APPENDIX A – EXISTING & PROPOSED CONTOURS

N

0 250m

1:7,500 @ A3

OHINEWAI STRUCTURE PLAN

Illustrative Masterplan

Date: 03 October 2019 | Revision J

Drawing Number: 1805_018

Plan prepared by Adapt Studio Ltd for Gaze Property Solutions

REVISION DETAILS		INT	DATE	SURVEYED	RH
1	ISSUED FOR INFORMATION	BP	20/11/2019	DESIGNED	MC
				DRAWN	BP
				CHECKED	BP
				APPROVED	

231 TAHUNA ROAD
& 88 LUMSDEN ROAD
OHINEWAI
WAIKATO

WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS

MASTER PLAN EXISTING CONTOURS

N

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:7500 @ A3, 1:3750 @ A1	1
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	P19-137-00-1015-SK	

LEGEND

PROPOSED CONTOURS — 23.0

ZONE BOUNDARY

REVISION DETAILS		INT	DATE	SURVEYED	RH
1	ISSUED FOR INFORMATION	BP	20/11/2019	DESIGNED	MC
				DRAWN	BP
				CHECKED	BP
				APPROVED	

231 TAHUNA ROAD
& 88 LUMSDEN ROAD
OHINEWAI
WAIKATO
WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS

MASTER PLAN PROPOSED CONTOURS

N

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:7500 @ A3, 1:3750 @ A1	1
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	P19-137-00-1016-SK	

VOLUMES

CUT	=	500 000 m³
FILL	=	2 450 000 m³
AREA	=	176 Ha

LEGEND

EXISTING CONTOURS 23.0

CUT AREAS

FILL AREAS

ZONE BOUNDARY

REVISION DETAILS		INT	DATE	SURVEYED	RH
1	ISSUED FOR INFORMATION	BP	20/11/2019	DESIGNED	MC
				DRAWN	BP
				CHECKED	BP
				APPROVED	

231 TAHUNA ROAD
& 88 LUMSDEN ROAD
OHINEWAI
WAIKATO
WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS

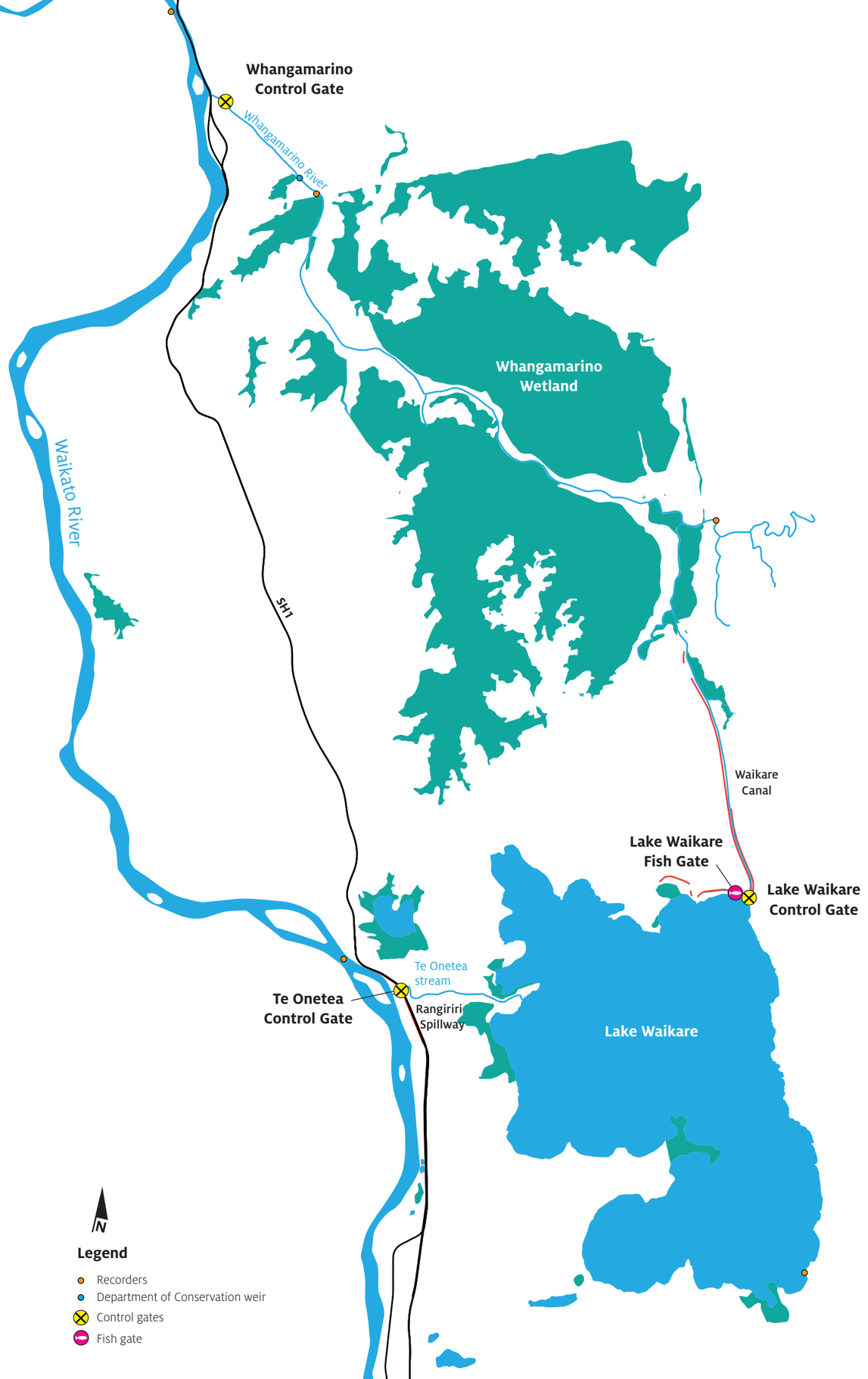
MASTER PLAN CUT & FILL DEPTH POLYGONS

N

STATUS	ISSUED FOR INFORMATION
SCALE	1:7500 @ A3, 1:3750 @ A1
COUNCIL	WAIKATO DISTRICT COUNCIL
DWG NO	P19-137-00-1017-SK

REV 1

APPENDIX B – WRC COMMUNITY GATE OPERATIONS



TE ONETEA GATE OPERATION

Action is determined primarily by the relationship between the Waikato River level at the gate and the Lake Waikare level.

Situation	Action
Waikato River level is below Lake Waikare Levels	Te Onetea gate will be closed
Waikato River level is above Lake Waikare Level but below RL 7.00 metres	Te Onetea gate will be open
Waikato River level is above Lake Waikare Level and above RL 7.00 metres	Te Onetea gate will be closed

WAIKARE GATE OPERATION

Action is determined by the relationship between the Lalce Level and the appropriate seasonal Target Level.

Season	Action
April 1 to September 30 RL 5.50 metres	Gate opening/closing levels and apertures are to be set with the objective of keeping the Lake level between RL's 5.40 and 5.60 metres.
October 1 to December 31 RL 5.65 metres	Gate opening/closing levels and apertures are to be set with the objective of keeping the Lake level between RL's 5.55 and 5.75 metres.
January 1 to March 31 RL 5.60 metres	Gate opening/closing levels and apertures are to be set with the objective of keeping the Lake level between RL's 5.50 and 5.70 metres.
Situation	**Action**
Whangamarino Gate is closed	Waikare Gate is then closed. Te Onetea Gate is also closed.
Rangiriri Spillway is operating	Waikare Gate is then closed. Te Onetea Gate is also closed.

WHANGAMARINO GATE OPERATION

Action is determined by the relationship between the Whangamarino River Level and the Waikato River Level.

Situation	Action
Waikato River level is above Whangamarino River Level	Whangamarino gate will be closed, unless agreed otherwise by key parties.
Waikato River level is below Whangamarino River Level	Whangamarino gate is opened.

WAIKARE GATE FISH PASS

Situation	Action
Lake is operating under a flood.	Fish pass gate is closed.
Lake is at or below RL 5.40 meters.	Fish pass gate is closed.
Lake is operating in normal range.	Fish pass gate is opened.

Reference: EWDOCS n1348507 v2 Lake Waikare system structures mitigation management plan - Lower Waikato Waipa flood control

APPENDIX C – STAKEHOLDER ENGAGEMENT RECORDS / MEETING MINUTES

To

Mark Pennington
Tonkin + Taylor (T+T) /
Waikato Regional Council (WRC)

Circulation: Woods, WRC

From

Woods
Ajay Desai – Senior Stormwater Modeller

W-REF: P19-186
13 September 2019

Meeting Minutes - 12/09/2019

88 Lumsden Road/231 Tahuna Road, Ohinewai

Location	Microsoft Team Meeting			
Time & Date		12/09/2019	**Taken by**	Ajay Desai
Attendees	**Initials**	**Name**		**Company**
	AD	Ajay Desai		Woods
	MP	Mark Pennington		T+T / WRC
	SG	Sakti Gounder		Woods
	PW	Pranil Wadan		Woods
Apologies	**Initials**	**Name**		**Company**
	DG	David Gaze		Gaze Holdings Limited

Proposal / Introduction

Mark Pennington has been engaged by Waikato Regional Council to review the modelling completed by Woods (working on behalf of Ambury Properties Ltd) for the proposed development at 88 Lumsden Road/231 Tahuna Road, Ohinewai. Findings will be discussed and shared with WRC. This meeting was the first model review discussion meeting to agree on items listed below.

Minutes

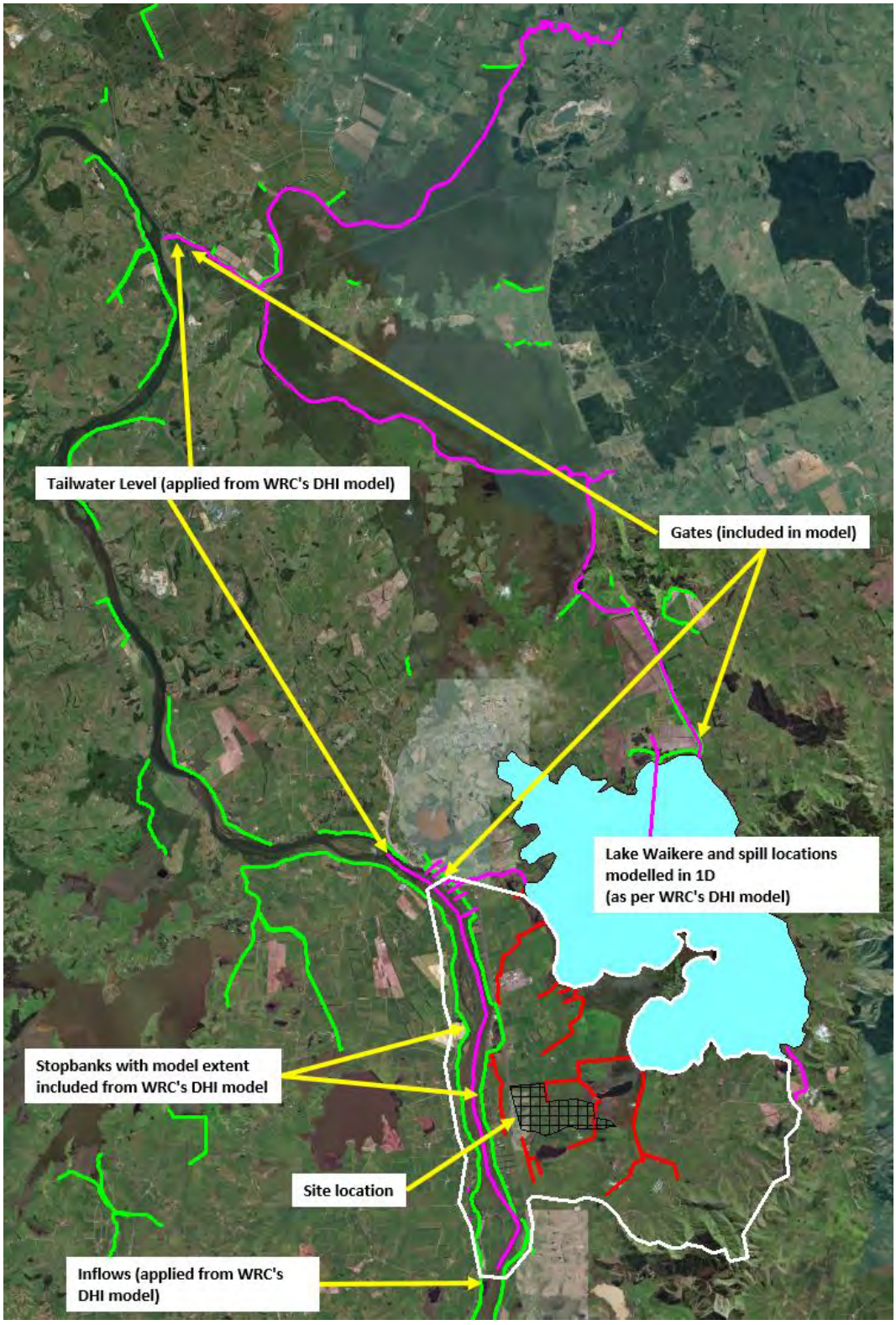
Action Items	Responsibility	Status	Agreement between Reviewer and Modeller
a) Findings to the review will be discussed and shared with WRC	MP	Ongoing	Agreed
b) Stormwater drains being surveyed, to be included in the model (to be represented in 2D)	AD	Ongoing	
c) Check the DHI model vertical datum - possibly Moturiki 1953	AD / MP	Ongoing	
d) Survey datum to be checked and confirmed to match DHI model	AD	Ongoing	
Pre-Development Model Development discussions			
e) 2D model boundary extent as shown in Appendix A		Completed	Agreed
f) 2D model extent to be subtracted from the contributing NAM runoff catchment (catchment 25)	AD	Ongoing	Agreed
g) Infiltration losses to be modelled for 2D domain once predevelopment model is validated against the Waikato River model	AD	Ongoing	Agreed
h) Stormwater drain survey data to be included in the model when available		Waiting for drain survey to be completed	Agreed
i) River Waikato (along with the associated lateral link) trimmed as per the 2D model extent		Completed	Agreed
j) River Waikato stop banks within 2D extents to be modelled as per DHI model		Completed	Agreed
k) Rangiri Spillway to be modelled as per DHI model in 1D		Completed	Agreed
l) 1D model extent to include modelled streams to include all control gates - Lake Waikare Control gate, Whangamarino Control gate, Te Onetea Control gate		Completed	Agreed
m) All the control gates to be included in the model based on the DHI model (Lake Waikare Control gate, Whangamarino Control gate, Te Onetea Control gate)		Completed	Agreed
n) Lake Waikere to be modelled in 1D based on Waikato River DHI model as additional storage in cross section data		Completed	Agreed
o) Level storage relationship to be checked against DEM elevations to avoid double counting of storage. Area represented in 2D domain to be subtracted from Lake Waikere storage.	AD	Ongoing	Agreed
p) DHI model to be checked for Lake Waikere storage being modelled appropriately	AD	Ongoing	Agreed
q) Lake Ohinewai included in 2D model using depth contours provided by WRC		Completed	Agreed
r) Hydraulic grade between Lake Rotokawau and Lake Waikere to be checked against connecting stormwater drain survey data is available		To be checked when drain survey data is available	Agreed
Post Development Model Development Scenarios:			
s) To be discussed on completion of Pre-Development scenario	AD / MP	Planned	Agreed
Stop bank breach scenarios:			
t) To be discussed on completion of Pre-Development scenario. Initial thoughts:	AD / MP	Planned	Agreed
u) Calculate water level differences between River Waikato and eastern land adjoining the stop bank along the stopbank length to assess the critical location for stopbank breach.	AD / MP	Planned	Agreed

Ajay Desai

Senior Stormwater Modeller

Approved as true and accurate record of meeting

Appendix A


Tailwater Level (applied from WRC's DHI model)
Gates (included in model)
Lake Waikere and spill locations modelled in 1D (as per WRC's DHI model)
Stopbanks with model extent included from WRC's DHI model
Site location
Inflows (applied from WRC's DHI model)

To	From
Mark Pennington *Tonkin + Taylor (T+T) /* *Waikato Regional Council (WRC)*	*Woods* *Ajay Desai – Senior Stormwater Modeller*
Circulation: Woods, WRC	*W-REF: P19-186* *10 October 2019*

Meeting Minutes - 12/09/2019

88 Lumsden Road/231 Tahuna Road, Ohinewai

Location	Microsoft Team Meeting			
Time & Date		10/10/2019	**Taken by**	Ajay Desai
Attendees	**Initials**	**Name**		**Company**
	AD	Ajay Desai		Woods
	MP	Mark Pennington		T+T / WRC
Apologies	**Initials**	**Name**		**Company**
	DG	David Gaze		Gaze Holdings Limited
	SG	Sakti Gounder		Woods
	PW	Pranil Wadan		Woods

Proposal / Introduction

Mark Pennington has been engaged by Waikato Regional Council to review the modelling completed by Woods (working on behalf of Ambury Properties Ltd) for the proposed development at 88 Lumsden Road/231 Tahuna Road, Ohinewai. Findings will be discussed and shared with WRC. This meeting was the third model review discussion meeting to agree on items listed below.

Minutes

Action Items	Responsibility	Status	Agreement between Reviewer and Modeller
Pre-Development Model Development discussions			
a) Update the maximum dx for Waikato River to 10 (DHI model uses 10,000)	AD	Completed	Agreed
b) Update the Mike 11 initial water levels for surveyed drains as follows: Drain 1 and Drain 2 – 4.9mRL; Drain 3 – 5.0mRL	AD	Completed	Agreed
c) Lake Waikare and Lake Rotokawau modelled as 1D without any storage associated with Lake Rotokawau (no data available and surveying is difficult with no access)	AD	Completed	Agreed
d) Refer to WRC's Modelling Specifications for Curve Number method for subcatchment based modelling approach instead of rain on grid to represent losses associated with land uses appropriately	AD	Ongoing	Agreed
e) Compare CN approach with wider DHI model to assure they have similar results (minor differences are expected with CN and NAM Runoff methods)	AD	Ongoing	Agreed
Post Development Model Development Scenarios:			
f) To be discussed on completion of Pre-Development scenario	AD / MP	Planned	Agreed
Stop bank breach scenarios:			
g) Calculate water level differences between River Waikato and eastern land adjoining the stop bank along the stopbank length to assess the critical location for stopbank breach.	AD	Planned	Agreed
h) Check model results to the south west of site if flows from breach would enter site	AD	Planned	Agreed

Ajay Desai

Senior Stormwater Modeller

Approved as true and accurate record of meeting

To	From
Mark Pennington *Tonkin + Taylor (T+T) /* *Waikato Regional Council (WRC)*	*Woods* *Ajay Desai – Senior Stormwater Modeller*
Circulation: Woods, WRC	*W-REF: P19-186* *24 October 2019*

Meeting Minutes - 23/10/2019

88 Lumsden Road/231 Tahuna Road, Ohinewai

Location	Microsoft Team Meeting			
Time & Date		23/10/2019	**Taken by**	Ajay Desai
Attendees	**Initials**	**Name**		**Company**
	AD	Ajay Desai		Woods
	MP	Mark Pennington		T+T / WRC
Apologies	**Initials**	**Name**		**Company**
	DG	David Gaze		Gaze Holdings Limited
	SG	Sakti Gounder		Woods
	PW	Pranil Wadan		Woods

Proposal / Introduction

Mark Pennington has been engaged by Waikato Regional Council to review the modelling completed by Woods (working on behalf of Ambury Properties Ltd) for the proposed development at 88 Lumsden Road/231 Tahuna Road, Ohinewai. Findings will be discussed and shared with WRC. This meeting was the third model review discussion meeting to agree on items listed below.

Minutes

Action Items	Responsibility	Status	Agreement between Reviewer and Modeller
Pre-Development Model Development discussions			
a) Waikato River model built by DHI gives a maximum water level of approximately 8.5mRL around Lake Waikere which is higher than the spillway which would operate at 8mRL. Hence the model results cannot be relied upon for this assessment and Woods should continue using the local model that has been built using Curve Number approach (as per Waikato Stormwater Runoff Modelling Guideline)	AD / MP		Agreed
b) Use a constant boundary condition of 8mRL for Lake Waikere and exclude interactions between River Waikato and Lake Waikare which operates above 8mRL	AD / MP		Agreed
c) River Waikato and other streams to be excluded from the model as there is no interaction between River Waikato and proposed site (flood effects are only from Lake Waikare). DHI model to be used as reference only.	AD / MP		Agreed
d) AD to document DHI model results around Lake Waikare in an email and circulate to MP and Rick Liefting (WRC).	AD		Agreed
Post Development Model Development Scenarios:			
e) To be discussed on completion of Pre-Development scenario	AD / MP	Planned	Agreed
Stop bank breach scenarios:			
f) 2 locations identified for breach discussed and agreed to be tested in one model run, if needed these can be tested separately following discussion between AD and MP.	AD	Agreed	Agreed
g) Use steady state analysis with a breach of approximately 30m by applying a constant water level of 10mRL at River Waikato and 8mRL at Lake Waikare for checking the impact of breach on proposed development. This is not an effects assessment for comparing pre and post development scenarios but only to understand and highlight risk by breach of stop bank.	AD	Planned	Agreed

Ajay Desai

Senior Stormwater Modeller

Approved as true and accurate record of meeting

To

Mark Pennington
Tonkin + Taylor (T+T) /
Waikato Regional Council (WRC)

Circulation: Woods, WRC

From

Woods
Ajay Desai – Senior Stormwater Modeller

W-REF: P19-186
25 October 2019

Meeting Minutes - 25/10/2019

88 Lumsden Road/231 Tahuna Road, Ohinewai

Location	Microsoft Team Meeting			
Time & Date		23/10/2019	**Taken by**	Ajay Desai
Attendees	**Initials**	**Name**		**Company**
	AD	Ajay Desai		Woods
	RL	Rick Liefting		WRC
	GB	Ghassan Basheer		WRC
	SG	Sakti Gounder		Woods
Apologies	**Initials**	**Name**		**Company**
	MP	Mark Pennington		T+T / WRC

Proposal / Introduction

This meeting was arranged between WRC and Woods to discuss the modelling approach taken and agreed with Mark Pennington has been engaged by Waikato Regional Council to review the modelling completed by Woods for the proposed development at 88 Lumsden Road/231 Tahuna Road, Ohinewai.

Findings will be discussed and shared with WRC. This meeting was the fourth model review discussion meeting to agree on items listed below.

Minutes

Action Items	Responsibility	Status	Agreement between Reviewer and Modeller
Pre-Development Model Development discussions			
a) Waikato River model built by DHI gives a maximum water level of approximately 8.5mRL around Lake Waikere which is higher than the spillway which would operate at 8mRL. Hence the model results cannot be relied upon for this assessment and Woods should continue using the local model that has been built using Curve Number approach (as per Waikato Stormwater Runoff Modelling Guideline).	AD	Done	Agreed
b) Use a constant boundary condition of 8mRL for Lake Waikere and exclude interactions between River Waikato and Lake Waikare which operates above 8mRL	AD	Done	Agreed
c) River Waikato and other streams to be excluded from the model as there is no interaction between River Waikato and proposed site (flood effects are only from Lake Waikare). DHI model to be used as reference only.	AD	Done	Agreed
Post-Development Model Development discussions			
d) WRC and Woods have agreed that the proposed development would not be discharging to any of the existing WRC drains. This will be reflected in the ongoing Stormwater Management, design and modelling.	AD/SG		Information only
Stop bank breach scenarios:			
e) 2 locations identified for breach discussed and agreed to be tested in one model run, if needed these can be tested separately following discussion between AD and MP.	AD	Ongoing	Agreed
f) Use steady state analysis with a breach of approximately 30m by applying a constant water level extracted from the DHI Waikato River model using RCP8.5 scenario and 8mRL at Lake Waikare for checking the impact of breach on proposed development. This is not an effects assessment for comparing pre and post development scenarios but only to understand and highlight risk by breach of stop bank.	AD	Ongoing	Agreed

g)	Include earth bund around Rangiriri Spillway (part of Flood Management Emergency Plan) upstream end the spillway across the state highway terminating at the railway embankment to have no overland flow around the highway corridor at this location. Details provided by GB.	AD	Ongoing	Agreed

Ajay Desai

Senior Stormwater Modeller

Approved as true and accurate record of meeting

To

Mercury Energy
Fraser Graafhuis
Level 3/17 Grantham Street
Hamilton 3204

From

Woods
Sakti Gounder – Stormwater Engineer

W-REF: P18-258
16 September 2019

Memorandum

88 Lumsden Road/231 Tahuna Road – Stormwater Summary

This memo has been written to summarise the stormwater modelling proposed to be undertaken for the site at 88 Lumsden Road and 231 Tahuna Road, Ohinewai. Both addresses are part of the development site held by the New Zealand Comfort Group (NZCG), a subsidiary of Ambury Properties Ltd (APL).

APL are intending to develop both sites to include industry, factory outlet shops, a service centre and community focused shops/activities and a medium density residential development.

This memo summarises the stormwater flood modelling strategy for the proposed development. The flood modelling strategy has been formulated to quantify the effects of development on the water levels in Lake Waikare, Lake Rotokawau and neighbouring sites.

1. Modelling approach

The site lies to the east of the Waikato Expressway and the Waikato River. The site location is indicated in green in Figure 1. The site is located to the east of the stop banks along the Waikato River.

Three modelling scenarios are proposed to be run:

- Pre-development model: to quantify the existing scenario.
- Post development model: to quantify the effects of development. Effects includes any increases in water level or flood extents within Lake Waikare, Lake Rotokawau or neighbouring sites.
- Post development optioneering models: to quantify the effects of development across Lake Waikare/Lake Rotokawau and other neighbouring sites with proposed stormwater management devices in place.
    - It should be noted that the post development optioneering models will quantify flood effects with stormwater attenuation devices in place.
- An emergency management scenario: to quantify effects in the instance of a damn/stop bank breach. Flood results to quantify inundation risk to the development.

Waikato Regional Council (WRC) have requested that all future/post development models use the RCP6.0 temperature increase to model future rainfall scenarios with an additional sensitivity analysis to be done for RCP8.5 temperature increase.

RCP6.0 and RCP8.5 are models to represent increase in rainfall resulting from climate change. RCP stands for representative concentration pathways for the greenhouse gas emissions currently in the atmosphere. RCP6.0 represents a 'stabilisation pathway' scenario, where the effect of greenhouse gas emissions stabilises after 2100. This is a conservative estimate of increases in rainfall due to climate change.

RCP8.0 represents a 'business as usual' concentration pathway, with very high greenhouse gas concentrations by 2100 and beyond. This represents extreme increases in temperature and will result in a conservative estimate of flood levels for the project. It should be noted that the RCP8.0 scenario will only be run as part of a sensitivity analysis.

WRC are kept involved and informed throughout the project as Woods are working collaboratively with Mark Pennington who has been appointed as the reviewer by WRC.

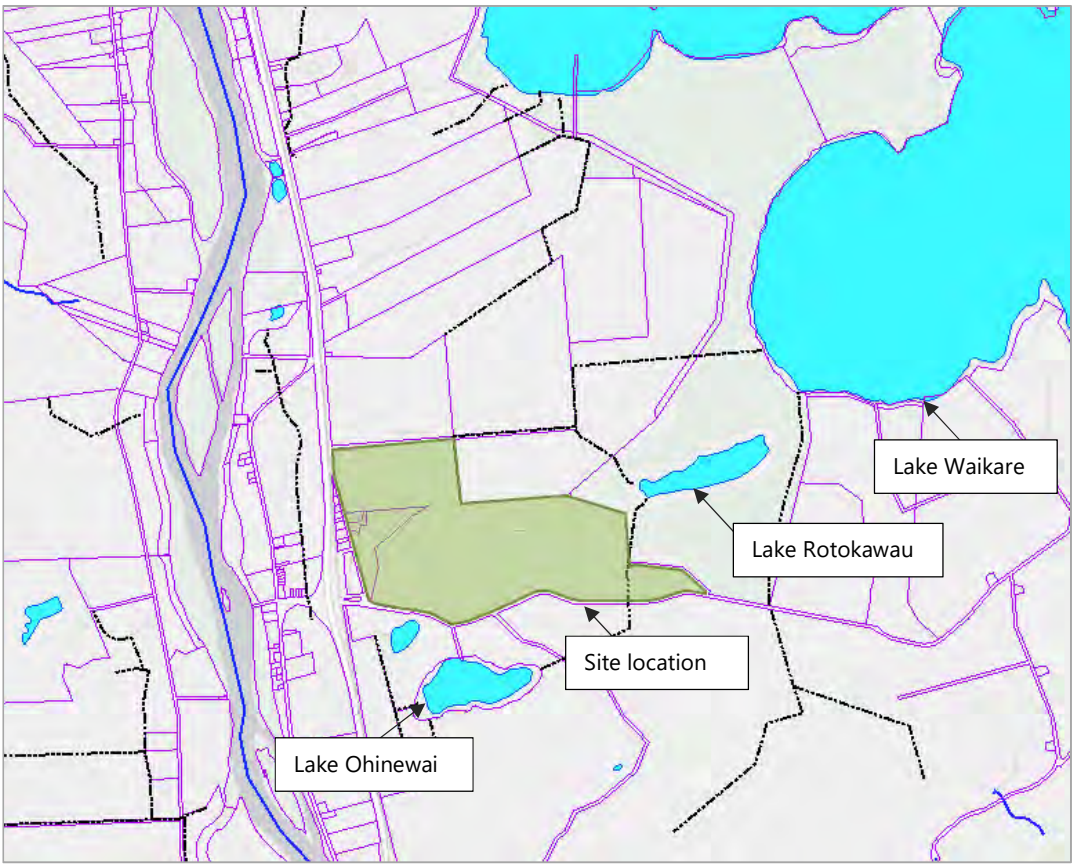


Figure 1: Site location

2. Modelled extent

Woods have received Waikato Regional Council's (WRC's) Mike by DHI model of the Waikato River. The modelling scope includes running a 'cut down' version of the model to set a baseline scenario to be used to quantify the effects of the development on Lake Waikare, Lake Rotokawau and other land holders in the area.

The DHI model is a 1D model of the Waikato River only and does not include the rivers and lakes to the east of the expressway. Woods have defined a modelling approach, which has been shared with WRC. This section summarises the modelling approach.

Woods propose to take the existing 1D model and incorporate the 2D extents to quantify the effects of filling in the site. The proposed extents of the 1D/2D model can be seen in Figure 2.

Figure 2 shows the following features:

- The proposed model extent in white;
- Farm drains– to be modelled in 2D highlighted with red lines;
- Lake Ohinewai – to be modelled in 2D as lake depths are available;
- Lake Rotokawau – representation to be discussed with WRC;
- Lake Waikare to be modelled as a 1D storage node with spillway and flood gate as per WRC' Waikato River DHI model;
- Boundary conditions:
    - Inflows into Lake Waikare within the proposed model extent
    - Tailwater boundary conditions to be considered from Lake Waikare; and
    - Tailwater boundary conditions in the Waikato at the outlet from the model extent

- Alternate boundary condition for Lake Waikare to be confirmed in discussion with WRC (described in section 3)

- Location of the proposed stop banks to the west of the Waikato Expressway as per WRC 's Waikato River DHI model (shown in green in Figure 3 below)
- The proposed model also includes the gates as shown in Figure 2 below and gate operations are modelled as per the Waikato River model.

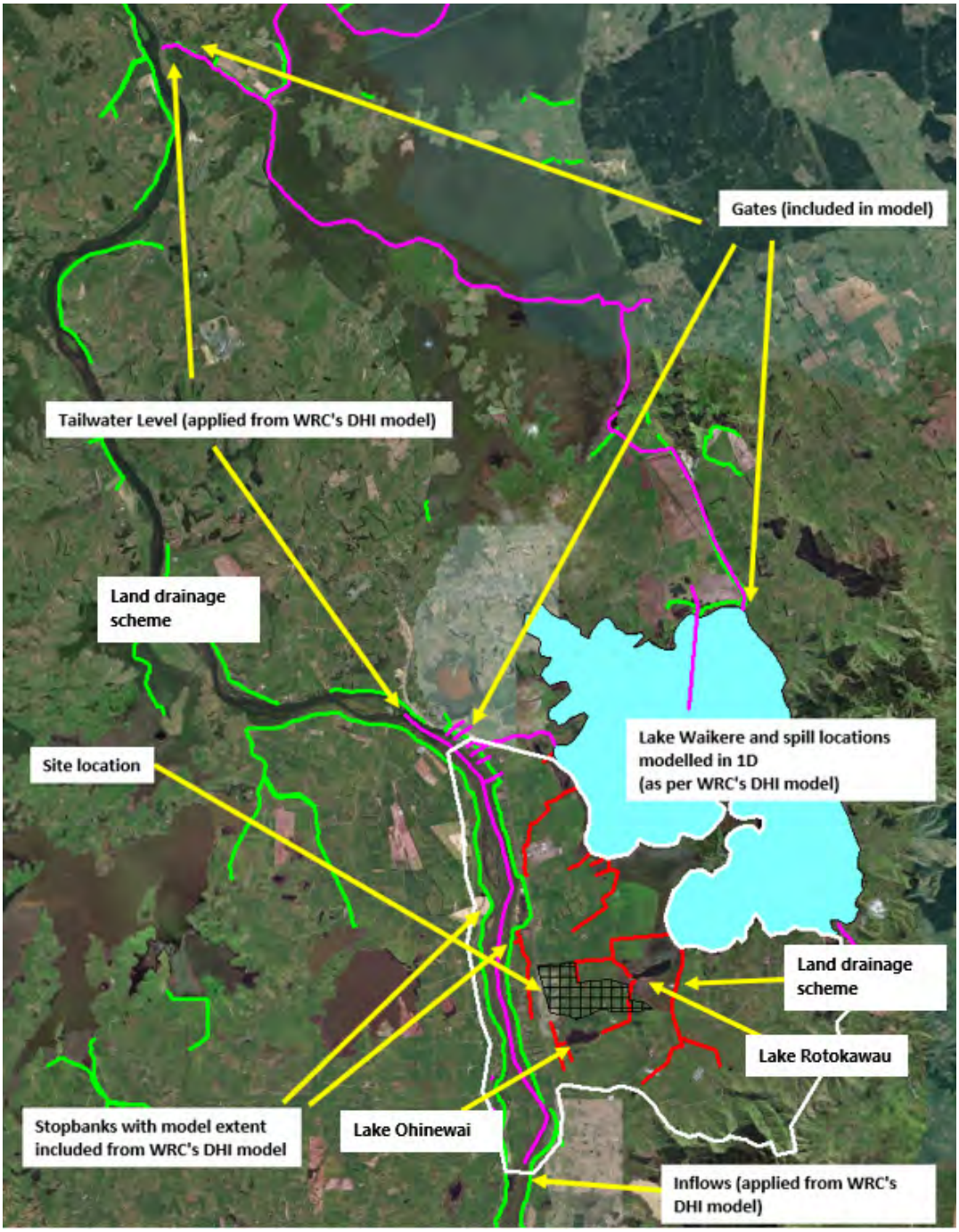


Figure 2: Proposed model extents

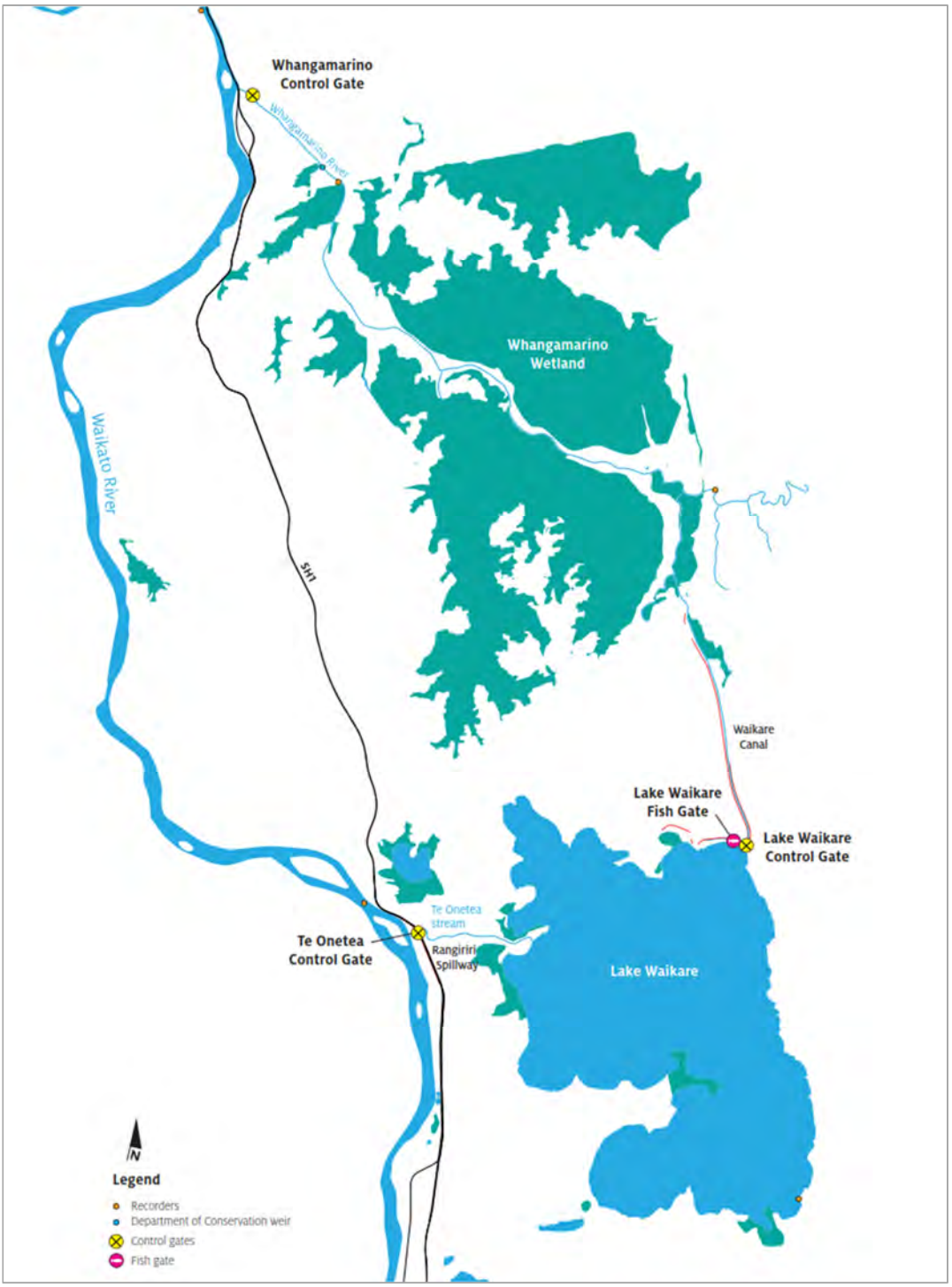


Figure 3: Control Gate locations

3. Other Considerations

Based on records of the Waikato Regional Flood Event of 9 – 20 July 1998, the following information is known about historical flooding in Lake Waikare:

- The lake level in the 1998 event is approximately 6.29 m RL.
- The lake levels are artificially controlled between 5.50-5.65 m RL.
- The design flood level of the land drainage scheme is 7.37 m RL.

- The spillway for Lake Waikare is at 8.00 mRL. This means that water levels in Lake Waikare will reach a maximum of 8.00 mRL.

There will be proposed topographical changes to the site following development, including the filling in of existing floodplain storage to raise the site out of the floodplain, as well as increases in runoff volume resulting from on-site intensification. All stormwater management devices on site will address both flood displacement volume and attenuation volume from the increase in impervious area.

APPENDIX D – CATCHMENT EXTENTS

Lake Waikare

Lake Rotokawau

Lake Ohinewai

Legend

- Proposed Site Layout
- Sleepyhead Site Extent
- WRC Drains
- Lakes
- Stop Bank
- Lake Waikare Catchment
- Sleepyhead Model Extent

REVISION DETAILS		INT	DATE
1	Final issue	AD	21/11/19

SURVEYED	n/a
DESIGNED	AD
DRAWN	SH
CHECKED	PW
APPROVED	DW

231 TAHUNA ROAD
& 88 LUMSDEN ROAT
OHINEWAI
WAIKATO

WOODS.CO.NZ

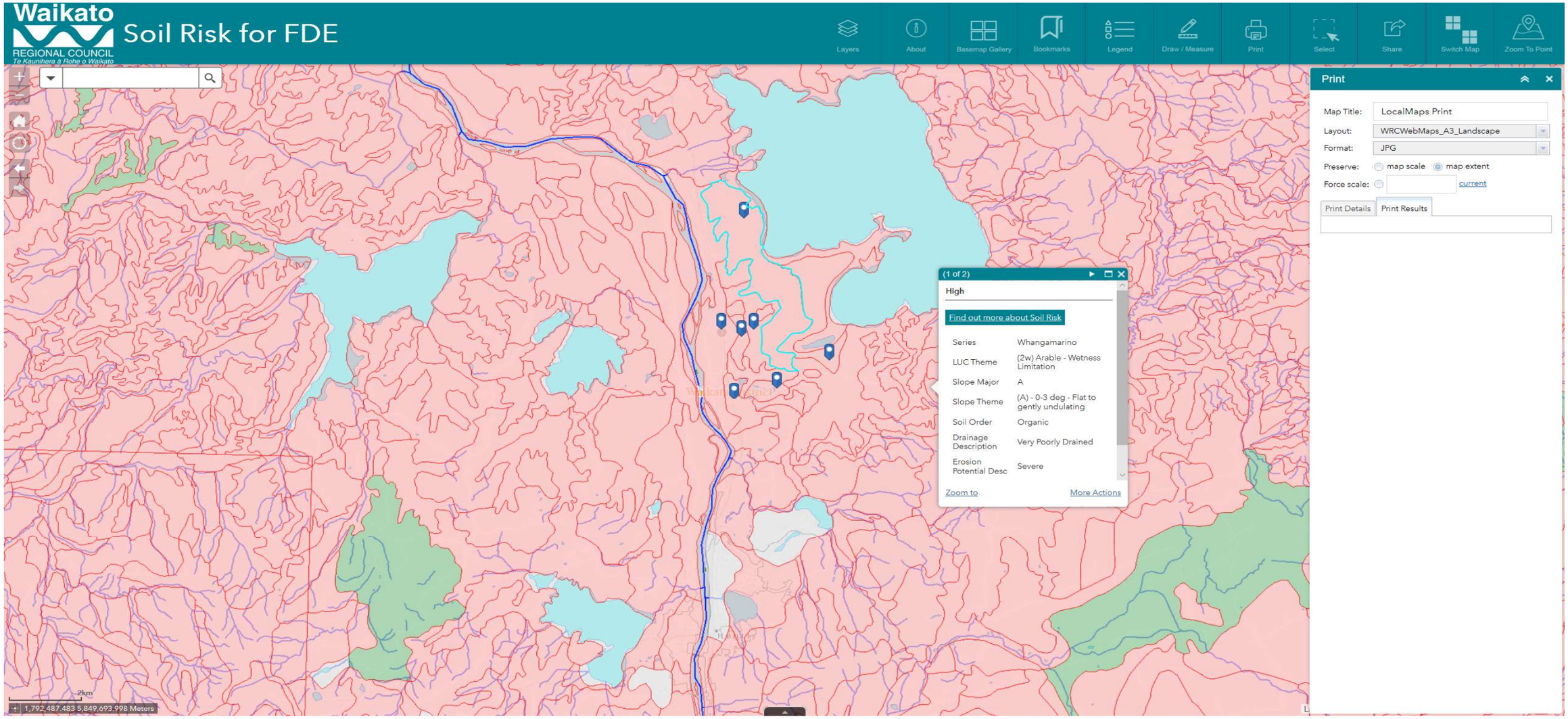
the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS
Catchment Extents

STATUS	ISSUED FOR INFORMATION
SCALE	1:XXXX @ A3
COUNCIL	WAIKATO DISTRICT COUNCIL
DWG NO	..\GIS\P19-268-reports.qgz P19-140-00-1106-SK

REV

APPENDIX E – MODELLING INPUTS


Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato
Soil Risk for FDE
Layers
About
Basemap Gallery
Bookmarks
Legend
Draw / Measure
Print
Select
Share
Switch Map
Zoom To Point
Print
Map Title: LocalMaps Print
Layout: WRCWebMaps_A3_Landscape
Format: JPG
Preserve: map scale map extent
Force scale: current
Print Details
Print Results
(1 of 2)
High
Find out more about Soil Risk
Series Whangamarino
LUC Theme (2w) Arable - Wetness Limitation
Slope Major A
Slope Theme (A) - 0-3 deg - Flat to gently undulating
Soil Order Organic
Drainage Description Very Poorly Drained
Erosion Potential Desc Severe
Zoom to
More Actions
2km
1,792,487.483 5,849,693.998 Meters

HIRDS V4 Depth-Duration-Frequency Results
Sitename: Ohinewai_Centroid
Coordinate system: WGS84
Longitude: 175.185
Latitude: -37.4834

DDF Mode	Parameter:	c	d	e	f	g	h	i
	Values:	0.000258	0.391302	-0.01917	0	0.253632	-0.00903	2.954586
	Example:	Duration (h	ARI (yrs)	x	y	Rainfall Depth (mm)		
		24	100	3.178054	4.600149	146.0617		

Rainfall depths (mm) :: Historical Data

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	8.95	12.2	14.5	19.2	24.9	36.4	45.1	54.8	65.5	72	76.8	80.5
2	0.5	9.81	13.4	15.9	21	27.3	39.9	49.4	60.1	71.8	79	84.2	88.3
5	0.2	12.8	17.5	20.8	27.5	35.8	52.2	64.7	78.7	94	103	110	116
10	0.1	15.1	20.6	24.5	32.4	42.2	61.6	76.3	92.9	111	122	130	137
20	0.05	17.5	23.9	28.4	37.6	49	71.5	88.6	108	129	142	151	159
30	0.033	19	25.9	30.8	40.8	53.1	77.5	96.1	117	140	154	164	172
40	0.025	20.1	27.4	32.6	43.2	56.1	82	102	124	148	163	173	182
50	0.02	21	28.6	34	45	58.5	85.5	106	129	154	170	181	190
60	0.017	21.7	29.5	35.1	46.5	60.5	88.4	110	133	159	175	187	196
80	0.012	22.8	31.1	37	49	63.7	93.1	115	140	168	185	197	207
100	0.01	23.7	32.3	38.4	50.9	66.2	96.7	120	146	175	192	205	215
250	0.004	27.5	37.5	44.6	59.1	76.9	112	139	170	203	223	238	250

Depth standard error (mm) :: Historical Data

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	1.1	1.4	1.5	2.1	2.8	5.1	7	12	14	16	17	18
2	0.5	1.2	1.5	1.6	2.4	3.1	5.6	7.7	13	16	18	19	19
5	0.2	1.7	2.2	2.4	3.3	4.4	7.5	10	17	21	24	25	26
10	0.1	2.1	2.9	3.2	4.3	5.7	9.3	13	20	25	28	30	31
20	0.05	2.8	3.8	4.3	5.6	7.6	12	16	24	29	33	35	36
30	0.033	3.3	4.5	5.1	6.6	9	13	18	26	32	36	38	40
40	0.025	3.6	5.1	5.7	7.4	10	15	20	28	34	39	41	43
50	0.02	3.9	5.5	6.2	8.1	11	16	21	29	36	41	43	45
60	0.017	4.2	5.9	6.7	8.8	12	17	23	31	38	43	45	47
80	0.012	4.7	6.7	7.5	9.9	13	19	25	33	40	46	48	50
100	0.01	5.1	7.3	8.2	11	15	21	27	35	42	48	50	53
250	0.004	7.2	10	12	16	21	29	38	43	53	59	62	65

Rainfall depths (mm) :: RCP2.6 for the period 2031-2050

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	9.58	13.1	15.5	20.5	26.6	38.4	47.2	57.1	67.7	74.2	78.9	82.6
2	0.5	10.5	14.3	17	22.6	29.2	42.2	51.9	62.7	74.4	81.6	86.8	90.8
5	0.2	13.8	18.8	22.3	29.6	38.4	55.4	68.2	82.3	97.8	107	114	119
10	0.1	16.3	22.2	26.4	35	45.3	65.5	80.6	97.3	116	127	135	141
20	0.05	18.9	25.8	30.7	40.6	52.6	76.1	93.7	113	134	147	157	164
30	0.033	20.5	28	33.3	44.1	57.1	82.7	102	123	146	160	170	178
40	0.025	21.7	29.6	35.2	46.6	60.4	87.4	108	130	154	169	180	188
50	0.02	22.6	30.9	36.7	48.6	63	91.2	112	135	161	176	188	196
60	0.017	23.4	31.9	37.9	50.2	65.2	94.3	116	140	166	183	194	203
80	0.012	24.6	33.6	39.9	52.9	68.6	99.3	122	148	175	192	204	214
100	0.01	25.6	34.9	41.5	55	71.3	103	127	153	182	200	213	223
250	0.004	29.7	40.5	48.2	63.9	82.8	120	148	178	212	232	247	259

Rainfall depths (mm) :: RCP2.6 for the period 2081-2100

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	9.58	13.1	15.5	20.5	26.6	38.4	47.2	57.1	67.7	74.2	78.9	82.6
2	0.5	10.5	14.3	17	22.6	29.2	42.2	51.9	62.7	74.4	81.6	86.8	90.8
5	0.2	13.8	18.8	22.3	29.6	38.4	55.4	68.2	82.3	97.8	107	114	119
10	0.1	16.3	22.2	26.4	35	45.3	65.5	80.6	97.3	116	127	135	141
20	0.05	18.9	25.8	30.7	40.6	52.6	76.1	93.7	113	134	147	157	164
30	0.033	20.5	28	33.3	44.1	57.1	82.7	102	123	146	160	170	178
40	0.025	21.7	29.6	35.2	46.6	60.4	87.4	108	130	154	169	180	188
50	0.02	22.6	30.9	36.7	48.6	63	91.2	112	135	161	176	188	196
60	0.017	23.4	31.9	37.9	50.2	65.2	94.3	116	140	166	183	194	203
80	0.012	24.6	33.6	39.9	52.9	68.6	99.3	122	148	175	192	204	214
100	0.01	25.6	34.9	41.5	55	71.3	103	127	153	182	200	213	223
250	0.004	29.7	40.5	48.2	63.9	82.8	120	148	178	212	232	247	259

Rainfall depths (mm) :: RCP4.5 for the period 2031-2050

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	9.74	13.3	15.8	20.9	27	38.9	47.7	57.7	68.3	74.7	79.4	83.2
2	0.5	10.7	14.6	17.3	22.9	29.7	42.8	52.5	63.3	75.1	82.2	87.4	91.4
5	0.2	14	19.1	22.7	30.1	39	56.3	69.1	83.3	98.7	108	115	120
10	0.1	16.6	22.6	26.9	35.6	46.1	66.5	81.7	98.5	117	128	136	142
20	0.05	19.3	26.3	31.2	41.4	53.6	77.3	95	114	136	149	158	165
30	0.033	20.9	28.5	33.9	44.9	58.2	84	103	124	147	162	172	180
40	0.025	22.1	30.1	35.8	47.4	61.5	88.8	109	131	156	171	182	190
50	0.02	23	31.4	37.4	49.5	64.2	92.6	114	137	163	178	189	198
60	0.017	23.8	32.5	38.6	51.2	66.3	95.8	118	142	168	184	196	205
80	0.012	25.1	34.2	40.7	53.9	69.9	101	124	149	177	194	206	216
100	0.01	26.1	35.6	42.3	56	72.6	105	129	155	184	202	215	225
250	0.004	30.3	41.3	49.1	65.1	84.4	122	150	180	214	235	250	261

Rainfall depths (mm) :: RCP4.5 for the period 2081-2100

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	10.2	14	16.6	21.9	28.3	40.5	49.4	59.5	70.1	76.5	81.1	84.9
2	0.5	11.3	15.3	18.2	24.1	31.2	44.6	54.5	65.4	77.1	84.3	89.4	93.4
5	0.2	14.8	20.2	24	31.8	41.1	58.8	71.9	86.2	102	111	118	123
10	0.1	17.5	23.9	28.4	37.6	48.6	69.6	85.1	102	120	132	140	146
20	0.05	20.4	27.8	33	43.7	56.5	81.1	99	119	140	153	163	170
30	0.033	22.1	30.1	35.8	47.5	61.4	88	108	129	152	166	177	184
40	0.025	23.4	31.9	37.9	50.2	64.9	93.2	114	136	161	176	187	195
50	0.02	24.4	33.2	39.5	52.4	67.7	97.2	119	142	168	184	195	204
60	0.017	25.2	34.4	40.9	54.1	70	101	123	147	174	190	202	210
80	0.012	26.6	36.2	43.1	57	73.8	106	129	155	183	200	212	222
100	0.01	27.6	37.6	44.8	59.3	76.7	110	135	161	190	208	221	231
250	0.004	32	43.7	52	68.8	89.1	128	156	187	221	242	257	268

Rainfall depths (mm) :: RCP6.0 for the period 2031-2050

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	9.67	13.2	15.7	20.7	26.8	38.7	47.5	57.4	68.1	74.5	79.2	82.9
2	0.5	10.6	14.5	17.2	22.8	29.5	42.5	52.3	63.1	74.8	82	87.1	91.2
5	0.2	13.9	19	22.6	29.9	38.8	55.9	68.7	82.9	98.3	108	115	120
10	0.1	16.5	22.5	26.7	35.3	45.8	66.1	81.3	98	116	128	135	142
20	0.05	19.1	26.1	31	41.1	53.2	76.9	94.4	114	135	148	158	165
30	0.033	20.7	28.3	33.6	44.6	57.8	83.4	103	124	147	161	171	179
40	0.025	21.9	29.9	35.6	47.1	61.1	88.3	108	131	155	170	181	189
50	0.02	22.9	31.2	37.1	49.1	63.7	92	113	136	162	178	189	197
60	0.017	23.7	32.3	38.4	50.8	65.9	95.2	117	141	167	184	195	204
80	0.012	24.9	34	40.4	53.5	69.4	100	123	149	176	193	206	215
100	0.01	25.9	35.3	42	55.6	72.1	104	128	155	183	201	214	224
250	0.004	30	41	48.7	64.6	83.7	121	149	180	213	234	249	260

Rainfall depths (mm) :: RCP6.0 for the period 2081-2100

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	10.7	14.6	17.3	22.9	29.5	41.9	50.9	61.1	71.7	78	82.6	86.4
2	0.5	11.8	16	19.1	25.2	32.6	46.3	56.3	67.2	79	86.1	91.2	95.2
5	0.2	15.5	21.1	25.1	33.3	42.9	61.1	74.4	88.7	104	114	121	126
10	0.1	18.3	25	29.7	39.4	50.8	72.4	88.1	105	124	135	143	149
20	0.05	21.3	29.1	34.6	45.8	59.2	84.4	103	122	144	157	166	174
30	0.033	23.2	31.6	37.6	49.8	64.3	91.7	111	133	156	171	181	189
40	0.025	24.5	33.4	39.7	52.6	67.9	97.1	118	141	165	181	191	200
50	0.02	25.6	34.9	41.5	54.9	70.9	101	123	147	173	188	200	208
60	0.017	26.4	36	42.9	56.8	73.3	105	127	152	179	195	207	215
80	0.012	27.9	38	45.2	59.8	77.3	110	134	160	188	206	218	227
100	0.01	29	39.5	47	62.2	80.4	115	140	167	196	214	227	236
250	0.004	33.6	45.8	54.5	72.2	93.3	133	162	193	228	248	263	275

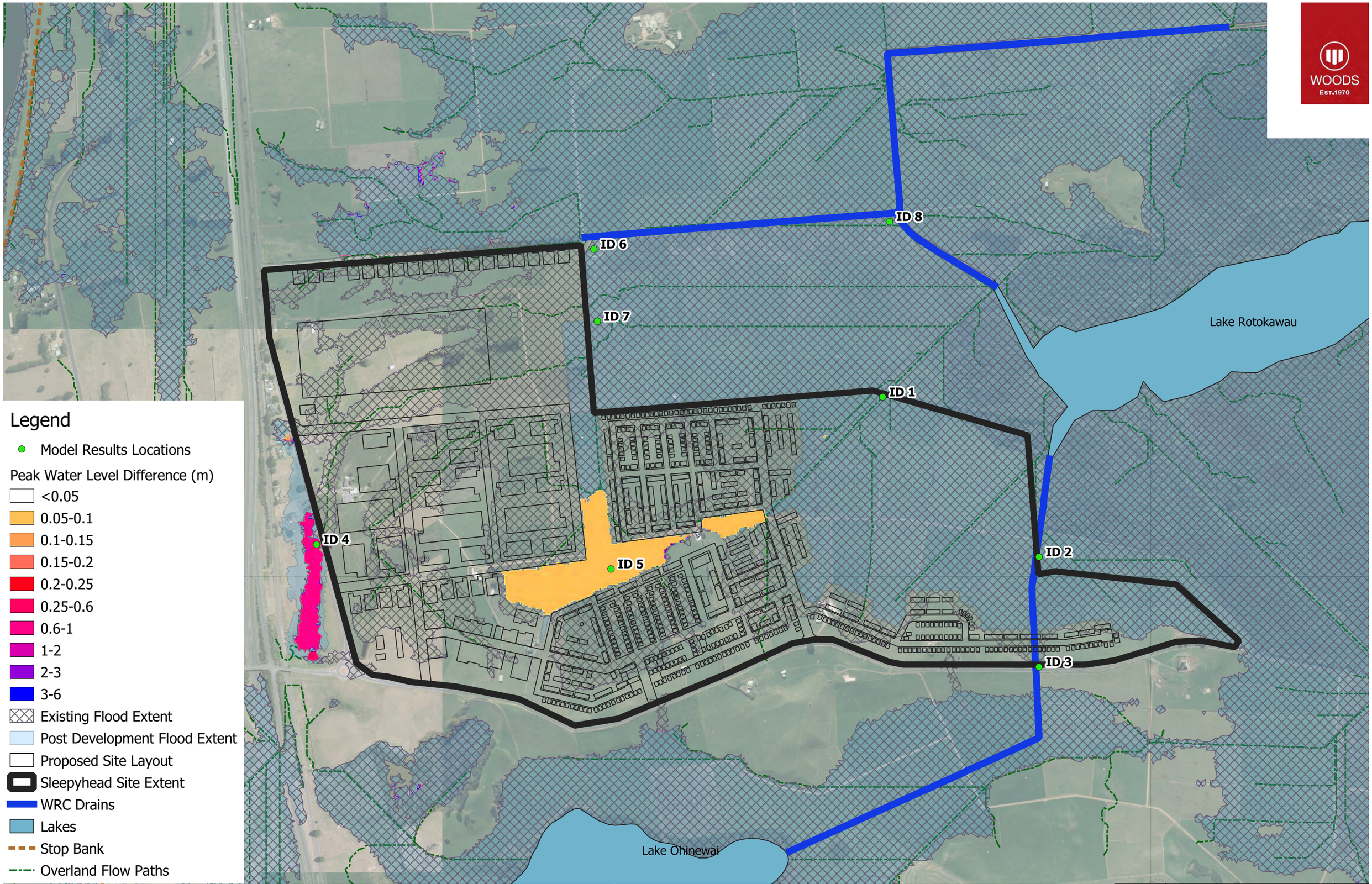
Rainfall depths (mm) :: RCP8.5 for the period 2031-2050

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	9.85	13.4	16	21.1	27.3	39.3	48.1	58.1	68.7	75.1	79.8	83.6
2	0.5	10.8	14.8	17.5	23.2	30.1	43.2	53	63.8	75.5	82.7	87.9	91.9
5	0.2	14.2	19.4	23	30.5	39.5	56.9	69.8	83.9	99.4	109	116	121
10	0.1	16.8	22.9	27.2	36.1	46.7	67.2	82.5	99.3	118	129	137	143
20	0.05	19.5	26.6	31.6	41.9	54.3	78.2	95.9	115	137	150	159	166
30	0.033	21.2	28.9	34.3	45.5	58.9	84.9	104	125	149	163	173	181
40	0.025	22.4	30.5	36.3	48.1	62.3	89.8	110	133	157	172	183	191
50	0.02	23.4	31.9	37.9	50.2	65	93.7	115	138	164	179	191	199
60	0.017	24.1	32.9	39.2	51.9	67.2	96.9	119	143	169	186	197	206
80	0.012	25.4	34.7	41.3	54.6	70.8	102	125	151	179	196	208	217
100	0.01	26.4	36.1	42.9	56.8	73.6	106	130	157	186	203	216	226
250	0.004	30.7	41.9	49.8	65.9	85.5	123	151	182	216	236	251	263

Rainfall depths (mm) :: RCP8.5 for the period 2081-2100

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h	96h	120h
1.58	0.633	11.7	15.9	18.9	25.1	32.1	45.2	54.4	64.7	75.3	81.5	86.1	89.8
2	0.5	12.9	17.6	20.9	27.7	35.6	50	60.3	71.3	83.1	90.2	95.3	99.2
5	0.2	17.1	23.3	27.6	36.6	47.1	66.3	80	94.6	110	120	127	132
10	0.1	20.2	27.6	32.8	43.4	55.9	78.7	95	112	131	143	150	157
20	0.05	23.6	32.1	38.2	50.6	65.1	91.9	111	131	153	166	175	182
30	0.033	25.6	34.9	41.5	55	70.8	99.9	120	142	166	180	191	198
40	0.025	27	36.9	43.9	58.1	74.8	106	128	151	176	191	202	210
50	0.02	28.3	38.5	45.8	60.7	78.2	110	133	157	184	199	211	219
60	0.017	29.2	39.8	47.4	62.7	80.8	114	138	163	190	207	218	227
80	0.012	30.8	42	50	66.2	85.2	120	145	171	200	218	230	239
100	0.01	32	43.7	51.9	68.8	88.6	125	151	178	208	226	239	249
250	0.004	37.2	50.7	60.3	79.9	103	146	176	207	242	263	278	289

APPENDIX F – MODELLING RESULTS



Legend

- Model Results Locations

Peak Water Level Difference (m)

- <0.05
- 0.05-0.1
- 0.1-0.15
- 0.15-0.2
- 0.2-0.25
- 0.25-0.6
- 0.6-1
- 1-2
- 2-3
- 3-6
- Existing Flood Extent
- Post Development Flood Extent
- Proposed Site Layout
- Sleepyhead Site Extent
- WRC Drains
- Lakes
- Stop Bank
- Overland Flow Paths

REVISION DETAILS		INT	DATE
1	Final issue	AD	18/11/19

SURVEYED	n/a
DESIGNED	AD
DRAWN	SH
CHECKED	PW
APPROVED	DW

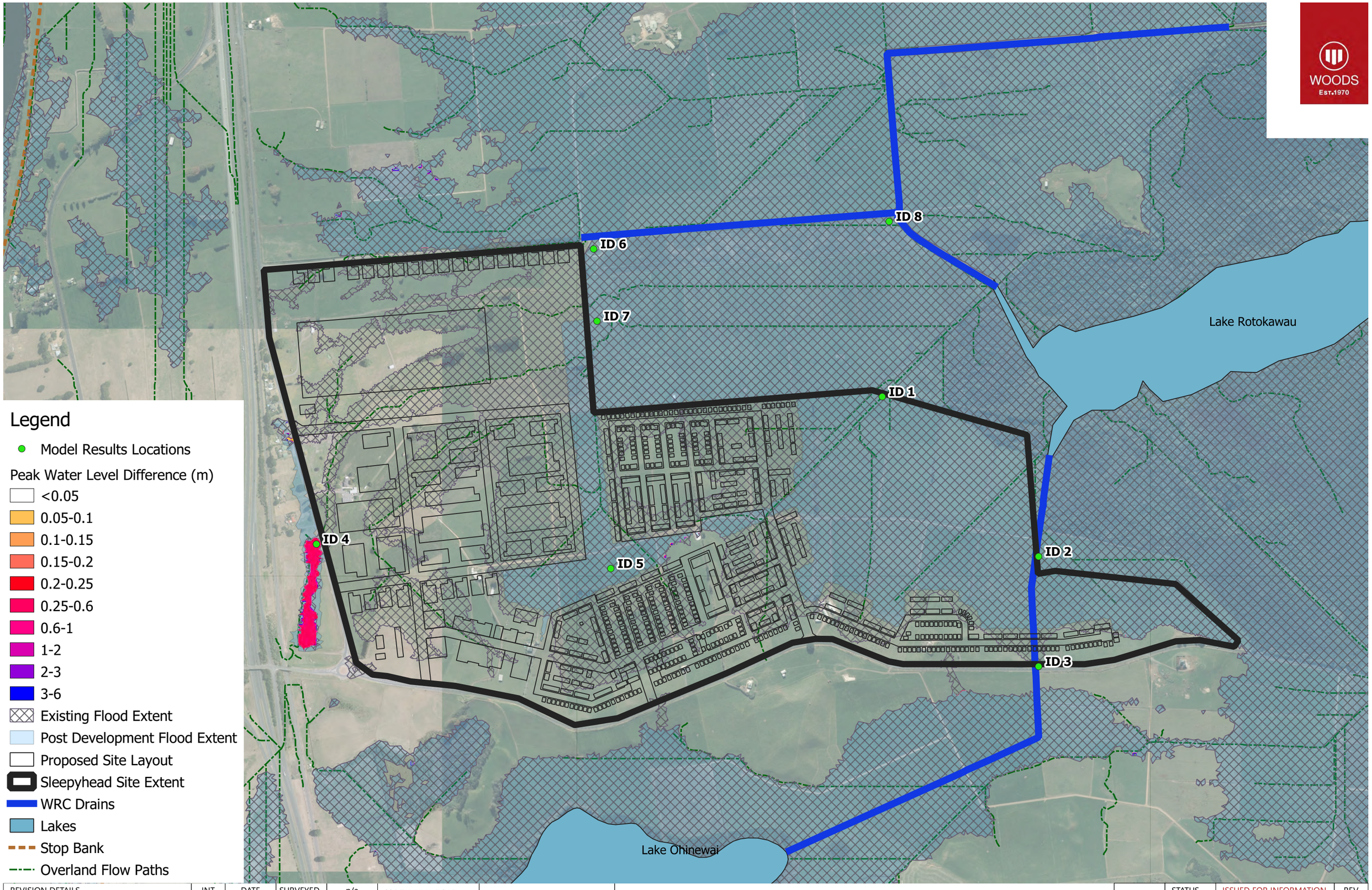
231 TAHUNA ROAD
& 88 LUMSDEN ROAT
OHINEWAI
WAIKATO
WOODS.CO.NZ

the comfort group.

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS
Modelled Flood Level Difference (m) - Post Development vs. Pre Development
100 year ARI with Climate Change

STATUS	ISSUED FOR INFORMATION
SCALE	1:XXXX @ A3
COUNCIL	WAIKATO DISTRICT COUNCIL
DWG NO	..\GIS\P19-268-reports.qgz P19-140-00-1103-SK

REV



Legend

- Model Results Locations

Peak Water Level Difference (m)

- <0.05
- 0.05-0.1
- 0.1-0.15
- 0.15-0.2
- 0.2-0.25
- 0.25-0.6
- 0.6-1
- 1-2
- 2-3
- 3-6
- Existing Flood Extent
- Post Development Flood Extent
- Proposed Site Layout
- Sleepyhead Site Extent
- WRC Drains
- Lakes
- Stop Bank
- Overland Flow Paths

REVISION DETAILS		INT	DATE
1	Final issue	AD	18/11/19

SURVEYED	n/a	231 TAHUNA ROAD & 88 LUMSDEN ROAT OHINEWAI WAIKATO
DESIGNED	AD	
DRAWN	SH	
CHECKED	PW	
APPROVED	DW	WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS
Modelled Flood Level Difference (m) - Post Development vs. Pre Development
10 year ARI with Climate Change

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:XXXX @ A3	
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	..\GIS\P19-268-reports.qgz P19-140-00-1102-SK	

WOODS
EST.1970

ID 6
ID 8
ID 7
ID 1
ID 4
ID 5
ID 2
ID 3

Lake Rotokawau

Lake Ohinewai

Legend

- Model Results Locations

Peak Water Level Difference (m)

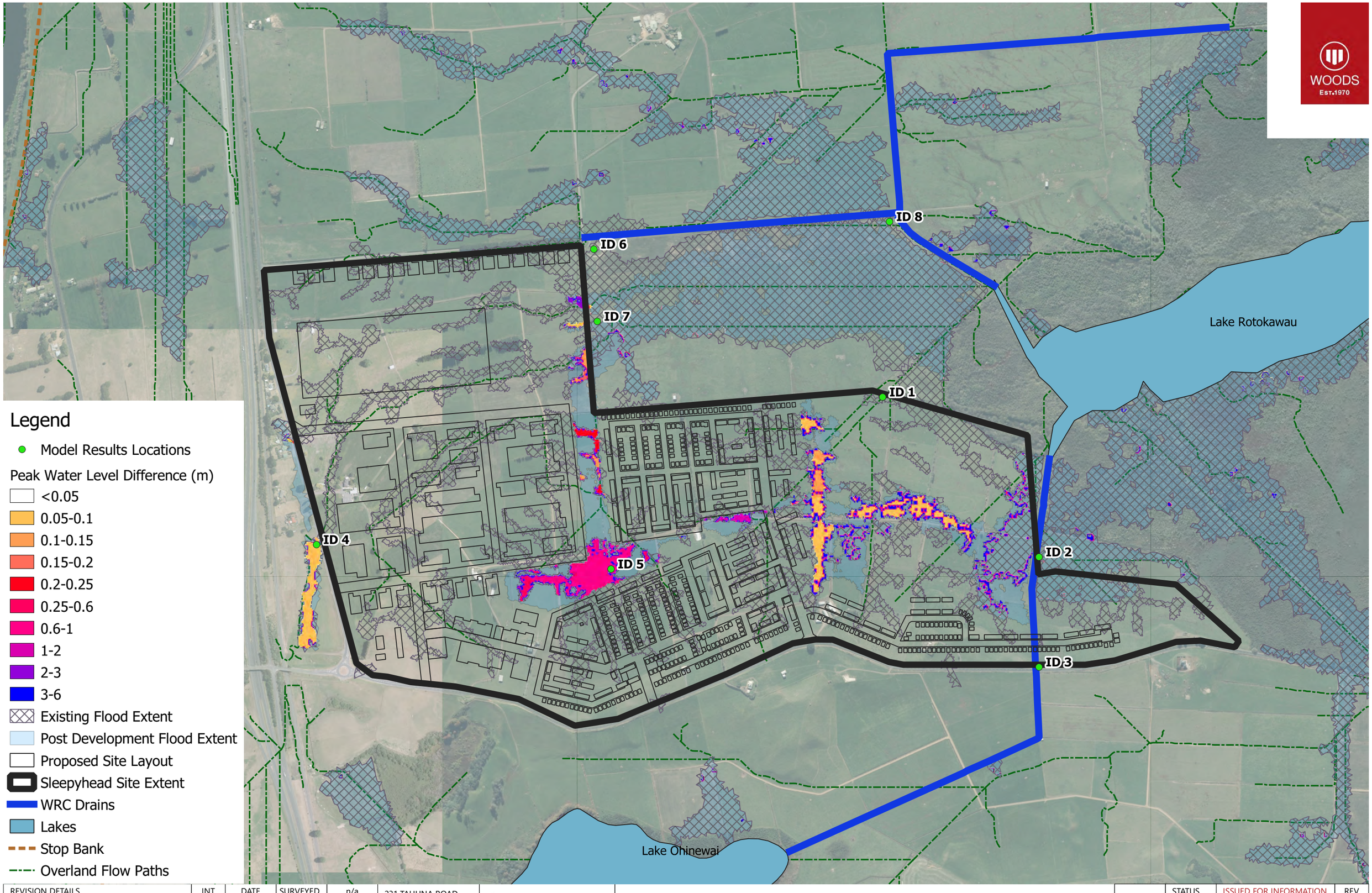
- <0.05
- 0.05-0.1
- 0.1-0.15
- 0.15-0.2
- 0.2-0.25
- 0.25-0.6
- 0.6-1
- 1-2
- 2-3
- 3-6
- Existing Flood Extent
- Post Development Flood Extent
- Proposed Site Layout
- Sleepyhead Site Extent
- WRC Drains
- Lakes
- Stop Bank
- Overland Flow Paths

REVISION DETAILS		INT	DATE	SURVEYED	n/a	231 TAHUNA ROAD & 88 LUMSDEN ROAT OHINEWAI WAIKATO
1	Final issue	AD	18/11/19	DESIGNED	AD	
				DRAWN	SH	
				CHECKED	PW	
				APPROVED	DW	WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS
Modelled Flood Level Difference (m) - Post Development vs. Pre Development
2 year ARI with Climate Change

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:XXXX @ A3	
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	..\GIS\P19-268-reports.qgz P19-140-00-1100-SK	



Legend

- Model Results Locations

Peak Water Level Difference (m)

- <0.05
- 0.05-0.1
- 0.1-0.15
- 0.15-0.2
- 0.2-0.25
- 0.25-0.6
- 0.6-1
- 1-2
- 2-3
- 3-6
- Existing Flood Extent
- Post Development Flood Extent
- Proposed Site Layout
- Sleepyhead Site Extent
- WRC Drains
- Lakes
- Stop Bank
- Overland Flow Paths

REVISION DETAILS		INT	DATE
1	Final issue	AD	18/11/19

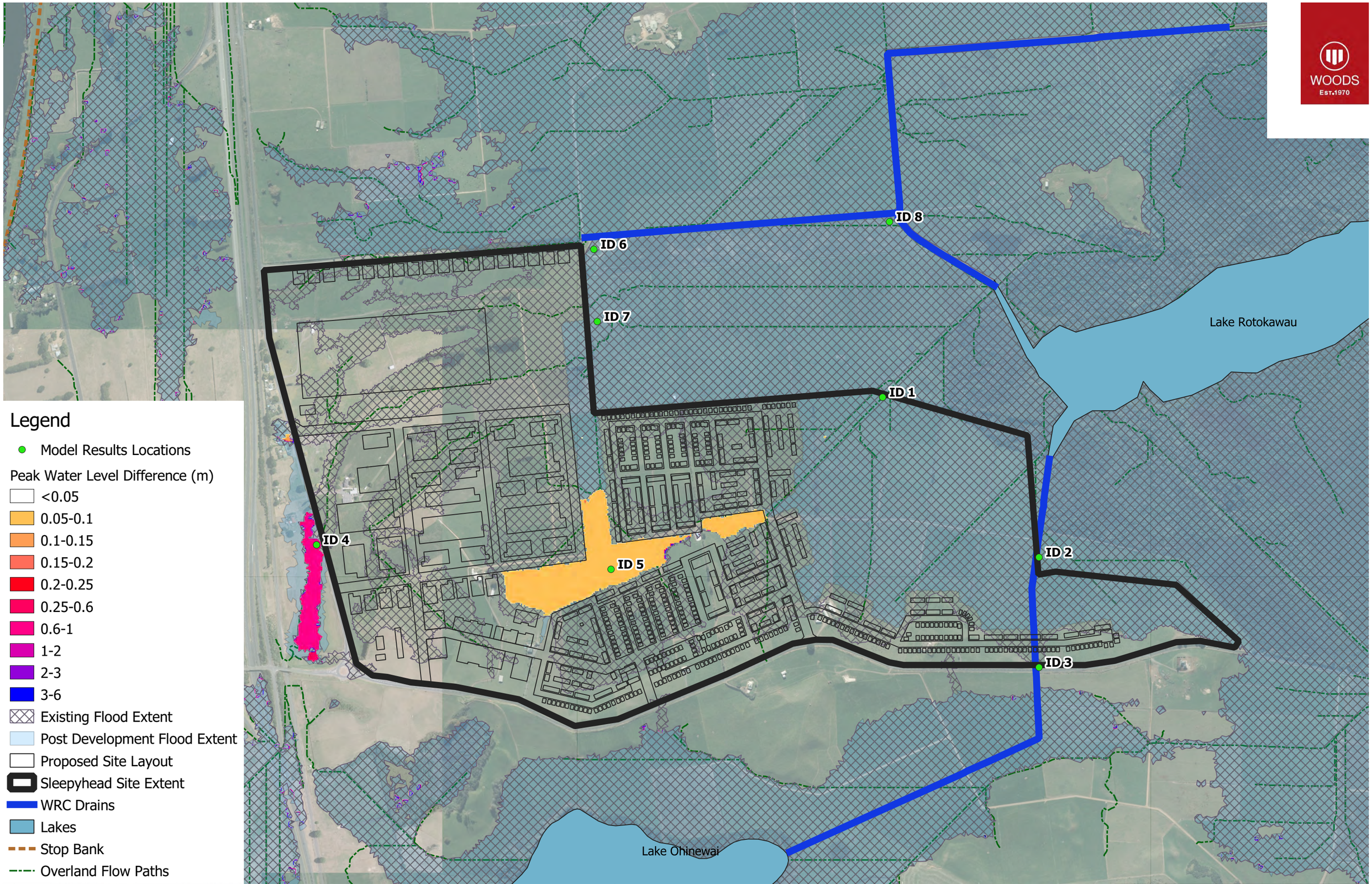
SURVEYED	n/a
DESIGNED	AD
DRAWN	SH
CHECKED	PW
APPROVED	DW

231 TAHUNA ROAD
& 88 LUMSDEN ROAT
OHINEWAI
WAIKATO
WOODS.CO.NZ

the comfort group.

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS
Modelled Flood Level Difference (m) - Post Development vs. Pre Development
2 year(Lower Tail Water Level Scenario) ARI with Climate Change

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:XXXX @ A3	
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	..\GIS\P19-268-reports.qgz P19-140-00-1101-SK	



Legend

- Model Results Locations

Peak Water Level Difference (m)

- <0.05
- 0.05-0.1
- 0.1-0.15
- 0.15-0.2
- 0.2-0.25
- 0.25-0.6
- 0.6-1
- 1-2
- 2-3
- 3-6
- Existing Flood Extent
- Post Development Flood Extent
- Proposed Site Layout
- Sleepyhead Site Extent
- WRC Drains
- Lakes
- Stop Bank
- Overland Flow Paths

REVISION DETAILS		INT	DATE
1	Final issue	AD	18/11/19

SURVEYED	n/a
DESIGNED	AD
DRAWN	SH
CHECKED	PW
APPROVED	DW

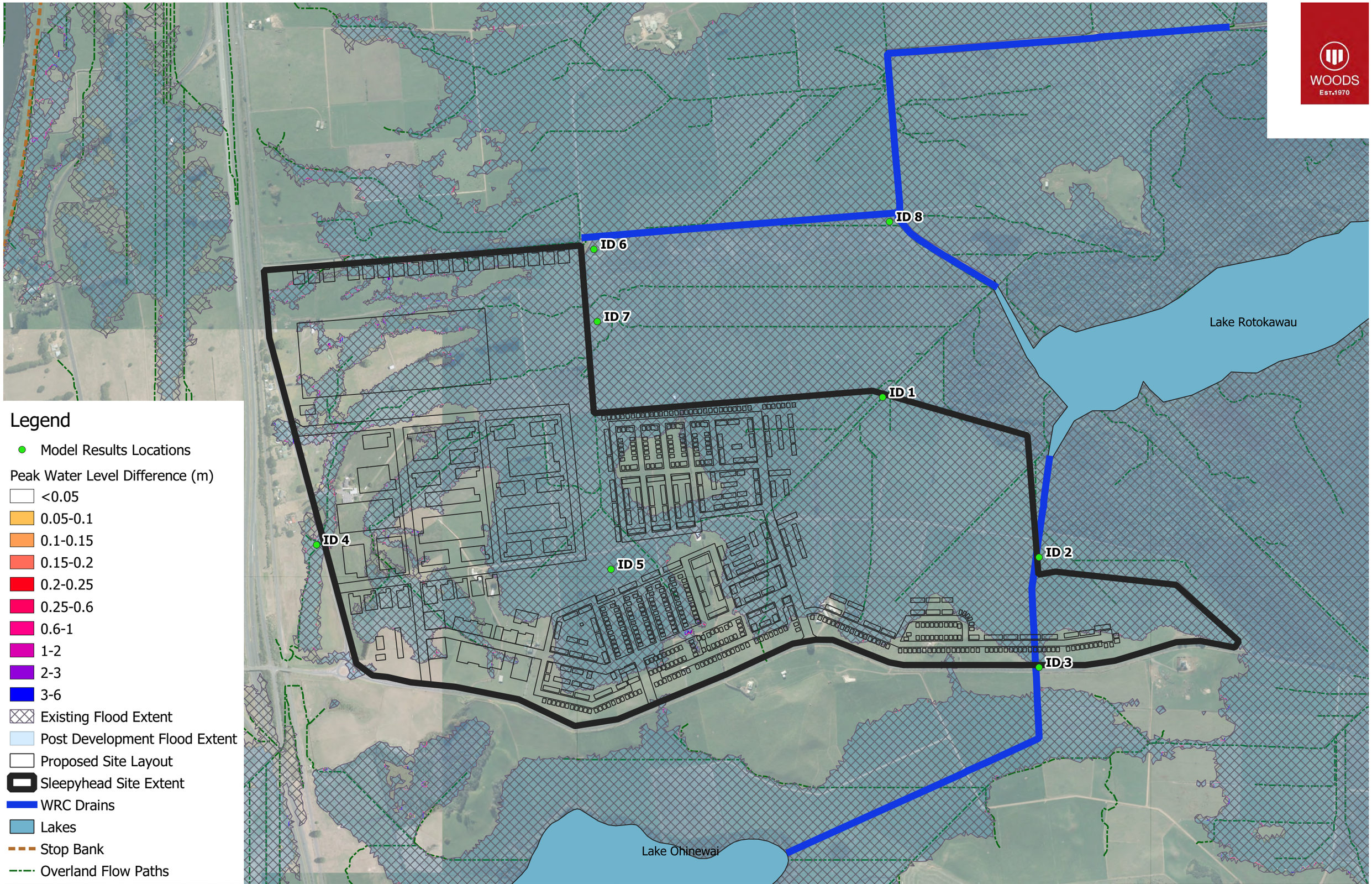
231 TAHUNA ROAD
& 88 LUMSDEN ROAT
OHINEWAI
WAIKATO
WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS
Modelled Flood Level Difference (m) –
Scenario 3 (Maximum Probable Development) vs. Scenario 1 (Pre Development)
100 year MPD ARI with Climate Change

STATUS	ISSUED FOR INFORMATION
SCALE	1:XXXX @ A3
COUNCIL	WAIKATO DISTRICT COUNCIL
DWG NO	..\GIS\P19-268-reports.qgz P19-140-00-1104-SK

REV



Legend

- Model Results Locations

Peak Water Level Difference (m)

- <0.05
- 0.05-0.1
- 0.1-0.15
- 0.15-0.2
- 0.2-0.25
- 0.25-0.6
- 0.6-1
- 1-2
- 2-3
- 3-6
- Existing Flood Extent
- Post Development Flood Extent
- Proposed Site Layout
- Sleepyhead Site Extent
- WRC Drains
- Lakes
- Stop Bank
- Overland Flow Paths

REVISION DETAILS		INT	DATE
1	Final issue	AD	18/11/19

SURVEYED	n/a
DESIGNED	AD
DRAWN	SH
CHECKED	PW
APPROVED	DW

231 TAHUNA ROAD
& 88 LUMSDEN ROAT
OHINEWAI
WAIKATO
WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS
Modelled Flood Level Difference (m) –
Scenario 5 (Pre Development Sensitivity) vs. Scenario 1 (Pre Development)
100 year SENS ARI with Climate Change

STATUS	ISSUED FOR INFORMATION
SCALE	1:XXXX @ A3
COUNCIL	WAIKATO DISTRICT COUNCIL
DWG NO	..\GIS\P19-268-reports.qgz P19-140-00-1105-SK

REV