



Rockview Farm

Addendum to Flood Risk Assessment

Tobin Consulting Engineers

26 March 2008

Draft Final Report

9S4067A0

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1 INTRODUCTION

This report presents a short addendum to the Flood Risk Assessment report for the Rockview Farm development. This report should be read in conjunction with the Flood Risk Assessment report dated the 12th of June 2007 and has been written subsequent to the completion of a peer review which was carried out by Scott Wilson at the request of Dundalk Town Council (DTC). It should be noted that this addendum adds to the flood risk assessment report and that the former report is still valid with the exception of specific changes set out in this addendum report.

This report addresses the issues identified by the peer review and briefly covers the correspondence between Royal Haskoning and Scott Wilson during the process. In general the flood risk assessment received a positive review although a number of recommendations asked to be further clarified and these comments are addressed in this report.

In order to address the comments raised by Scott Wilson slight amendments have been made to the design options thereby affecting the option cost estimates presented in the original flood risk assessment report. However, at this stage it is not deemed necessary to quantify the increase in the costs and this can be added in later development stages of the project.

The contents of the peer review and the correspondence that followed are set out in section 2 of this report. Section 3 describes the changes that were made to the flood risk assessment, the works undertaken and the final options. The revised conclusions and recommendations can be found in section 4.

2 PEER REVIEW

2.1 Scott Wilson peer review report

The flood risk assessment report prepared by Royal Haskoning for Rockview Farm issued to Scott Wilson Consulting Engineers to carry out a peer review on behalf of DTC. A report setting out the findings of this review was issued in February 2008.

In general the peer review concluded that the flood risk assessment work and methodologies used were appropriate and in keeping with best practice. However, a number of comments were made for further consideration.

The review report identified the following five points that require further consideration:

1. The 1 in 200 year water level at the project site is predicted to be +4.1mODM. The procedures used to calculate the extremes are appropriate with the exception of the last step of selecting a median value from the sensitivity analysis. As such, it is possible that the extreme water level at the project site could be underestimated.

Considering the risk of flooding and the potential hazard, transferring the joint probability of tide and surge from Dublin to Dundalk should be carried out to provide a comprehensive analyses for the determination of the 1 in 200 year event.

2. Consideration should be given to use of an upper sea level rise rate for such a large development.
3. The preferred option 2 cost does not include for the cost of infilling the proposed residential land to a level of +4.25mODM.
4. The proposed level of the landward berm of 1.25 metres below embankment crest level should be reconsidered to ensure the benefits of the walkway/cycleway are not unduly limited as a result of restricted views over the saltmarsh.
5. The report did not comment on finished floor levels for the development.

Point no 3 is not within Royal Haskoning's scope of works. The decision to raise the land had been taken before the flood risk assessment was undertaken, hence pricing of this aspect of the development was not included in the original report.

In respect of point no 4, the levels of the berm have been carefully chosen so that there is a balance between the view onto the saltmarsh and the level of concealment of the people using the berm from the fauna using the saltmarsh. Should this embankment option be taken forward, the level of the berm can be finalised in consultation with statutory bodies and DTC.

Points 1, 2 and 5 are addressed in section 3 of this report.

2.2 Correspondence and communication between Scott Wilson and Royal Haskoning

Following the issue of the peer review report there was a period of correspondence and communication between Royal Haskoning and Scott Wilson, discussing the issues raised and clarifying matters. A brief overview of this process is given below in chronological order.

Date	February 2008
Item	Peer review report Scott Wilson
Summary/Conclusion	As per point 1 to 5 in section 2.1.

Date	29 th of February 2008
Item	Memo from Owen McManus (RH) replying to peer review report
Summary/Conclusion	Memo replies to point no 1 in the peer review. It further explains the calculation process to derive the extreme water levels and that the recommendations made in respect of transfer of extreme tide level from Dublin to Dundalk are considered to be conservative.

Date	7 th March
Item	Meeting with Tobin Consulting Engineers and Dundalk Town Council
Summary/Conclusion	In this meeting the peer review report as produced by Scott Wilson was discussed. A memo from Scott Wilson in reply to the memo from Owen McManus on the 29th of February 2008 was provided during this meeting. The meeting confirmed that subject to agreement being reached between Scott Wilson and Royal Haskoning on the review issues, the council would be happy to proceed with the local area plan application. In a follow on e-mail from Dundalk Town Council to Tobin Consulting Engineers, it was confirmed that Royal Haskoning could contact Scott Wilson directly to discuss these issues.

Date	7 th of March 2008 (Memo date 6 th March 2008)
Item	Memo from Scott Wilson in reply to Royal Haskoning memo date the 29 th of February 2008
Summary/Conclusion	Memo acknowledges the method as used by Royal Haskoning. Scott Wilson suggests that due to the uncertainty involved in this type of analysis it would be recommended to take the upper bound of estimates. Values range from 3.67 to 3.76, Scott Wilson recommends a value of 3.8 rather than 3.7.

Date	14 th of March 2008
Item	E-mail from Owen McManus (RH) to Karol McCusker (SW) in reply to memo date the 6 th of March 2008 after initial phone contact on the 13 th of March 2008
Summary/Conclusion	The e-mail addresses the 1 in 200 year extreme water levels as well as climate change and the finished floor levels, i.e. issues 1, 2 and 5 as mentioned in the review report.

	The e-mail explains how the best data available was used to determine extreme water levels and how uncertainty is included in the recommendations. However, in the interests of seeking a final agreement it was proposed to take a present day 1 in 200 year water level of 3.76mODM, which is the upper limit of the sensitivity analysis in the acceptable range of values. To address climate change, the latest IPCC summary report was reviewed. It is suggested that the allowance for sea level rise is increased from 400mm to 500mm, which is closer to the upper band in the IPCC guidance. Taking the highest value (high scenario with high estimate) is deemed over conservative and it is considered better to build in some degree of flexibility to the new defences. Combining the 1 in 200 year water level of 3.76mODM with 0.5m sea level rise and a freeboard for uncertainty of 0.15m, a revised infill/finished floor level of 4.41mODM was suggested.
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Date	20 th of March 2008
Item	E-mail from Zongyan Yang (SW) in reply to e-mail of Owen McManus (RH) dated the 14 th of March 2008
Summary/ Conclusion	The message states agreement with the new recommendations as set out in the e-mail from Owen McManus of 14 th March 2008.

3 REVIEW OF FLOOD RISK ASSESSMENT OPTIONS

3.1 Water levels and wave heights

3.1.1 Present day extreme water level

Following the peer review by Scott Wilson and subsequent discussion, a final agreement was reached on the 1 in 200 year extreme water level. The level increases from 3.7mODM to 3.76mODM. For more details on the way this level was derived, please refer to section 4.1 of the original flood risk assessment report and section 2 of this report.

3.1.2 Climate change

For details of the assessment of sea level rise allowance see the section 4.2 of the original report. Following that work and recommendation for further consideration by the Scott Wilson review, the initial work was reviewed in light of the latest guidance from the Intergovernmental Panel on Climate Change (IPPC).

Following this review it was agreed to increase the sea level rise allowance to 2100 from 400mm to 500mm. This revised value being close to the upper limit of the range of estimates made by the latest guidance summary report. Combined with the new 1 in 200 year extreme water level as mentioned in the section above, this results in a 1 in 200 extreme water level of 4.26mODM in 2100, increased from 4.1mODM as recommended in the original flood risk assessment report.

3.1.3 Wave heights

The increased water levels could give rise to larger waves due to the depth limited conditions at the site. Whilst the increase is likely to be small, it has been assessed using similar methods to that for the original flood risk assessment. Previous wave heights were presented in Table 4.5 of the flood risk assessment report and these have been revised as set out in table 3.1 below.

Table 3-1 – Revised Wave Heights at the Site

Extreme Water Level (mODM)	Wave Heights (m)
3.76	0.75 – 1
4.26	0.9 – 1.25

3.2 Assessment of options for updated conditions

3.2.1 General

The increased design conditions require an increase in the embankment levels for the three options, as rates of overtopping will increase with the higher water levels and slightly larger wave heights. The overtopping criteria is the same as presented in the flood risk assessment report, see table 3.2 below.

Table 3-2 - Maximum Mean Overtopping Rates in l/s/m

	Results if overtopping (l/s/m) > indicated value	
	CUR Rock Manual	HR Wallingford W178
Danger for pedestrians	>0.03	
Damage if crest not protected	1.7 to 20	2 to 20
Damage if back slope not protected	20 to 80	20 to 50
Damage even if fully protected	>80	>50

The three methods used in the original assessment were used again and include,

- A. Wave overtopping model AMAZON.
- B. An overtopping spreadsheet based on the EA report W178 "Wave overtopping of seawalls"[3] produced following research by HR Wallingford.
- C. An overtopping spreadsheet to assess the mean overtopping for an embankment developed by University of Liverpool.

3.2.2 Option 1

Option 1 originally included for the improvement of the main coastal defence by raising the embankment crest to 6.25mODM and armouring the front face and provision of additional return embankments to secure the site at the north and southern boundaries and along Blackrock Road to the Village.

When this option was retested using the revised water levels and wave heights, the overtopping rates proved to be larger than acceptable for an embankment without a fully protected crest and a protected back slope. Overtopping rates can be found in Table 3.3 below.

Table 3-3 - Overtopping of Option 1 Main Embankment Level 6.25mODM

Tide Conditions	Overtopping Model – Mean Overtopping		
	A (l/s/m)	B (l/s/m)	C (l/s/m)
WL – 3.76mODM	0.0	8.8	0.04
WL – 4.26mODM	3.4	38.9	10.8

To reduce the overtopping rates to acceptable levels, the embankment was raised to a level of 6.75mODM. The overtopping results for the higher crest level can be found in Table 3.4. Overtopping amounts are reduced to within the acceptable limits for model A and C. Model B is known from experience to predict high overtopping.

Table 3-4 Overtopping of Option 1 Main Embankment Level 6.75mODM

Tide Conditions	Overtopping Model – Mean Overtopping		
	A (l/s/m)	B (l/s/m)	C (l/s/m)
WL – 3.76mODM	0.0	3.9	0.0
WL – 4.26mODM	0.7	18.8	2.6

3.2.3 Option 2

Option 2 originally included for the improvement of the main coastal defence by raising the embankment crest to 5.6mODM and armouring the front face and crest. Furthermore the development lands would be raised to 4.25mODM in residential areas and 3.5mODM in amenity areas. In addition provision would be made for return embankments for the amenity lands at the north and south boundaries.

The fully protected crest in this option allows for larger amounts of overtopping, with the upper acceptable limit being 20l/s/m. The increased water levels and wave heights result in overtopping rates that are larger than acceptable for the original crest level of 5.6mODM. Overtopping rates can be found in Table 3.5 below.

Table 3-5 - Overtopping of Option 2 Main Embankment Level 5.6mODM

Tide Conditions	Overtopping Model – Mean Overtopping		
	A (l/s/m)	B (l/s/m)	C (l/s/m)
WL – 3.76mODM	0.3	25.9	2.1
WL – 4.26mODM	16.5	100.3	42.7

To reduce the overtopping rates to acceptable levels, the embankment has been raised to a level of 6.0mODM. The overtopping results for the higher crest level can be found in Table 3.6 below. Overtopping amounts are reduced to be within the acceptable limits for model A and C. Model B again predicts higher rates of overtopping, but can be considered to be conservative.

Table 3-6 - Overtopping of Option 2 Main Embankment Level 6.0mODM

Tide Conditions	Overtopping Model – Mean Overtopping		
	A (l/s/m)	B (l/s/m)	C (l/s/m)
WL – 3.76mODM	0.03	13.3	0.3
WL – 4.26mODM	6.4	56	19.2

In addition to increasing the crest level of the embankment to ensure no damage during the design event, the development lands will also be raised. Based on the revised extreme tide levels set out in section 3.1.1 and 3.1.2 it is suggested that the residential areas be raised to 4.41mODM and not less than 4.25mODM at any location. Property thresholds should be not less than 4.41mODM.

It is considered that infill to the amenity lands can remain at a level of 3.5mODM provided that any properties located within this area have a threshold level of not less than 4.41mODM.

3.2.4 Option 3

Option 3 originally included for improving the main coastal defence by raising the embankment crest to 5.0mODM and armouring the front, crest and rear slope. Furthermore a secondary embankment with a crest level of 5.0mODM at the residential and amenity area interface would also be provided. In addition return embankments at

the north and south boundaries and along the Blackrock Road to the south would be provided.

With a fully protected embankment as proposed in option 3 a larger amount of overtopping can be permitted. Acceptable limits of between 50 to 80l/s/m are considered before the embankment is damaged. The original crest level of 5.0mODM does not provide sufficient protection and as can be seen in Table 3.7, overtopping rates are larger than acceptable when the revised water level and wave climate are applied.

Table 3-7 - Overtopping of Option 3 Main Embankment Level 5.0mODM

Tide Conditions	Overtopping Model – Mean Overtopping		
	A (l/s/m)	B (l/s/m)	C (l/s/m)
WL – 3.76mODM	3.8	69.9	15.7
WL – 4.26mODM	57.3	>140	115

The crest level of the embankment was raised by 0.4m to a level of 5.4mODM. The increase in freeboard results in a reduction in the predicted overtopping rates, as shown in Table 3.8 below. Model A predicts overtopping rates well within the acceptable limits and model C predicts rates between the lower and upper limit. As before, model B predicts larger rates of overtopping.

Table 3-8 - Overtopping of Option 3 Main Embankment Level 5.4mODM

Tide Conditions	Overtopping Model – Mean Overtopping		
	A (l/s/m)	B (l/s/m)	C (l/s/m)
WL – 3.76mODM	0.5	36.1	4.5
WL – 4.26mODM	21.1	134.2	60.7

3.3 Final flood alleviation options

The options as outlined in the flood risk assessment report have been modified slightly for the increased extreme conditions. This section describes the changes in the options compared to the flood risk assessment report.

3.3.1 Option 1

The general layout of this option can be found in Figure F1 in Appendix A, an alternative embankment layout is presented in Figure F16. As described in Section 3.2.1, the increased extreme conditions require for an increase in the crest level of the main embankment. The level is raised by 0.5m from 6.25mODM to 6.75mODM. The new main embankment is shown in Figures F2, F3 and F4 in Appendix A.

The return embankments to the road on the north and south side are raised from 4.6mODM to 4.8mODM, to allow for the increased extreme water levels. Cross-sections of these embankments can be found in Figure F13 in Appendix A.

The embankment along the road is not as sheltered as the return embankments and hence was designed to a higher crest level. Due to the increase in the extreme

conditions the level of this embankment is raised from 5.25mODM to 5.4mODM, as shown in Figure F14 in Appendix A.

As there is no increase in the overtopping rates, there is no requirement to increase the infill levels of the site. Although it is recommended that any buildings in the amenity area have a threshold level of 3.5mODM, to prevent flooding from small amounts of water overtopping the embankment during an extreme event.

3.3.2 Option 2

Figure F5 in Appendix A shows the general layout for this option. The armoured crest of the embankment was raised by 0.4m to 6.0mODM to reduce overtopping as a result of the increased extreme conditions. Figures F6, F7 and F8 show cross-sections for the raised main embankment.

The return embankments to the raised land on the north and to the road on the south side are raised from 4.6mODM to 4.8mODM, to allow for the increased extreme water levels. Cross-sections of these embankments can be found in Figure F13 in Appendix A.

It was previously recommended that the residential area be raised to a level of 4.25mODM, which consisted of a 1 in 200 year water level for 2100 combined with a 0.15m freeboard. Due to the increase in the 1 in 200 year water level by 0.16m for 2100, it is now recommended that the infill of the residential area should in general be raised to 4.41mODM and not less than 4.25mODM at any location. Furthermore all properties should have a threshold level of not less than 4.41mODM.

3.3.3 Option 3

This option consists of a primary and a secondary embankment, as shown in Figure F9. The crest of the fully armoured embankment was raised by 0.4m to 5.4mODM to reduce overtopping rates, resulting from new extreme conditions, to acceptable values. Cross-sections for the raised embankment are presented in Figures F10, F11 and F12 in Appendix A.

The return embankments to the road on the north and south side are raised from 4.6mODM to 4.8mODM to allow for the increased extreme water levels. Cross-sections of these embankments can be found in Figure F13 in Appendix A.

The embankment along the road is less sheltered than the return embankments and hence was designed with a higher crest level. Due to the increase in the extreme conditions the level of this embankment is raised from 5.25mODM to 5.4mODM, as shown in Figure F14 in Appendix A.

As overtopping rates over the primary defence have not increased and the return embankment crest levels are lower than the secondary defence it is not considered necessary to increase the crest level of the secondary defence in this option. Hence the cross-section of this embankment as presented in Figure F15 has not changed.

As for option 1, there is no increase in overtopping, hence no need to increase the infill levels of both the amenity and residential areas. However, it is recommended that any

buildings in the amenity area have a threshold level of 3.5mODM, to prevent flooding from small amounts of water that could overtop the embankment during an extreme event.

4 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations given in the original flood risk assessment report dated June 2007 are still valid, unless stated otherwise below.

4.1 Conclusions

The main conclusions of the flood risk assessment work are as follows;

- An assessment of extreme tides at the site has resulted in the following design water levels
 - 200 year in 2007 – 3.76mODM
 - 200 year in 2100 – 4.26mODM
- The wave conditions at the site are depth limited due to the extensive width of mudflats and salt marsh. The maximum waves which are likely to be experienced along the toe of the structure are between 0.75 and 1.25m. The latter are associated with sea level rise to the end of the century.
- The most sustainable means of reducing flood risk to the site without having a detrimental impact of the adjacent areas, is to raise the development site to provide a level above the design tide level predicted. As such a level of 4.41mODM has been chosen for the residential development which is above the 200 year tide in 2100. The amenity lands have been proposed to be set at 3.5mODM.

4.2 Recommendations

In order to ensure adequate flood protection against coastal flooding at the Rockview Farm site the following recommendation has been made,

- Option 2 – To improve the main coastal embankment and infill the development site to a level of between 4.25 and 4.41mODM with a minimum property threshold level of 4.41mODM for the residential site and to a level of 3.5mODM for the amenity site as set out for option 2 in section 3.3.2.

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Appendix A

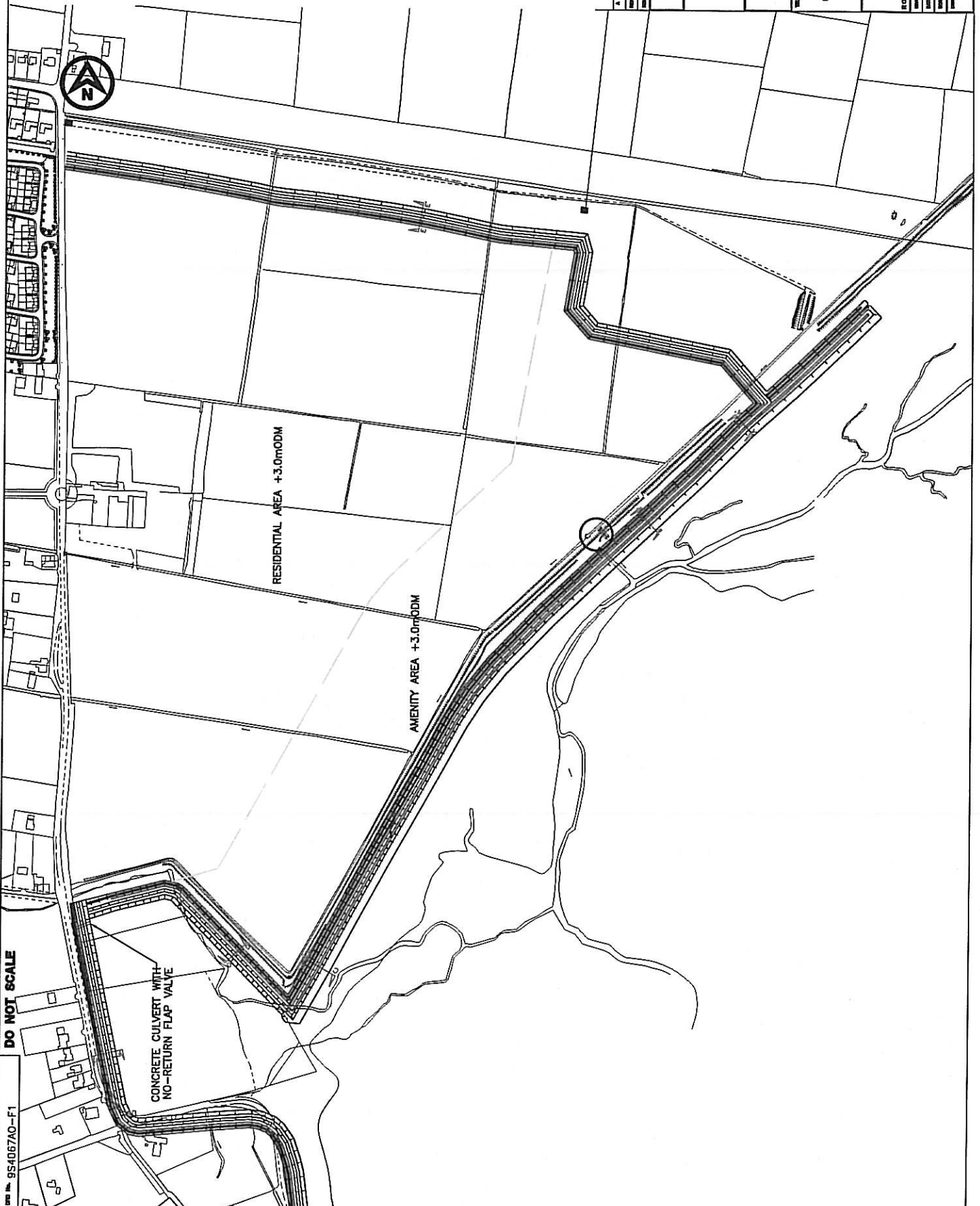
Option Drawings

NOTES

1. ALL TOLERANCES IN MM UNLESS OTHERWISE STATED.

2. ALL LEVELS RELATIVE TO SURFACE OF BASE PLATE.

1. ALL INDICATORS IN NEW UNLESS OTHERWISE STATED.
2. ALL LEVELS RELATIVE TO CRACKING OUTLET UNIT HEAD.



REP	DATE	DESCRIPTION	IN	CR	APP
A		ORDER FOR ARMED VEHICLES	VL	AM	GM

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**ROCKVIEW FARM
FLOOD RISK ASSESSMENT**

TABLE	EMBANKMENT OVERVIEW OPTION 1 - EMBANKMENT 2
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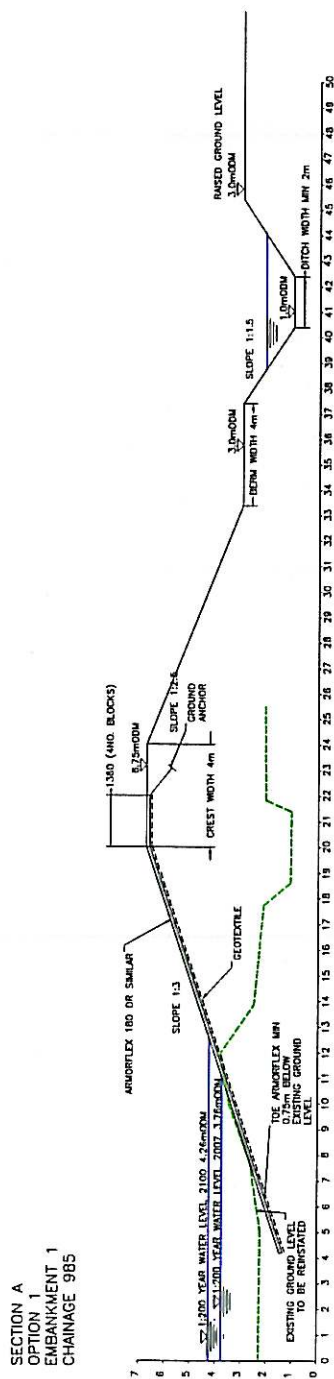
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Figure F1

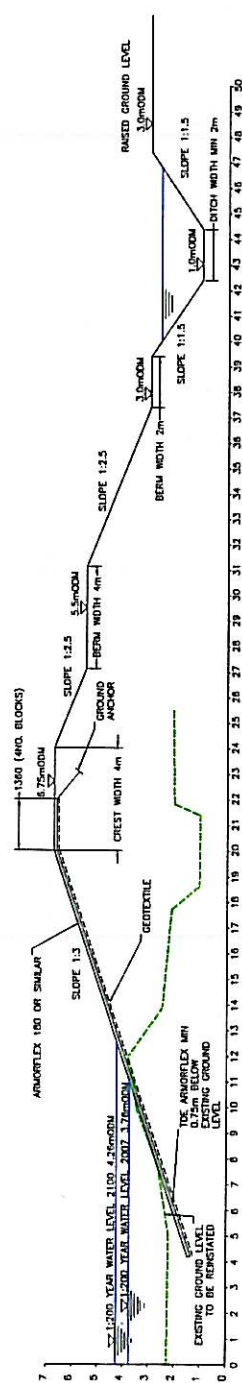
Figure F1	A
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NOTES

1. ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED.
2. ALL LEVELS RELATIVE TO ORIGINATE DATUM MARKING.



SECTION A
OPTION 1
EMBANKMENT 2
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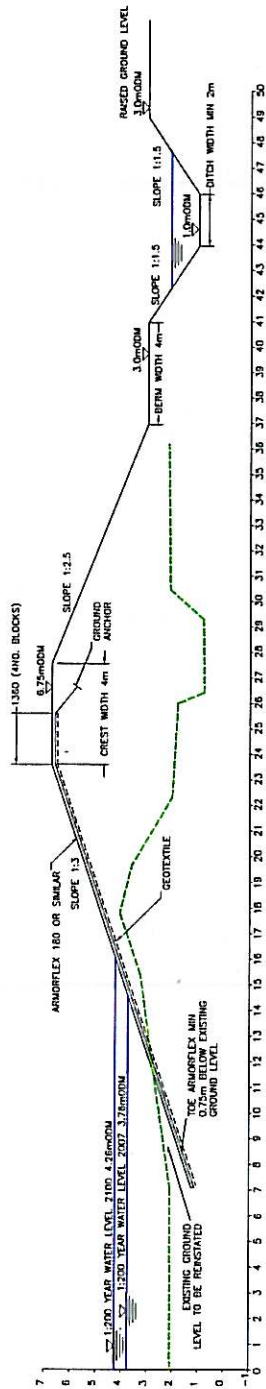


ROCKVIEW FARM FLOOD RISK ASSESSMENT

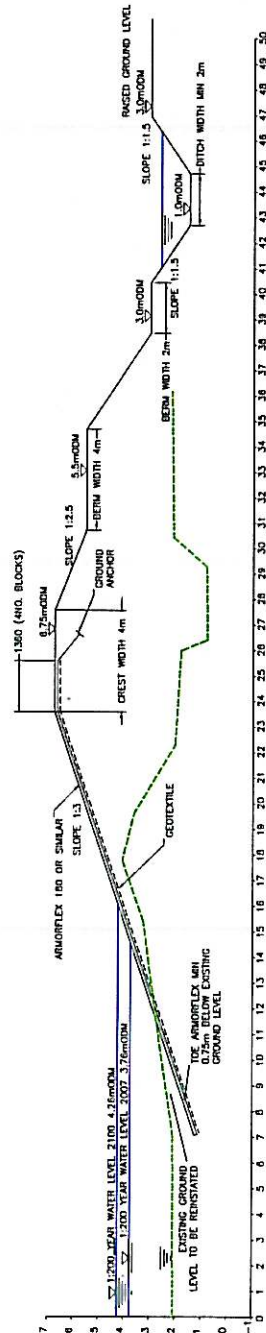
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CROSS-SECTION A, OPTION 1
EMBANKMENT OPTIONS 1 & 2

SECTION B
OPTION 1
EMBANKMENT 1
CHAINAGE 1385



SECTION B
EMBANKMENT 2
CHAINAGE 1385



NOTES

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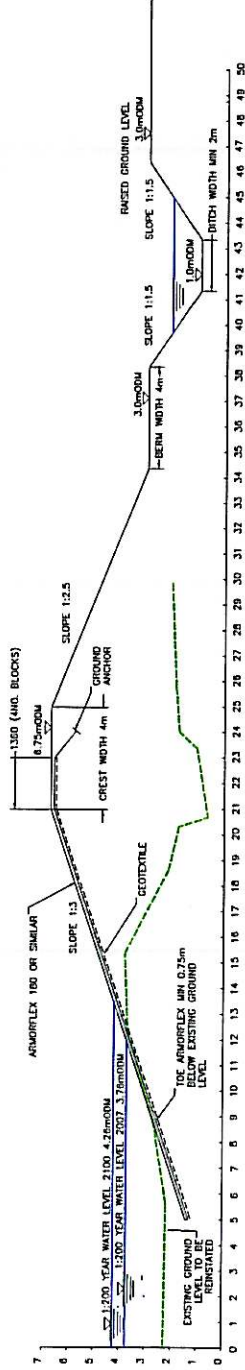
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ROCKVIEW FARM
FLOOD RISK ASSESSMENT

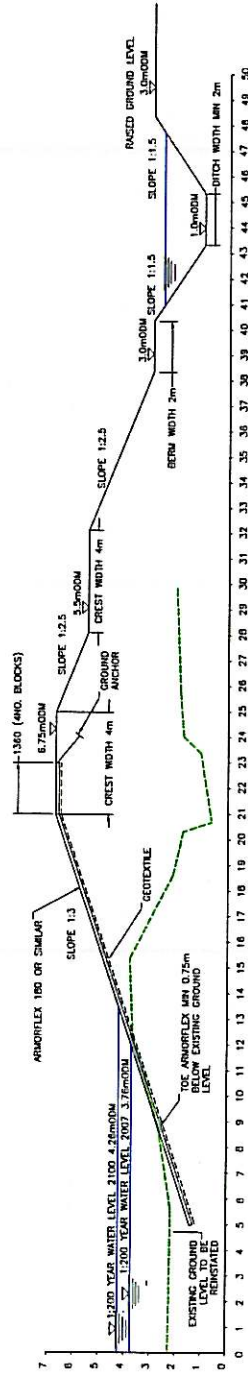
MAIN COASTAL EMBANKMENT
CROSS-SECTION B: OPTION 1
EMBANKMENT OPTIONS 1 & 2

DESIGNED BY: [Signature]		CHECKED BY: [Signature]	
DRAWN BY: [Signature]		APPROVED BY: [Signature]	
DATE: 23.03.08		SCALE: 1:1	
PROJECT NO: 9S4067AO-F3		FIGURE NO: A	

SECTION C
OPTION 1
EMBANKMENT 1
CHAINAGE 1991



SECTION C
OPTION 1
EMBANKMENT 2
CHAINAGE 1991



NOTES

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2. ALL LEVELS RELATIVE TO ORDNANCE DATUM MAUN PAUL.

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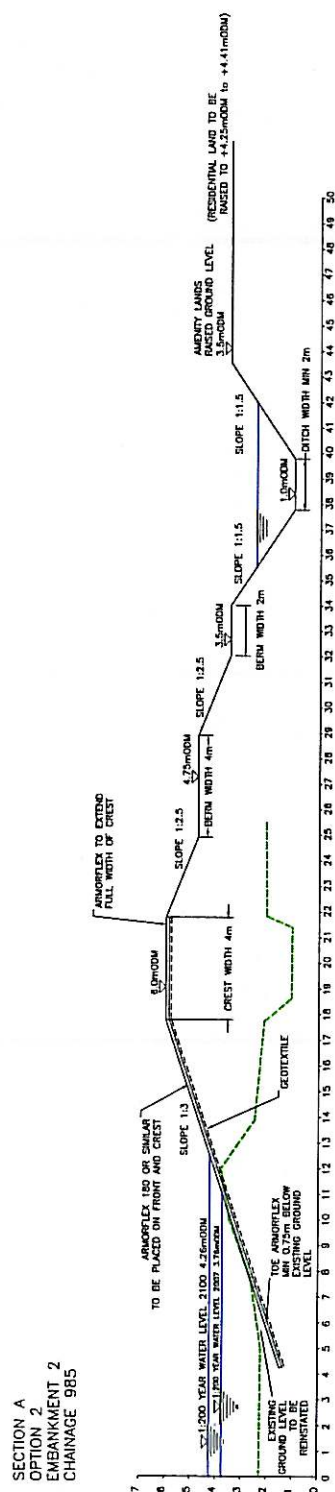
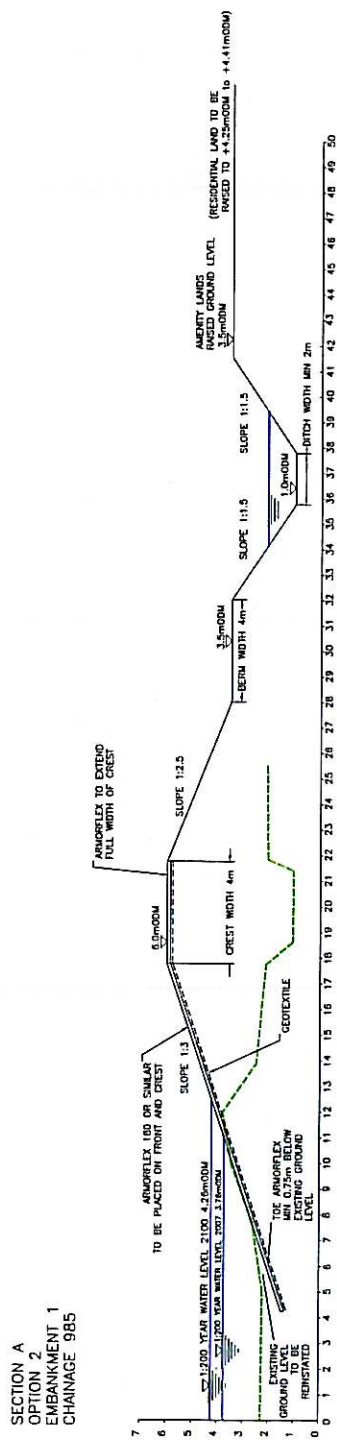
ROCKVIEW FARM
FLOOD RISK ASSESSMENT

MAIN COASTAL EMBANKMENT
CROSS-SECTION C, OPTION 1
EMBANKMENT OPTIONS 1 & 2

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PROJECT NO.		PROJECT REF.		PROJECT REF. 954087AO-F4	
FIGURE NO.		FIGURE F4		A	

NOTES

1. ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED.
2. ALL LEVELS RELATIVE TO ORDNANCE DATUM MAJOR HEAD.



DATE	BY	REMARKS	TIME
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ROCKVIEW FARM
FLOOD RISK ASSESSMENT

MAIN COASTAL EMBANKMENT
CROSS-SECTION A, OPTION 2
EMBANKMENT OPTIONS 1 & 2

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 vol. 57, no. 2
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ROYAL HAKKONING	TOTAL	PERCENTAGE	NEW	RE-ENTRY	MMU
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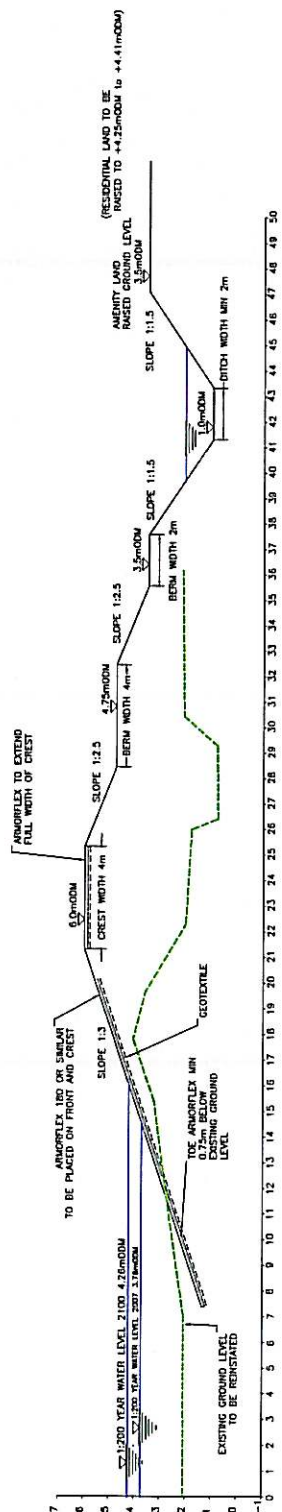
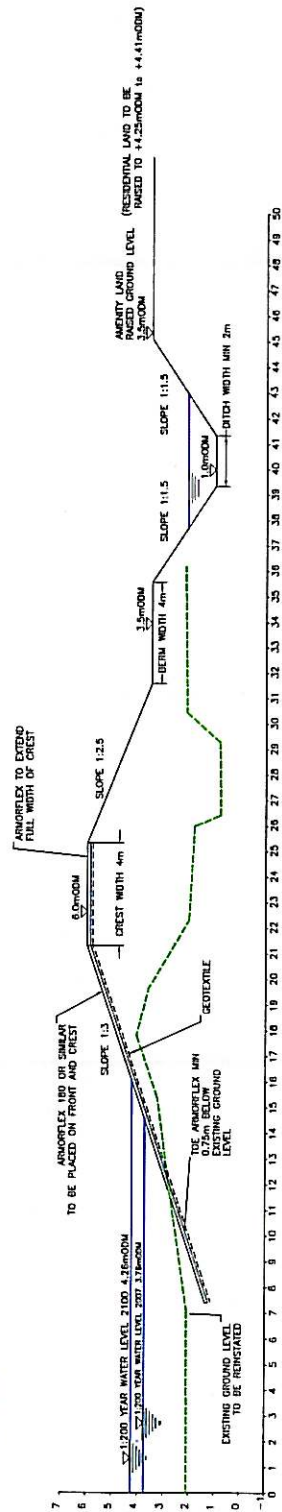
DATE 25.03.08	CLIENTS REF.	PREVIOUS ORDER
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SCALE AT 1	ADDITIONAL REF. SYMBOLS	REVISION A
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FIGURE F6

A

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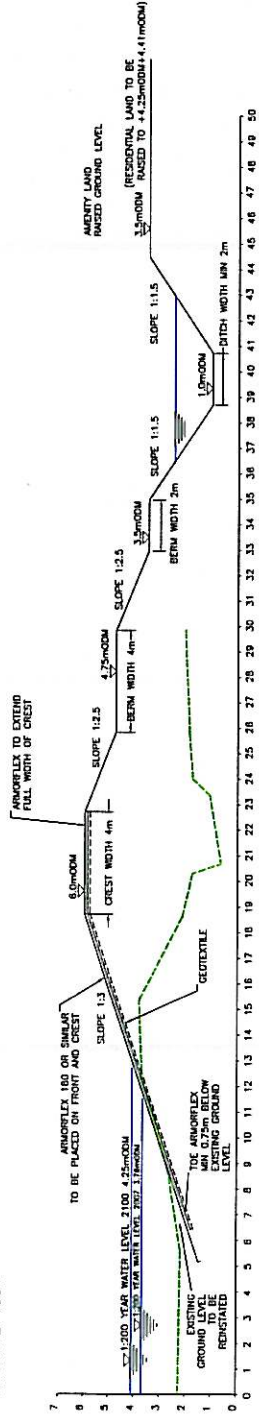
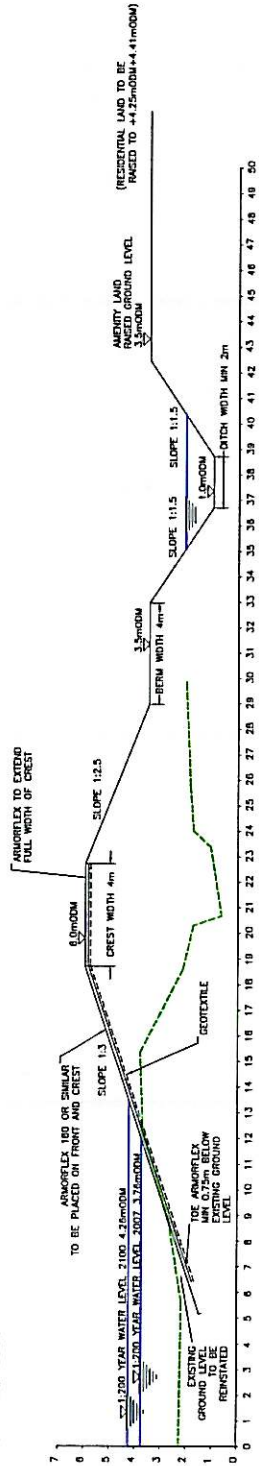


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DATE	DESCRIPTION	INIT	INIT	DATE

ROCKVIEW FARM
FLOOD RISK ASSESSMENT

MAIN COASTAL EMBANKMENT
CROSS-SECTION B, OPTION 2
EMBANKMENT OPTIONS 1 & 2

1. ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED.
2. ALL LEVELS RELATIVE TO ORDNANCE DATUM WUJH HEAD.



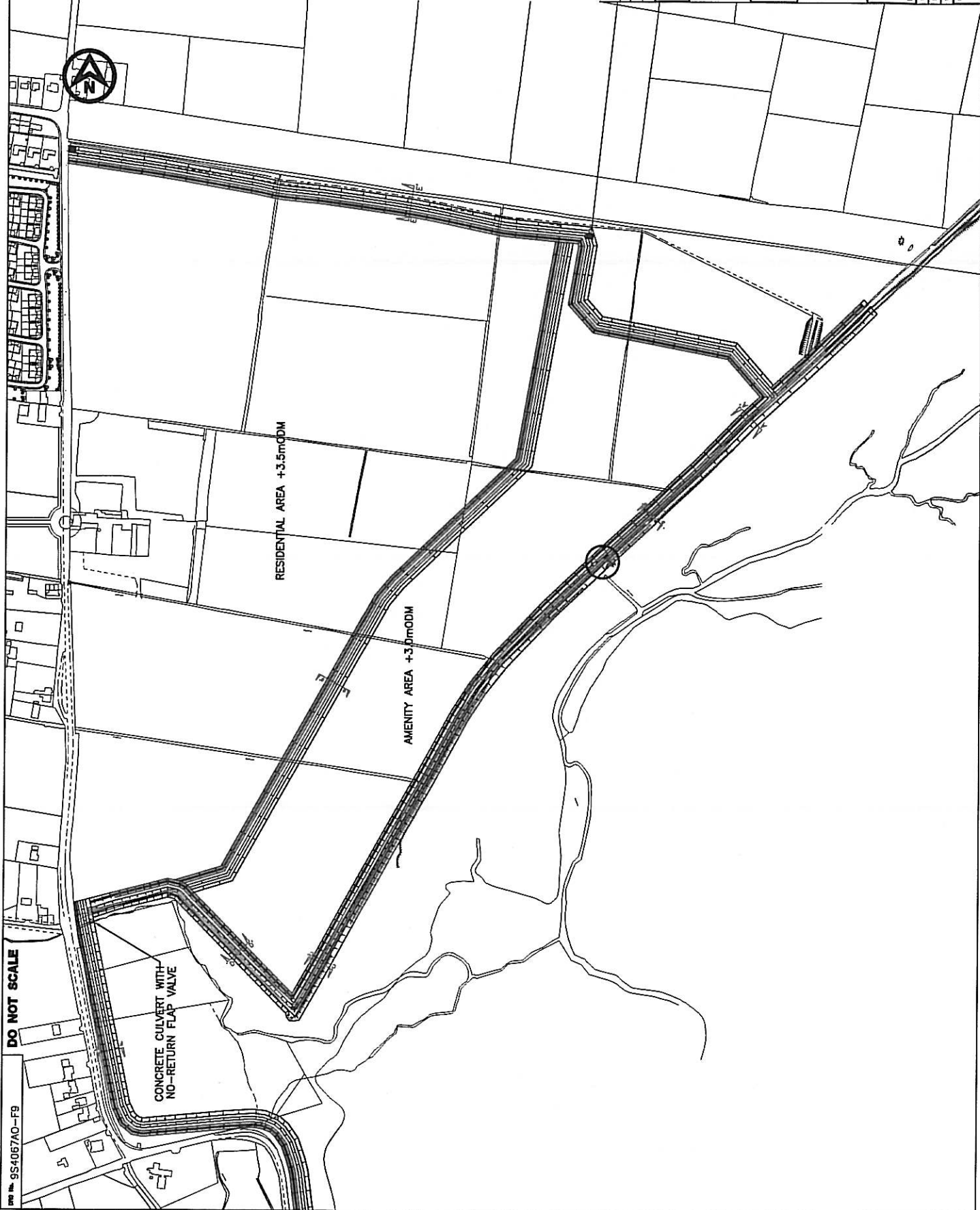
1000

ROCKVIEW FARM FLOOD RISK ASSESSMENT

MAIN COASTAL EMBANKMENT
CROSS-SECTION C, OPTION 2
EMBANKMENT OPTIONS 1 & 2

954067AO-F9

DO NOT SCALE

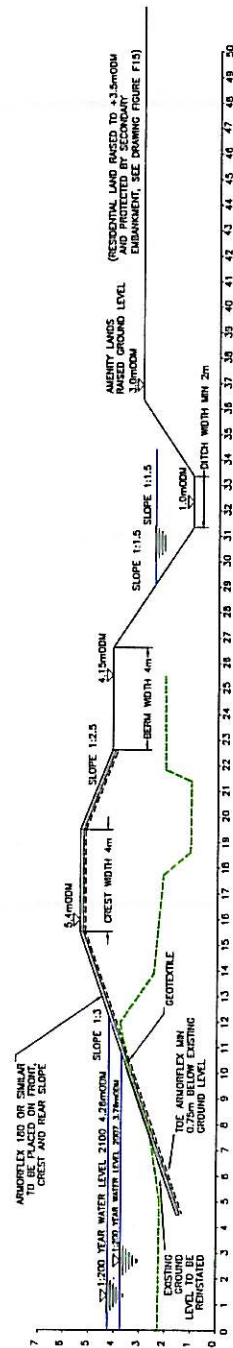


NOTES

- 1. ALL DIMENSIONS IN THIS DRAWING ARE IN METERS.
- 2. ALL LEVELS RELATIVE TO CHANGING DATUM MARK.

A		BANKING FOR ARMED FORCES ONLY		15	15	15	15
B		BANKING FOR ARMED FORCES ONLY		15	15	15	15
C		BANKING FOR ARMED FORCES ONLY		15	15	15	15
D		BANKING FOR ARMED FORCES ONLY		15	15	15	15
E		BANKING FOR ARMED FORCES ONLY		15	15	15	15
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GP		BANKING FOR ARMED FORCES ONLY		15	15	15	15
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HC		BANKING FOR ARMED FORCES ONLY		15	15	15	15
HD		BANKING FOR ARMED FORCES ONLY		15	15	15	15
HE		BANKING FOR ARMED FORCES ONLY		15	15	15	15
HF							

1. ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED.
2. ALL LEVELS RELATIVE TO ORDNANCE DATUM MALIN HEAD.



SHEET NO.		DATE		BY		CHK		APP	
A		10/10/2010		S. K. SINGH		S. K. SINGH		S. K. SINGH	

ROCKVIEW FARM
FLOOD RISK ASSESSMENT

**MAIN COASTAL EMBANKMENT
CROSS-SECTION A, OPTION 3
EMBANKMENT OPTIONS 1 & 2**

[illegible]

☐ ☐ ☐ ☐ ☒ ☐ ☐ ☐ ☐ ☐

NAME	TDL	CHECKED	NUM	PASSED	QMM
ROYAL HARRINGTON					

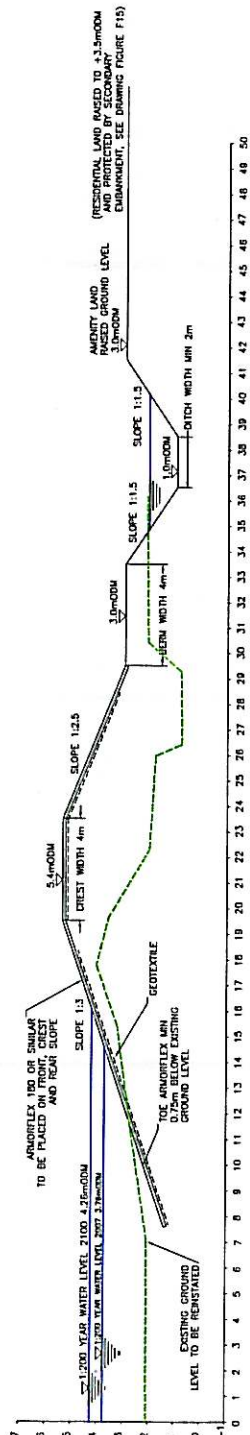
DATE 25.03.08	CLIENT REF.
NAME OF AI	AI/POD REF. 954067AO-F10

FIGURE F10	REVISION A
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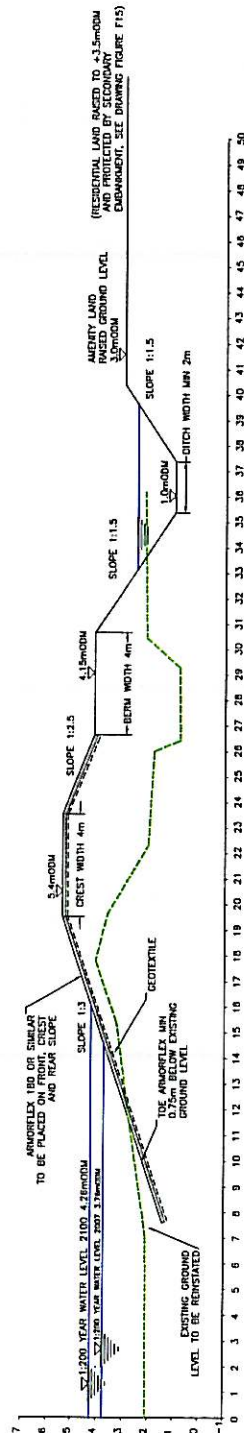
NOTES

1. ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED.
2. ALL LEVELS RELATIVE TO ORDNANCE DATUM UNLESS NOTED.

SECTION B
OPTION 3
EMBANKMENT 1
CHANGING 1385



SECTION B
OPTION 3
EMBANKMENT 2
CHANGING 1385



ROCKVIEW FARM
FLOOD RISK ASSESSMENT

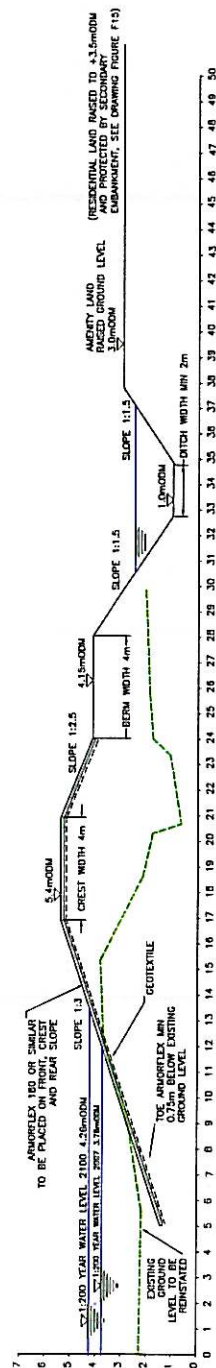
MAIN COASTAL EMBANKMENT
CROSS-SECTION B, OPTION 3
EMBANKMENT OPTIONS 1 & 2

DESIGNED BY		DRAWN BY		CHECKED BY		APPROVED BY	
ROYAL HASKONING		ROYAL HASKONING		ROYAL HASKONING		ROYAL HASKONING	
DATE: 25.03.00		DATE: 25.03.00		DATE: 25.03.00		DATE: 25.03.00	
SCALE: 1:1		SCALE: 1:1		SCALE: 1:1		SCALE: 1:1	
PROJECT No.		PROJECT No.		PROJECT No.		PROJECT No.	
FIGURE F11		FIGURE F11		FIGURE F11		FIGURE F11	

NOTES

1. ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED.
2. ALL LEVELS RELATIVE TO ORDNANCE DATUM MALIN HEAD

SECTION C
OPTION 3
EMBANKMENT 2
CHAINAGE 1991



APP	CHG	JA	INDICATOR	DATE	ANY
QAM	RM	TOL	STOULT KEYING CROCHARD MOI HIGHER		Y

ROCKVIEW FARM FLOOD RISK ASSESSMENT

TABLE

MAIN COASTAL EMBANKMENT CROSS-SECTION C, OPTION 3 EMBANKMENT OPTIONS 1 & 2

HAJONGMO BELLAND LTD

IN LANCET'S BACKCOUNTRY ATTEMPT
PUBLISHED BY THE
NEW YORK PUBLIC LIBRARY

MEMO	CREATED	FIN	BOOKED	TTL	AMOUNT
ROYAL HASKONING					
(company) use: Haskoning bank and: Haskoning bank and: Haskoning bank					

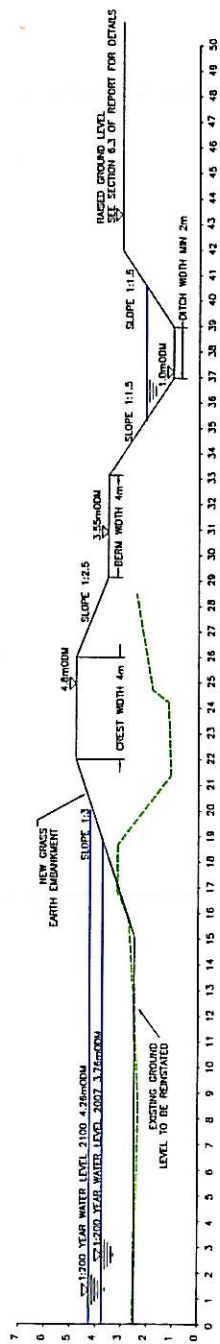
DATE 25.03.06	CLIENT'S REF.
ISSUED AT 11	ALFORDS REF. 954067AQ-F12

FIGURE F12 A

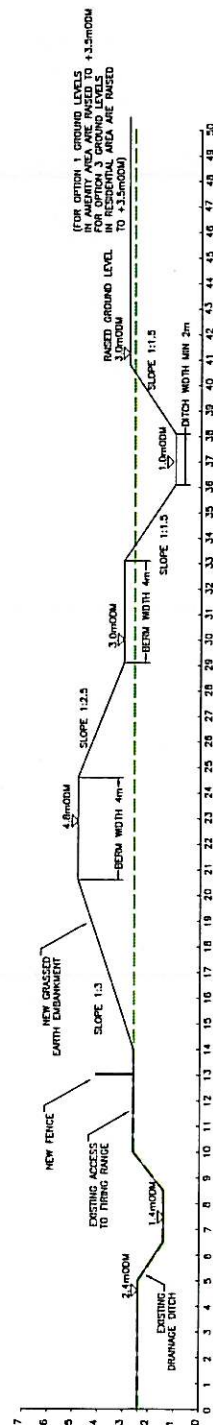
NOTES

1. ALL DOWNGRADES IN PAY UNLESS OTHERWISE STATED.
2. ALL LEVELS RELATIVE TO ORDINANCE DATUM MAIN HEAD.
3. SECTION 3. GRAB THE LOWER LEVEL OF THE RETURN ENLIGHTENMENT FOR ALL OPTIONS. ONLY ONE ENLIGHTENMENT OPTION HAS BEEN CONNECTED WITH A BEING LEVEL OF 4.35%GCEL.
4. NOTE FOR OPTION 4. SECTION 4. THIS MORTGAGE ENLIGHTENMENT IS ONLY BEING USED TO DETERMINE LOWER STG AS THE PRECEDENTIAL LANDS ARE ALREADY RATED TO 4.25%GCEL.

SECTION D
OPTION 1, 2 & 3
EMBANKMENT 1
CHAINAGE 2188



SECTION E
OPTION 1, 2 & 3
EMBANKMENT NORTH BOUNDARY SITE



DATE	BY	DESCRIPTION	DATE	BY
		STUDENT RESEARCH		

ROCKVIEW FARM
FLOOD RISK ASSESSMENT

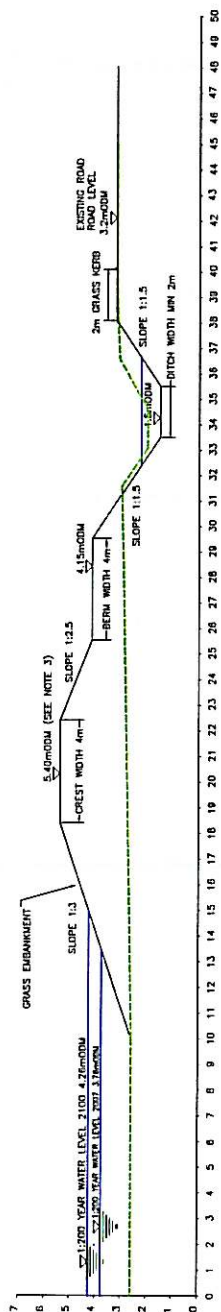
SOUTHERN & NORTHERN
RETURN EMBANKMENTS
CROSS-SECTIONS D & E
OPTIONS 1, 2 & 3

[illegible]

NOTES

1. ALL DIMENSIONS HEREIN STATED.
2. ALL LEVELS RELATED TO ORDNANCE DATUM MAIN HEAD.
3. COST LEVEL AVERAGE OF 40.00% AS TOWNSHIP LIVES OFF OIL IN MAIN CONSTITUTE TOWNSHIP BLACKOCCO VALLEY THE COST LEVEL SHOULD INCREASE IN LINE WITH MAIN COASTAL OIL INCREASE TO THE NORTH AND SHOULD BE ADJUSTED WITH ANNUALITY AS REQUIRED SEE PLAN FOR NOTES.

SECTION F
OPTION 1 & 3
ALONG BLACKROCK ROAD, SOUTH OF SITE



STATION		DATE		RECEIPT		BY		CHK		APP	
A		10/10/10		10/10/10		10/10/10		10/10/10		10/10/10	

ROCKVIEW FARM
FLOOD RISK ASSESSMENT

EMBANKMENT ALONG
BLACKROCK ROAD
CROSS-SECTION F

MAJORITY HOLDING LTD

Polynomial	Roots
$x^2 - 1$	± 1
$x^2 - 4$	± 2
$x^2 - 9$	± 3
$x^2 - 16$	± 4
$x^2 - 25$	± 5
$x^2 - 36$	± 6
$x^2 - 49$	± 7
$x^2 - 64$	± 8
$x^2 - 81$	± 9
$x^2 - 100$	± 10
$x^2 - 121$	± 11
$x^2 - 144$	± 12
$x^2 - 169$	± 13
$x^2 - 196$	± 14
$x^2 - 225$	± 15
$x^2 - 256$	± 16
$x^2 - 289$	± 17
$x^2 - 324$	± 18
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$x^2 - 1369$	± 37
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$x^2 - 1521$	± 39
$x^2 - 1600$	± 40
$x^2 - 1681$	± 41
$x^2 - 1764$	± 42
$x^2 - 1849$	± 43
$x^2 - 1936$	± 44
$x^2 - 2025$	± 45
$x^2 - 2116$	± 46
$x^2 - 2209$	± 47
$x^2 - 2304$	± 48
$x^2 - 2401$	± 49
$x^2 - 2500$	± 50
$x^2 - 2601$	± 51
$x^2 - 2704$	± 52
$x^2 - 2809$	± 53
$x^2 - 2916$	± 54
$x^2 - 3025$	± 55
$x^2 - 3136$	± 56
$x^2 - 3249$	± 57
$x^2 - 3364$	± 58
$x^2 - 3481$	± 59
$x^2 - 3600$	± 60
$x^2 - 3721$	± 61
$x^2 - 3844$	± 62
$x^2 - 3969$	± 63
$x^2 - 4096$	± 64
$x^2 - 4225$	± 65
$x^2 - 4356$	± 66
$x^2 - 4489$	± 67
$x^2 - 4624$	± 68
$x^2 - 4761$	± 69
$x^2 - 4900$	± 70
$x^2 - 5041$	± 71
$x^2 - 5184$	± 72
$x^2 - 5329$	± 73
$x^2 - 5476$	± 74
$x^2 - 5625$	± 75
$x^2 - 5776$	± 76
$x^2 - 5929$	± 77
$x^2 - 6084$	± 78
$x^2 - 6241$	± 79
$x^2 - 6400$	± 80
$x^2 - 6561$	± 81
$x^2 - 6724$	± 82
$x^2 - 6889$	± 83
$x^2 - 7056$	± 84
$x^2 - 7225$	± 85
$x^2 - 7396$	± 86
$x^2 - 7569$	± 87
$x^2 - 7744$	± 88
$x^2 - 7921$	± 89
$x^2 - 8100$	± 90
$x^2 - 8281$	± 91
$x^2 - 8464$	± 92
$x^2 - 8649$	± 93
$x^2 - 8836$	± 94
$x^2 - 9025$	± 95
$x^2 - 9216$	± 96
$x^2 - 9409$	± 97
$x^2 - 9604$	± 98
$x^2 - 9801$	± 99
$x^2 - 10000$	± 100

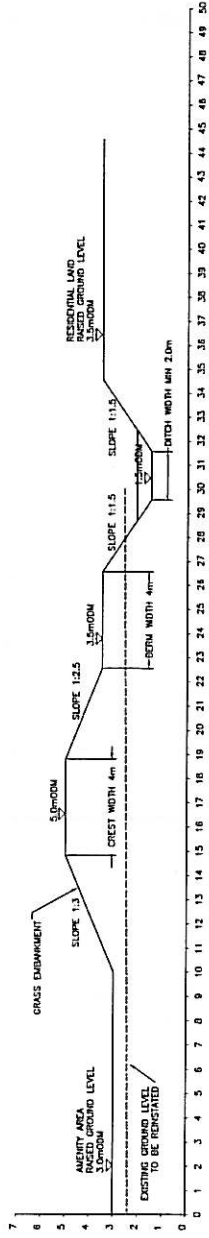
ROYAL HAWKING	PROGRAM CC	CHECKED NM	PASSED DMU
	DAILY 2501.08	CLIENT'S REF.	

SCALE AT A1	AUTOCAD REV. 954067AO-F14
FIGURE F14 REVISION A	

NOTES

- 1. ALL DIMENSIONS IN MM UNLESS OTHERWISE STATED.
- 2. ALL LEVELS RELATIVE TO ORDNANCE DATUM (A.M.S.L.).

SECTION G
SECONDARY EMBANKMENT FOR
OPTION 3



A. SHOW ELEVATION FOR MARKED WATER LEVELS				DATE
DATE	DESCRIPTION	BY	CHKD	DATE
REVISIONS				

ROCKVIEW FARM
FLOOD RISK ASSESSMENT

SECONDARY EMBANKMENT
FOR OPTION 3
CROSS-SECTION G

PROJECT NO. 954067AO-F15	
CLIENT: ROCKVIEW FARM	
DESIGNED BY: [Signature]	
CHECKED BY: [Signature]	
DATE: 23.03.08	
SCALE: 1:10	
PROJECT REF: 954067AO-F15	
DRAWING NO. FIGURE F15	
REVISION: A	

