats of international or national value were recorded on or adjacent to the site. All the habitats recorded on site are widespread within the landscape and of moderate to low species-richness. A summary of the habitats present on site at the time of the original study in 2005 is provided in Figure 12.2. As part of the recently completed construction works there has been some loss of the hedgerow and other generally low importance habitat as was anticipated in previous assessments.

12.4.1 Flora

All the habitats recorded on site are widespread within the landscape and of moderate to low species-richness. The dominant habitats on site are arable crops and improved agricultural grassland, which are highly modified habitats. They are of low scientific interest and represent a low contribution to local biodiversity.

12.4.1.1 Flora Mitigation Measures

There are no habitats on site of high ecological importance that warrant conservation. As part of the recently completed construction process, hedgerows and treelines have been incorporated where possible. The development provides good potential to increase the biodiversity value of the site with appropriate landscaping. The amendments proposed in this application will not detract from this. Best practices methods should ensure that there is no impact on surrounding watercourses and subsequently the River Nanny. By undertaking, these measures it is envisaged that there will be no negative impact on the ecology of the area and there will be a net gain in biodiversity value of the site.

A review of the Heritage Division datasets indicates that no part of the site or the immediate surroundings is covered by a scientific or conservation designation or proposed designation as recognized by the National Parks and Wildlife Service (NPWS). Four designated sites occur within the vicinity of the site; the nearest Duleek Commons proposed Natural Heritage Area c. 2km to the south west of the development. The surrounding habitats consist largely of arable land and improved agricultural grassland bounded by hedgerow of similar composition and structure as those described on the site. In addition no rare, threatened or legally protected plant species, as listed in the Irish Red Data Book (Curtis & McGough, 1988), were found throughout the site nor have been known to occur in the general area in the past. The species are widespread within the landscape and are typical of the habitats in which they were found.

The air quality assessment shows that the nearest conservation designation is outside the range of the air emission plume. The other designated sites; the Boyne River Islands, Dowth Wetlands and Thomastown Bog are c.4-5km from the site and also outside the range of the air emission plume. Please refer to Chapter 7 for details.

A comprehensive assessment of the air emissions from the facility has been prepared by AWN as detailed in Chapter 7. The cumulative emissions of the waste to energy plant and the other developments in the vicinity did not cause the maximum predicted ground level of emissions to reach air quality standard limit values and guidelines. As the projected emissions will be within European Limits, it is considered that there would be no significant impacts by air emissions on the flora and fauna within the surrounding area or on designated sites for conservation in the region.

12.4.1.2 Flora Conclusion

Mitigation measures identified in the previous assessments have now been implemented as part of the construction of the facility. Existing treelines and hedgerows have been retained where possible, it is therefore envisaged that there will be no negative impact on the ecology of the area..

12.4.2 Fauna

The site has a very low representation of Irish fauna, due to the intensive agricultural practice (most of the site was composed of arable land) and therefore a limited range of habitats on site. The vegetated boundaries are of low species diversity and poor structure. There is an almost total lack of ponds, and there are no rivers or streams. There are very limited areas of scrub or other habitat types.

12.4.2.1 Fauna Mitigation Measures

The construction of the facility has resulted in the loss of some arable lands, improved pasture and boundaries of low ecological interest. No species of ecological importance were noted on the site. No signs of current active use of the site by badgers were found. Bats were considered likely to utilise the

area for feeding, summer and winter roosts may be present in mature trees or within ivy covered trees on site. Bat foraging and roosting areas may be affected. No significant impacts are expected on other species known or expected on site.

Since the completion of the previous EIS for the site and recent construction works a number of mitigation measures have been implemented, namely;

- Bat and Vertebrate Faunal Survey
- Erection of Bat Boxes
- Supervised felling of Potential Bat Roosts

Bat and Vertebrate Faunal Study

A bat survey was completed at the site on the 28th of April 2008 and 1st May 2008. A vertebrate faunal survey, with a focus on badgers was undertaken on the 10th April 2008. Both surveys were undertaken at suitable times of the year for the species assessed though it is noted that there are no seasonal constraints in relation to badgers. In summary it was identified that Bats utilise the area for feeding, commuting and roosting. Mitigation measures in the form of bat boxes and supervised felling of trees were recommended to ensure minimum impact to bat species as a result of the proposed development. Impacts on the other vertebrate fauna that were the main focus of the assessment were found to be insignificant/neutral or minor negative.

Erection of Bat Boxes

In order to mitigate against the potential loss of bat foraging/roosting sites identified for bat species, six bat boxes were erected at the site in 2008. The main function of bat boxes is to provide alternative safe roosting sites for groups of bats where natural sites become unavailable. Details of the Bat Box scheme have been forwarded to Bat Conservation Ireland to be included in their database for monitoring purposes. The scheme will be monitored for a period of over 2 years in order to ensure best placement and effectiveness of the boxes. Recent results (2011) indicate two of the bat boxes are now in use by bats. Monitoring is ongoing.

Supervised Felling of Trees marked as Potential Bat Roosts (PBR)

In order to ensure felling of trees with potential to be bat roosts is undertaken sensitively, felling of trees was undertaken in accordance with NRA Guidelines: Guidelines for the treatment of Bats during the construction of National Road Schemes (Tree felling and Hedgerow Removal). This requires large mature trees to be felled carefully by gradually dismantling the tree by a qualified tree surgeon under supervision of a bat specialist. One PBR tree was felled on September 22nd 2008 under the supervision of the bat specialist. No bat droppings or other evidence of bat usage was recorded in the tree felled. Three other trees identified as PBR trees were located at the site boundary and have been retained.

12.4.2.2 Fauna Conclusion

No species of ecological importance were noted on the site. No signs of current active use of the site by badgers were found. As bats have been recorded as using the site, a number of mitigation measures for bats have now been implemented at the site. This will ensure that impacts on fauna in the locality are negligible.

12.4.3 Birds

The bird species recorded breeding in the survey area are typical of agricultural habitats in eastern Ireland. The presence of a nesting pair of peregrines in the locality is of note as this species is listed in Annex I of the EU Birds Directive. However, the peregrine is not a species of high conservation concern in Ireland, and a national survey in 2002 indicated a stable population with significant increases in the use of artificial sites, such as quarries and buildings.

The maturing trees and shrubs within the site will support all of those species which already occur and it is likely that a higher diversity of species will occur once the trees and shrubs that have been planted as part of the landscaping plan for the site become established.

12.5 CONCLUSIONS

The amendments to the proposed development will have no significant impact on the ecology of the site. A number of mitigation measures have now been completed and should ensure that any potential impacts to flora, fauna and birds are minimised.

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