ATTACHMENTS TO

Finance and Facilities Committee Meeting Business Paper

3 December 2025

EXCLUDED FROM AGENDA

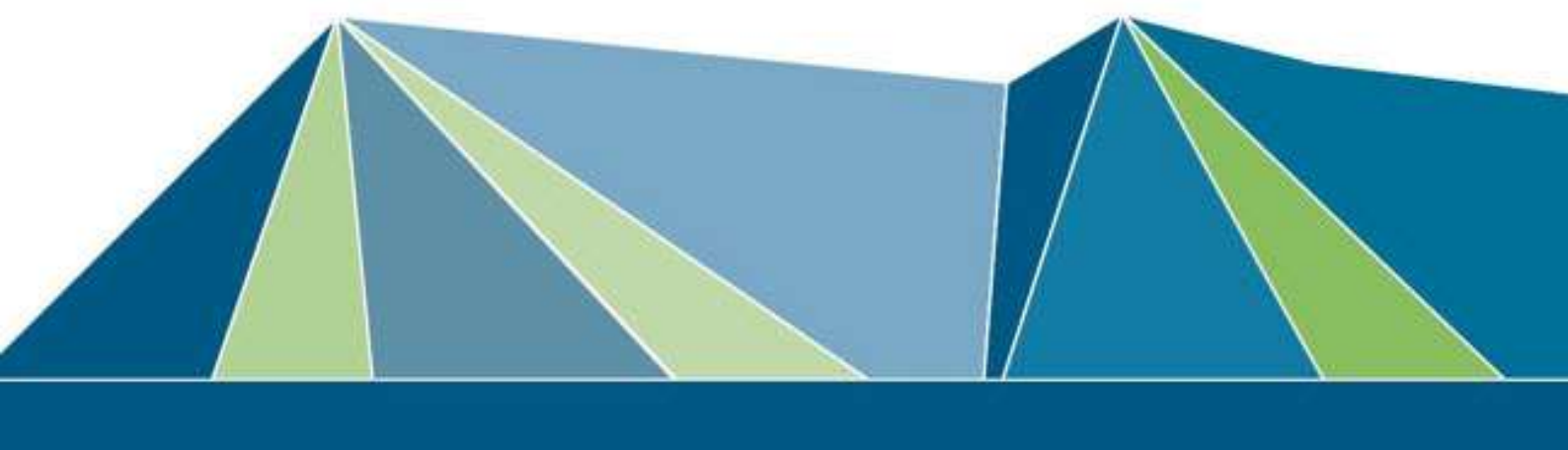


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Attachment 2: BMT - Flood Impact Assessment for Ross Lane Raising Concept Design Report.....31

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100mm AT ORIGINAL SIZE

BALLINA SHIRE COUNCIL

PRELIMINARY ROAD DESIGN DRAWINGS, ROSS LANE, KINVARA MR7735/15

PLANIT CONSULTING

DRAWING REGISTER		
DRAWING NUMBER	DRAWING TITLE	DRAWING REVISION
0001	COVER PAGE & LOCALITY PLAN	C
0010	OVERALL LAYOUT PLAN	B
0100	OPTION 1a 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 4	B
0101	OPTION 1a 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 4	B
0102	OPTION 1a 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 3 OF 4	B
0103	OPTION 1a 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 4 OF 4	B
0110	OPTION 1b 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 2	B
0111	OPTION 1b 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 2	B
0150	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 9	B
0151	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 9	B
0152	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 3 OF 9	B
0153	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 4 OF 9	B
0154	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 5 OF 9	B
0155	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 6 OF 9	B
0156	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 7 OF 9	B
0157	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 8 OF 9	B
0158	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 9 OF 9	B
0160	OPTION 2b 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 2	B
0161	OPTION 2b 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 2	B
0200	ROAD LONGITUDINAL SECTION SHEET 1 OF 5	B
0201	ROAD LONGITUDINAL SECTION SHEET 2 OF 5	B
0202	ROAD LONGITUDINAL SECTION SHEET 3 OF 5	B
0203	ROAD LONGITUDINAL SECTION SHEET 4 OF 5	C
0204	ROAD LONGITUDINAL SECTION SHEET 5 OF 5	C
0210	ROAD TYPICAL CROSS-SECTIONS OPTION 1	B
0211	ROAD TYPICAL CROSS-SECTIONS OPTION 2 SHEET 1 OF 2	B
0212	ROAD TYPICAL CROSS-SECTIONS OPTION 2 SHEET 2 OF 2	B
0220	CULVERT LONGITUDINAL SECTION	B

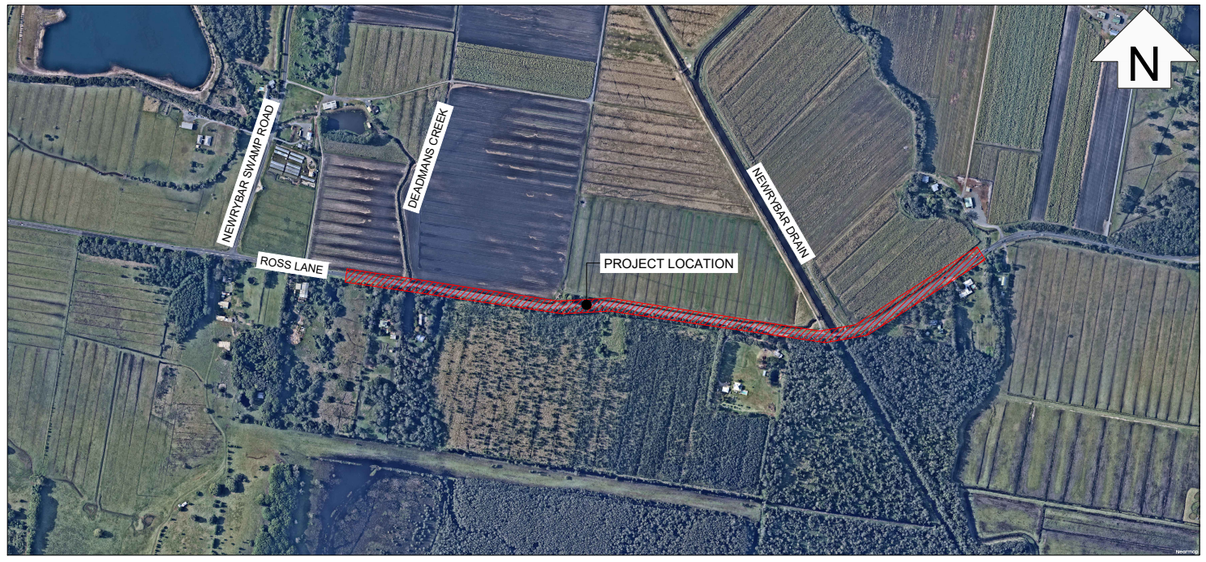


IMAGE SOURCE: NEARMAP

LOCALITY PLAN
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A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
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C	OPTION 1D PROVIDED AS PER COUNCIL COMMENTS	07/05/25	DM	IR	JM	CG

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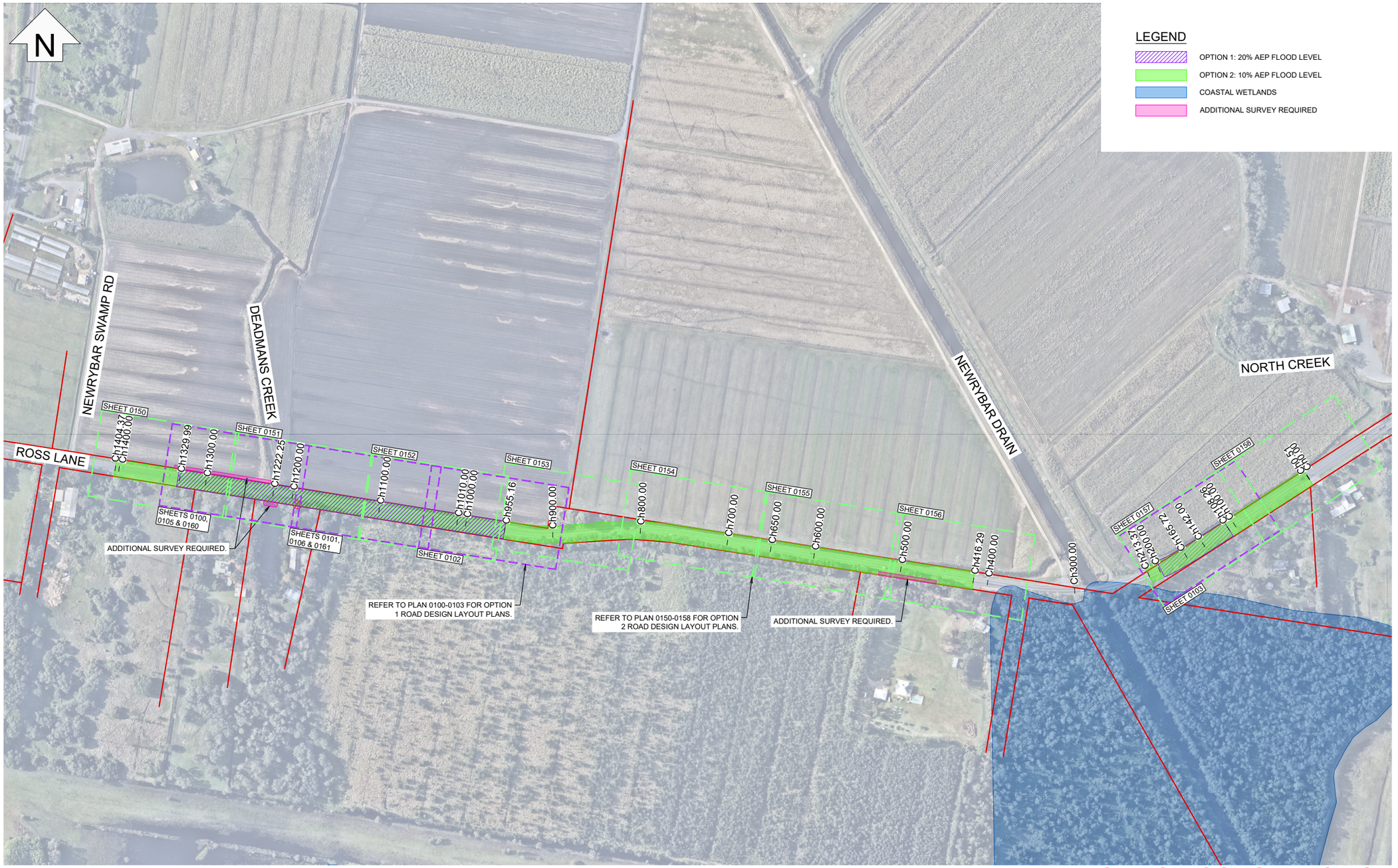
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CLIENT: BALLINA SHIRE COUNCIL
PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: COVER PAGE & LOCALITY PLAN
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0001	C

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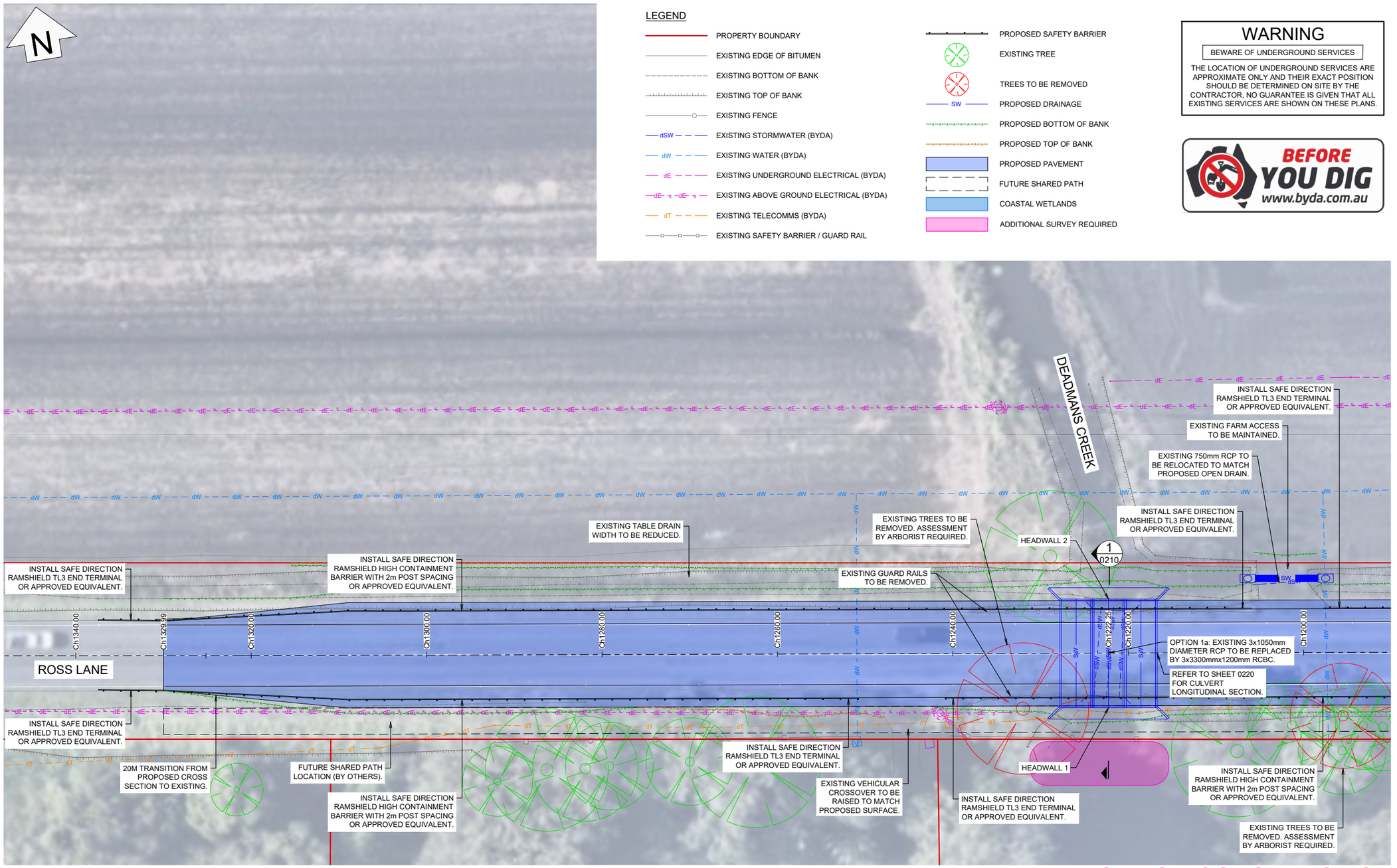
PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OVERALL LAYOUT PLAN

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
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100mm AT ORIGINAL SIZE



LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
- EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
- PROPOSED DRAINAGE
- PROPOSED BOTTOM OF BANK
- PROPOSED TOP OF BANK
- PROPOSED PAVEMENT
- FUTURE SHARED PATH
- COASTAL WETLANDS
- ADDITIONAL SURVEY REQUIRED

WARNING

BEWARE OF UNDERGROUND SERVICES

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OPTION 1a - CULVERT UNDER ROAD

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CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 1A 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 4

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0100	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0100 - OPTION1 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:29:49 AM

100mm AT ORIGINAL SIZE

N

LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
- EXISTING ABOVE GROUND ELECTRICAL (BYDA)
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EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

Ch1180.00 Ch1160.00 Ch1140.00 Ch1120.00 Ch1100.00 Ch1080.00 Ch1060.00 Ch1040.00

ROSS LANE

INSTALL SAFE DIRECTION RAMSHIELD TL3 END TERMINAL OR APPROVED EQUIVALENT.

INSTALL SAFE DIRECTION RAMSHIELD TL3 END TERMINAL OR APPROVED EQUIVALENT.

EXISTING DRIVEWAY TO BE RAISED TO MATCH PROPOSED ROAD SURFACE.

EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

FUTURE SHARED PATH LOCATION (BY OTHERS).

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

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PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 1A 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 4

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
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100mm AT ORIGINAL SIZE

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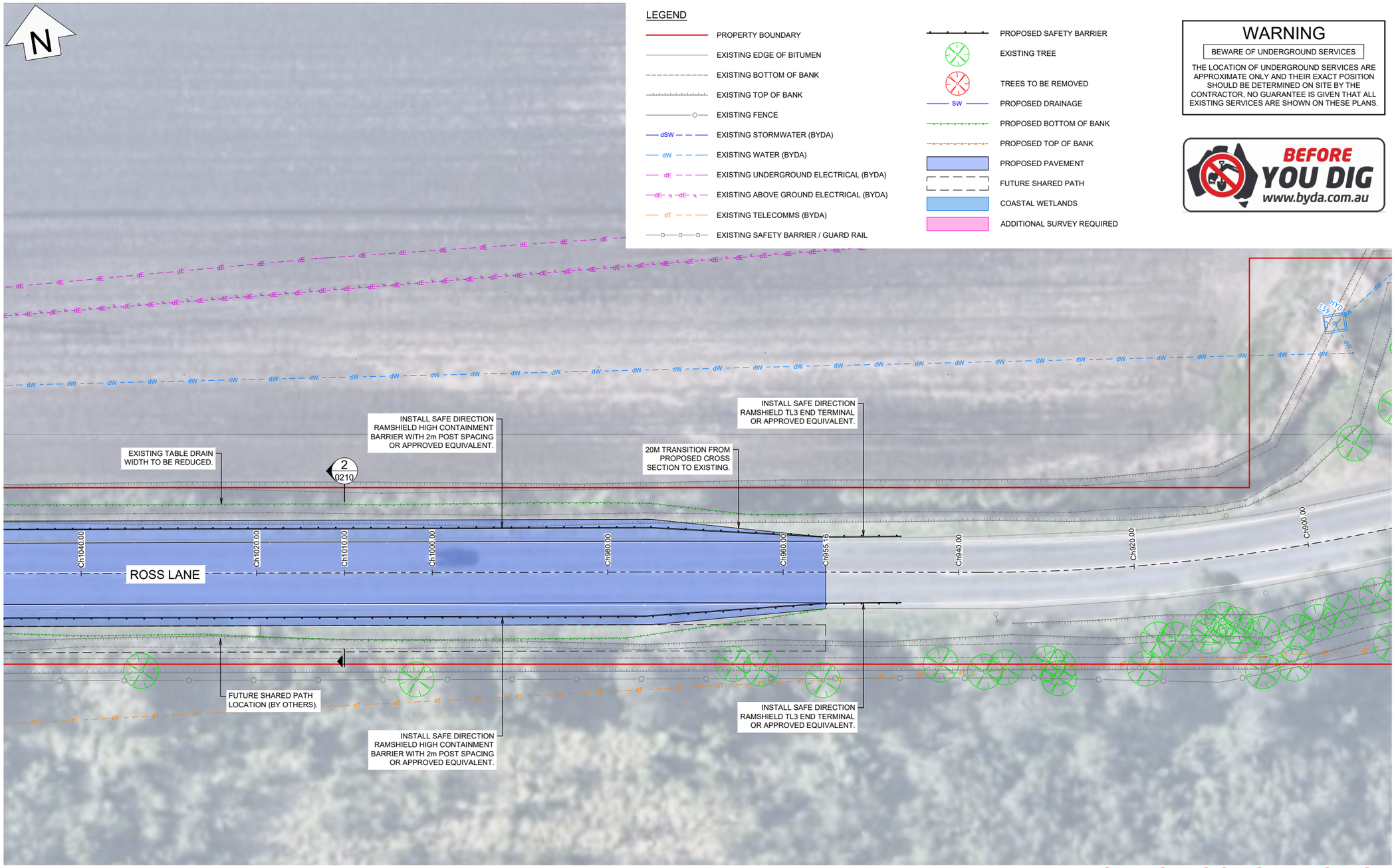
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PLANIT CONSULTING

CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 1A 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 3 OF 4

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100mm AT ORIGINAL SIZE

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LEGEND

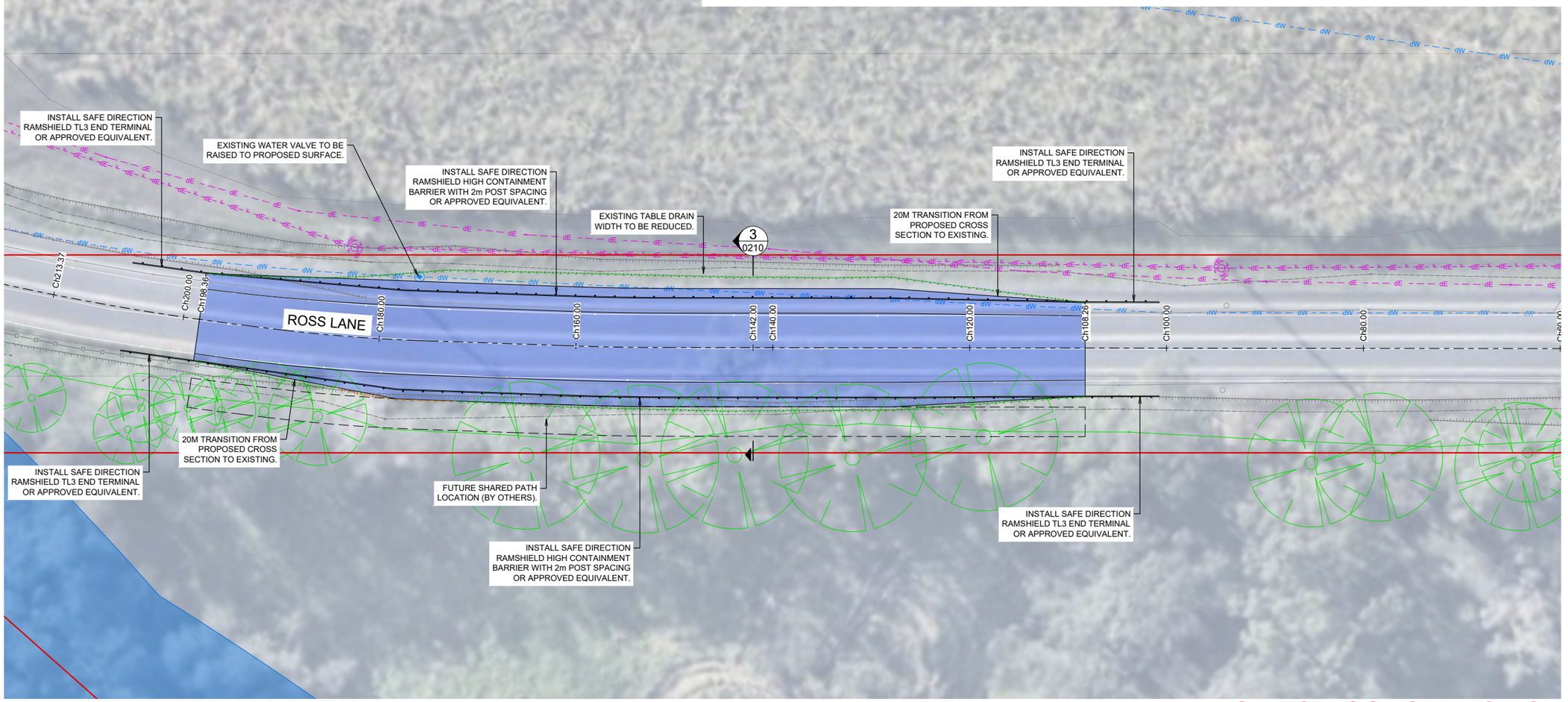
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PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 1A 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 4 OF 4

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
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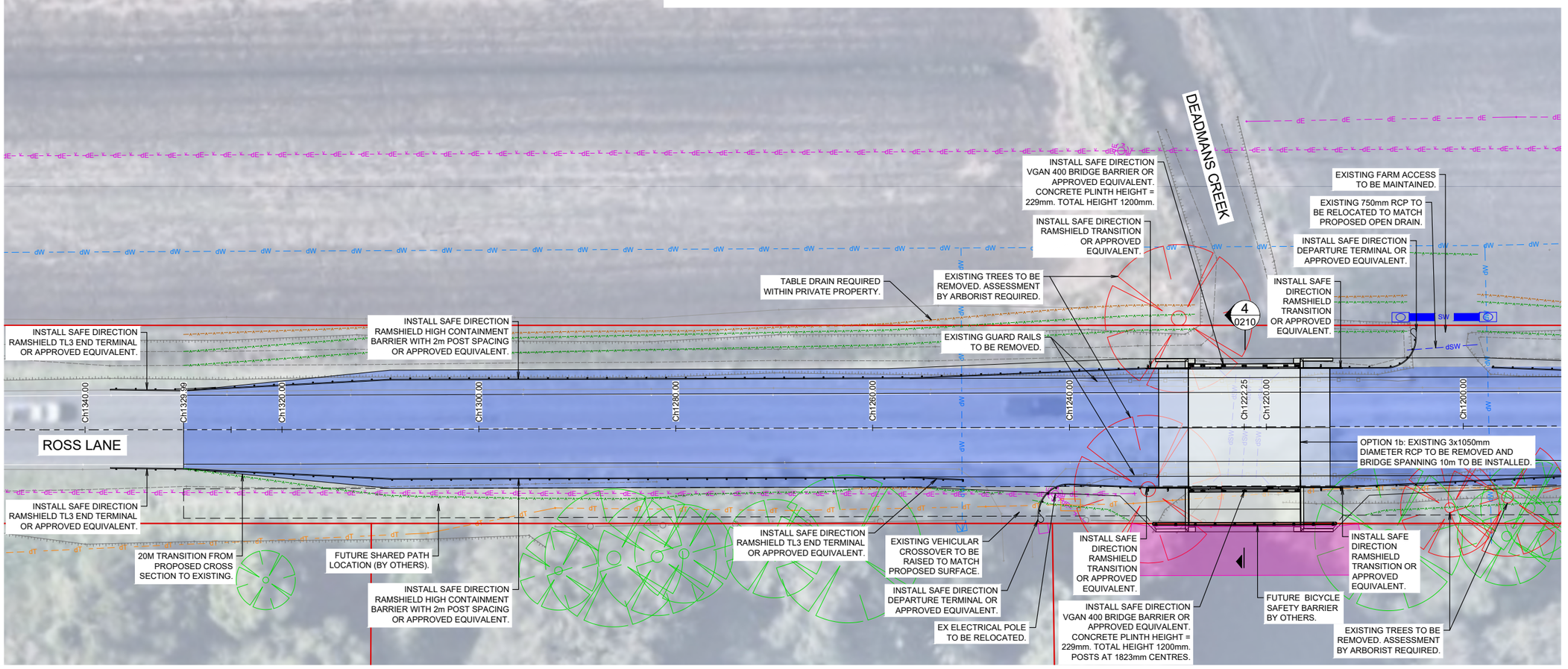
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OPTION 1b - BRIDGE

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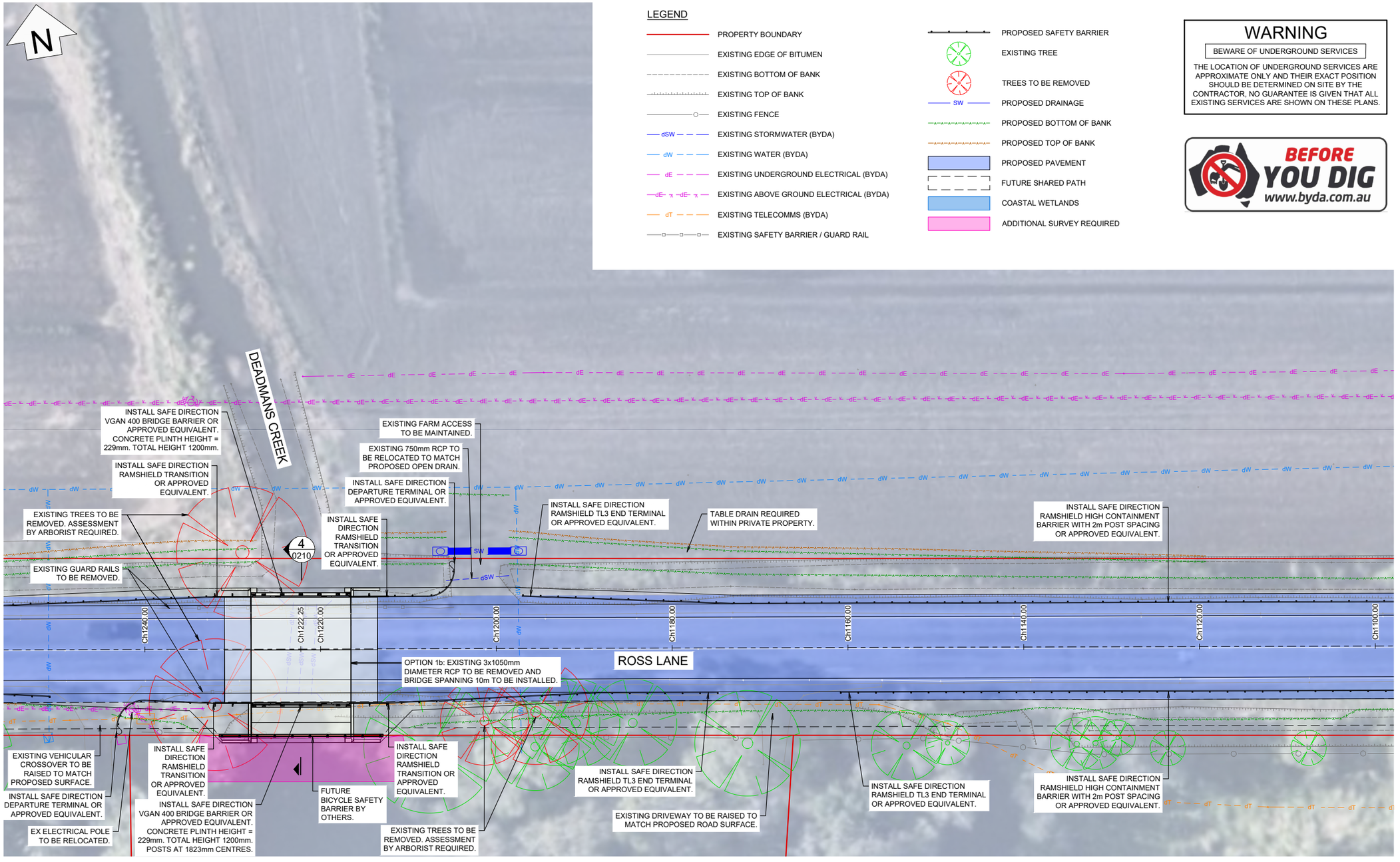
PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 1B 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 2

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0110	B

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100mm AT ORIGINAL SIZE



LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
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- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
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- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
- PROPOSED DRAINAGE
- PROPOSED BOTTOM OF BANK
- PROPOSED TOP OF BANK
- PROPOSED PAVEMENT
- FUTURE SHARED PATH
- COASTAL WETLANDS
- ADDITIONAL SURVEY REQUIRED

WARNING

BEWARE OF UNDERGROUND SERVICES

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OPTION 1b - BRIDGE

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGN	CHECK	APPROVED
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 2 4 8 12
Full Size 1:200 ; Half Size 1:400
Scale (m)

DO NOT SCALE FROM DRAWING

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APPROVED BY:

DATE:

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LENNOX HEAD NSW 2478
PH: 02 6687 4666
ABN: 20 099 261 711
administration@planitconsulting.com.au

CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 1B 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 2

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0111	B

CAD FILE: C:\12DSDATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0100 - OPTION1 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:32:31 AM

100mm AT ORIGINAL SIZE

N

LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
- EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
- PROPOSED DRAINAGE
- PROPOSED BOTTOM OF BANK
- PROPOSED TOP OF BANK
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- FUTURE SHARED PATH
- COASTAL WETLANDS
- ADDITIONAL SURVEY REQUIRED

WARNING

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INSTALL SAFE DIRECTION RAMSHIELD TL3 END TERMINAL OR APPROVED EQUIVALENT.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

Ch1404.37 Ch1400.00 Ch1380.00 Ch1360.00 Ch1340.00 Ch1329.99 Ch1320.00 Ch1300.00 Ch1280.00

ROSS LANE

INSTALL SAFE DIRECTION RAMSHIELD TL3 END TERMINAL OR APPROVED EQUIVALENT.

FUTURE SHARED PATH LOCATION (BY OTHERS).

EXISTING ELECTRICAL POLE TO BE RELOCATED.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

20M TRANSITION FROM PROPOSED CROSS SECTION TO EXISTING.

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGN	CHECK	APPROVED
A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 2 4 8 12
Full Size 1:200 ; Half Size 1:400
Scale (m)
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CLIENT: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 9

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0150	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:31:22 AM

100mm AT ORIGINAL SIZE

LEGEND

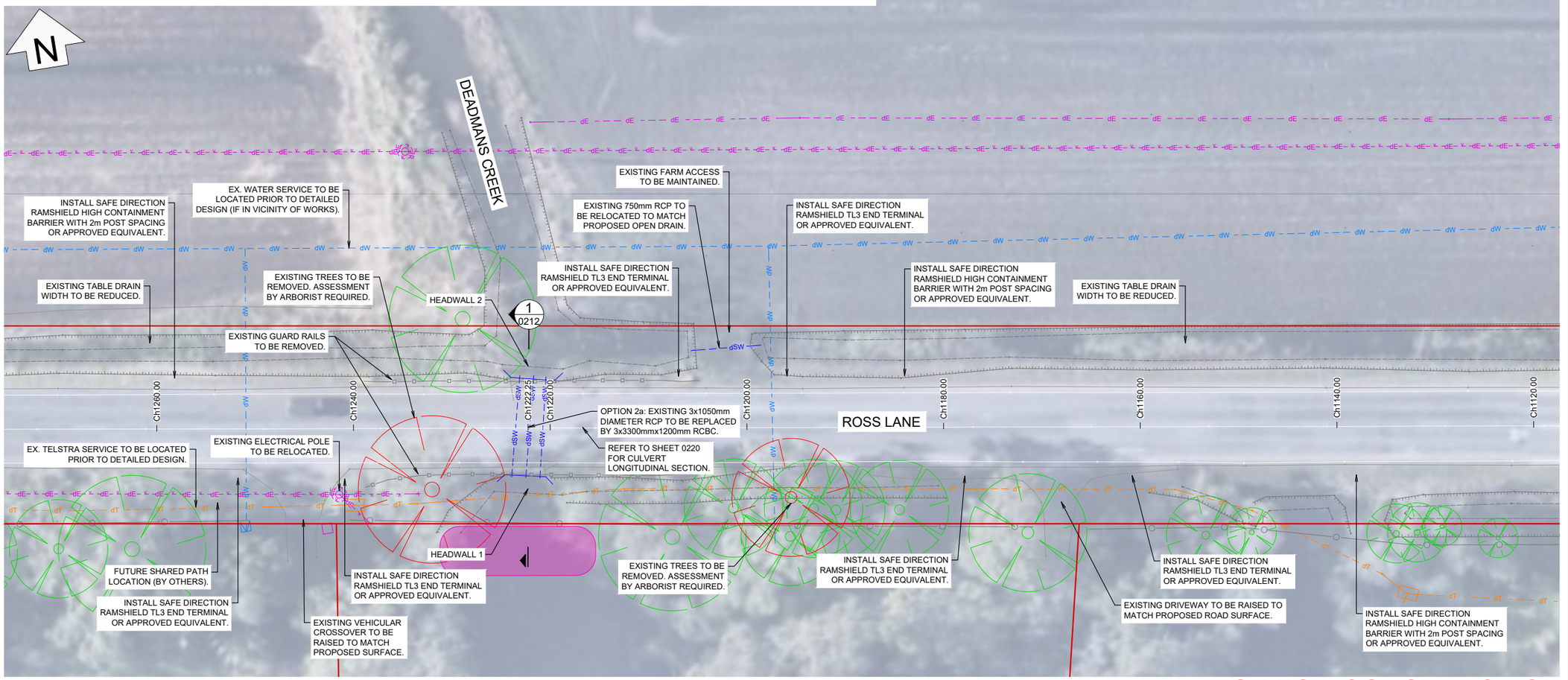
- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
- EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
- PROPOSED DRAINAGE
- PROPOSED BOTTOM OF BANK
- PROPOSED TOP OF BANK
- PROPOSED PAVEMENT
- FUTURE SHARED PATH
- COASTAL WETLANDS
- ADDITIONAL SURVEY REQUIRED

WARNING

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OPTION 2a - CULVERT UNDER ROAD

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A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 2 4 8 12
Full Size 1:200 ; Half Size 1:400
Scale (m)
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PLANIT CONSULTING

CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0151	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:34:00 AM

100mm AT ORIGINAL SIZE

N

LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- dSW — EXISTING STORMWATER (BYDA)
- dW — EXISTING WATER (BYDA)
- dE — EXISTING UNDERGROUND ELECTRICAL (BYDA)
- dE — EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- dT — EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
- SW — PROPOSED DRAINAGE
- PROPOSED BOTTOM OF BANK
- PROPOSED TOP OF BANK
- PROPOSED PAVEMENT
- FUTURE SHARED PATH
- COASTAL WETLANDS
- ADDITIONAL SURVEY REQUIRED

WARNING

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EX. WATER SERVICE TO BE LOCATED PRIOR TO DETAILED DESIGN (IF IN VICINITY OF WORKS).

EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

2 0211

Ch1100.00 Ch1080.00 Ch1060.00 Ch1040.00 Ch1020.00 Ch1010.00 Ch1000.00 Ch980.00

ROSS LANE

FUTURE SHARED PATH LOCATION (BY OTHERS).

EX. TELSTRA SERVICE TO BE LOCATED PRIOR TO DETAILED DESIGN.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGN	CHECK	APPROVED
A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 2 4 8 12
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Scale (m)

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PLANIT CONSULTING

CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 3 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0152	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:34:39 AM

100mm AT ORIGINAL SIZE

N

LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
- EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
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EX. WATER SERVICE TO BE LOCATED PRIOR TO DETAILED DESIGN (IF IN VICINITY OF WORKS).

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

WORKS WITHIN PRIVATE PROPERTY.

EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

Ch960.00

Ch955.16

Ch940.00

ROSS LANE

Ch920.00

Ch900.00

Ch880.00

Ch860.00

Ch840.00

Ch820.00

EXISTING TREES TO BE REMOVED. ASSESSMENT BY ARBORIST REQUIRED.

EX. WATER METER TO BE RAISED TO PROPOSED LEVELS.

EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

EX. TELSTRA SERVICE TO BE LOCATED PRIOR TO DETAILED DESIGN.

FUTURE SHARED PATH LOCATION (BY OTHERS).

EXISTING TREES TO BE REMOVED. ASSESSMENT BY ARBORIST REQUIRED.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

EXISTING TREES TO BE REMOVED. ASSESSMENT BY ARBORIST REQUIRED.

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REV	DESCRIPTION	DATE	DRAWN	DESIGN	CHECK	APPROVED
A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 2 4 8 12
Full Size 1:200 ; Half Size 1:400
Scale (m)

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ABN: 20 099 261 711
administration@planitconsulting.com.au

CLIENT: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 4 OF 9

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0153	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:30:46 AM

100mm AT ORIGINAL SIZE

N

LEGEND

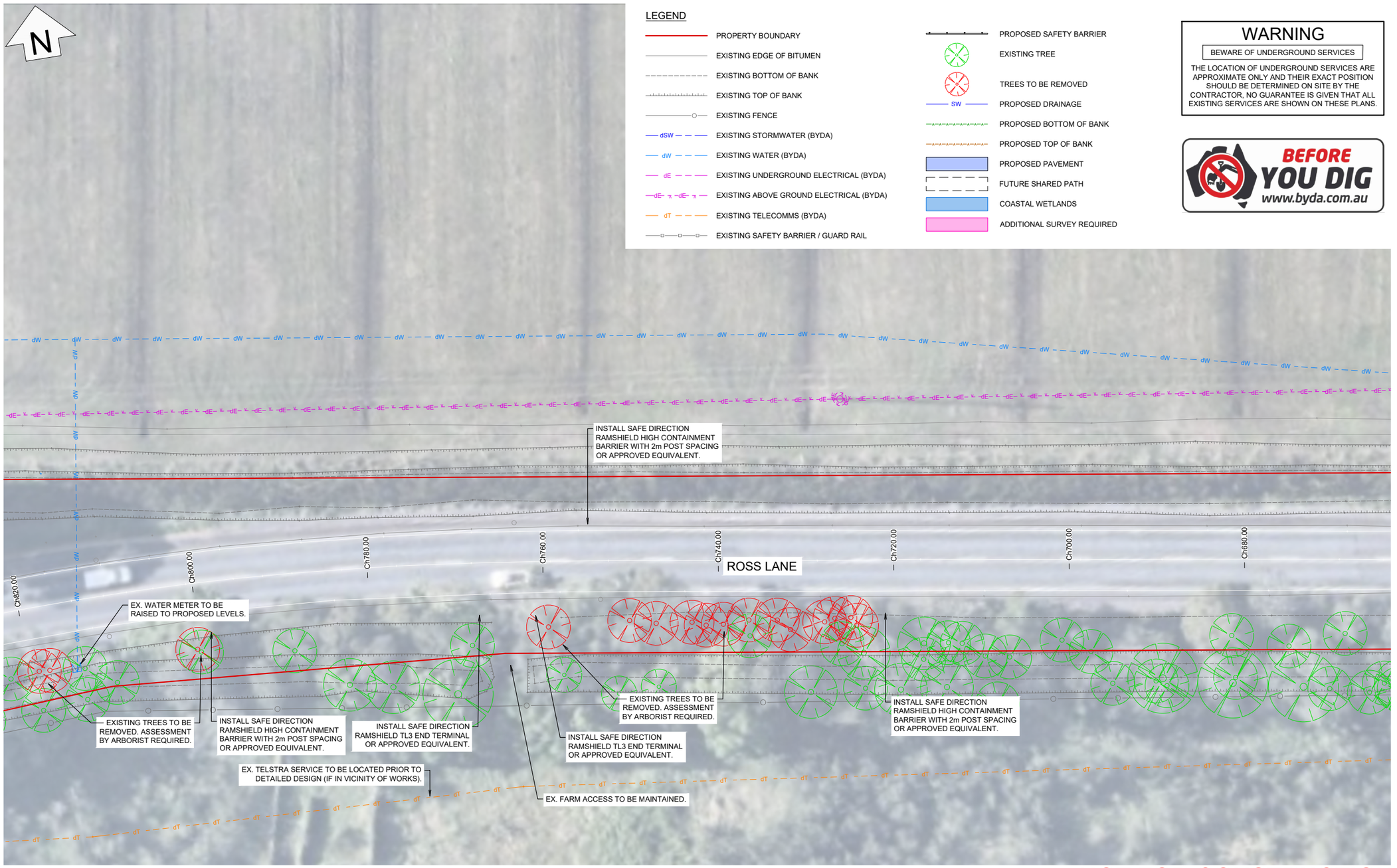
- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
- EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
- PROPOSED DRAINAGE
- PROPOSED BOTTOM OF BANK
- PROPOSED TOP OF BANK
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- FUTURE SHARED PATH
- COASTAL WETLANDS
- ADDITIONAL SURVEY REQUIRED

WARNING

BEWARE OF UNDERGROUND SERVICES

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A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 2 4 8 12
Full Size 1:200 ; Half Size 1:400
Scale (m)
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ABN: 20 099 261 711
administration@planitconsulting.com.au

CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 5 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0154	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ\8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:32:49 AM

100mm AT ORIGINAL SIZE

N

LEGEND

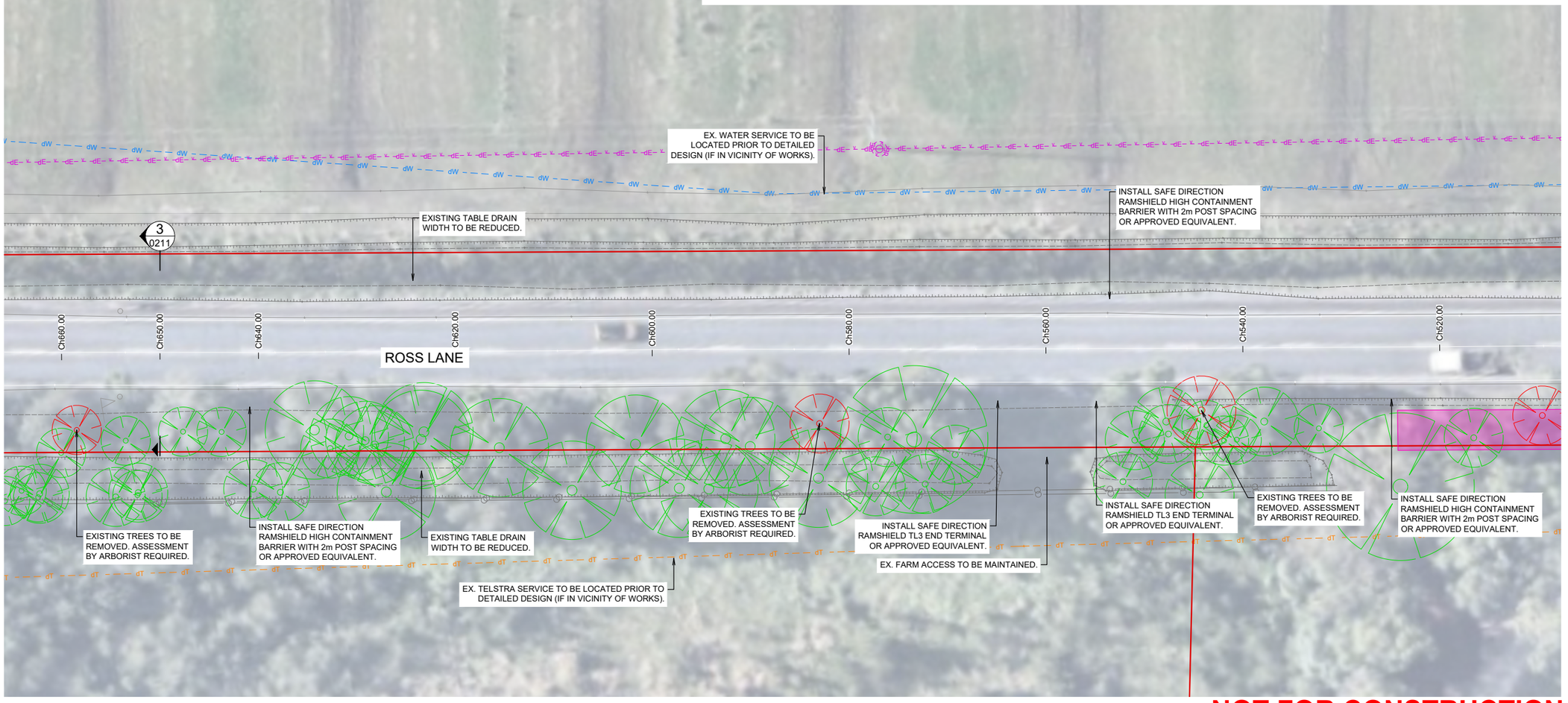
- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
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A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 2 4 8 12
Full Size 1:200 ; Half Size 1:400
Scale (m)
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ABN: 20 099 261 711
administration@planitconsulting.com.au

PLANIT CONSULTING

CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 6 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0155	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:31:06 AM

100mm AT ORIGINAL SIZE

N

LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
- EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
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EX. WATER SERVICE TO BE LOCATED PRIOR TO DETAILED DESIGN (IF IN VICINITY OF WORKS).

EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

INSTALL SAFE DIRECTION RAMSHIELD TL3 END TERMINAL OR APPROVED EQUIVALENT.

Ch500.00 Ch480.00 Ch460.00 Ch440.00 Ch420.00 Ch416.29 Ch400.00 Ch380.00 Ch360.00

ROSS LANE

EXISTING ELECTRICAL POLE TO BE RELOCATED.

EXISTING TREES TO BE REMOVED. ASSESSMENT BY ARBORIST REQUIRED.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

INSTALL SAFE DIRECTION RAMSHIELD TL3 END TERMINAL OR APPROVED EQUIVALENT.

FUTURE SHARED PATH LOCATION (BY OTHERS).

EX. CROSSOVER TO BE RAISED TO MATCH PROPOSED SURFACE.

20M TRANSITION FROM PROPOSED CROSS SECTION TO EXISTING.

EX. TELSTRA SERVICE TO BE LOCATED PRIOR TO DETAILED DESIGN (IF IN VICINITY OF WORKS).

NOT FOR CONSTRUCTION

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A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

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Scale (m)
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ABN: 20 099 261 711
administration@planitconsulting.com.au

CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

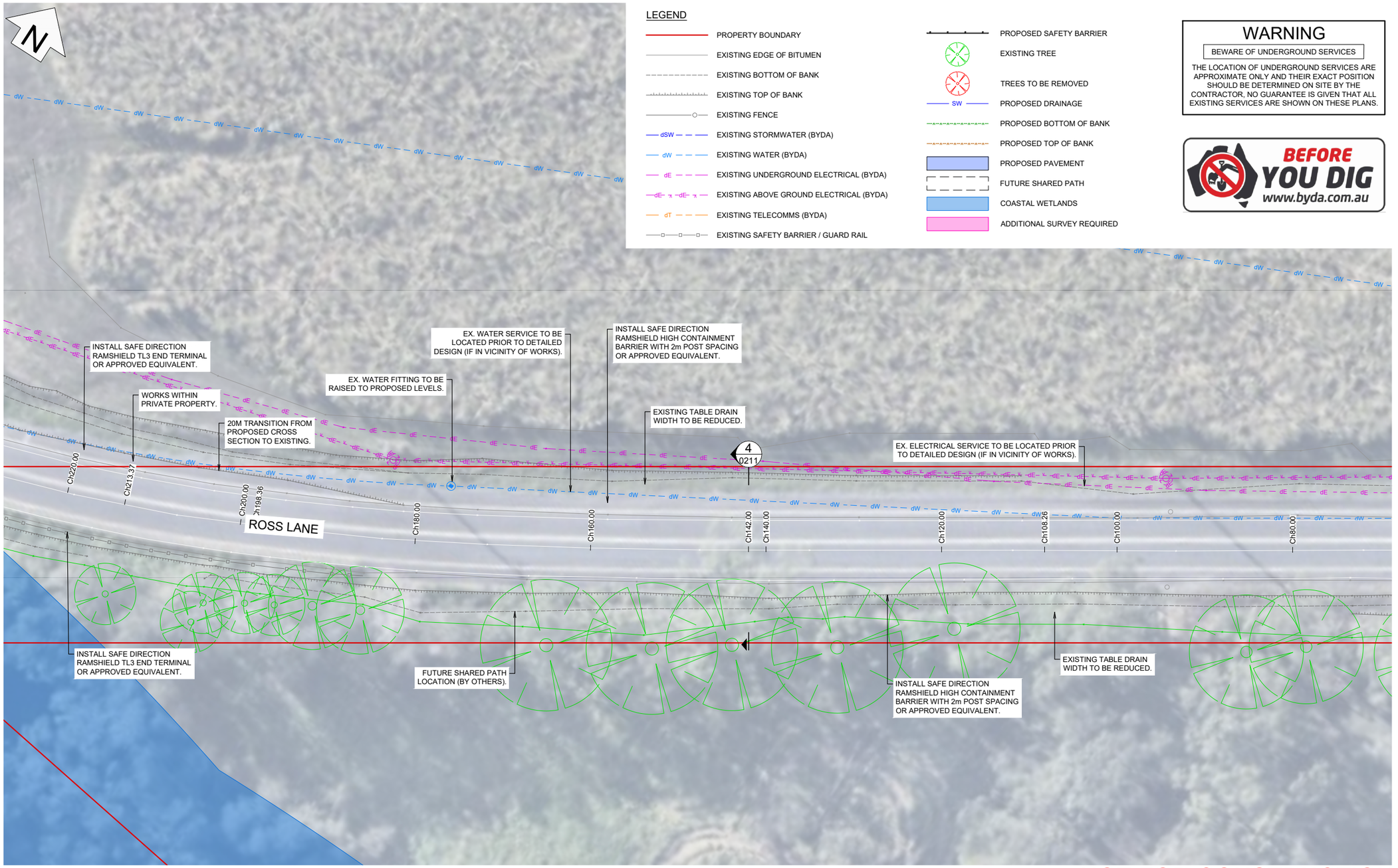
PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 7 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0156	B

CAD FILE: C:\12DS\DATA\PLANITS\YNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:29:34 AM

100mm AT ORIGINAL SIZE



LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
- EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
- PROPOSED DRAINAGE
- PROPOSED BOTTOM OF BANK
- PROPOSED TOP OF BANK
- PROPOSED PAVEMENT
- FUTURE SHARED PATH
- COASTAL WETLANDS
- ADDITIONAL SURVEY REQUIRED

WARNING

BEWARE OF UNDERGROUND SERVICES

THE LOCATION OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE DETERMINED ON SITE BY THE CONTRACTOR, NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN ON THESE PLANS.

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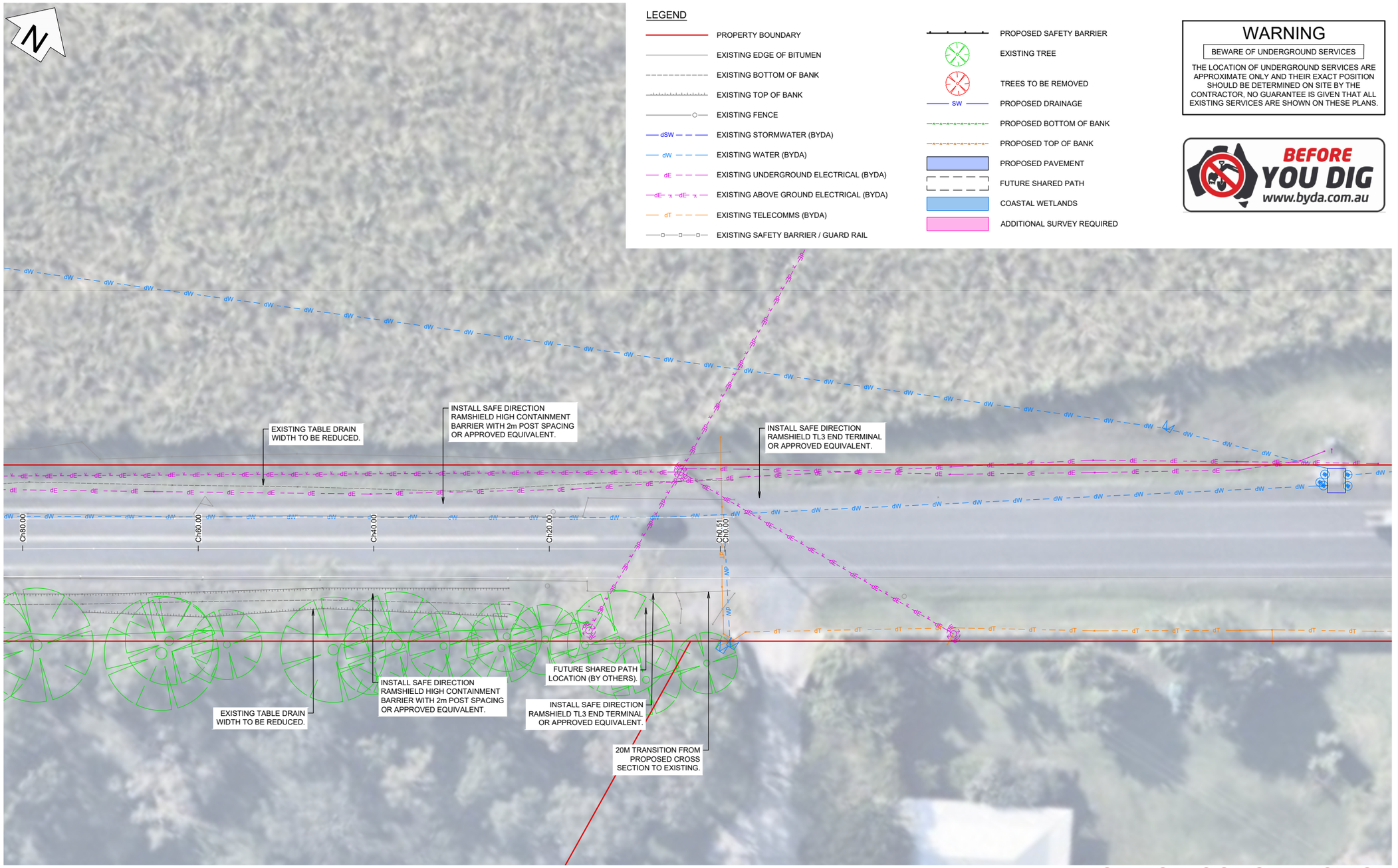
PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 8 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0157	B

CAD FILE: C:\12DS\DATA\PLANITS\YNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:32:14 AM

100mm AT ORIGINAL SIZE



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CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 9 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0158	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:30:18 AM

100mm AT ORIGINAL SIZE

N

LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
- EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
- PROPOSED DRAINAGE
- PROPOSED BOTTOM OF BANK
- PROPOSED TOP OF BANK
- PROPOSED PAVEMENT
- FUTURE SHARED PATH
- COASTAL WETLANDS
- ADDITIONAL SURVEY REQUIRED

WARNING

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INSTALL SAFE DIRECTION RAMSHIELD TL3 END TERMINAL OR APPROVED EQUIVALENT.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

WORKS WITHIN PRIVATE PROPERTY.

ADDITIONAL SURVEY REQUIRED TO CALCULATE NORTHERN EXTENTS OF TABLE DRAIN.

Ch1404.37 Ch1400.00 Ch1380.00 Ch1360.00 Ch1340.00 Ch1329.99 Ch1320.00 Ch1300.00 Ch1280.00

ROSS LANE

INSTALL SAFE DIRECTION RAMSHIELD TL3 END TERMINAL OR APPROVED EQUIVALENT.

FUTURE SHARED PATH LOCATION (BY OTHERS).

EXISTING ELECTRICAL POLE TO BE RELOCATED.

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

20M TRANSITION FROM PROPOSED CROSS SECTION TO EXISTING.

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGN	CHECK	APPROVED
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 2 4 8 12
Full Size 1:200 ; Half Size 1:400
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CLIENT: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2B 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 2

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0160	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:33:46 AM

100mm AT ORIGINAL SIZE

LEGEND

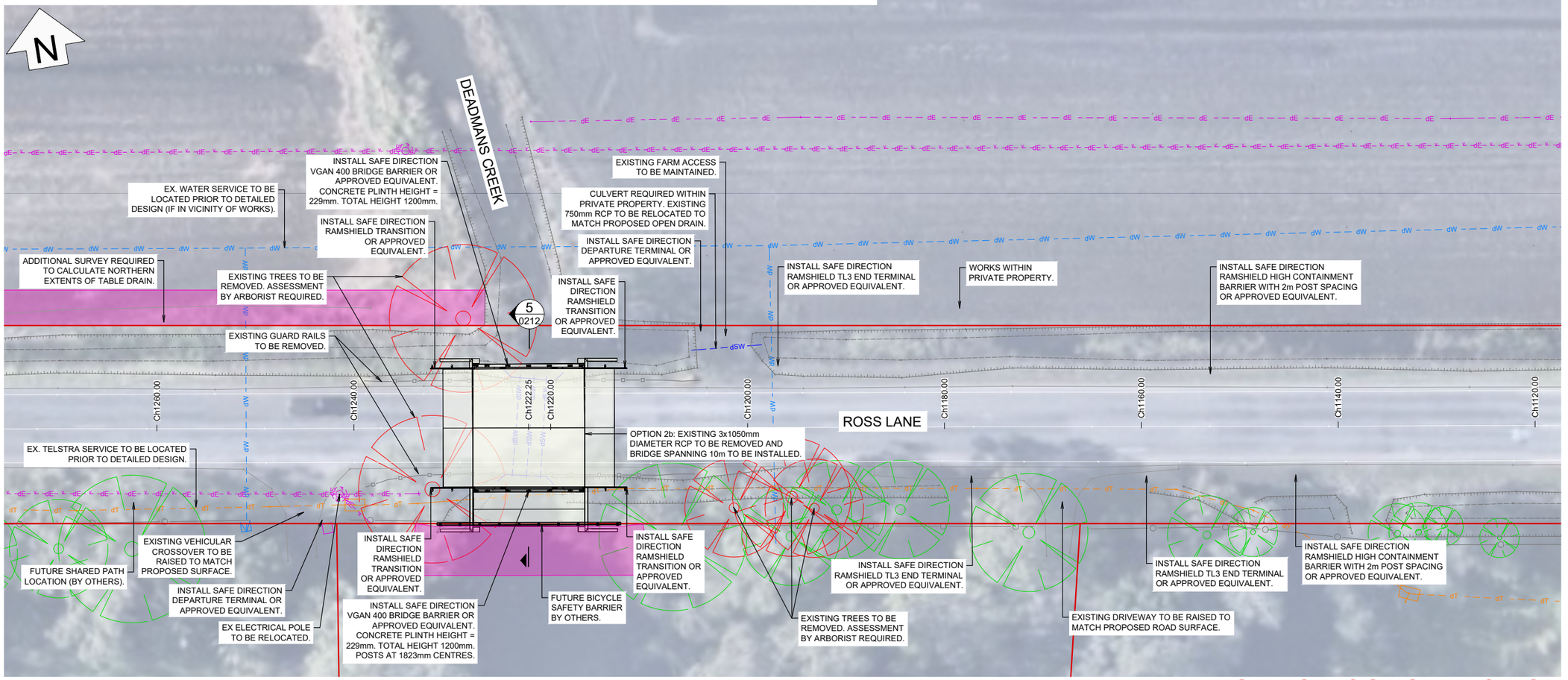
- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- EXISTING STORMWATER (BYDA)
- EXISTING WATER (BYDA)
- EXISTING UNDERGROUND ELECTRICAL (BYDA)
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OPTION 2a - CULVERT UNDER ROAD

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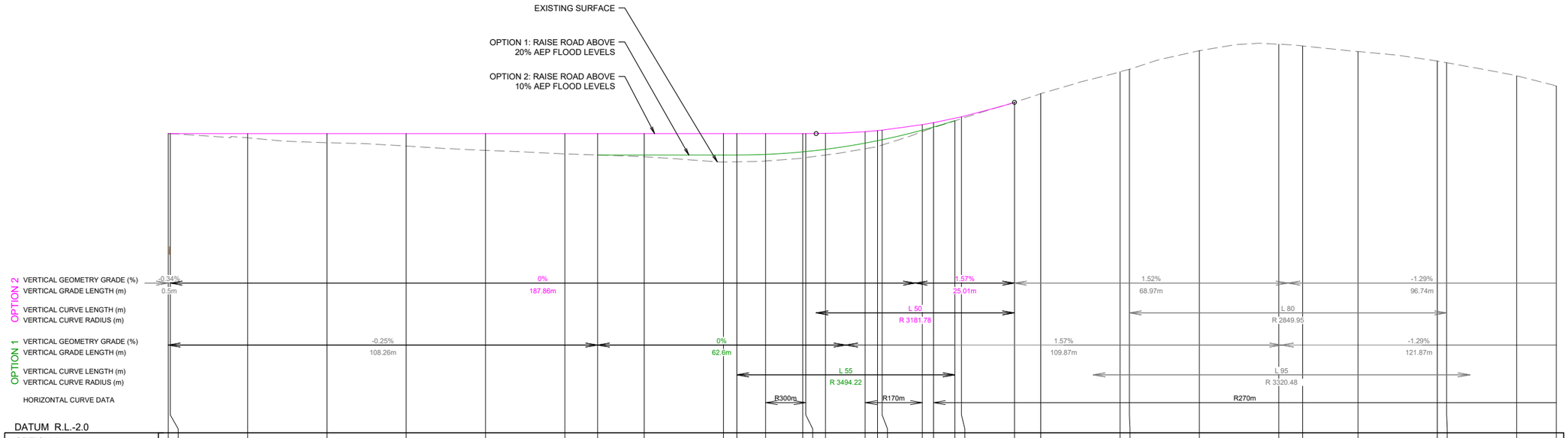
PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2B 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 2

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0161	B

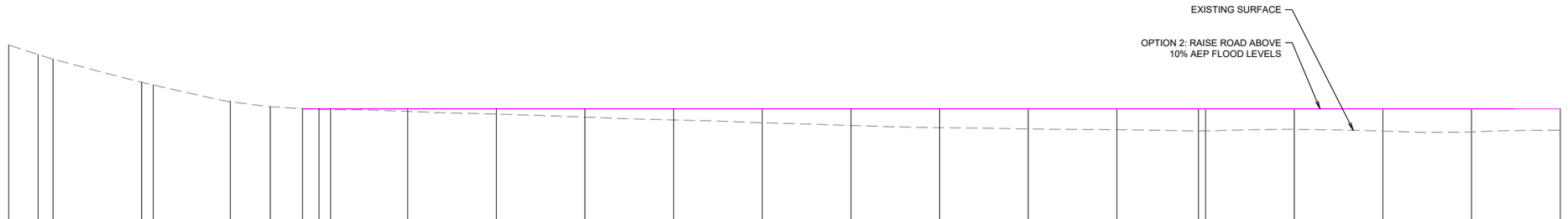
CAD FILE: C:\12DS\DATA\PLANITS\YNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:35:18 AM

100mm AT ORIGINAL SIZE



| | | |

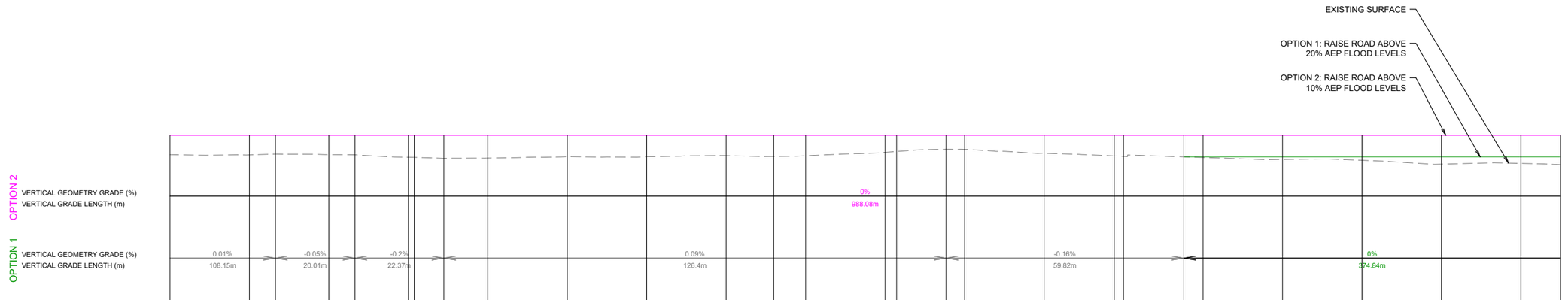
100mm AT ORIGINAL SIZE



OPTION 2

| | | |

100mm AT ORIGINAL SIZE



OPTION 2 VERTICAL GEOMETRY GRADE (%)														0%																			
OPTION 2 VERTICAL GRADE LENGTH (m)														988.08m																			
OPTION 1 VERTICAL GEOMETRY GRADE (%)		0.01%		-0.05%		-0.2%						0.09%						-0.16%										0%					
OPTION 1 VERTICAL GRADE LENGTH (m)		108.15m		20.01m		22.37m						126.4m						59.82m										374.84m					
HORIZONTAL CURVE DATA							R-375m										R220m																
DATUM R.L.-1.0																																	
OPTION 2 DEPTH TO EXISTING	0.242	0.248	0.242	0.275	0.278	0.285	0.287	0.268	0.255	0.264	0.256	0.213	0.202	0.174	0.224	0.257	0.263		0.278	0.303	0.313	0.362	0.352	0.369									
OPTION 2 10% AEP FLOOD LEVEL	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65									
OPTION 1 DEPTH TO EXISTING																		0.00	0.01	0.03	0.04	0.09	0.08	0.10									
OPTION 1 20% AEP FLOOD LEVEL																		1.38	1.38	1.38	1.38	1.38	1.38	1.38									
EXISTING SURFACE	1.41	1.40	1.42	1.41	1.41	1.38	1.37	1.36	1.36	1.38	1.38	1.40	1.39	1.39	1.44	1.45	1.48	1.48	1.43	1.39	1.39	1.38	1.37	1.35	1.34	1.29	1.30	1.28					
CHAINAGE	700.00	720.00	726.56	740.00	746.57	760.00	761.50	768.94	780.00	800.00	820.00	840.00	851.97	860.00	880.00	882.89	895.34	900.00	920.00	937.64	940.00	955.16	960.00	980.00	1000.00	1020.00	1040.00	1050.00					

SCALE HZ 1:500, VT 1:25

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Scale (m)
0 2.5 5.0 7.5
Full Size 1:125 ; Half Size 1:250
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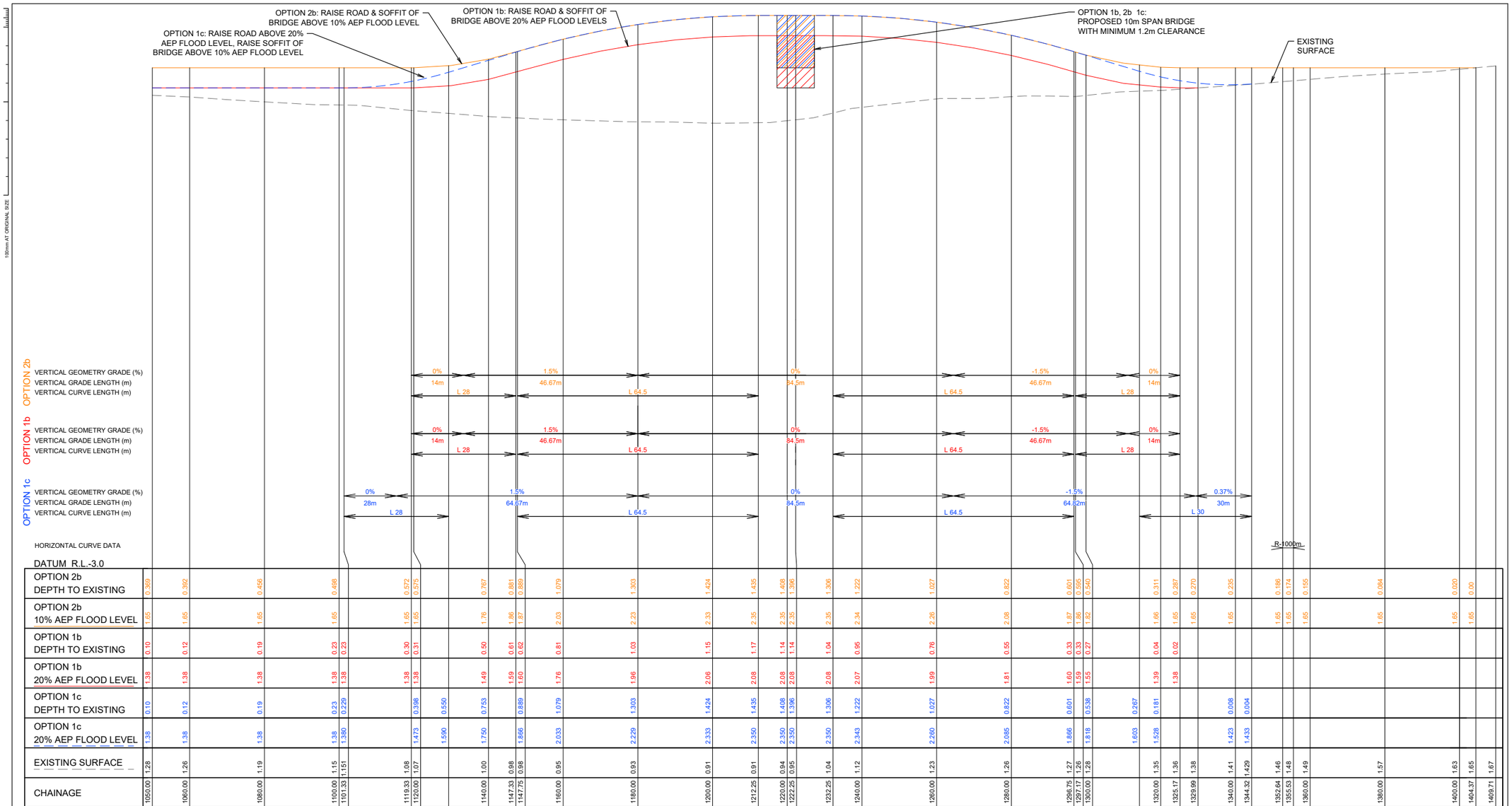
PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: ROAD LONGITUDINAL SECTION SHEET 3 OF 5

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0202	B

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CHAINAGE	1050.00	1060.00	1080.00	1100.00	1101.33	1119.33	1120.00	1140.00	1147.33	1147.75	1160.00	1180.00	1200.00	1212.25	1220.00	1222.25	1232.25	1240.00	1260.00	1280.00	1298.75	1297.17	1300.00	1320.00	1325.17	1329.99	1340.00	1344.32	1352.64	1355.53	1360.00	1380.00	1400.00	1404.37	1409.71
EXISTING SURFACE	1.28	1.26	1.19	1.15	1.151	1.08	1.07	1.00	1.00	0.98	0.98	0.95	0.93	0.91	0.91	0.91	0.94	0.95	1.04	1.12	1.23	1.26	1.28	1.27	1.26	1.28	1.41	1.429	1.46	1.48	1.49	1.57	1.63	1.65	1.67
OPTION 2b DEPTH TO EXISTING	0.369	0.392	0.466	0.498		0.572	0.575	0.767	0.861	0.869	1.079	1.303	1.424	1.435	1.408	1.396	1.306	1.222	1.027	0.822	0.601	0.595	0.540	0.311	0.287	0.270	0.235		0.186	0.174	0.155	0.064	0.020	0.00	
OPTION 2b 10% AEP FLOOD LEVEL	1.65	1.65	1.65	1.65		1.65	1.65	1.76	1.86	1.87	2.03	2.23	2.33	2.35	2.35	2.35	2.35	2.34	2.26	2.08	1.87	1.90	1.82	1.66	1.65	1.65	1.65		1.65	1.65	1.65	1.65	1.65	1.65	
OPTION 1b DEPTH TO EXISTING	0.10	0.12	0.19	0.23	0.23	0.30	0.31	0.50	0.61	0.62	0.81	1.03	1.15	1.17	1.14	1.14	1.04	0.95	0.76	0.55	0.33	0.33	0.27	0.04	0.02										
OPTION 1b 20% AEP FLOOD LEVEL	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.49	1.59	1.60	1.76	1.96	2.06	2.08	2.08	2.08	2.08	2.07	1.99	1.81	1.60	1.59	1.55	1.39	1.38										
OPTION 1c DEPTH TO EXISTING	0.10	0.12	0.19	0.23	0.229	0.398	0.550	0.753		0.869	1.079	1.303	1.424	1.435	1.408	1.396	1.306	1.222	1.027	0.822	0.601	0.595	0.538	0.267	0.181		0.008	0.004							
OPTION 1c 20% AEP FLOOD LEVEL	1.38	1.38	1.38	1.38	1.380	1.473	1.590	1.750		1.866	2.033	2.229	2.333	2.350	2.350	2.350	2.350	2.343	2.260	2.085	1.866	1.818	1.818	1.603	1.528		1.423	1.433							

SCALE HZ 1:500, VT 1:25

ROAD CENTRELINE LONGITUDINAL SECTION
(BRIDGE OPTIONS)

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A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG
C	OPTION 1D PROVIDED AS PER COUNCIL COMMENTS	07/05/25	DM	IR	JM	CG

SCALES:
0 5 10 20 30
Full Size 1:500 ; Half Size 1:1000
Scale (m)
0 0.25 0.5 1.0 1.5
Full Size 1:25 ; Half Size 1:50
Scale (m)
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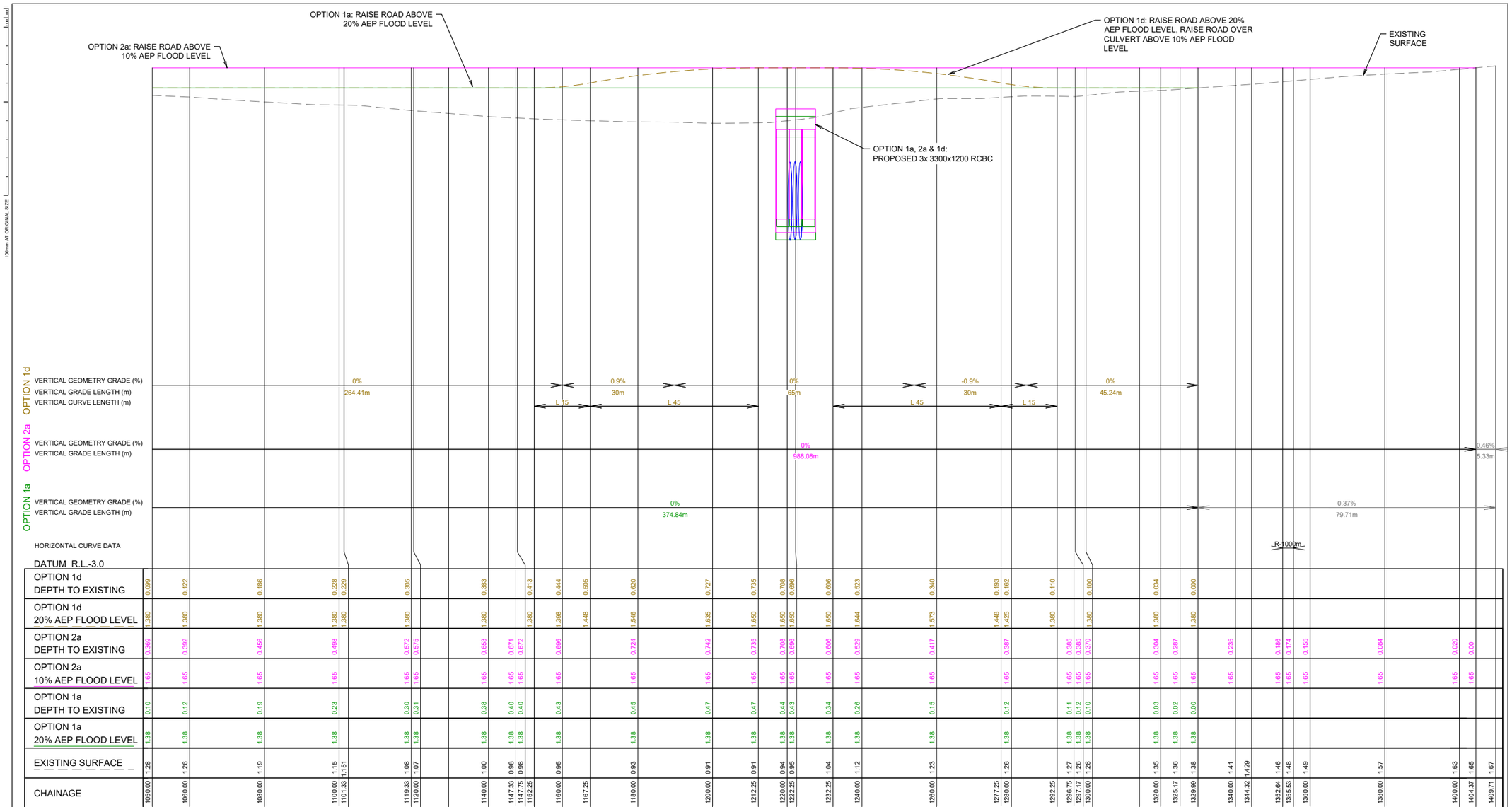
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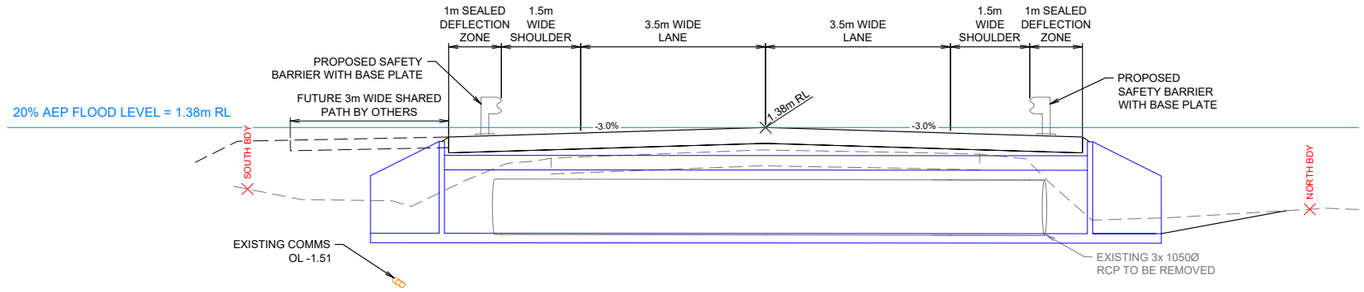
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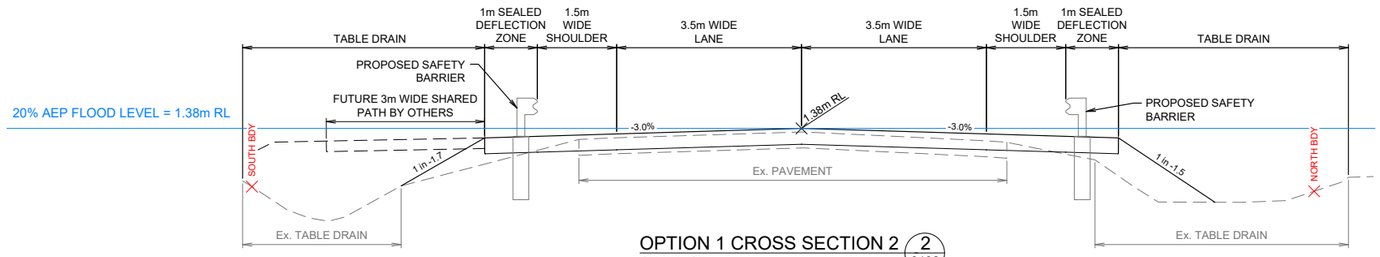
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OPTION 1a: RAISE ROAD ABOVE 20% AEP FLOOD LEVEL
OPTION 2a: RAISE ROAD ABOVE 10% AEP FLOOD LEVEL
OPTION 1d: RAISE ROAD ABOVE 20% AEP FLOOD LEVEL, RAISE ROAD OVER CULVERT ABOVE 10% AEP FLOOD LEVEL
EXISTING SURFACE
OPTION 1a, 2a & 1d: PROPOSED 3x 3300x1200 RCBC
100mm AT ORIGINAL SIZE
OPTION 1d
VERTICAL GEOMETRY GRADE (%)
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VERTICAL CURVE LENGTH (m)
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L 15
0.9%
30m
L 45
0%
65m
L 45
-0.9%
30m
L 15
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OPTION 2a
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OPTION 1a
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R-1000m
DATUM R.L.-3.0

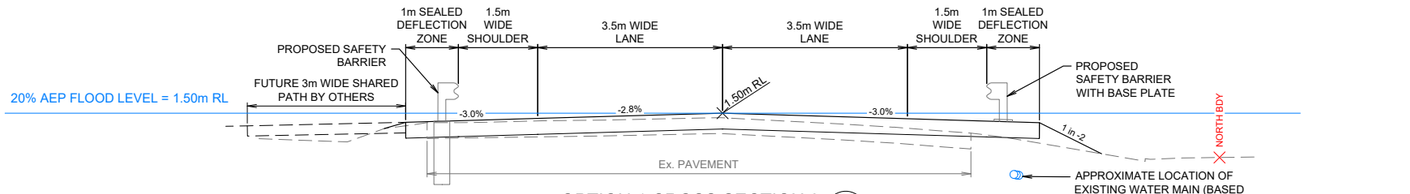
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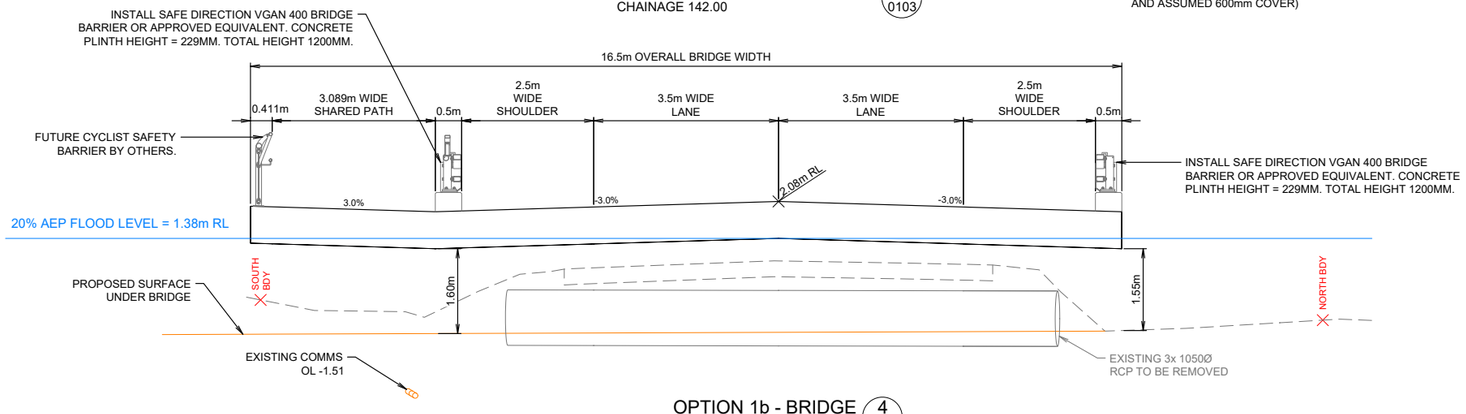
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CHAINAGE 1222.25



OPTION 1 CROSS SECTION 2 (2 / 0102)
CHAINAGE 1010.00



OPTION 1 CROSS SECTION 3 (3 / 0103)
CHAINAGE 142.00



OPTION 1b - BRIDGE (4 / 0110)
CHAINAGE 1222.25

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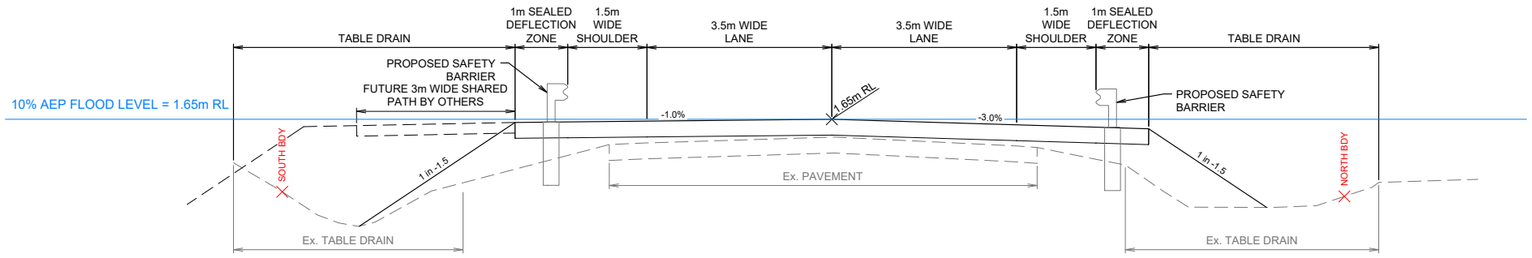
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PROJECT: ROAD DESIGN ROSS LANE KINVARA
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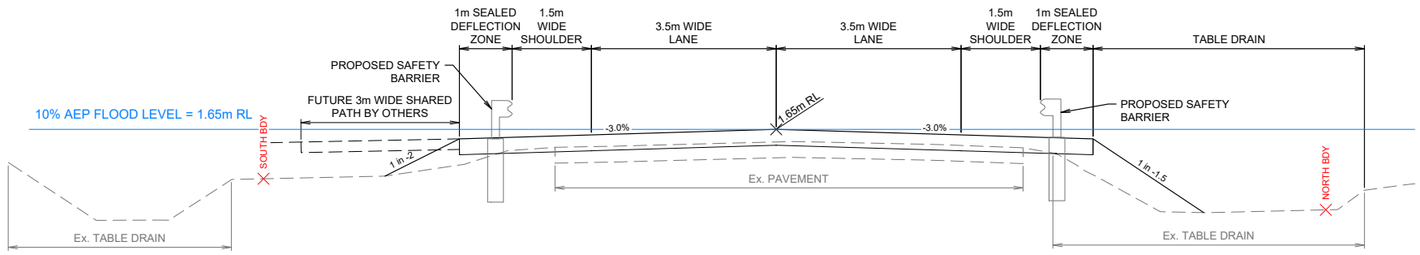
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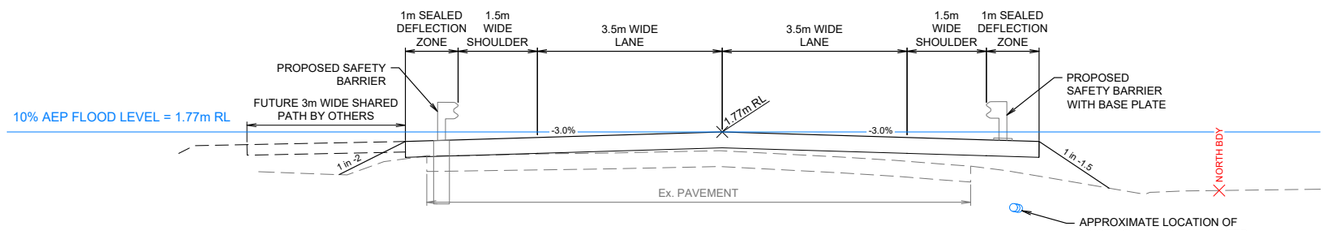
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OPTION 2 CROSS SECTION 2 (2)
CHAINAGE 1010.00 (0152)



OPTION 2 CROSS SECTION 3 (3)
CHAINAGE 650.00 (0155)



OPTION 2 CROSS SECTION 4 (4)
CHAINAGE 142.00 (0157)

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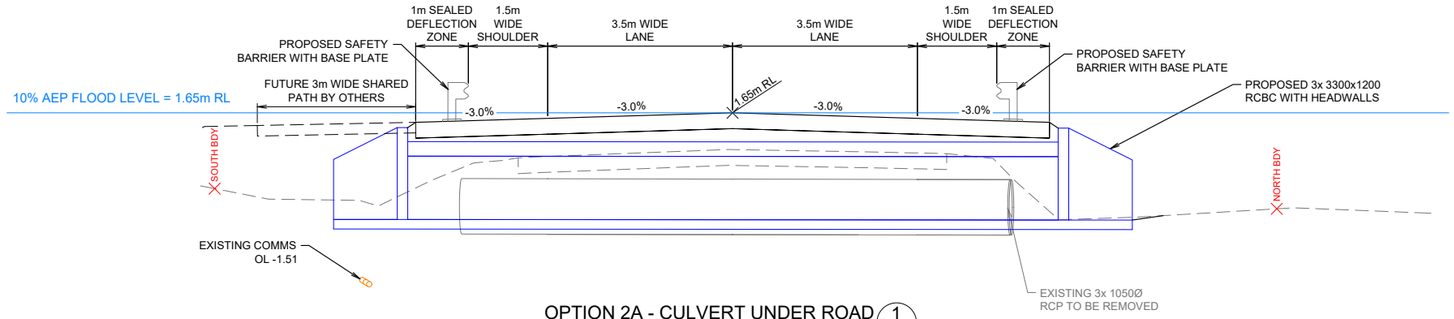
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OPTION 2 SHEET 1 OF 2
10% AEP FLOOD EVENT

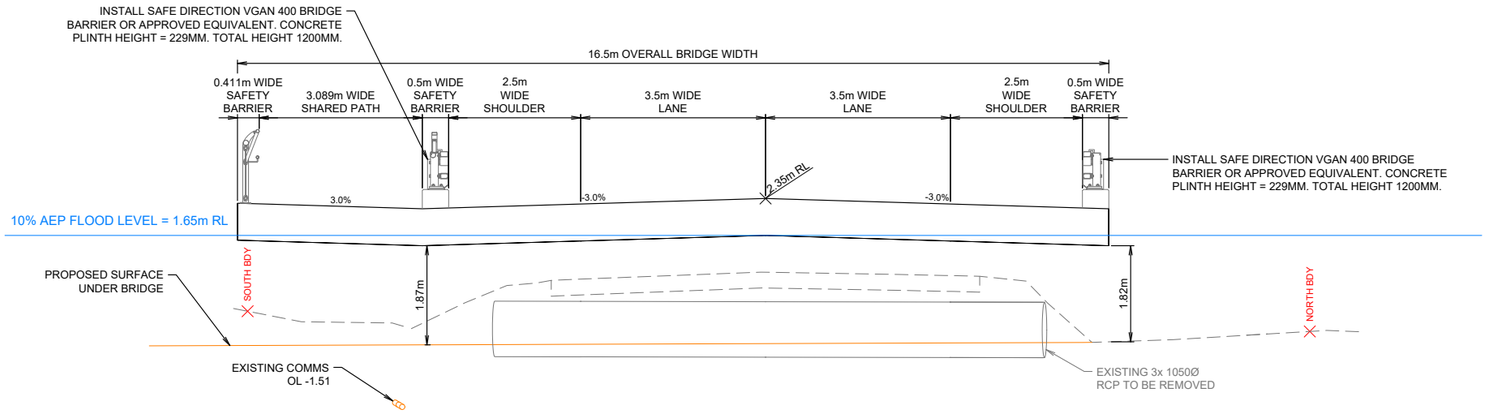
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OPTION 2A - CULVERT UNDER ROAD (1/0151)
CHAINAGE 1222.25



OPTION 2B - BRIDGE (5/0161)
CHAINAGE 1222.25

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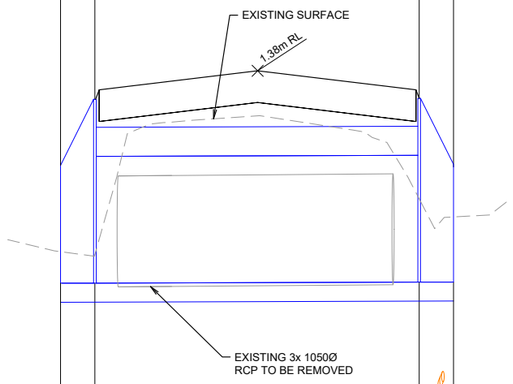
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OPTION 2 SHEET 2 OF 2
10% AEP FLOOD EVENT

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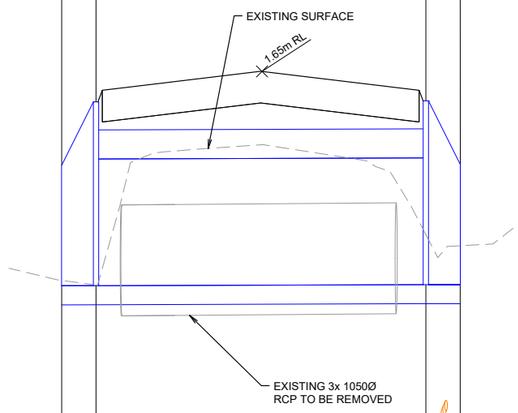
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SETOUT CO-ORDINATES												
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STRUCTURE NAME	HW 2								HW 1			
STRUCTURE DESCRIPTION	HEADWALL								HEADWALL			
PIPE SIZE (mm)	HEADWALL		(3x)3300x1200						HEADWALL			
PIPE CLASS			BC									
PIPE GRADE (%)			0.06%									
PIPE SLOPE (1 in X)			1714.20									
DATUM RL	-4.0											
DEPTH TO INVERT	0.855	0.855	1.740	1.740					0.620	0.620	0.873	
INVERT LEVEL	-0.630	-0.630	-0.630	-0.630					-0.620	-0.620	-0.620	
FINISHED SURFACE LEVEL	0.225		1.110						0.000		0.253	
CHAINAGE	0.000		1.300						13.582		14.882	



OPTION 1 CULVERT

SETOUT CO-ORDINATES												
	E554088.126 N6815446.944		E554087.919 N6815445.661						E554085.157 N6815428.511		E554084.950 N6815427.227	
STRUCTURE NAME	HW 2								HW 1			
STRUCTURE DESCRIPTION	HEADWALL								HEADWALL			
PIPE SIZE (mm)	HEADWALL		(3x)3300x1200						HEADWALL			
PIPE CLASS			BC									
PIPE GRADE (%)			0.06%									
PIPE SLOPE (1 in X)			1737.10									
DATUM RL	-4.0											
DEPTH TO INVERT	1.200	1.200	1.740	1.740					1.740	1.740	1.200	
INVERT LEVEL	-0.380	-0.380	-0.380	-0.380					-0.370	-0.370	-0.370	
FINISHED SURFACE LEVEL	0.820		1.360						1.370		0.830	
CHAINAGE	0.000		1.300						13.791		15.091	



OPTION 2 CULVERT

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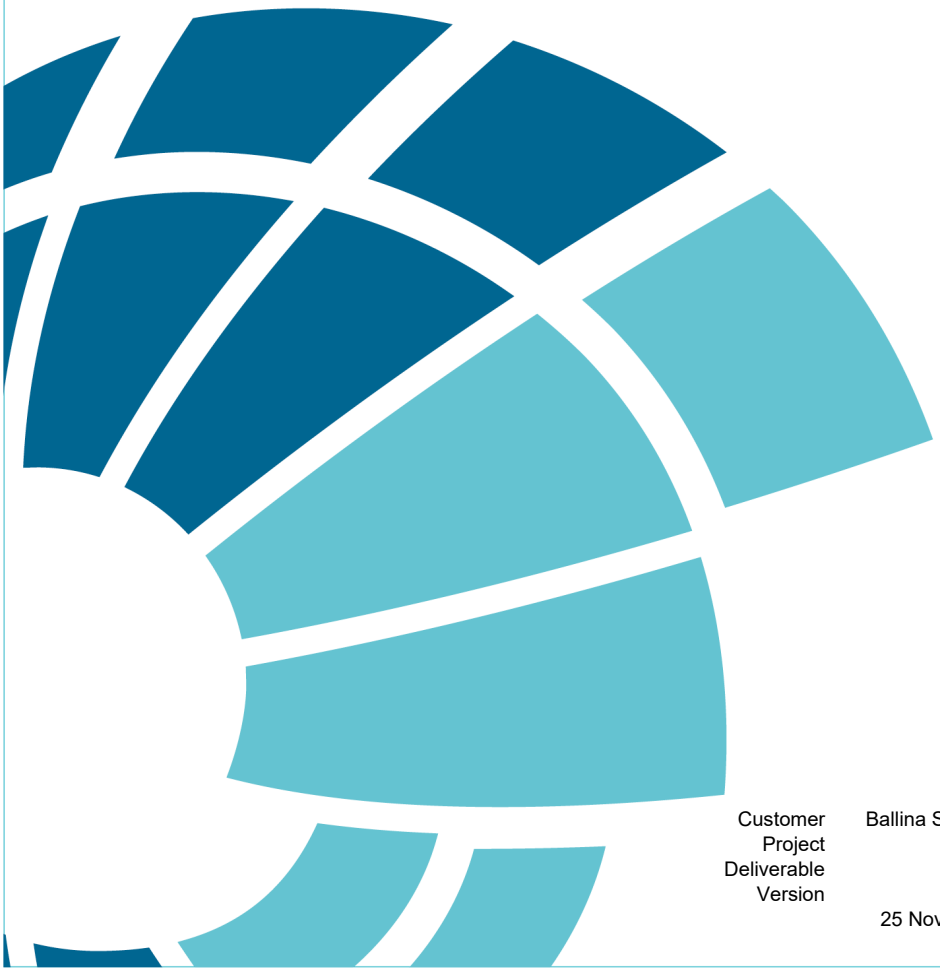
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Ross Lane Upgrade

Flood Impact Assessment



Customer	Ballina Shire Council
Project	003764
Deliverable	001
Version	03
	25 November 2025

Document Control

Document Identification

Title	Ross Lane Upgrade: Flood Impact Assessment
Project No	003764
Deliverable No	001
Version No	03
Version Date	25 November 2025
Customer	Ballina Shire Council
Classification	PRIVATE

Author	Barry Rodgers
Checked By	Zita Dore
Approved By	Zita Dore
Project Manager	Barry Rodgers

Amendment Record

The Amendment Record below records the history and issue status of this document.

Version	Version Date	Distribution	Record
00	09 October 2025	BSC	Working Draft
01	07 November 2025	BSC	Draft Report
02	14 November 2025	BSC	Draft Report
03	25 November 2025	BSC	Final Report

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Executive Summary

Ross Lane is a key road which connects the coastal community of Lennox Head to the Pacific Highway, north of Ballina in northern NSW. It crosses the floodplain associated with Newrybar Swamp and is prone to prolonged flooding at low points causing disruption and inconvenience to residents in Lennox Head and the surrounding area.

Ballina Shire Council (Council) is currently looking at options to raise low lying sections of Ross Lane in order to reduce the frequency of flooding and consequent disruption to local residents. The road raising will be accompanied by an upgrade to the cross drainage structure for Deadmans Creek under Ross Lane. Nine road raising options were supplied to BMT for assessment within the flood model recently developed for Council as part of the Ballina Flood Study Update 2023.

The flood model was updated to include higher spatial resolution in the vicinity of Ross Lane. The model was also updated with ground survey of the existing Ross Lane and nearby drains.

The model scenarios tested raise the low points along Ross Lane to different elevations corresponding to design flood levels. The lowest crest level along Ross Lane is currently around 0.92mAHD. The scenarios raise this by differing heights up to an increase of 0.76m.

The flood impact assessment (FIA) was undertaken for flood events ranging from a ‘nuisance’ flood up to a 1% AEP flood. The assessment presents results showing:

- Mapped changes in peak water level
- Mapped changes in peak flood velocity
- Plots of water levels over time to assesses the potential for changes in flood duration
- Tabulated peak level and changes in peak level, including at buildings where flood levels are compared to floor levels to identify impacted buildings.

The results show all modelled scenarios result in upstream impacts (impacts to the north of Ross Lane). These impacts are predominantly increases in peak flood level. The impacts vary in severity with higher road levels creating greater impacts.

No impacts in terms of extended durations of flooding are predicted. Whilst the road raising scenarios affect the peak flood levels, the overall drain down time is unaffected as this is controlled by downstream conditions.

Depending on the road raising scenario, up to four buildings are impacted by increased flood levels occurring within 0.3m of the floor level. Two of these floors are habitable with the other two being sheds. Under the worst case scenario for impacts, the maximum impacts at the two affected habitable buildings are 0.01m above floor and 0.12m above floor respectively.

Ross Lane was also assessed for flood impacts under two future topographic base cases (B2 and B3) which include future development. Most notably these two base cases include the Cumbalum Urban Release Area (CURA) B development. It was found that the impacts of the Ross Lane project were almost identical under these future base cases.

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1 Introduction

1.1 Background

Ross Lane is a key road which connects the coastal community of Lennox Head to the Pacific Highway, north of Ballina in northern NSW. It also provides access to numerous rural residential properties, farms and other businesses. Ross lane is situated on a general east-west alignment and crosses the floodplain associated with Newrybar Swamp. Newrybar Swamp is drained by numerous creeks and drains which converge into North Creek and ultimately join the Richmond River at Ballina. Figure 1.1 shows Ross Lane along with the main nearby watercourses.

Ross Lane is prone to flooding at low points. The flooding occurs frequently (typically 1 to 2 times per year) and can also last for extended periods causing disruption and inconvenience to residents in Lennox Head and the surrounding area. The lowest part of Ross Lane is located near to where it crosses Deadmans Creek and this is the most vulnerable point with regards to inundation.

Ballina Shire Council (Council) is currently looking at options to raise low lying sections of Ross Lane in order to reduce the frequency of flooding and consequent disruption to local residents. The road raising will be accompanied by an upgrade to the cross drainage structure for Deadmans Creek under Ross Lane.

This report documents a flood modelling assessment which considers 9 potential road raising options (scenarios) for Ross Lane. Council's latest flood model, developed as part of the *Ballina Flood study Update* (BFSU) (BMT,2025), herein referred to as the 'BFS model', is used to assess the potential for flood impacts resulting from each scenario. A preferred scenario is then nominated for the purposes of sensitivity testing of the underlying modelling assumptions.

1.2 Scope of Works

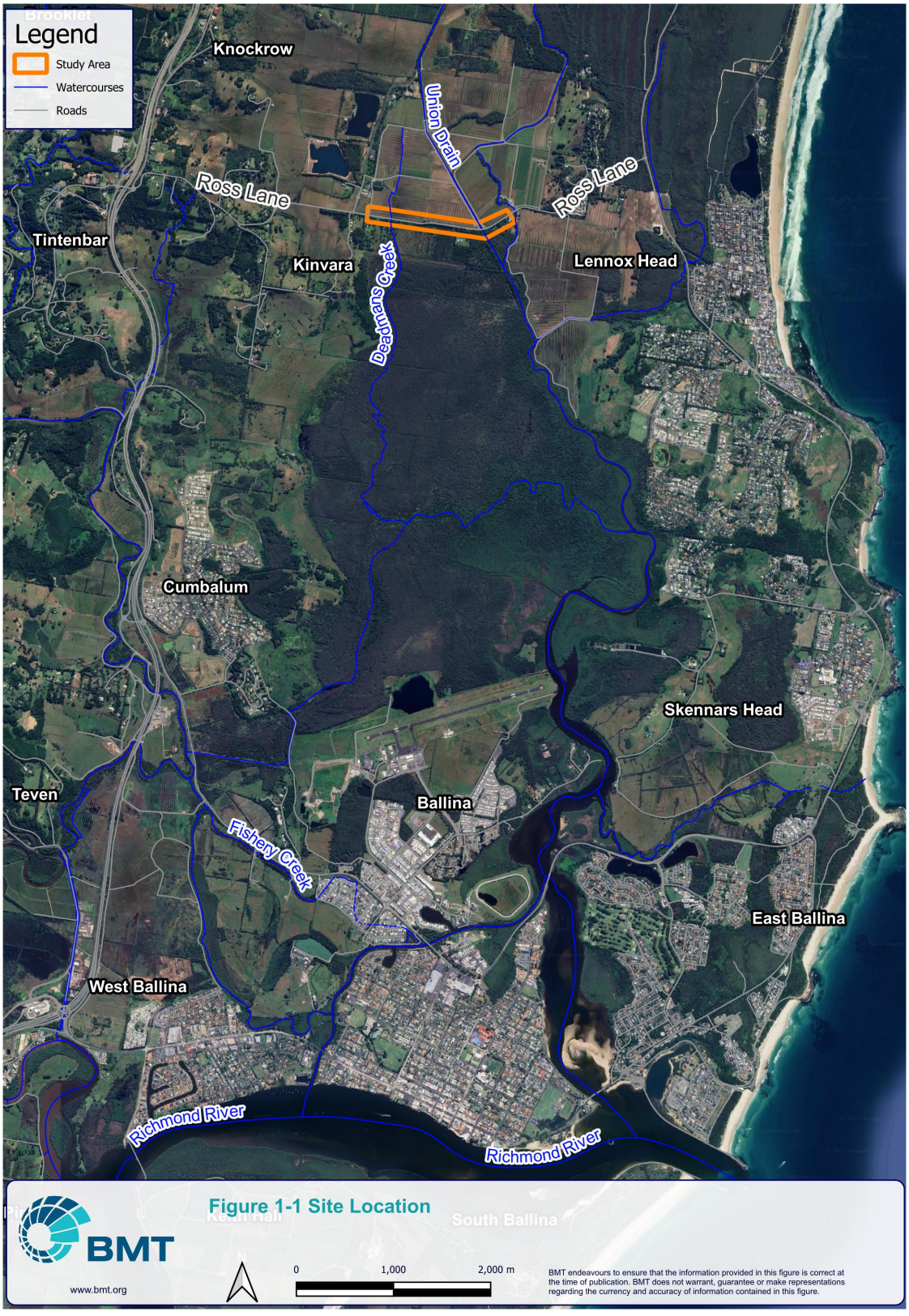
The scope of work is broadly set out as follows:

- Review and update the BFS model in the vicinity of Ross Lane with a particular focus on representing the local topography and drains using the best available data.
- Use the updated BFS model to assess 9 road raising concept designs provided to BMT by Council. Determine the potential for flood impacts from each option using BFSU design flood events.
- Undertake additional sensitivity tests including varying the assumed hydraulic roughness in the drains to account for greater vegetation.
- Present and summarise the findings of the assessment.

Detailed descriptions of the BFS model updates made to both the existing case and the developed (road raising) cases are described herein along with the outcomes from the assessment.

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5.1 Ross Lane Betterment



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2 Base Case Model Updates

2.1 Overview of BFS Flood Model

The BFSU was adopted by Council in 2025 and included development of a hydraulic flood model (BFS model) which is currently the most up to date flood model available for the study area. The model includes the North Creek catchment extending from Midgen Flat Road down to the ocean at Ballina. It also includes the lower Richmond River. Runoff from the entire Richmond River basin is accounted for through hydrologic modelling, the outputs of which are then applied as inputs to the hydraulic flood model.

The BFS model was calibrated to flood events that occurred in June 2005, February 2022, March 2022 and January 2023 and was used to simulate design flood events ranging from the 20% AEP event through to the Probable Maximum Flood (PMF). Design flood events were derived in accordance with the Australian Rainfall and Runoff 2019 Guideline (ARR2019) and give consideration to all dominant sources of flooding in Ballina i.e. from the Richmond River, from local catchments and from storm tide.

The BFS model uses an overall 20m grid resolution which is refined down to a 10m grid resolution around hydraulic structures, embankments and smaller watercourses and further refined down to a 5m grid resolution along small channels/watercourses and urban areas.

Flood mapping presented in the BFSU shows that local catchment flooding is the dominant source of flooding for the North Creek catchment in the vicinity of Ross Lane for all design events considered in this assessment.

The adopted flood model developed for the BFSU was used as the base model for the purposes of assessing road raising options. This study focuses on flooding within the vicinity of Ross Lane and additional detail was added at a local scale to better represent the drainage features, roads and cross drainage structures as described in section 2.2.

2.2 Base Case Model Updates

2.2.1 Topographic Data

The BFS model uses LiDAR data captured in 2023 to represent the base topography across the area of interest. For the current assessment of Ross Lane, the LiDAR data has been supplemented with available ground survey data. Key survey datasets of relevance to this assessment are shown in Figure 2.1 and are as follows:

- Cross section survey of Deadmans Creek and adjacent drains upstream and downstream of Ross Lane, captured as part of the Cumbalum Urban Release Area (CURA) B project. The surveyed channel cross sections captured in 2017 by Northern Rivers Land Solutions (now Barker Ryan Stewart) and were later converted into a digital terrain model (DEM) by BMT and which was applied in a previous Ross Lane modelling assessment (BMT, 2021).
- Cross section survey of Deadmans Creek and adjacent drains to the north of Ross Lane. It is understood this survey was used in a report by WRM to investigate drainage issues at 38 Newrybar Swamp Road. The survey is indicated as being captured by Northern Rivers Land Solutions for a local landowner Monica Anderson and was supplied to Council in 2018 by WRM consultants (NRLS_17002-06.kml). The survey appears to be an extract from the CURA B survey listed above with survey point locations and elevations matching.

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- Survey of the drain adjacent to Ross Lane on its northern side, captured as part of Council's drainage improvement works (2025 08 06 BSC Survey ROSS LANE DRAIN cleaned.dwg).
- Survey of existing land elevations compiled for CURA B project by Barker Ryan Stewart (17002 (DTM Updated Sep 2023).dwg)
- Survey of Ross Lane supplied by Council (2025 06 20 export natural tin ross lane.dwg)

The DEM of drainage channels created from the surveyed cross sections was applied in the model to override the LiDAR data and to ensure the drains in the vicinity of Ross Lane were sufficiently represented.

The Council survey of the drain adjacent to Ross Lane was captured in 2025 and overlaps with the cross sectional drain survey. The surveyed channel invert elevations compare reasonably well although the more recent Council survey typically shows lower invert levels. It is assumed that this is due to the drain clearing works which preceded the Council survey. As the Council survey is more recent and samples elections at a more frequent interval then the council survey is used in preference to the cross section survey.

The survey of existing ground elevations compiled in 2023 for the CURA B development was used to extract the bed levels of drains not included in other survey datasets. The remainder of the survey was not used as the density of the surveyed points is less than that of the LiDAR data and so the LiDAR data is more suited to use in a 2D flood model.

The survey of Ross Lane was applied as a DEM in the model and the crest elevation was enforced using a breakline.

2.2.2 Model Resolution

The BFS model represents the terrain using a spatial grid of cells containing elevations sampled from the topographic input data. The cell size is a combination of 20m, 10m and 5m across the area of interest with 20m typically used across the broad flat floodplain and the smaller cell sizes used to represent smaller or narrower features in the floodplain such as Ross Lane and drainage channels.

For the purposes of the current assessment, areas of higher spatial resolution which are located a significant distance from the area of interest were replaced with a 20m resolution grid. This included much of the urban area of Ballina. Within the area of interest all 10m domain areas were converted to 5m to result in an overall improvement in model resolution for the study area.

Figure 2.2 shows the modelled spatial resolution of the model used for the assessment of Ross Lane.

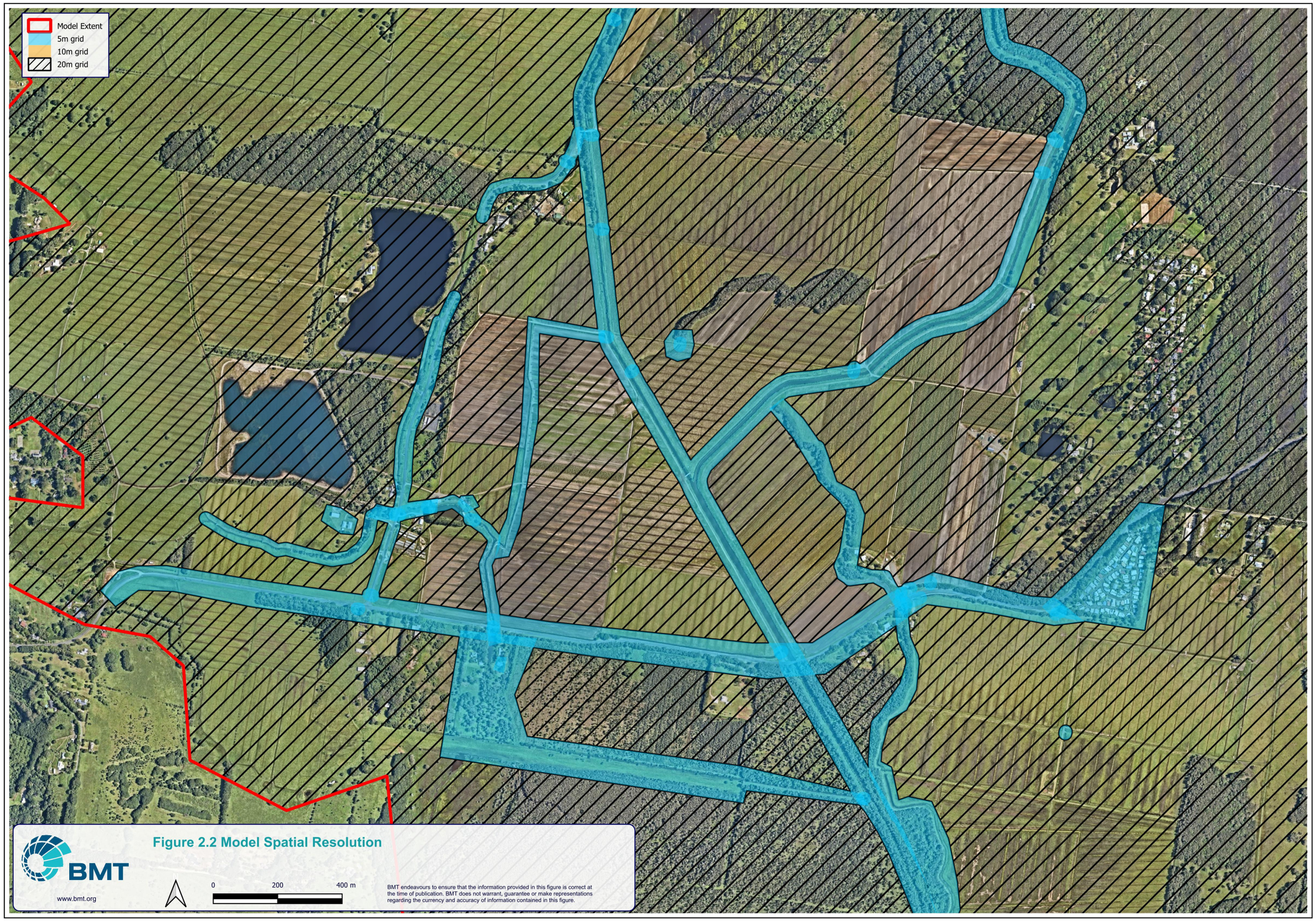
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5.1 Ross Lane Betterment



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5.1 Ross Lane Betterment



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2.2.3 Model Land Use

The land use delineation and associated Manning's n roughness values from the regional model were refined to a finer resolution within the project study area. Upon review it was found that some of the smaller drainage channels were not delineated and were lumped into more regional land use categories. Additional drainage channels were therefore delineated and attributed a Manning's n roughness of 0.06 corresponding to a watercourse with medium density vegetation.

2.2.4 Modelled Structures

Hydraulic structures (culverts and bridges) in the BFS model were reviewed in the vicinity of Ross Lane. The main structures were all included in the BFS model. The model was updated to include one additional 0.75m diameter RCP within the drainage channel immediately north of Ross Lane approximately 20m east of Deadmans Creek.

2.3 Incorporation of Future Base Case Scenarios

The assessment was undertaken in general accordance with Council's Draft Interim Flood Impact Assessment Procedure herein 'the Procedure'. The Procedure defines three base case scenarios, each corresponding to an assumed level of development at a different time horizon to account for the immediate short-term impacts and the long-term cumulative impacts. The base case scenarios are as follows:

- Current catchment conditions (B1) – taken to be the BFS model base case with the refinements to the study area described in Section 2.2
- Future catchment conditions (B2) – as B1 but with the addition of developments with consent and rezoned land that, if developed to Council's flood planning level, would involve filling of the floodplain. This also includes future infrastructure and flood mitigation works that is planned but not constructed at the date of this assessment
- Ultimate catchment conditions (B3) – as B2 but with the addition of strategic growth areas that have not yet been rezoned, strategic infrastructure and strategic flood mitigation works.

The Procedure was prepared at a point in time when the Integrated Model was Council's adopted flood model. Additional development associated with the B2 and B3 catchment conditions is configured within the Integrated Model through use of model scenarios. As the Ross Lane assessment uses the BFS model, it has been necessary to update the BFS model by incorporating the B2 and B3 developments.

The additional developments incorporated into the BFS model for the B2 and B3 catchment conditions are summarised in Table 2.1. The only B2 and B3 inclusions in proximity to Ross Lane are Cumbulam Precinct B (also referred to as CURA B) (B2 and B3 cases) located south of Ross Lane and west of Deadmans Creek and Barretts Development (B3 case) located south of Ross Lane and east of North Creek.

Whilst there are other development sites in the Shire other than those listed below, it is not necessary to include them in this study as they are far away and will not have any influence on the flood heights at Ross Lane.

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Table 2.1 B2 and B3 Model Inclusions

Name	Status	B2	B3
Teven Transport Precinct	Partially constructed	✓	✓
Ballina Racecourse	DA Approved	✓	✓
'Barretts development' North Creek	Strategic growth area		✓
Cumbalum Precinct B	Not Yet Constructed	✓	✓
Smith Drive Future Urban	Not Yet Constructed	✓	✓
River Bend Future Urban	Not Yet Constructed	✓	✓
West Ballina Arterial	Strategic		✓
West Ballina Service Centre and Flood Relief Culverts	DA Approved	✓	✓
Waste Transfer Centre floodway*	Strategic		✓

* Represented as changed land use with no topographic adjustments

The Procedure specifies the need to consider flooding from different dominant sources with those being Richmond River dominated flooding, local catchment dominated flooding and storm surge dominated flooding. Under the former Integrated Model, these different flooding sources were set out under different scenarios and results were then enveloped together to determine the peak water levels. Under the BFS model, the joint probability of the different flood sources is accounted for within the final design events. As such, enveloping of results from different model simulations is not required for this study.

2.4 Simulated Events

The design events simulated for the assessment were the 20%, 10%, 5% and 1% AEP events. In addition, a frequent (nuisance) event was defined for this assessment which is nominally half of the flow applied in the 20% AEP event. The nuisance event, although is nominal and does not have an AEP, has been selected to resemble the kind of rainfall that causes the regular irruption at Ross Lane and surrounding properties. Each design event was modelled for two separate design storms, expressed in terms of their duration, as follows:

- A critical storm – this is the storm duration adopted in the BFSU and is the storm duration which results in the highest peak flood level for a given AEP event.
- A non-critical storm – these storms are not adopted in the BFSU but have been additionally used in the Ross Lane assessment. These storms are of a shorter duration and result in lower flood levels than the critical duration storms. However, they may have higher velocities or may experience greater impacts associated with road raising and may result in greater flood impacts.

The relevant (critical) storm durations and rainfall temporal patterns for each AEP are identified in the BFSU. Non-critical storm durations were identified by analysing the full set of results from the BFSU and selecting shorter duration storms which still result in reasonably high flood levels. The critical and non-critical storm durations and rainfall temporal patterns at Ross Lane, used in this assessment, are summarised in Table 2.2.

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Table 2.2 Modelled Events

AEP	Event Type	Duration / Temporal Pattern ID
Nuisance*	Critical	72h TP03
Nuisance*	Non-critical	12h TP4
20%	Critical	72h TP03
20%	Non-critical	12h TP4
10%	Critical	72h TP08
10%	Non-critical	12h TP10
5%	Critical	72h TP05
5%	Non-critical	12h TP10
1%	Critical	18h TP04
1%	Non-critical	12h TP10

* Nominally half of flow of the 20% AEP event

2.5 Base Case Model Results

Peak flood depths and elevations for the Base Case using the updated model are presented in Annex A. Table 2.3 summarises the peak flood levels on the northern side of Ross Lane immediately upstream from the lowest elevation on Ross Lane (0.9mAHD). This location is approximately 30m to the east of the Deadmans Creek culvert and is shown in Figure 2.3.

The Base Case figures and Table 2.3 show that Ross Lane is overtopped by all modelled events, including the Nuisance event. In the 1% AEP event, the depth of flooding at the low point in the road is over 1m.

Figure 2.4 plots the modelled design water levels over time at the low point in Ross Lane. It can be seen that the period of inundation is long, extending for 3 to 8 days. This is reflective of the large volume of water that accumulates within the floodplain and the slow drainage due to the flat nature of the topography. Table 2.4 summarises the duration of inundation for a depth greater than 0.1m at the lowest road elevation. At this depth Council closes the road to vehicles.

Table 2.3 Base Case (B1 Existing conditions) Flood Levels (mAHD) adjacent to Ross Lane low point (0.9mAHD)

AEP	Critical Duration	Non-Critical Duration
Nuisance	0.98	0.92
20%	1.42	1.16
10%	1.48	1.32
5%	1.60	1.43
1%	1.98	1.87

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5.1 Ross Lane Betterment

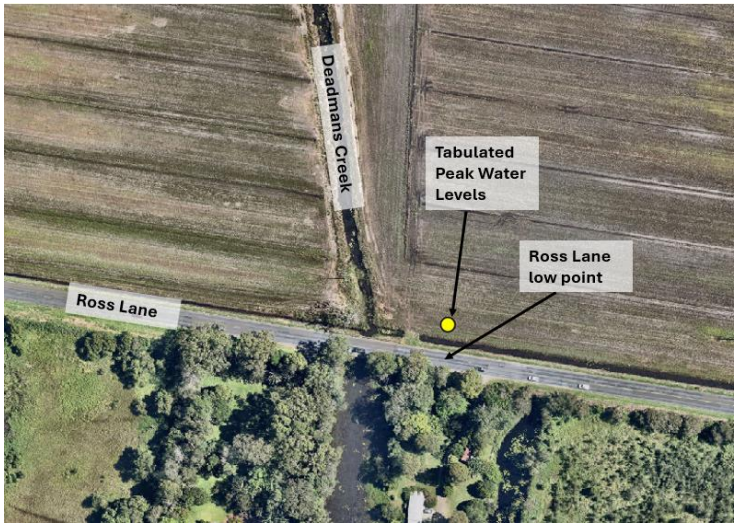


Figure 2.3 Reporting location for Base Case peak water levels

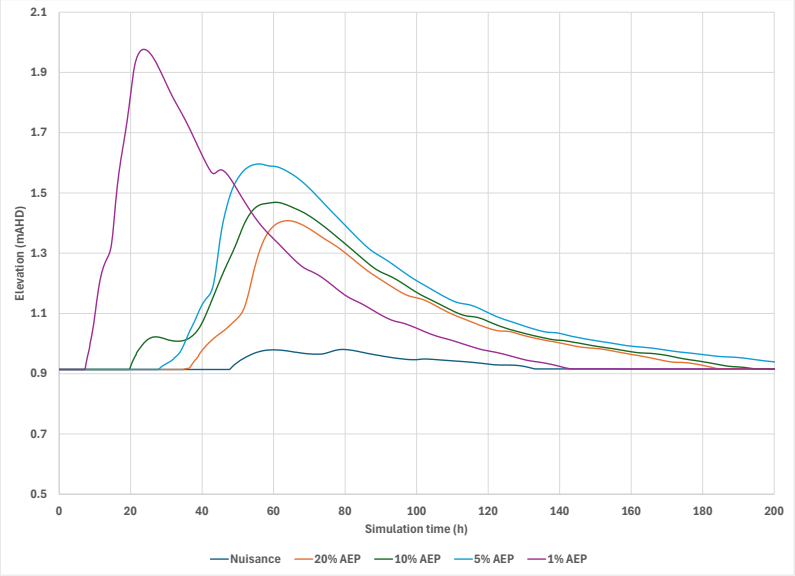


Figure 2.4 Design water levels over time at Ross Lane low point

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5.1 Ross Lane Betterment

Table 2.4 Duration where flood depth >0.1m over Ross Lane for design events

AEP	Duration (days)
Nuisance	0
20%	3.9
10%	4.6
5%	6.3
1%*	4.2

* The critical duration of the 1% AEP event is 18 hours compared to 72 hours for the other modelled events

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3 Road Upgrade Scenarios

3.1 Scenarios

Nine Ross Lane upgrade scenarios have been modelled in this assessment. The upgrades consist of a combination of road raising and upsized cross drainage at the Deadmans Creek culvert under Ross Lane.

The scenarios raise low points along Ross Lane to the height of different design flood levels. Road raising is implemented at two locations: a section including the lowest point near Deadmans Creek and a section of low lying road between the Union Drain and the remnant North Creek channel (see Figure 3.1). An initial set of road upgrade scenarios (Scenarios 1 to 4) was informed from design flood levels from modelling that pre-dated the BFSU. Additional scenarios that account for the more recent BFSU design flood levels were then added to the assessment (Scenarios 5 to 9).

Table 3.1 summarises the nine scenarios and states the design flood level (based on the BFSU) to which the road is raised. Some scenarios share the same minimum road crest elevation and differ due to the proposed cross drainage structure where Ross Lane crosses Deadmans Creek. The structure is modelled as either a culvert (deck at target flood level), a low level bridge (deck at target flood level) or a high level bridge (deck above target flood level).

Additional detail on each scenario's proposed cross drainage for Deadmans Creek is provided in Table 3.2. Figure 3.1 shows the lengths of Ross Lane affected by each option. The lengths of affected road vary due to differing proposed road elevations along with other design considerations such as gradients to achieve the nominated creek crossing elevation. Annex B contains design drawings for each option supplied to BMT.

Table 3.1 Road Upgrade Scenarios

Scenario	Min. Road Crest Elevation (mAHD)	Flood AEP (based on latest Flood Study)	Deadmans Creek Cross Drainage	Comment
Existing	0.92	>20% AEP	Culvert	
1	1.38	>20% AEP	Box Culvert	Height of old 20% AEP
2	1.38	>20% AEP	High Level Bridge	Bridge deck above 1% AEP Height of old 20% AEP
3	1.38	>20% AEP	Low Level Bridge	Bridge deck 20% AEP Height of old 20% AEP
4	1.65	~5% AEP	Box Culvert	Height of old 10% AEP

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Scenario	Min. Road Crest Elevation (mAHD)	Flood AEP (based on latest Flood Study)	Deadmans Creek Cross Drainage	Comment
5	1.45	20% AEP	Low Level Bridge	Bridge deck 20% AEP
6	1.51	10% AEP	Box Culvert	
7	1.51	10% AEP	High Level Bridge	Bridge deck above 1% AEP
8	1.51	10% AEP	Low Level Bridge	Bridge deck 10% AEP
9	1.38	>20% AEP	High Level Bridge	Bridge deck above 1% AEP Height of old 20% AEP

Table 3.2 Deadmans Creek Proposed Cross Drainage

Scenario	Proposed Structure	Structure Details
Existing	Culvert	3x 1.05m diameter pipes
1	Box Culvert	3 cells of 3.3m wide by 1.2m high
2	High Level Bridge	Bridge Soffit 1.38m AHD; Bridge Deck 2.08m AHD. Single Span
3	Low Level Bridge	Bridge Soffit 0.68m AHD; Bridge Deck 1.38m AHD. Single Span
4	Box Culvert	3 cells of 3.3m wide by 1.5m high
5	Low Level Bridge	Bridge Soffit 0.75m AHD; Bridge Deck 1.45m AHD. Single Span
6	Box Culvert	3 cells of 3.3m wide by 1.2m high
7	High Level Bridge	Bridge Soffit 1.51m AHD; Bridge Deck 2.21m AHD. Single Span
8	Low Level Bridge	Bridge Soffit 0.81m AHD; Bridge Deck 1.51m AHD. Single Span
9	High Level Bridge	Bridge Soffit 1.51m AHD; Bridge Deck 2.21m AHD. Single Span

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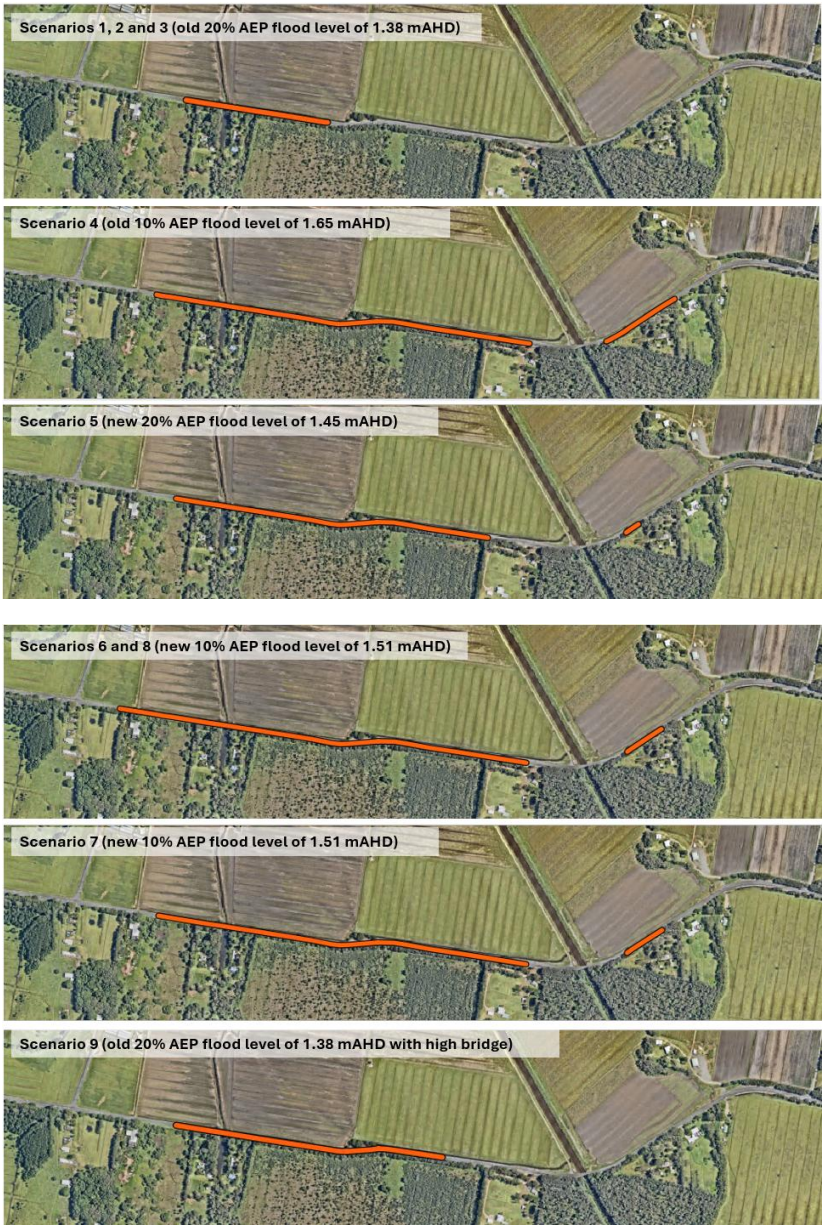


Figure 3.1 Ross Lane Upgrade Scenarios – extent of affected road

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3.2 Model Updates

In order to model the 9 road raising scenarios the Base Case model, which represents the existing Ross Lane road levels and culverts, was updated as follows.

For each scenario, the existing Ross Lane road level was replaced with the design case road level (supplied to BMT). The existing Deadmans Creek culverts were also replaced with either upsized culverts or a bridge (depending on the scenario). The crest elevations of the road were then enforced using a breakline to ensure that the crest level of the upgraded road was being applied in the model.

The cross drainage structure for Deadmans Creek was either represented as a 1D nested culvert (scenarios 1, 4 and 6) or as a 2D layered flow constriction for bridge crossings (Scenarios 2, 3, 5, 7, 8 and 9). Details for the cross drainage structures were extracted from the supplied drawings and were entered into the model. These details are summarised in Table 3.2.

The base case flood model results represent the existing flood heights and behaviour. These can then be compared to the design case model results which represent the flood heights and behaviour for each road raising scenario. In this way the changes in flood behaviour attributable to the changes in road level is quantified and assessed. The results and comparisons between the cases are covered in Section 4.

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4 Results

4.1 Overview

The modelling assessment of the 9 road upgrade scenarios involved 300 model simulations. This comprised of the 9 road upgrade scenarios plus the Base Case simulation assessed for the 10 flood events listed in Table 2.2 with the assessment repeated for the future topographic baselines B2 and B3. This generated a large volume of model results files.

For the purposes of reporting, flood impact maps have been presented using the current (B1) Base Case. These maps show changes in peak flood level and change in peak velocity as a result of the road upgrade scenario. The results from the B2 and B3 cases present very similar flood levels to the B1 case which indicates external development has very little influence on the outcomes of this assessment and as such this study has focused on the B1 case. Results for B2 and B3 are supplied digitally but not mapped (see Section 4.6 for additional details of the B2 and B3 results).

The results are presented as follows:

- Maps showing changes in peak flood level
- Maps showing changes in flood velocity
- Plots of water level over time, used to identify any change in flood duration
- Comparison of peak water levels (and changes in flood level) against surveyed floor levels

4.2 Change in Peak Water Level

Annex C and Annex E present maps showing the change in peak water level from the existing (B1) Base Case for each road raising scenario. Annex C shows the design events identified as being the critical events in the BFSU whereas Annex D shows the shorter duration, non-critical events. The non-critical events give lower flood levels but have the potential to result in greater flood impacts. The maps are grouped by modelled flood event allowing the effect of each scenario on that flood event to be compared.

To aid interpretation of the change in peak flood levels, the change in peak flood level from the base case has been tabulated at the four locations shown in Table 4.1. Locations 1 to 3 were selected as being upstream of the raised road and therefore will experience the greatest impacts. Location 4 is downstream of the upsized Deadmans Creek crossing and has the potential to experience increases in flood level.

The tabulated results are shown in Table 4.1 and Table 4.2 for the critical and non-critical duration events respectively. Each table presents the Base Case flood level for each location along with the change in flood level (mm) from the Base Case for each road raising scenario.

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5.1 Ross Lane Betterment



Figure 4.1 Locations used for summarising flood results

Table 4.1 Summary of Critical Duration Peak Level Impacts

AEP	Location	Base Case Peak Level (mAHD)	Change in Peak Level (mm) from Base Case for each Scenario								
			1 (1.38 mAHD)	2 (1.38 mAHD)	3 (1.38 mAHD)	4 (1.65 mAHD)	5 (1.45 mAHD)	6 (1.51 mAHD)	7 (1.51 mAHD)	8 (1.51 mAHD)	9 (1.38 mAHD)
Nuisance	1	0.99	-13	-18	-18	-5	-19	-13	-18	-19	-18
	2	0.99	-13	-18	-18	-4	-19	-13	-18	-19	-18
	3	1.23	0	0	1	1	1	1	0	0	0
	4	0.96	0	0	0	0	0	0	0	0	0
20% AEP	1	1.43	57	64	52	281	92	146	137	136	64
	2	1.44	56	63	51	280	91	145	137	135	62
	3	1.41	-1	0	-1	0	0	-2	0	-2	-1
	4	1.40	-5	1	0	13	5	-2	16	11	3
10% AEP	1	1.49	32	49	29	246	63	110	107	101	48
	2	1.49	32	47	29	246	63	109	106	102	47
	3	1.51	0	0	0	32	3	23	23	23	0
	4	1.46	-1	0	2	14	4	1	11	9	1
5% AEP	1	1.61	9	25	8	167	19	46	58	41	24
	2	1.62	9	24	8	168	19	47	57	41	23
	3	1.69	0	0	0	156	2	21	21	21	0
	4	1.59	0	-3	1	9	2	2	2	5	-2
1% AEP	1	1.98	1	3	1	7	1	2	4	1	3
	2	1.98	1	3	1	7	1	2	4	1	3
	3	1.99	0	1	0	6	0	1	1	1	1
	4	1.97	0	-1	0	1	0	0	-1	0	-1

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Table 4.2 Summary of Non-Critical Duration Peak Level Impacts

AEP	Location	Base Case Peak Level (mAHD)	Change in Peak Level (mm) from Base Case for each Scenario								
			1 (1.38 mAHD)	2 (1.38 mAHD)	3 (1.38 mAHD)	4 (1.65 mAHD)	5 (1.45 mAHD)	6 (1.51 mAHD)	7 (1.51 mAHD)	8 (1.51 mAHD)	9 (1.38 mAHD)
Nuisance	1	0.92	-12	-16	-16	-10	-16	-13	-11	-15	-8
	2	0.92	-20	-25	-25	-18	-25	-23	-25	-25	-25
	3	1.07	0	0	0	-2	0	0	0	0	0
	4	0.89	-1	-1	-1	2	-1	-1	-1	-1	-1
20% AEP	1	1.16	52	24	26	44	20	49	20	19	20
	2	1.16	53	26	27	45	21	50	21	21	21
	3	1.34	1	1	1	0	1	1	0	0	0
	4	1.11	-2	4	4	1	4	-2	5	5	5
10% AEP	1	1.34	115	109	105	283	147	210	180	187	106
	2	1.34	114	109	105	282	147	209	180	187	106
	3	1.36	0	0	0	0	0	0	0	0	0
	4	1.28	-5	10	6	7	11	-8	28	20	12
5% AEP	1	1.45	62	72	55	281	94	147	140	136	72
	2	1.45	61	71	55	279	93	146	139	135	70
	3	1.45	-1	-1	-1	3	1	1	1	1	-1
	4	1.40	-5	-1	0	4	3	-7	11	7	1
1% AEP	1	1.88	1	5	1	16	2	3	7	2	5
	2	1.88	1	5	1	16	2	3	7	2	5
	3	1.91	0	1	0	19	0	1	1	1	0
	4	1.87	0	-2	0	2	0	0	-2	0	-2

The following general commentary is provided on the peak flood level impacts.

- The critical duration ‘Nuisance’ event shows minor reductions in upstream peak water levels in the vicinity of Deadmans Creek for all scenarios. This is attributed to the upsized cross drainage at Deadmans Creek which has a proportionally greater capacity in smaller flood events.
- For the 20%, 10% and 5% AEP critical duration events there are upstream impacts in the form of increased peak flood levels in the vicinity of Deadmans Creek for all road raising scenarios.
- The 20% AEP is the design flood with the greatest impacts for all scenarios followed by the 10% AEP then the 5% AEP. In the 5% AEP event, Ross Lane is overtopped for all scenarios which has a mitigating effect on impacts.
- For all modelled critical events there are no impacts in the 1% AEP event and only Scenario 4 shows impacts for the non-critical events. This is due to significant overtopping occurring along Ross Lane during the 1% AEP event regardless of whether the road is raised or not.
- To the east of the Union Drain there are no peak flood level impacts in either the Nuisance or 20% AEP events. Impacts in the form of increased upstream water levels occur in the 10% and 5% AEP events scenarios 4,6,7 and 8.
- The higher the road raising level the greater the upstream flood impact. Scenario 4 results in the greatest flood impacts of all the road raising scenarios.

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- For a given proposed road elevation, the differences in peak level impacts between the box culvert, low level bridge and high level bridge at the Deadmans Creek crossing are relatively small. This can be observed when comparing Scenarios 1, 2 and 3 or comparing Scenarios 6, 7 and 8. For the critical events the upstream impacts are within 20mm of each other (30mm for the non critical events). Downstream impacts are also within 20mm of each other (40mm for the non critical events). Generally, the culvert option results in slightly higher upstream impacts and reduced downstream impacts compared to the bridge options. However, there are subtle variations in impacts for each flood event depending on where the bridge deck level sits in relation to the flood level.
- For all scenarios the downstream impacts are minimal and localised. Minor benefits (reductions in peak flood level) are shown for a number of events. There are highly localised increases in peak flood level in the immediate vicinity of the downstream (southern) end of the Deadmans Creek crossing and adjacent to the ends of the sections of raised road.
- The general pattern of impacts is similar between the critical and the equivalent non-critical events with impacts being slightly more pronounced in the non critical events.

4.3 Change in Peak Velocity

Annex D and Annex F present maps showing the change in peak water velocity from the existing (B1) Base Case for each road raising scenario. Annex D shows the events adopted as being the critical events in the BFSU whereas Annex F shows the events which are not critical in terms of peak level although can result in greater flood impacts.

The maps are grouped by modelled flood event allowing the effect of each scenario on that flood event to be compared. The following general commentary is provided.

- Changes in velocity are minor and are localised to the vicinity of Ross Lane.
- The greater flow capacity through the upgraded Deadmans Creek crossing results in localised increases peak velocity in Deadmans Creek downstream (south) of the crossing in events of the 20% AEP or rarer. These increases are up to 0.3m/s although the overall peak velocity remains less than 1.0m/s. In areas where flows are over-topping the road, the sections of raised road show adjacent reductions in velocity whereas parts of Ross Lane which are not raised show localised increases in velocity (typically by around 0.3m/s).
- The velocity impacts for the critical and non-critical events are similar and remain localised to the vicinity of Ross Lane for all modelled events.

4.4 Change in Flood Duration

To assess the potential for any change in the duration of flooding as a result of the road upgrade scenarios, a subset of scenarios were simulated for an extended period of time to quantify the time it takes for the system to drain down after the peak flood occurs. Annex G includes plots comparing water levels over time for the Base Case and two nominated road raising scenarios (Scenario 4 and Scenario 6). Scenario 4 was selected as this is expected to be the worst case for impacts as it proposes the highest level of road raising. Scenario 6 was selected as being a likely candidate for a preferred scenario. The locations used for the plots correspond to the four point locations shown in Figure 4.1 with locations 1 to 3 being upstream (north) of the road upgrade and location 4 being immediately downstream of Ross Lane crossing of Deadmans Creek.

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When looking at the plots in Annex G it should be noted that the model will not represent minor drainage features that typically do not have any influence on the flood peaks for major flood events. As such, the model has limitations whereby water can become trapped at shallow depths in pockets of terrain as the flood recedes. Plots of flood duration should therefore be considered in a relative sense comparing one option to another rather than focus on the absolute drainage time.

It can be seen from the plots in Annex G that at locations 1 and 2, whilst the peak flood level has increased for the 20%, 10% and 5% AEP events, there is no overall extension in the duration of the flood. It is similar at location 3 with increases in peak level for the 10% and 5% AEP events but no increase in the overall flood duration.

At location 4 there is no change in flood duration for either Scenario 4 or Scenario 6.

An observation from the model results is that Ross Lane is not a significant control on the drainage of Newrybar Swamp with flood levels upstream and downstream of Ross Lane remaining similar throughout the duration each modelled flood event. The floodplain is flat and low lying with dense downstream vegetation. Consequently, drain down times are relatively slow.

4.5 Impacts at Buildings

A property floor level survey was undertaken in September 2025 within the vicinity of the potential project works. Surveyed buildings are shown in Figure 4.2. The survey captured floor elevations of both habitable buildings (dwellings) and non-habitable buildings (typically sheds). These were then compared to modelled peak flood levels and flood impacts to understand the potential for above floor level impacts.

Table 4.3 and Table 4.4 present summary tables with counts of impacted buildings for the critical and non-critical events respectively. The table includes all modelled design flood events. Buildings are included within each table if they are impacted with increases in peak water level greater than 10mm and the water level is within 0.3m of the floor level.

Different design flood events can affect the same building. Table 4.5 and Table 4.6 provide alternative building counts which are irrespective of the AEP event and irrespective of whether the event is critical or non critical. In Table 4.5 and Table 4.6 a building that is affected by the project in one or more events is counted once. Table 4.5 counts buildings with impacts that occur within 0.3m of the surveyed floor level whereas Table 4.6 counts buildings where an impact is predicted to occur above floor level. A distinction is made between habitable and non-habitable floor levels. Individual buildings have not been identified for the purposes of this report which is about comparing road raising scenarios. Annex H is a digital annex that contains a detailed breakdown of flood levels and impacts at properties.

The greatest impacts occur in Scenario 4 with four buildings identified as being impacted and that have flood levels within 0.3m of the floor level. Two of these buildings are habitable and two are non habitable. The maximum impacts at the two affected habitable buildings are 0.01m above floor and 0.12m above floor respectively. For scenarios, 6, 7 and 8 up to 3 buildings are identified as being impacted with a flood level within 0.3m of the floor level, two of which occur above floor level. For scenarios 2, 5 and 9, one habitable building is impacted within 0.3m of the floor level although this impact occurs below the floor level. For Scenarios 1 and 3 no buildings are impacted within 0.3m of the floor level.

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Table 4.3 Buildings with peak flood level impacts (within 0.3m of floor level) (critical events)

AEP	Number of buildings showing flood level increases within 0.3m of floor level for each Scenario								
	1	2	3	4	5	6	7	8	9
Nuisance									
20%				1					
10%				4		2	2	2	
5%		1		4	1	3	3	3	1
1%									

Table 4.4 Buildings with peak flood level impacts (within 0.3m of floor level) (non critical events)

AEP	Number of buildings showing flood level increases within 0.3m of floor level for each Scenario								
	1	2	3	4	5	6	7	8	9
Nuisance									
20%									
10%									
5%				2					
1%				4					

Table 4.5 Total count of impacted buildings (flood impact within 0.3m of floor level)

Floor Level Type	Building Count for each Scenario								
	1	2	3	4	5	6	7	8	9
Habitable		1		2	1	2	2	2	1
Non-Habitable				2		1	1	1	

Table 4.6 Total count of impacted buildings (flood impact above floor level)

Floor Level Type	Building Count for each Scenario								
	1	2	3	4	5	6	7	8	9
Habitable				2		1	1	1	
Non-Habitable				1		1	1	1	

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5.1 Ross Lane Betterment

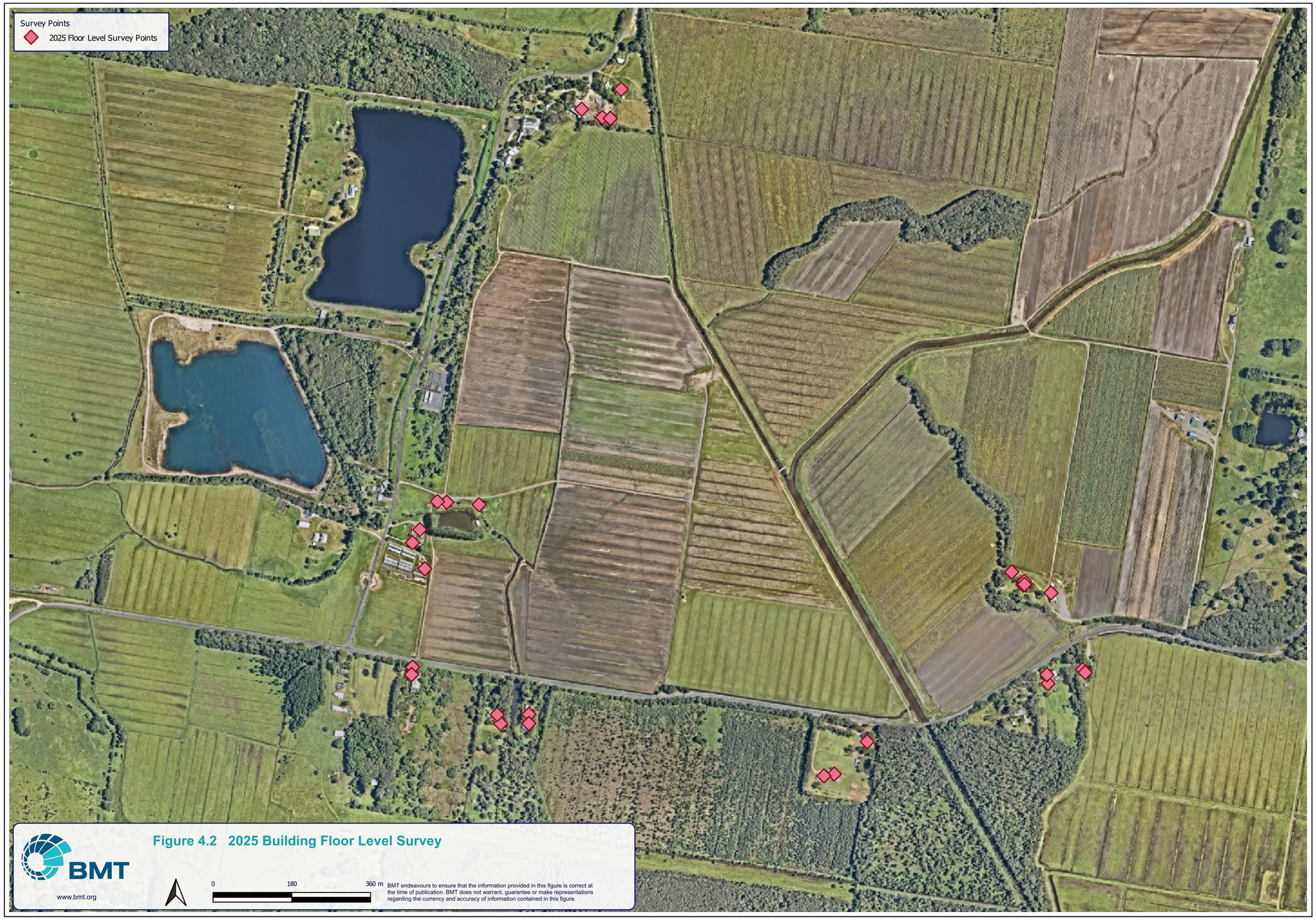


Figure 4.2 2025 Building Floor Level Survey

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4.6 Future Base Case Scenarios (B2 and B3)

The B2 and B3 assessments determine the flood impacts from the Ross Lane upgrade scenarios against future topographic Base Cases. Of relevance to this project, these future Base Cases include the CURA B development (within B2) and the CURA B and Barrets Development (within B3). It is important to note that this is not a flood impact assessment of these additional developments for which separate investigations would need to be undertaken but rather is included to evaluate if there are combined or cumulative impacts associated with potential future development.

As noted in Section 4.1, the B2 and B3 cases give very similar flood impact outcomes to the B1 case. This is illustrated in Figure 4.3 which shows an example comparison of peak flood level impacts in the 10% AEP, Scenario 6 for the B1, B2 and B3 cases. The 10%AEP is illustrated here because it is the is the event that presents the most extensive impacts of all the events run in this study. The flood impacts are very similar between all three cases with only minor differences apparent which indicates that the modelled external future development does not have a significant influence on flood behaviour at Ross Lane.

. Given the similarity of impacts across all assessed events, the B2 and B3 cases have not been mapped. A full set of B2 and B3 results has been digitally supplied to Council.

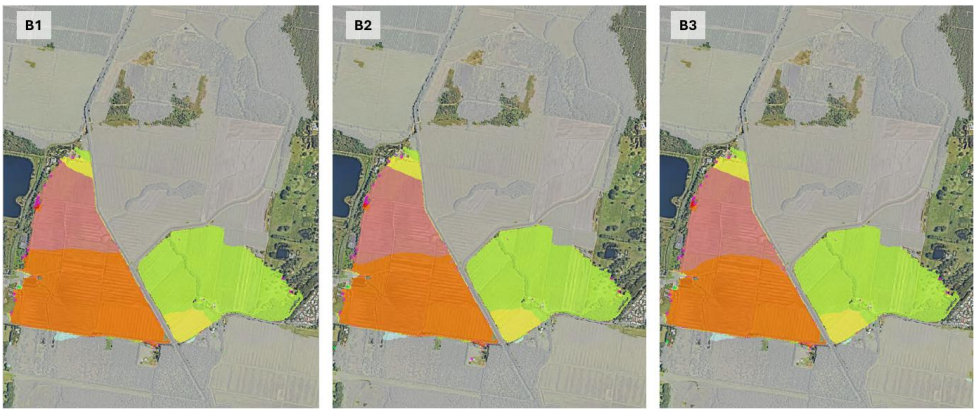


Figure 4.3 Comparison of Peak Flood Level Impacts (B1, B2 and B3) for 10% AEP (critical duration) Scenario 6

4.7 Comment on differences compared to previous investigations

In a BMT report prepared for Ballina Shire Council in May 2021, Ross Lane upgrade options were assessed using the 'Integrated Model' which was Council's adopted flood model at that time. Four road raising options were assessed in which Ross Lane, to the west of Union Drain, was raised to have minimum elevations corresponding to the following floods:

- A nuisance flood event (Option 1)
- A 20% AEP event (Option 2)
- A 10% AEP event (Option 3)
- A 5% AEP event (Option 4)

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Unlike the present study, the 2021 study did not consider any road raising to the east of Union Drain.

The design flood levels determined by the Integrated Model differed from those in the BFSU as key hydrological inputs and assumptions differed between the respective studies reflecting the guidance in place at the time.

Whilst the differences between the options modelled in the respective studies means that a strict like for like comparison of flood impacts cannot be undertaken, it is apparent that the peak flood level impacts were of a notably lower magnitude and extent in the 2021 study than the present one.

The key reason for the notable differences in flood impacts is likely to do with the differing downstream boundary assumptions of the respective models. In the Integrated Model, the 20% and 10% AEP events both included a storm surge component in the downstream boundary with peak levels of 1.6m and 1.7m AHD respectively. In the BFSU model, the 20% and 10% AEP peak downstream boundary level is 0.97m AHD which corresponds to a High High Water Springs (HHWS) peak tide. This is significantly lower than the downstream boundary in the Integrated Model and will effectively result in a steepening of the water surface slope. This in turn will mean that any obstructions in the floodplain, such as a raised road, will have a greater impact on flows.

4.8 Nomination of a Preferred Scenario

The determination of a preferred option will need to account for many factors as they apply to the wider community, not just those relating to flood considerations, and is a matter for Council.

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5 Sensitivity Testing

5.1 Introduction

Sensitivity testing in flood modelling is used to determine whether input variables or assumptions have a significant impact on the model's output. This analysis helps to identify and quantify model uncertainties and understand the reliability of the results relied on for a flood impact assessment.

A series of sensitivity tests have been performed for the following:

- Structure Blockage due to debris accumulation (Deadmans Creek culvert at Ross Lane)
- Drain Blockage (with vegetation representing a condition of the drain being overgrown if not routinely maintained)
- Newrybar Swamp Road regrading (two options)

For the purposes of this assessment Scenario 6 has been nominated as a Scenario on which to undertake the sensitivity testing. This scenario raises Ross Lane to a 10% AEP flood level with proposed box culverts at the Deadmans Creek crossing of Ross Lane. Scenario 6 was selected in agreement with Council.

Details of each sensitivity test along with a summary of the results are documented below. Flood impact maps are presented in Annex J and show the change in peak flood level between the Ross Lane works (Scenario 6) combined with the sensitivity test and the Base Case. Each annex figure shows two impact maps; the project impacts from Ross Lane Scenario 6, as summarised in Section 4 (left side) and the Ross Lane Scenario 6 with Sensitivity Test impact (right side). This allows the sensitivity test impact to be compared back to the original impact.

5.2 Structure Blockage

The flood impact assessment of Ross Lane described in Section 4 assumes that no blockage is affecting the Ross Lane crossing of Deadmans Creek. To determine the sensitivity the Project's flood impacts to a potential blockage of this crossing, a blockage sensitivity test was undertaken.

The potential for culvert blockage has been assessed for both floating debris and non floating debris (sediment) in accordance with the procedure set out in ARR2019 (Book 6, Chapter 6). The procedure takes into consideration factors such as the availability and type of debris, the mobility of debris and the transportability of the debris in order to determine the 'most likely' blockage.

5.2.1 Debris Potential

The source area for debris which can collect at the Ross Lane crossing of Deadman's Creek consists of predominantly agricultural land from a small upstream catchment. During large flood events there is greater connection with the larger upstream catchment covering Newrybar Swamp which is also predominantly agricultural. The dominant sediment types within the source catchment according to the Australian National Soil Information System are sand and loamy sand.

The procedure requires an estimate of the average length of the longest 10% of the debris that could arrive at the site (termed L_{10}). For the purposes of this assessment an L_{10} estimate of 2m has been applied which is considered relatively conservative and results from floating debris.

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The debris potential is also dependent on the following factors:

- Debris availability
- Debris mobility (ability to be moved into watercourses)
- Debris transportability (ability to be transported to the structure)

Under the procedure each of these factors is classified as high, medium or low by relating the source catchment to descriptions contained within the procedure. The classifications are then combined into an overall debris potential classification. The classifications are based on the 1% AEP. Table 5.1 summarises the classifications determined for floating debris and sediment for this assessment.

Table 5.1 Debris Potential

Category	Classification (Floating Debris)	Classification (Sediment Debris)
Debris Availability	Low	High
Debris Mobility	High	High
Debris Transportability	Medium	Medium
Debris Potential	**Medium**	**High**

5.2.2 Adjustment for AEP

In accordance with the blockage procedure the debris potential determined for the 1% AEP event is then adjusted for more frequent or rarer events. For the events under consideration in this assessment the debris potential for each AEP is listed in Table 5.2.

Table 5.2 Debris Potential By AEP

AEP	Classification (Floating Debris)	Classification (Sediment Debris)
Nuisance	Low	Medium
20%	Low	Medium
10%	Low	Medium
5%	Medium	High
1%	Medium	High

5.2.3 Design Blockage

Design blockage has been determined for inlet blockage (floating debris) and barrel blockage (sediment). For inlet blockage consideration is given to the debris potential, the L10 value and the culvert clear width. For barrel blockage the debris potential is considered with the peak velocity through the structure and the assumed mean sediment size. These details are provided below:

- Proposed culvert clear width: 3.3m
- Debris L10: 2.0m
- Sediment: Sand (0.04mm to 2mm)
- Peak Velocity through structure: 1.5m/s

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Table 5.3 lists the determined blockage factors for floating debris and sediment. In all cases sediment blockage of the culvert barrel is determined as resulting in the greatest potential blockage. This blockage factor has been applied within the model for the sensitivity test.

Table 5.3 Design blockages

AEP	Floating Debris Blockage	Sediment Blockage
Nuisance	0%	**15%**
20%	0%	**15%**
10%	0%	**15%**
5%	10%	**25%**
1%	10%	**25%**

5.2.4 Results

Peak flood level impacts are mapped in Annex J (Figures J1 to J5). Each figure shows the unblocked (Scenario 6) result on the left and then Scenario 6 with the blocked culvert on the right (Scenario 6). Both left and right images compare the peak flood levels to the Base Case.

Table 5.4 summarises the Scenario 6 peak flood levels for the sensitivity test (culvert blockage) at the four nominated locations shown in Figure 4.1. Table 5.4 also provides the change in peak flood level from the unblocked Scenario 6 case.

The mapped results show that the additional changes in peak flood level are minimal with no notable change in the flood impact extent and magnitude. This is confirmed by the results in Table 5.4. There are minor increases in upstream water level as a result of the culvert blockage (up to 2mm) with minor decreases downstream of the culvert blockage (decrease of up to 2mm).

Table 5.4 Summary of Scenario 6 Culvert Blockage Results at Point Locations

Location	Peak Level (mAHD) and change in peak level (mm) from unblocked case in brackets				
	Nuisance	20% AEP	10% AEP	5% AEP	1% AEP
1	0.97 (2)	1.58 (2)	1.60 (2)	1.66 (2)	1.98 (0)
2	0.97 (2)	1.58 (2)	1.60 (2)	1.66 (2)	1.99 (0)
3	1.24 (0)	1.41 (1)	1.53 (0)	1.71 (0)	2.00 (0)
4	0.96 (0)	1.39 (-2)	1.46 (-1)	1.59 (-1)	1.97 (0)

5.3 Blockage of Key Drains

The Ross Lane Drain (running on the north side of Ross Lane from Deadmans Creek to the Union Drain) and Drainline C (also referred to as NR1 and 'the national park drain') are modelled as watercourses with medium density vegetation (Manning's n = 0.06) to account for typical conditions. A sensitivity test has been undertaken by increasing the hydraulic roughness in these drains to account for increased vegetation. The Manning's n roughness has been increased to 0.08 to correspond with a narrow watercourse with dense vegetation, representing what would be an 'over grown' state. The

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increases have been applied to the developed case only with the base case Manning's n retained at 0.06 for these drains.

Peak flood level impacts are mapped in Annex J (Figures J6 to J10). Each figure shows the unblocked (Scenario 6) result on the left and then Scenario 6 with the blocked drain on the right (Scenario 6). Both left and right images compare the peak flood levels to the Base Case.

Table 5.5 summarises the Scenario 6 peak flood levels for the sensitivity test (drain blockage) at the four nominated locations shown in Figure 4.1. Table 5.5 also provides the change in peak flood level from the unblocked Scenario 6 case.

The mapped results show that the additional changes in peak flood level are minimal with no notable change in the flood impact extent and magnitude. This is confirmed by the results in Table 5.5 where differences are 1mm or less due to the effect of the blocked drain.

Table 5.5 Summary of Scenario 6 Drain Blockage Results at Point Locations

Location	Peak Level (mAHD) and change in peak level (mm) from unblocked case in brackets				
	Nuisance	20% AEP	10% AEP	5% AEP	1% AEP
1	0.97 (0)	1.58 (1)	1.60 (1)	1.66 (1)	1.98 (0)
2	0.97 (0)	1.58 (1)	1.60 (1)	1.66 (1)	1.99 (0)
3	1.24 (0)	1.41 (1)	1.53 (0)	1.71 (0)	2.00 (0)
4	0.96 (0)	1.39 (0)	1.46 (0)	1.59 (0)	1.97 (0)

5.4 Newrybar Swamp Road Regrading

In 2019 BMT prepared a report for Council that considered two options for regrading Newrybar Swamp Road to reduce flooding on the western side of Newrybar Swamp Road. Each option sought to reduce the obstruction to flows on Deadmans Creek due to the raised road. The two options were as follows:

- Option 1: Regrading and reconstruction of a 90m section of Newrybar Swamp Road to lower the existing road level by up to 0.4m
- Option 2: As Option 1 but with the addition of a culvert upgrade where Newrybar Swamp Road crosses Deadmans Creek. The upgrade doubles the culvert capacity from 3 circular pipes to 6 circular pipes.

A sensitivity test has been undertaken for the current Ross Lane assessment by including each of the Newrybar Swamp Road options in a developed case with the Ross Lane works. Ross Lane Scenario 6 was used for this purpose.

The extent of the regrading works is shown in Figure 5.1 and the regarded road surface was implemented in the model using the elevation model supplied for the original 2019 assessment. Figure 5.2 presents a long section of the regraded road surface taken from the 2019 report.

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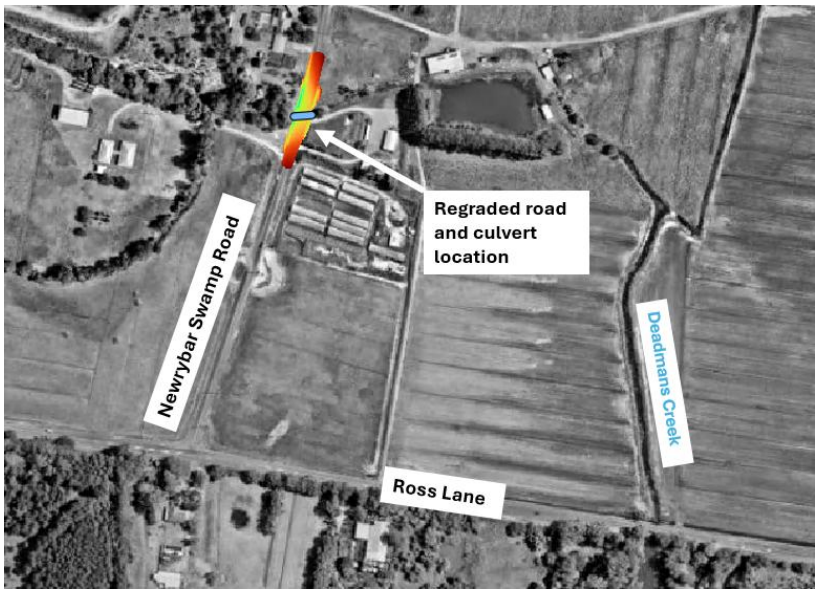


Figure 5.1 Newrybar Swamp Road: Location of regrading and culvert highlighted

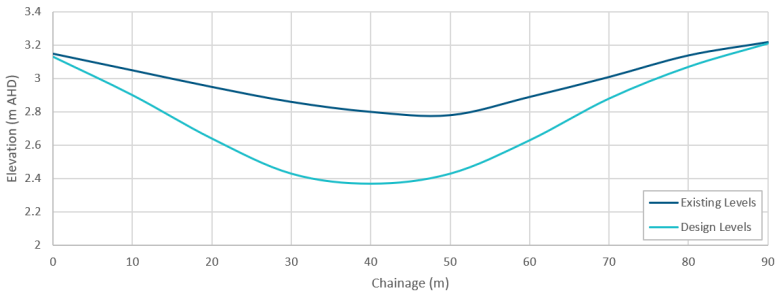


Figure 5.2 Newrybar Swamp Road: Long section of regrading works (Chainage 0 at southern end)

5.4.2 Option 1 Results

The results of the Option 1 sensitivity test are presented as peak flood level impact maps.

Peak flood level impacts are mapped in Annex J (Figures J11 to J15). Each figure shows the Ross Lane Scenario 6 result on the left and then Scenario 6 with the Newrybar Swamp Road upgrade on the right. Both left and right images compare the peak flood levels to the Base Case.

Table 5.6 summarises the Scenario 6 peak flood levels for the sensitivity test (Newrybar Swamp Road Upgrade) at the four nominated locations shown in Figure 4.1. In addition to the four standard reporting locations, two additional reporting locations are included for reporting flood levels as shown in Figure 5.3. These are located upstream (5) and downstream (6) of the regraded length of Newrybar

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Swamp Road Table 5.6 also provides the change in peak flood level from the Scenario 6 case with no Newrybar Swamp Road works.



Figure 5.3 Additional Reporting Locations for Newrybar Swamp Road Regrading Sensitivity Tests

The mapped results show that the additional changes in peak flood level are minimal for events up to and including the 10% AEP. In the 5% and 1% AEP events, the lower Newrybar Swamp Road overtops to a greater degree than it does prior to the road lowering. As a consequence, there are lower flood levels upstream (west) of Newrybar Swamp Road (189mm lower in the 5% AEP event and 176mm lower in the 1% AEP event at reporting location 5). In the 5% and 1% AEP events there is a consequent increase in peak levels downstream of Newrybar Swamp Road (up to 80mm at reporting location 6) which is highly localised to the vicinity of the road lowering. As shown by the results in Table 5.6 the differences in peak level near Ross Lane are negligible due to the sensitivity test.

Table 5.6 Summary of Scenario 6 Newrybar Swamp Road Upgrade (Option 1) Results at Point Locations

Location	Peak Level (mAHD) and change in peak level (mm) from unblocked case in brackets				
	Nuisance	20% AEP	10% AEP	5% AEP	1% AEP
1	0.97 (0)	1.58 (0)	1.60 (0)	1.66 (0)	1.98 (0)
2	0.97 (0)	1.58 (0)	1.60 (0)	1.66 (0)	1.99 (0)
3	1.22 (0)	1.41 (1)	1.53 (0)	1.72 (0)	2.00 (0)
4	0.96 (0)	1.39 (0)	1.46 (0)	1.59 (-2)	1.97 (0)
5	- (0)	2.28 (11)	2.45 (-10)	2.68 (-189)	2.81 (-176)

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Location	Peak Level (mAHD) and change in peak level (mm) from unblocked case in brackets				
	Nuisance	20% AEP	10% AEP	5% AEP	1% AEP
6	1.80 (0)	2.00 (0)	2.06 (2)	2.15 (73)	2.25 (80)

5.4.3 Option 2 Results

The results of the Option 2 sensitivity test are presented as peak flood level impact maps.

Peak flood level impacts are mapped in Annex J (Figures J16 to J20). Each figure shows Ross Labe Scenario 6 result on the left and then Scenario 6 with the Newrybar Swamp Road upgrade plus upsized culvert on the right. Both left and right images compare the peak flood levels to the Base Case.

Table 5.7 summarises the Scenario 6 peak flood levels for the sensitivity test (Newrybar Swamp Road Upgrade with Culvert upsized) at the four nominated locations shown in Figure 4.1 and two additional location shown in Figure 5.3. Table 5.7 also provides the change in peak flood level from the Scenario 6 case with no Newrybar Swamp Road works.

The mapped results show that the Newrybar Swamp Road works start to have an effect in the 20% AEP event with the upsized culverts resulting in lower upstream levels (west of Newrybar Swamp Road). Once the lower Newrybar Swamp Road starts to overtop in a 5% AEP event, the decreases in peak flood levels upstream of Newrybar Swamp Road are more pronounced and approach 300mm in the 5% AEP event. There is a consequent increase in peak levels downstream of Newrybar Swamp Road (96mm at reporting location 6 in the 1% AEP event) which is highly localised to the vicinity of the road lowering. As shown by the results in Table 5.7 the differences in peak level near Ross Lane are negligible due to the sensitivity test.

Table 5.7 Summary of Scenario 6 Newrybar Swamp Road Upgrade (Option 2) Results at Point Locations

Location	Peak Level (mAHD) and change in peak level (mm) from unblocked case in brackets				
	Nuisance	20% AEP	10% AEP	5% AEP	1% AEP
1	0.97 (0)	1.58 (0)	1.60 (-1)	1.66 (0)	1.98 (0)
2	0.97 (0)	1.58 (0)	1.60 (-1)	1.66 (1)	1.99 (0)
3	1.24 (0)	1.41 (1)	1.53 (0)	1.72 (0)	2.00 (1)
4	0.96 (0)	1.39 (0)	1.46 (0)	1.59 (-2)	1.97 (0)
5	- (0)	2.08 (-189)	2.19 (-276)	2.68 (-291)	2.76 (-232)
6	1.80 (0)	2.00 (3)	2.06 (10)	2.15 (84)	2.27 (96)

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6 Conclusions

This report has assessed 9 Ross Lane road raising scenarios and presented the resulting flood impacts (changes in peak flood level and velocity). The impacts have been assessed for a range of flood events from a nominal 'nuisance' flood up to a 1% AEP flood. The flood event durations identified as being critical in the Ballina Flood Study (those durations that result in the highest flood levels) were used for the assessment. A further set of non-critical shorter durations was also assessed as an additional check for flood impacts.

In addition to the flood impact mapping, results have also been reported in terms of considering changes in flood duration and impacts at properties.

The key findings of the assessment are summarised as follows:

- For the 20%, 10% and 5% AEP critical duration events there are upstream impacts in the form of increased peak flood levels in the vicinity of Deadmans Creek for all road raising scenarios.
- The 20% AEP is the design flood with the greatest impacts for all scenarios followed by the 10% AEP then the 5% AEP. In the 5% AEP event, Ross Lane is overtopped for all scenarios which has a mitigating effect on impacts.
- For all modelled critical events there are no impacts in the 1% AEP event and only Scenario 4 shows impacts for the non-critical events. This is due to significant overtopping occurring along Ross Lane during the 1% AEP event regardless of whether the road is raised or not.
- To the east of the Union Drain there are no peak flood level impacts in either the Nuisance or 20% AEP events. Impacts in the form of increased upstream water levels occur in the 10% and 5% AEP events scenarios 4,6,7 and 8.
- The higher the road raising level the greater the upstream flood impact. Scenario 4 results in the greatest flood impacts of all the road raising scenarios.
- For a given proposed road elevation, the differences in peak level impacts between the box culvert, low level bridge and high level bridge at the Deadmans Creek crossing are relatively small. This can be observed when comparing Scenarios 1,2 and 3 or comparing Scenarios 6, 7 and 8. For the critical events the upstream impacts are within 20mm of each other (30mm for the non critical events). Downstream impacts are also within 20mm of each other (40mm for the non critical events). Generally, the culvert option results in slightly higher upstream impacts and reduced downstream impacts compared to the bridge options. However, there are subtle variations in impacts for each flood event depending on where the bridge deck level sits in relation to the flood level.
- For all scenarios the downstream impacts are minimal and localised. Minor benefits (reductions in peak flood level) shown for a number of events. There are highly localised increases in peak flood level in the immediate vicinity of the downstream (southern) end of the Deadmans Creek crossing and adjacent to the ends of the sections of raised road.
- The general pattern of impacts is similar between the critical and the equivalent non-critical events with impacts being slightly more pronounced in the non critical events.
- Changes in velocity are minor and are localised to the vicinity of Ross Lane.

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5.1 Ross Lane Betterment

- There are no expected increases in the duration of the modelled floods. An observation from the model results is that Ross Lane is not a significant control on the drainage of Newrybar Swamp with flood levels upstream and downstream of Ross Lane remaining similar throughout the duration of each modelled flood event.
- The worst case modelled Scenario for impacts (Scenario 4) creates impacts at 4 buildings, two of which occur at habitable floors. Scenarios that have lesser impacts affect fewer properties.
- Sensitivity testing showed that the modelled impacts are not sensitive to assumptions on culvert blockage or degree of drain vegetation.

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7 References

BMT (2019) Newrybar Swamp Road Regrading Flood Assessment and Culvert Upgrade. Prepared for Ballina Shire Council, September 2019. (ref. R.B23687.001.03)

BMT (2021) Ross Lane Upgrade Options Assessment. Prepared for Ballina Shire Council, May 2021. (ref. R.A10014.001.02)

BMT (2025). Ballina Flood Study Update, Final Report. Prepared for Ballina Shire Council, April 2025 (ref. R.A12168.005.02)

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Annex A Base Case Results

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5.1 Ross Lane Betterment

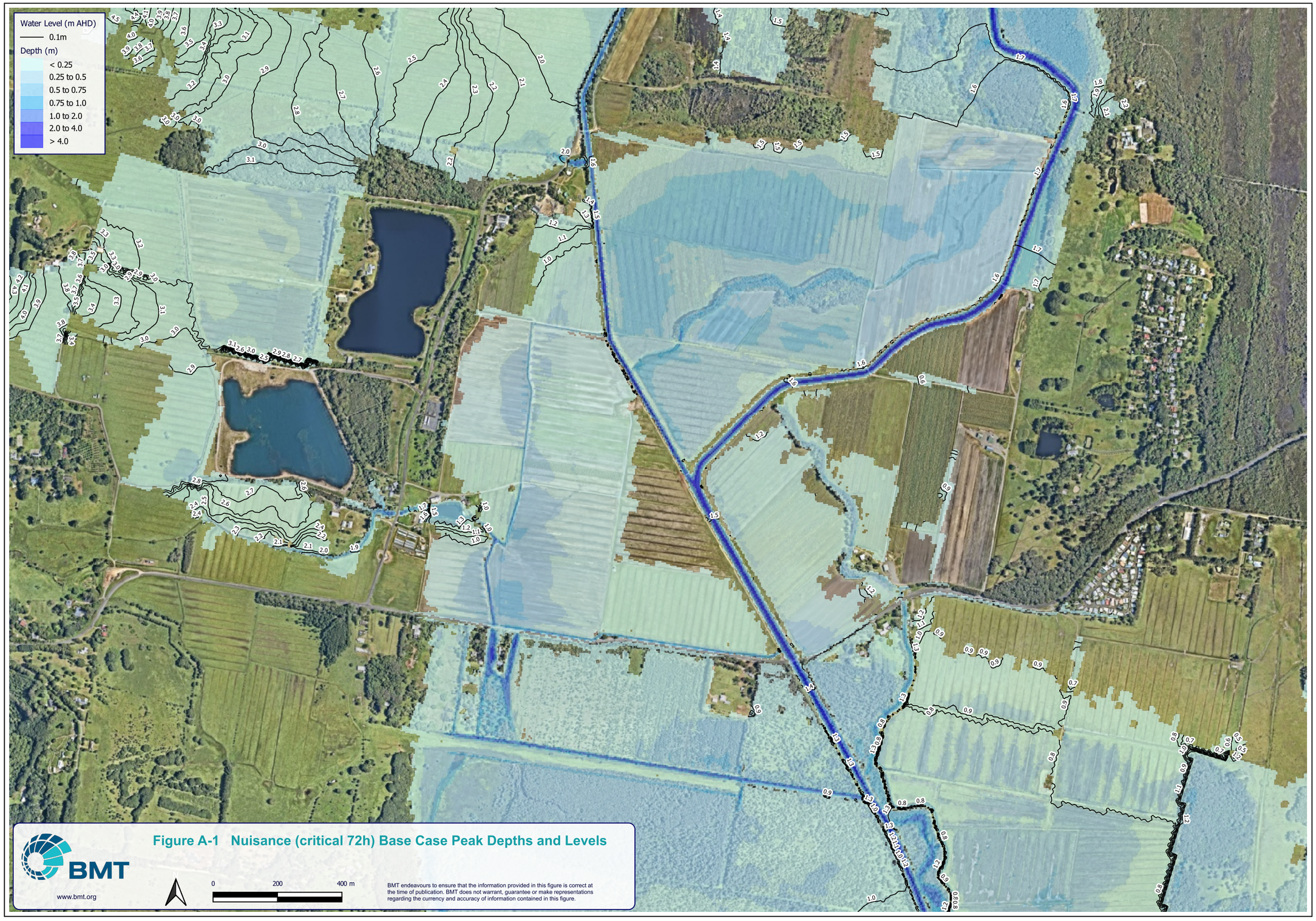


Figure A-1 Nuisance (critical 72h) Base Case Peak Depths and Levels

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5.1 Ross Lane Betterment

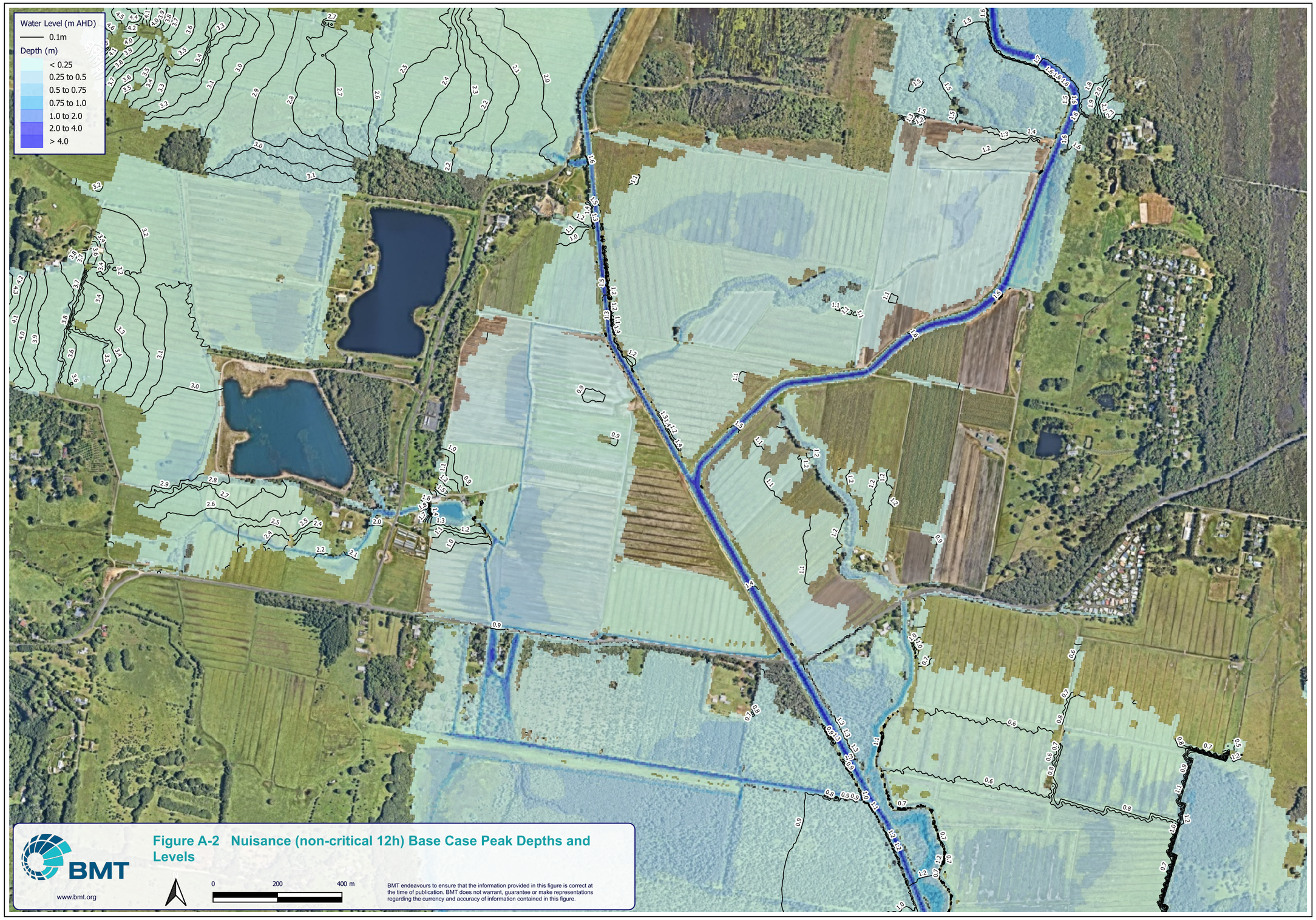


Figure A-2 Nuisance (non-critical 12h) Base Case Peak Depths and Levels

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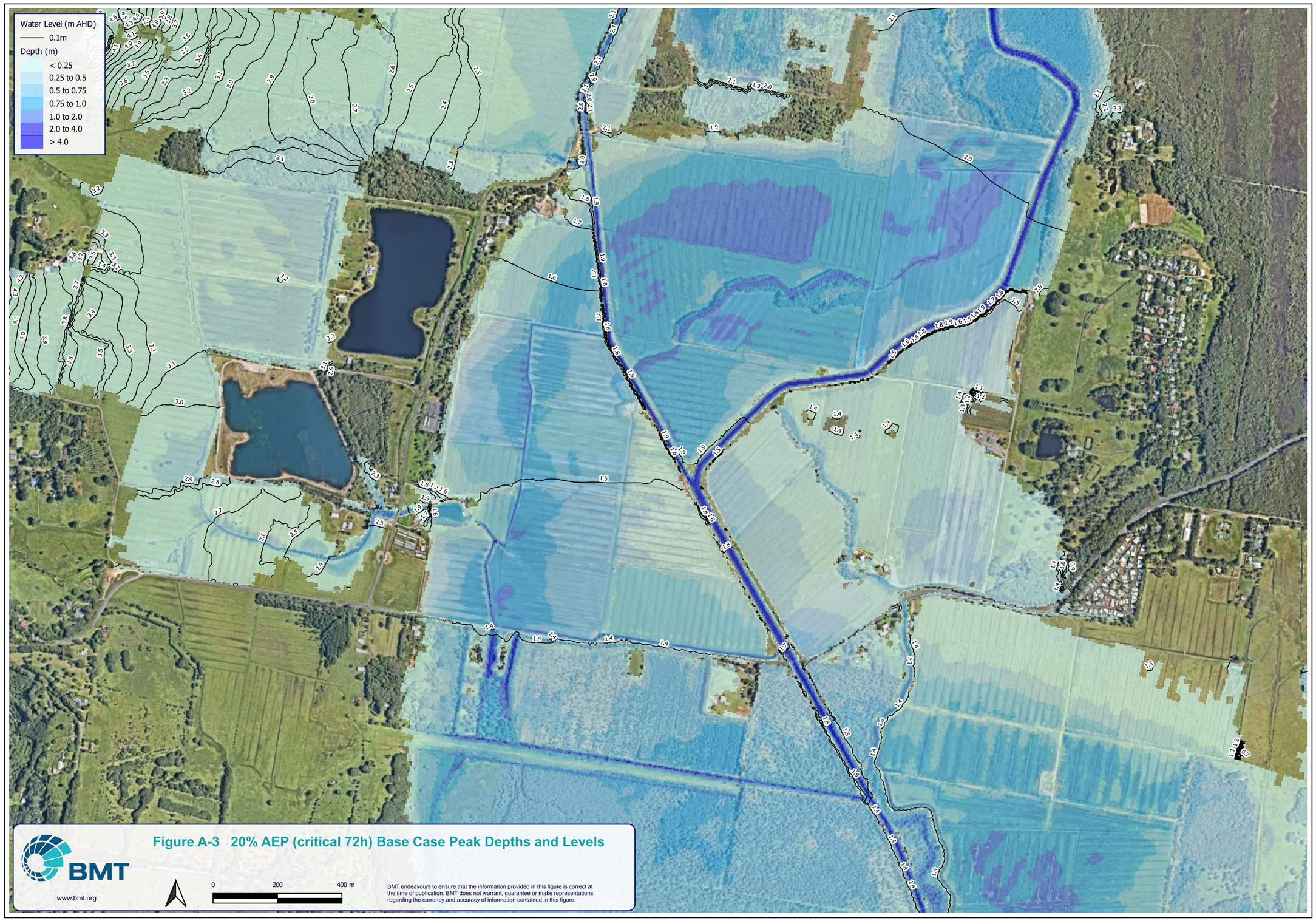


Figure A-3 20% AEP (critical 72h) Base Case Peak Depths and Levels

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5.1 Ross Lane Betterment

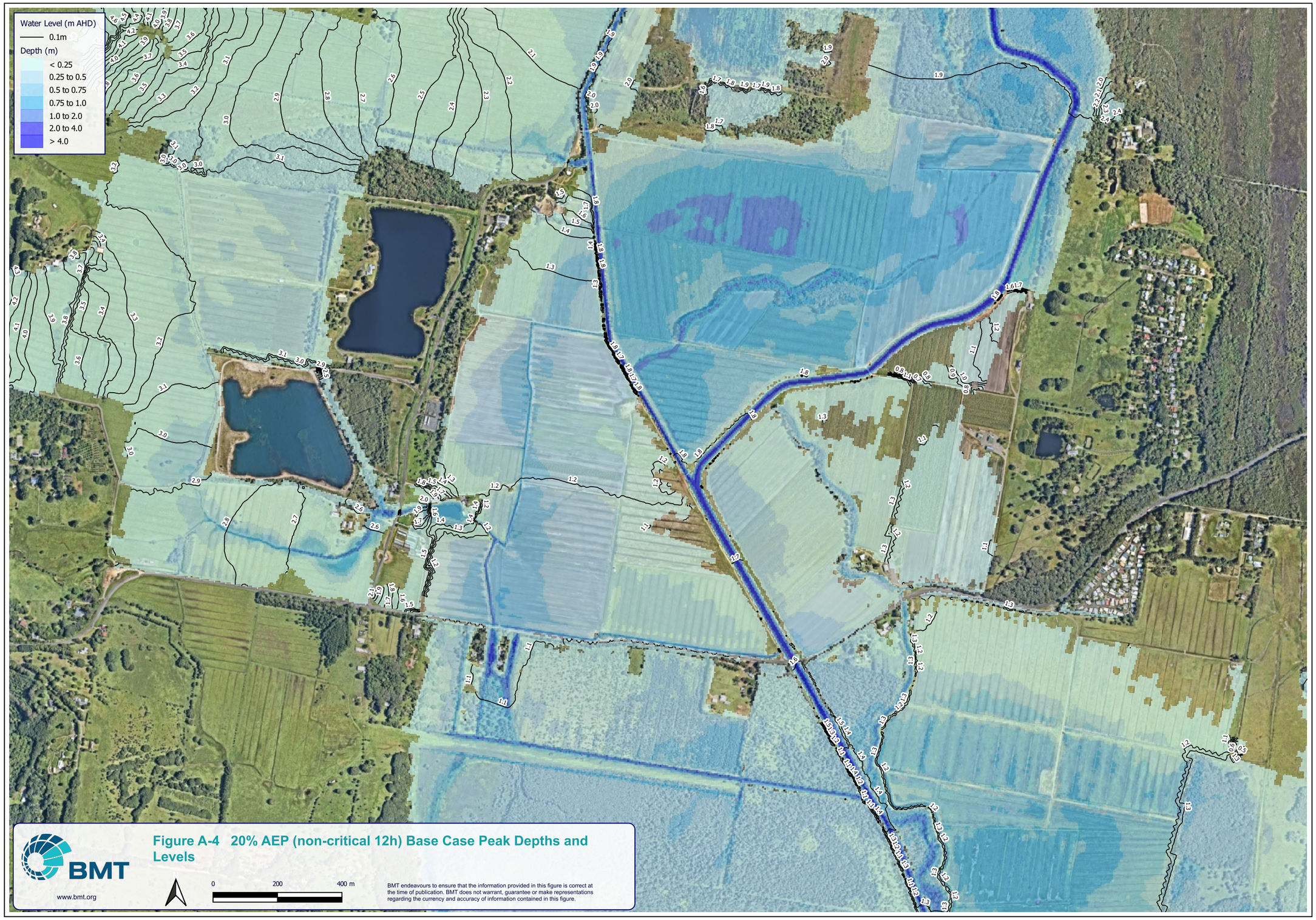


Figure A-4 20% AEP (non-critical 12h) Base Case Peak Depths and Levels

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5.1 Ross Lane Betterment



Figure A-5 10% AEP (critical 72h) Base Case Peak Depths and Levels

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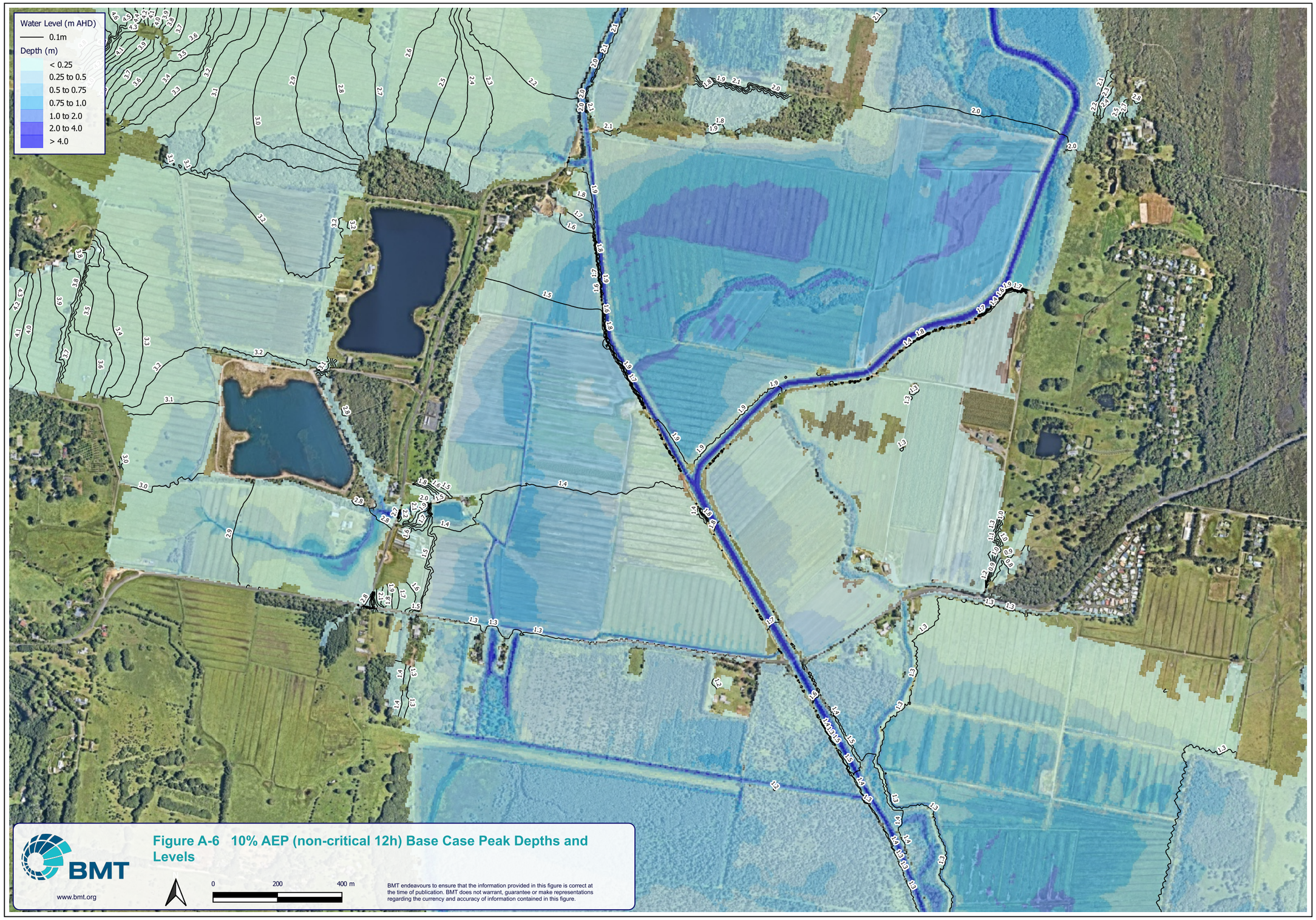


Figure A-6 10% AEP (non-critical 12h) Base Case Peak Depths and Levels

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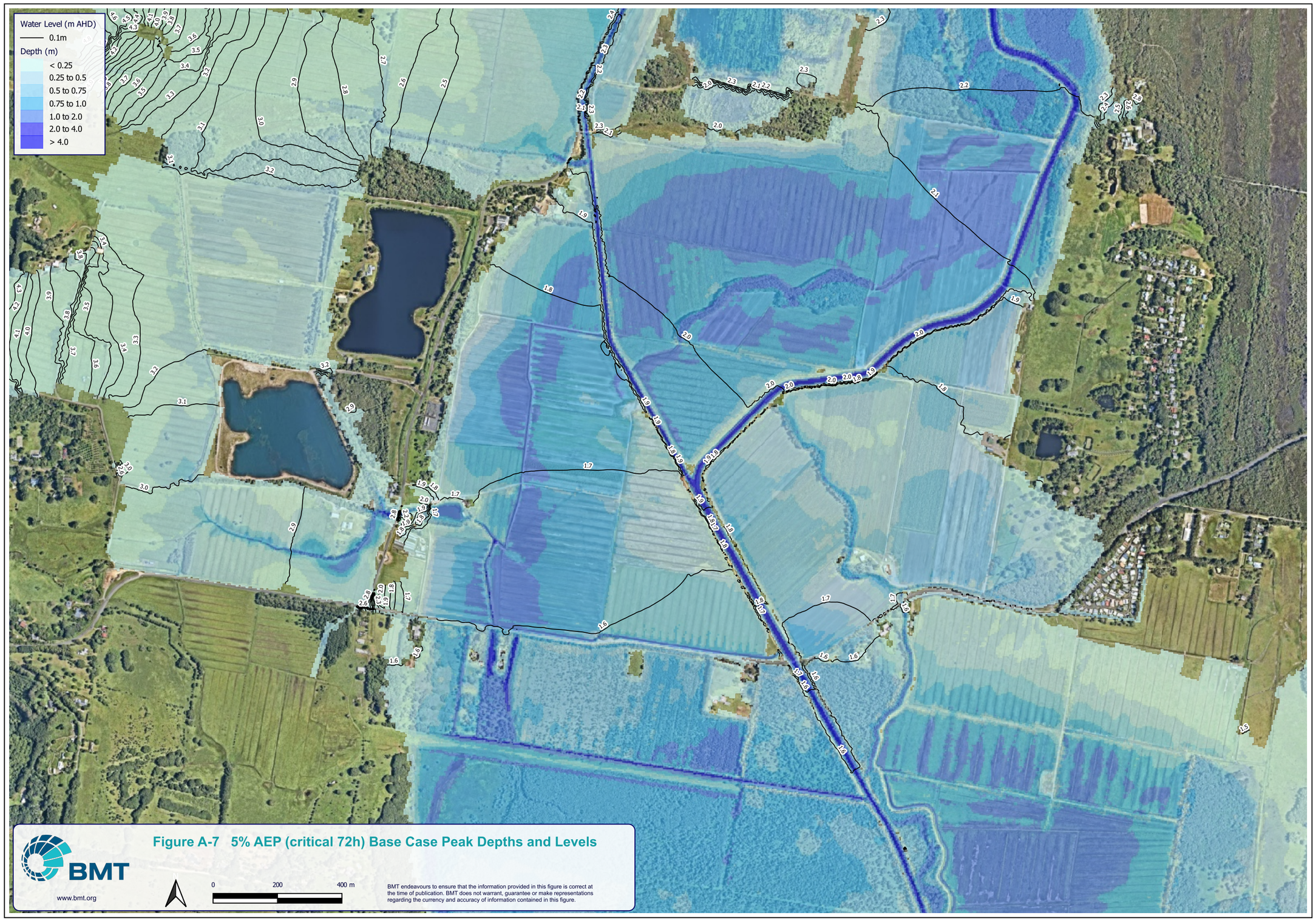


Figure A-7 5% AEP (critical 72h) Base Case Peak Depths and Levels

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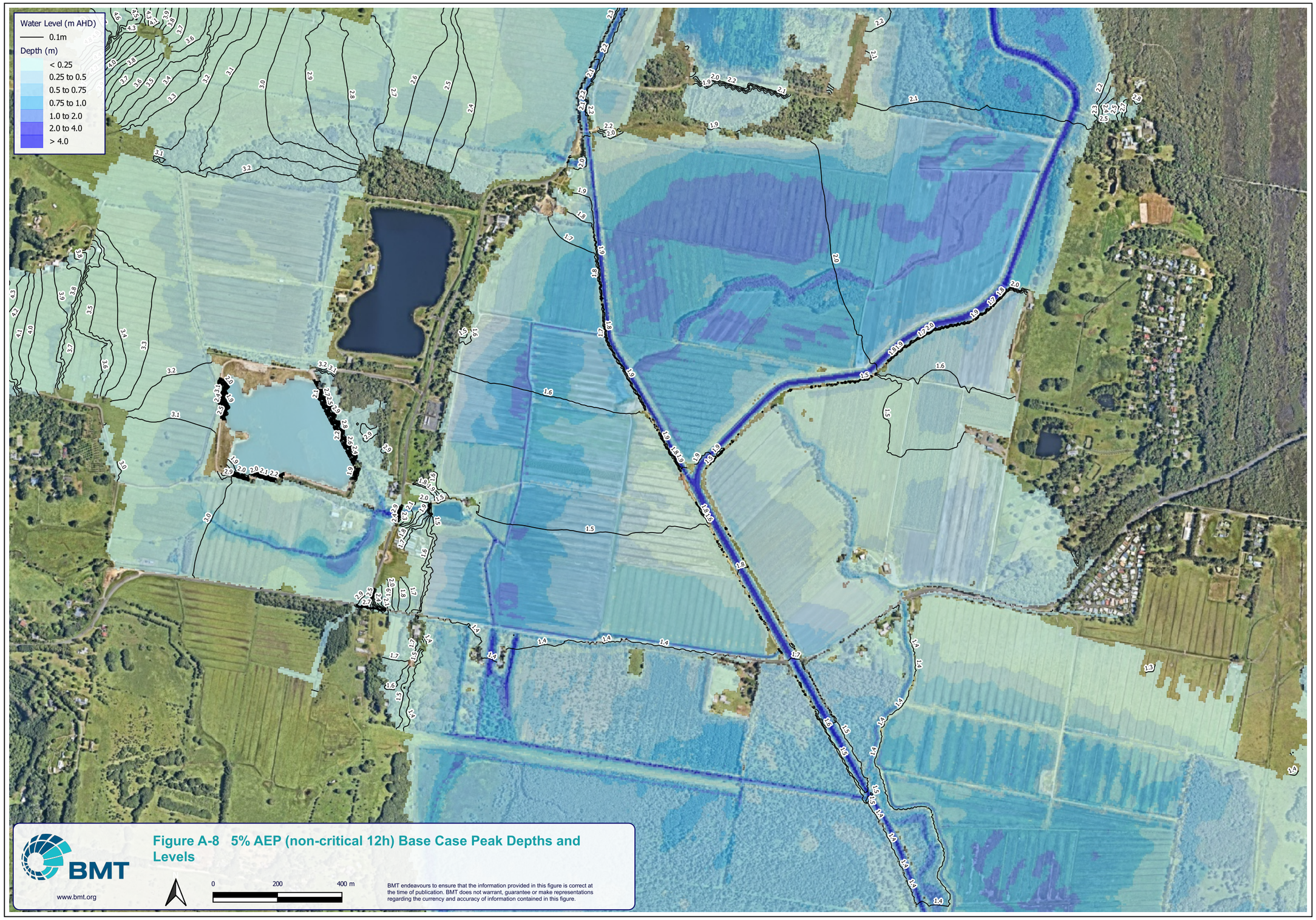


Figure A-8 5% AEP (non-critical 12h) Base Case Peak Depths and Levels

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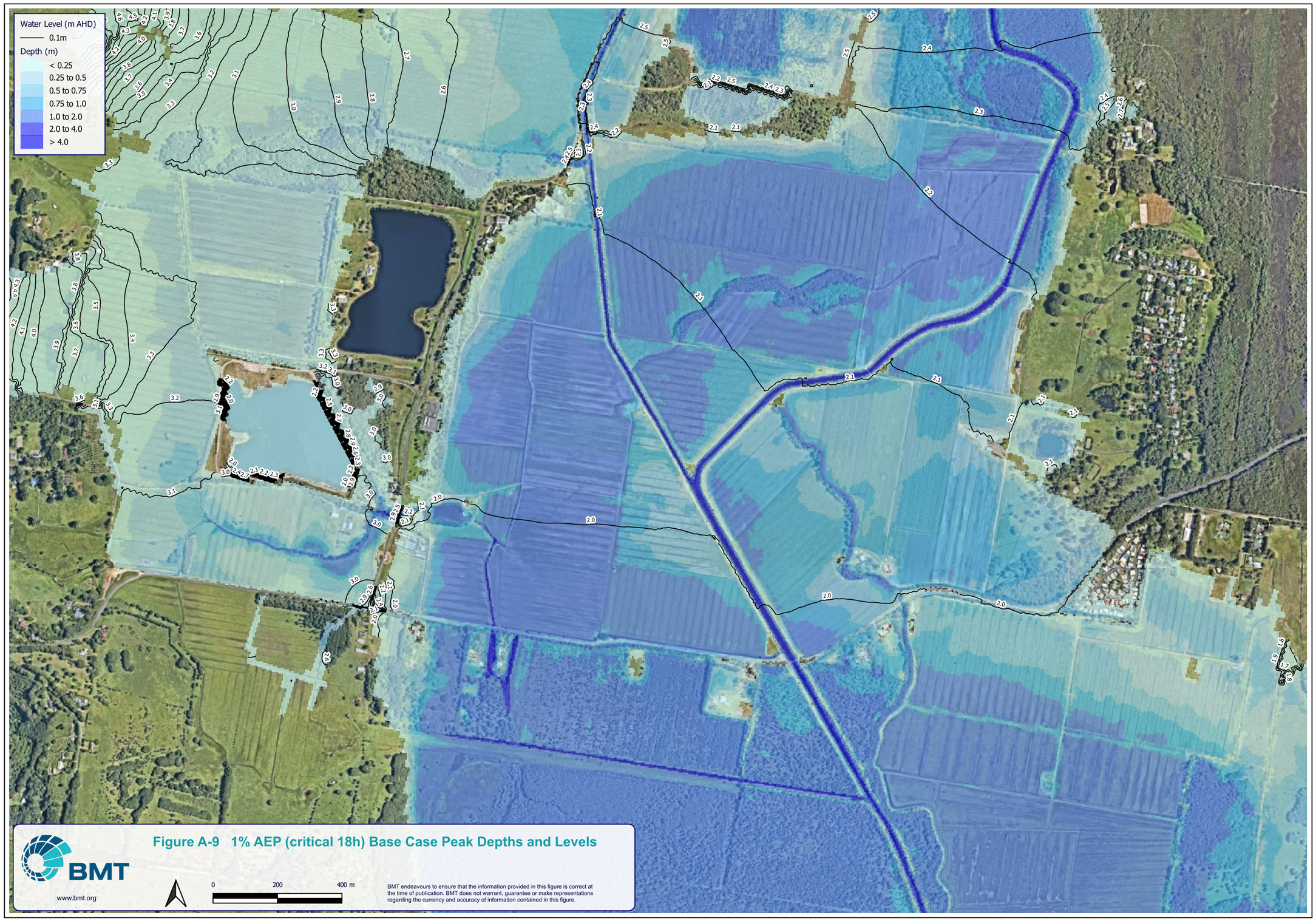


Figure A-9 1% AEP (critical 18h) Base Case Peak Depths and Levels

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5.1 Ross Lane Betterment

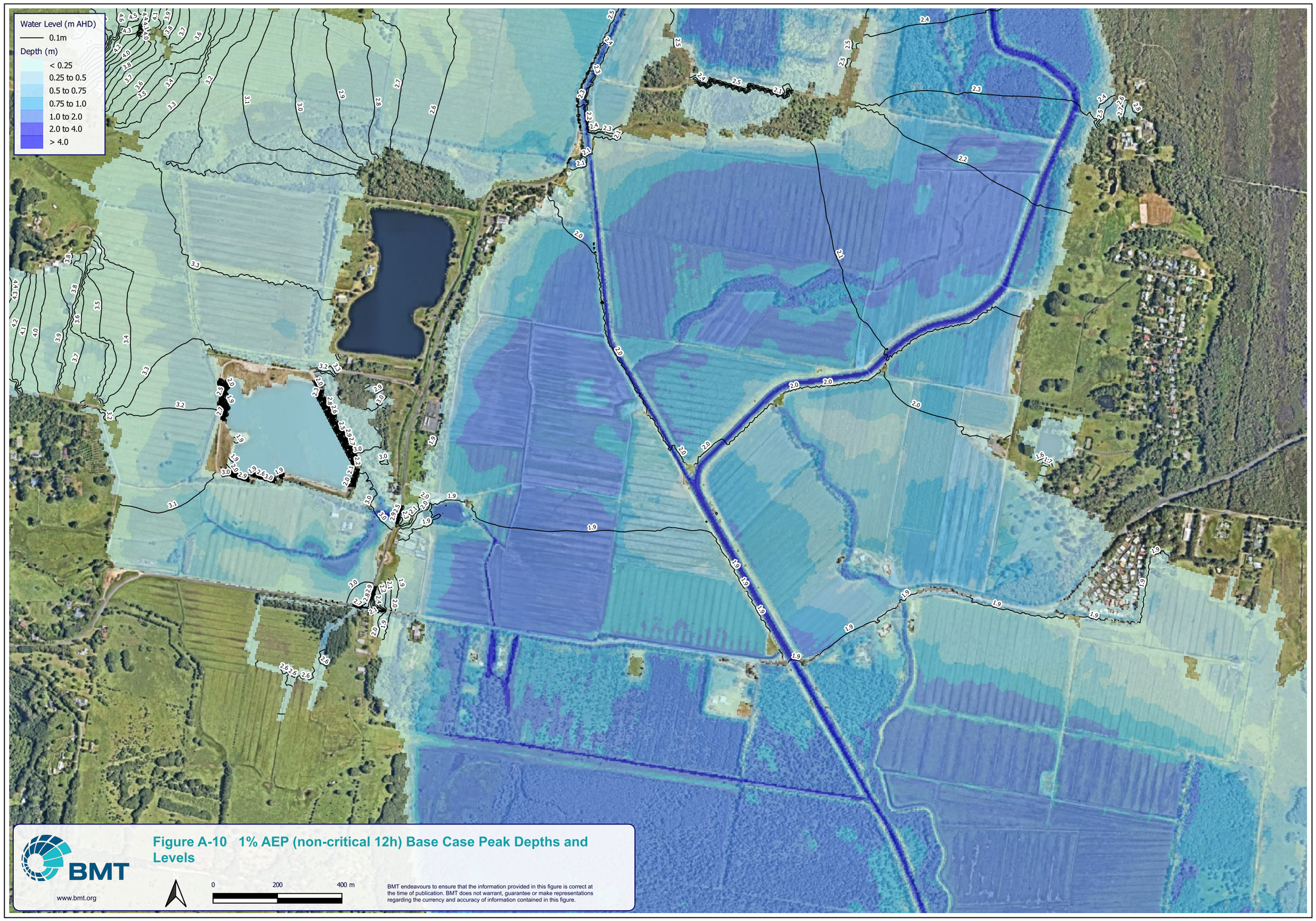


Figure A-10 1% AEP (non-critical 12h) Base Case Peak Depths and Levels

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Annex B Road Raising Designs

Ross Lane road raising designs supplied to BMT by Planit Consulting. Planit has used a different naming system for the various road raising scenarios. Please refer to Table B.1.

Table B.1. Road Raising Scenario Reference

BMT Reference	Planit Reference
Scenario 1	Option 1a*
Scenario 2	Option 1b
Scenario 3	Option 1a*
Scenario 4	Option 2a
Scenario 5	Option 4a
Scenario 6	Option 3a*
Scenario 7	Option 3b
Scenario 8	Option 3a*
Scenario 9	Option 1c

*** Planit use the same reference for the box culvert and low level bridge options which have the same road design**

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PRELIMINARY ROAD DESIGN DRAWINGS, ROSS LANE, KINVARA MR7735/15

PLANIT CONSULTING

DRAWING REGISTER		
DRAWING NUMBER	DRAWING TITLE	DRAWING REVISION
0001	COVER PAGE & LOCALITY PLAN	C
0010	OVERALL LAYOUT PLAN	B
0100	OPTION 1a 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 4	B
0101	OPTION 1a 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 4	B
0102	OPTION 1a 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 3 OF 4	B
0103	OPTION 1a 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 4 OF 4	B
0110	OPTION 1b 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 2	B
0111	OPTION 1b 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 2	B
0150	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 9	B
0151	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 9	B
0152	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 3 OF 9	B
0153	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 4 OF 9	B
0154	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 5 OF 9	B
0155	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 6 OF 9	B
0156	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 7 OF 9	B
0157	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 8 OF 9	B
0158	OPTION 2a 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 9 OF 9	B
0160	OPTION 2b 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 2	B
0161	OPTION 2b 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 2	B
0200	ROAD LONGITUDINAL SECTION SHEET 1 OF 5	B
0201	ROAD LONGITUDINAL SECTION SHEET 2 OF 5	B
0202	ROAD LONGITUDINAL SECTION SHEET 3 OF 5	B
0203	ROAD LONGITUDINAL SECTION SHEET 4 OF 5	C
0204	ROAD LONGITUDINAL SECTION SHEET 5 OF 5	C
0210	ROAD TYPICAL CROSS-SECTIONS OPTION 1	B
0211	ROAD TYPICAL CROSS-SECTIONS OPTION 2 SHEET 1 OF 2	B
0212	ROAD TYPICAL CROSS-SECTIONS OPTION 2 SHEET 2 OF 2	B
0220	CULVERT LONGITUDINAL SECTION	B

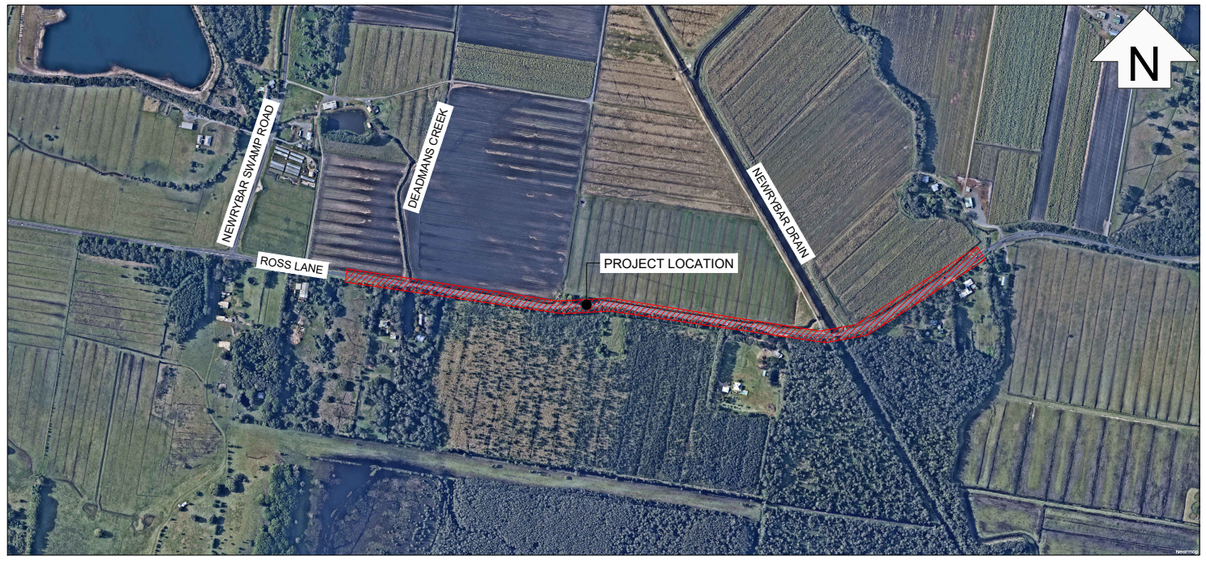


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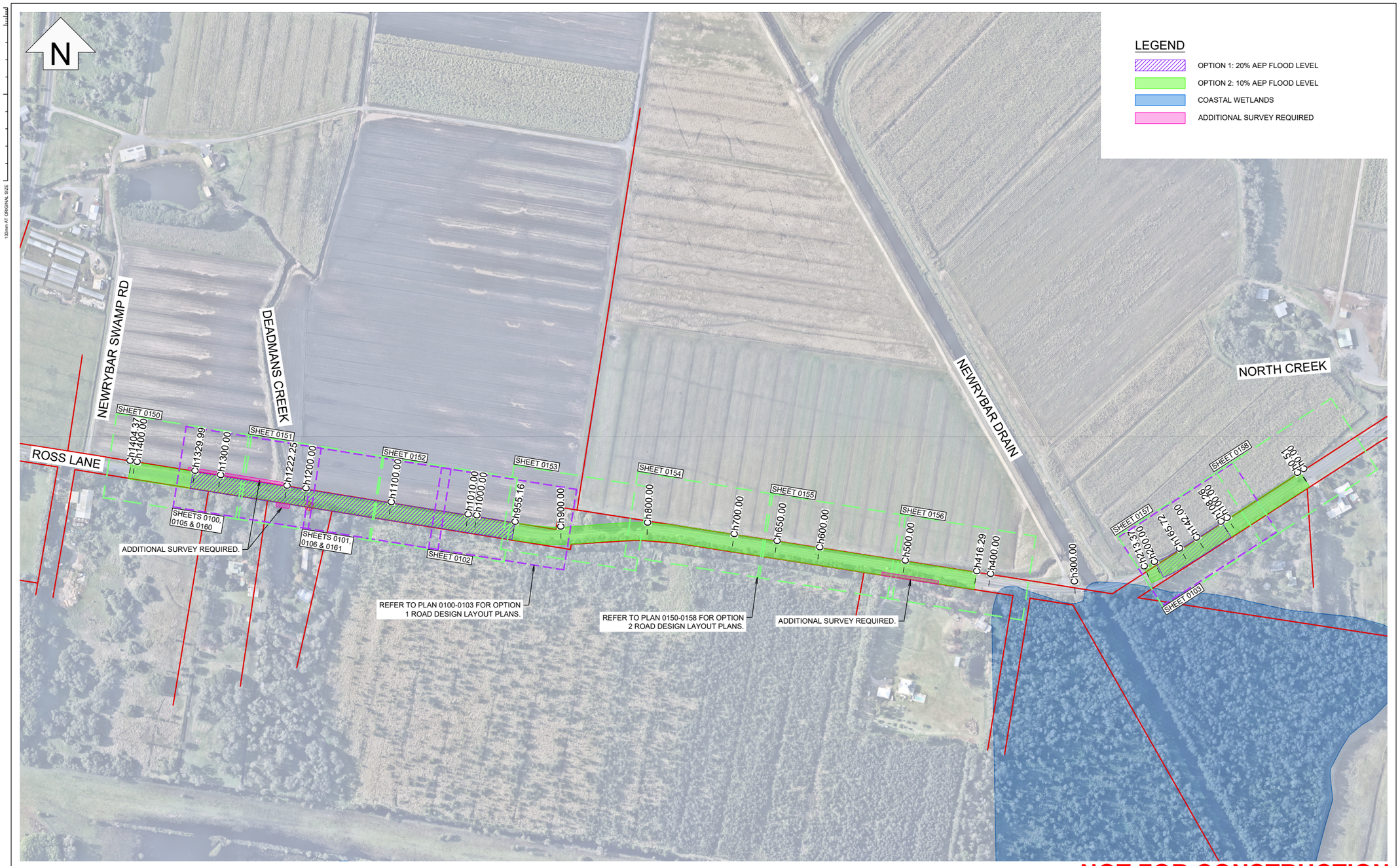
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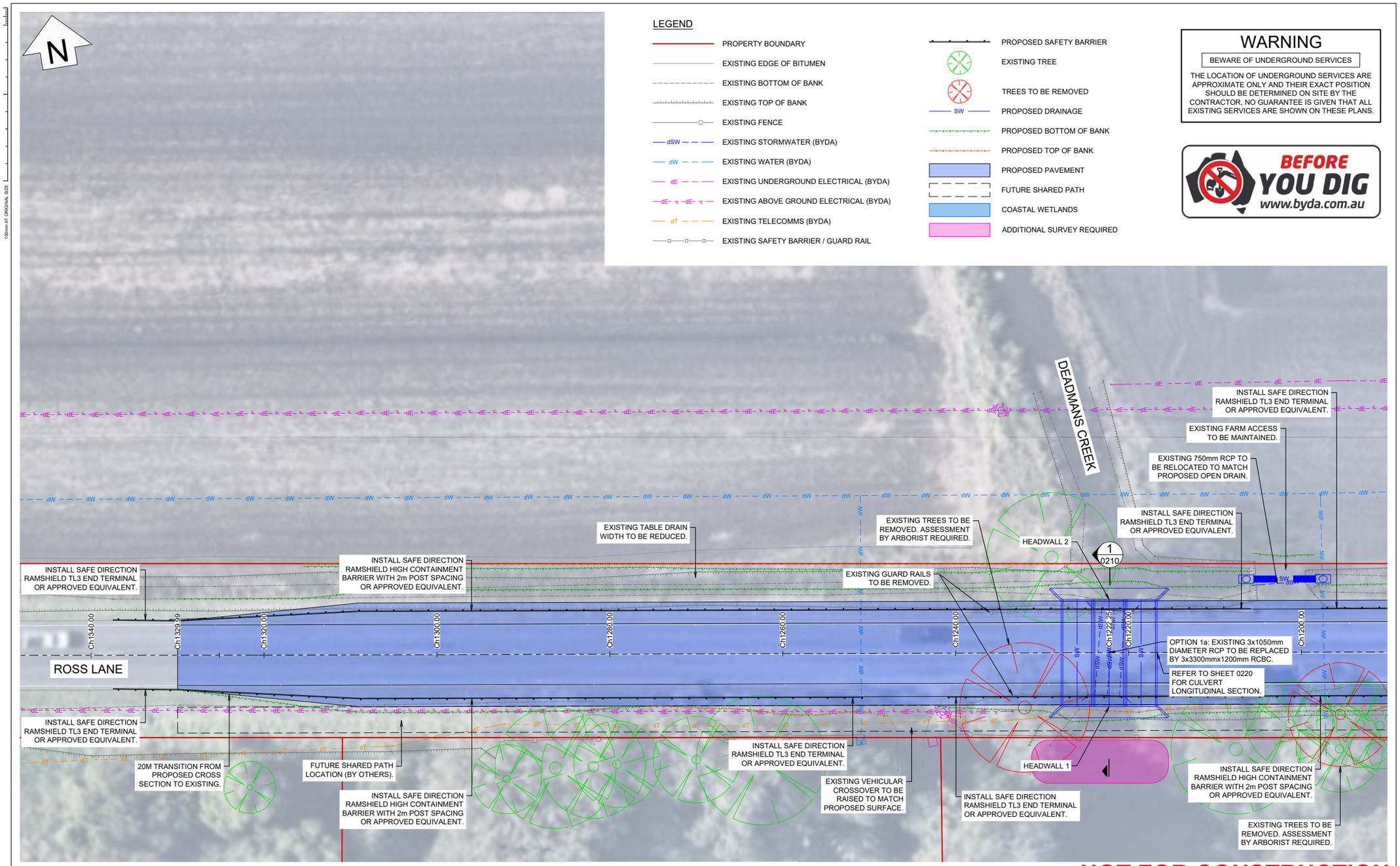
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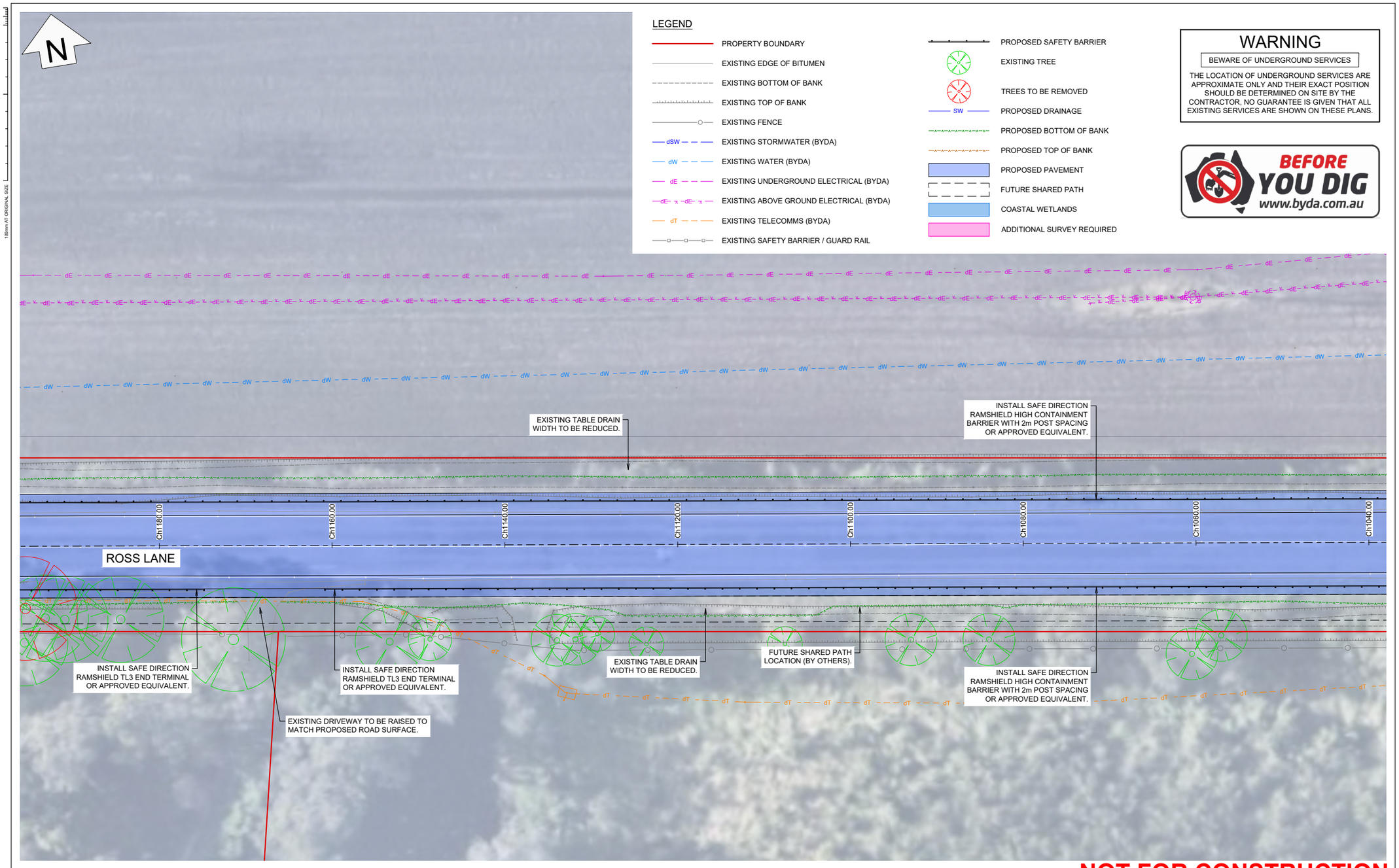
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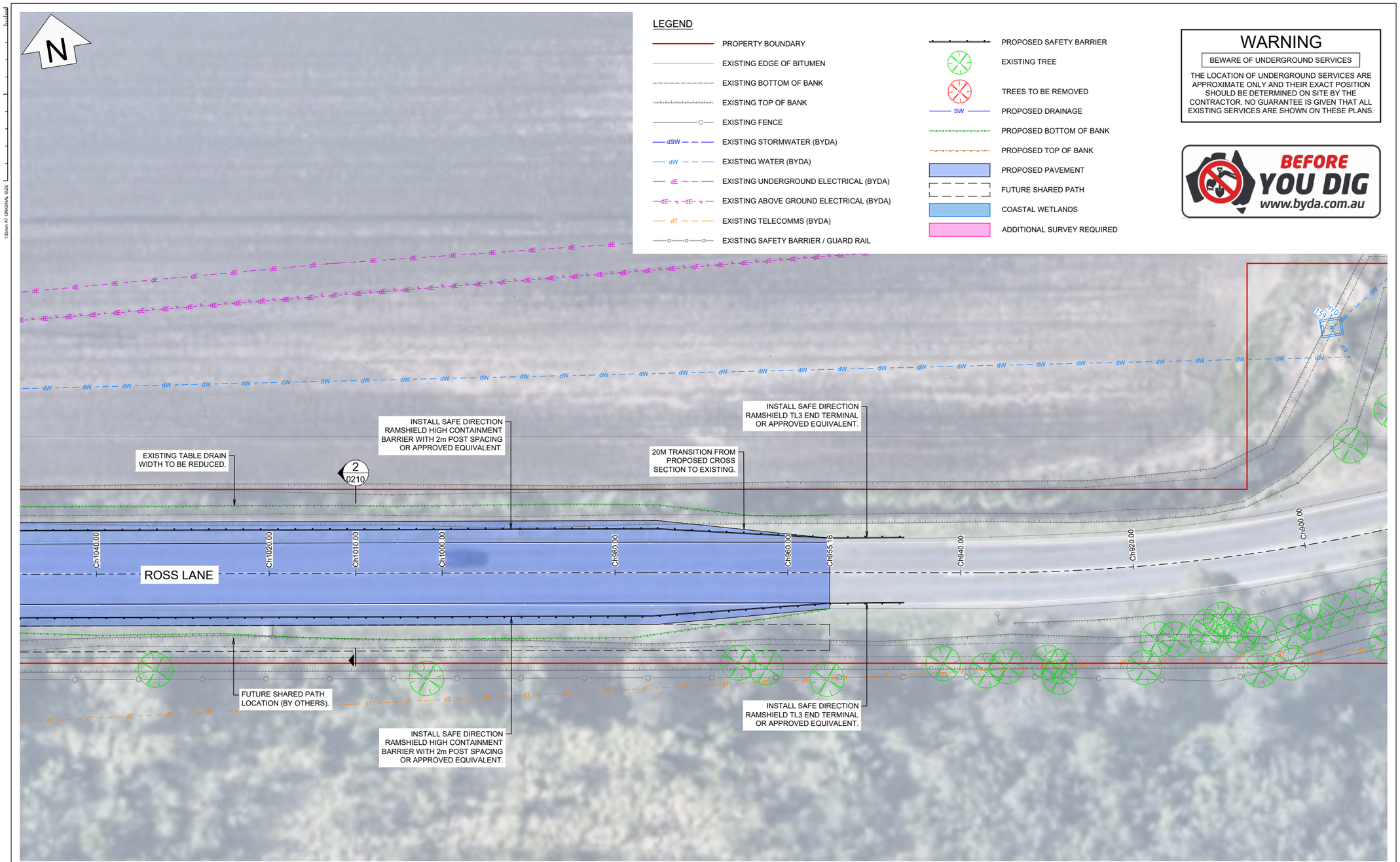
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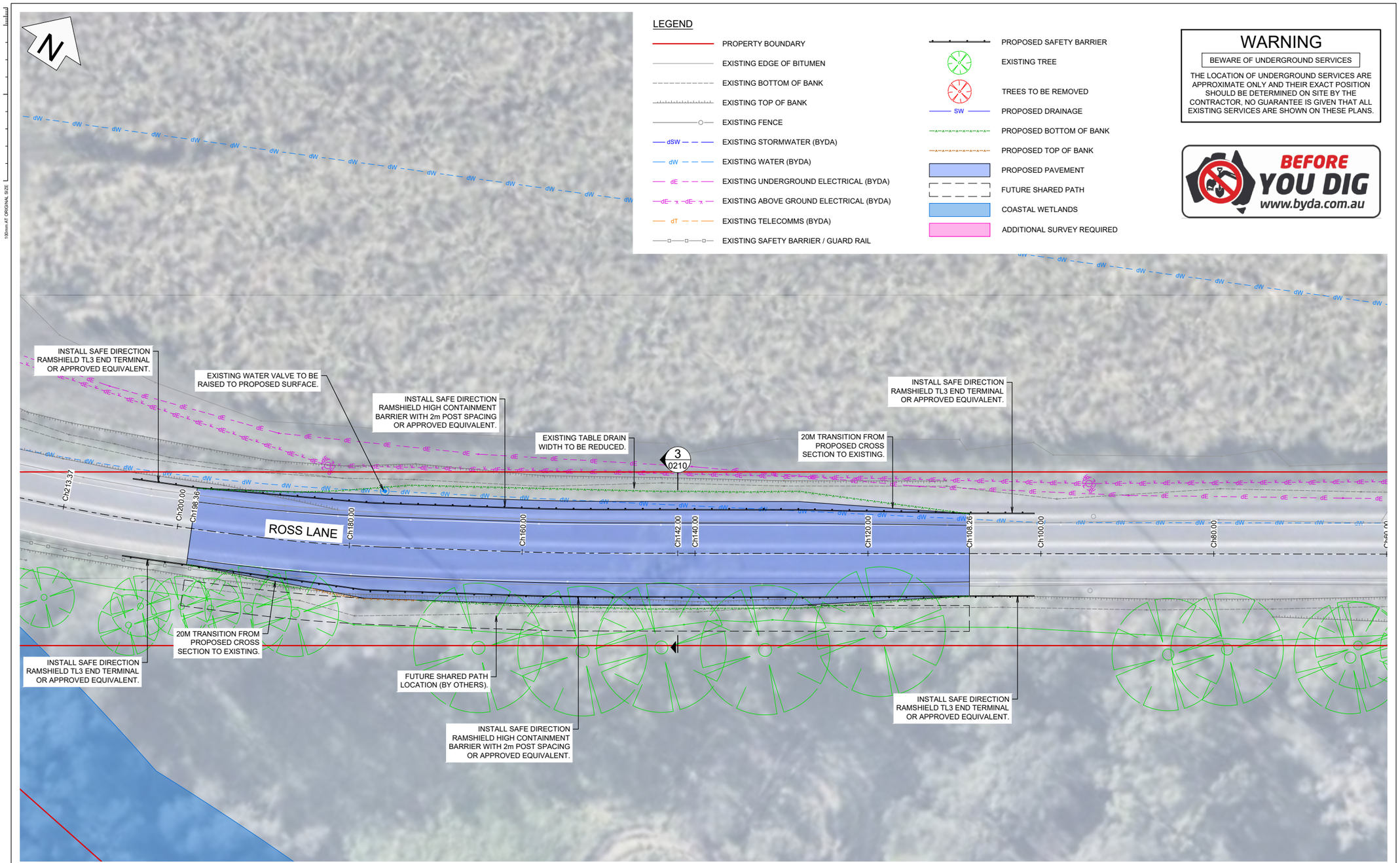
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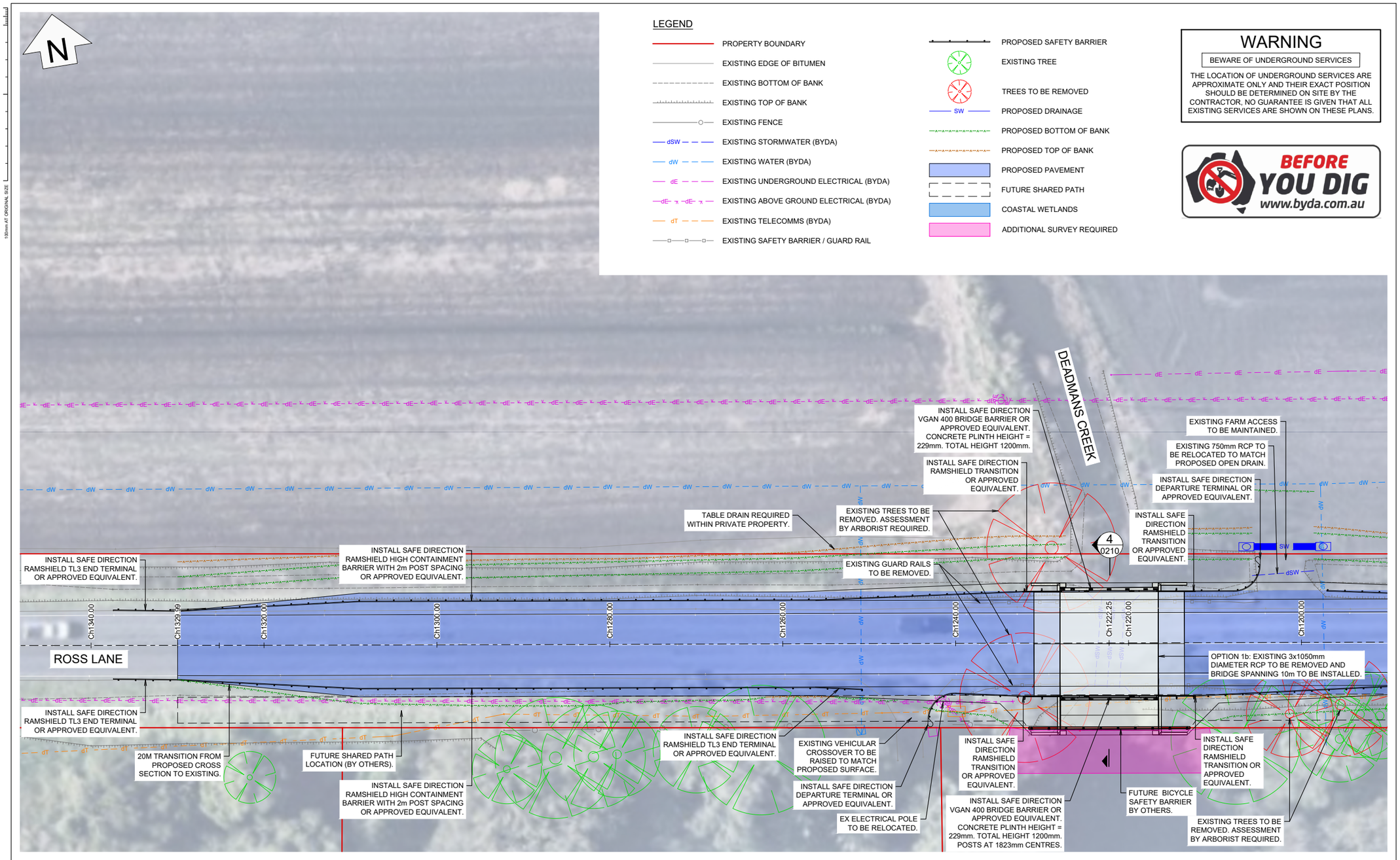
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OPTION 1b - BRIDGE

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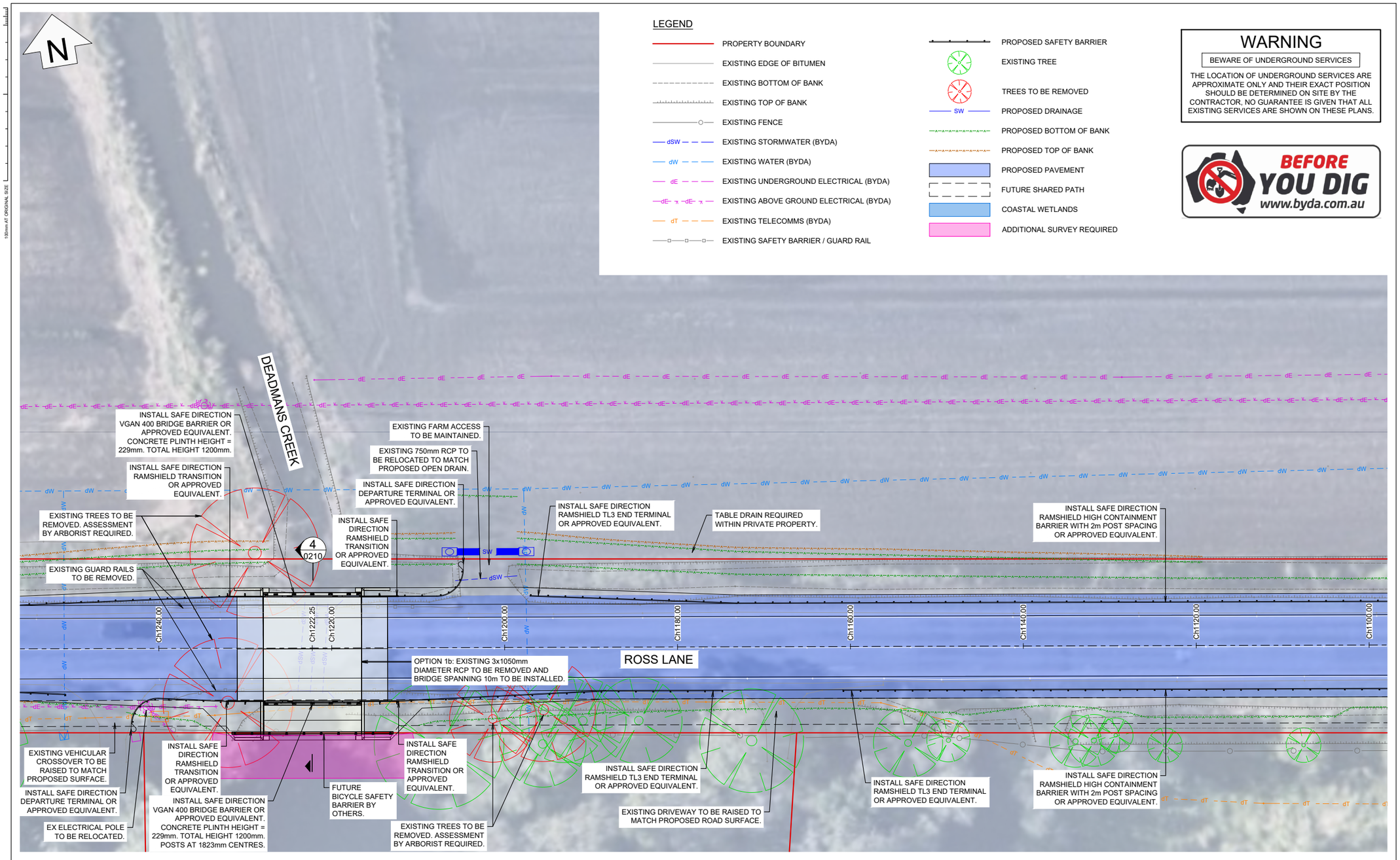
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DRAWING TITLE: OPTION 1B 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 2

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A1	J8274	0110	B

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OPTION 1b - BRIDGE

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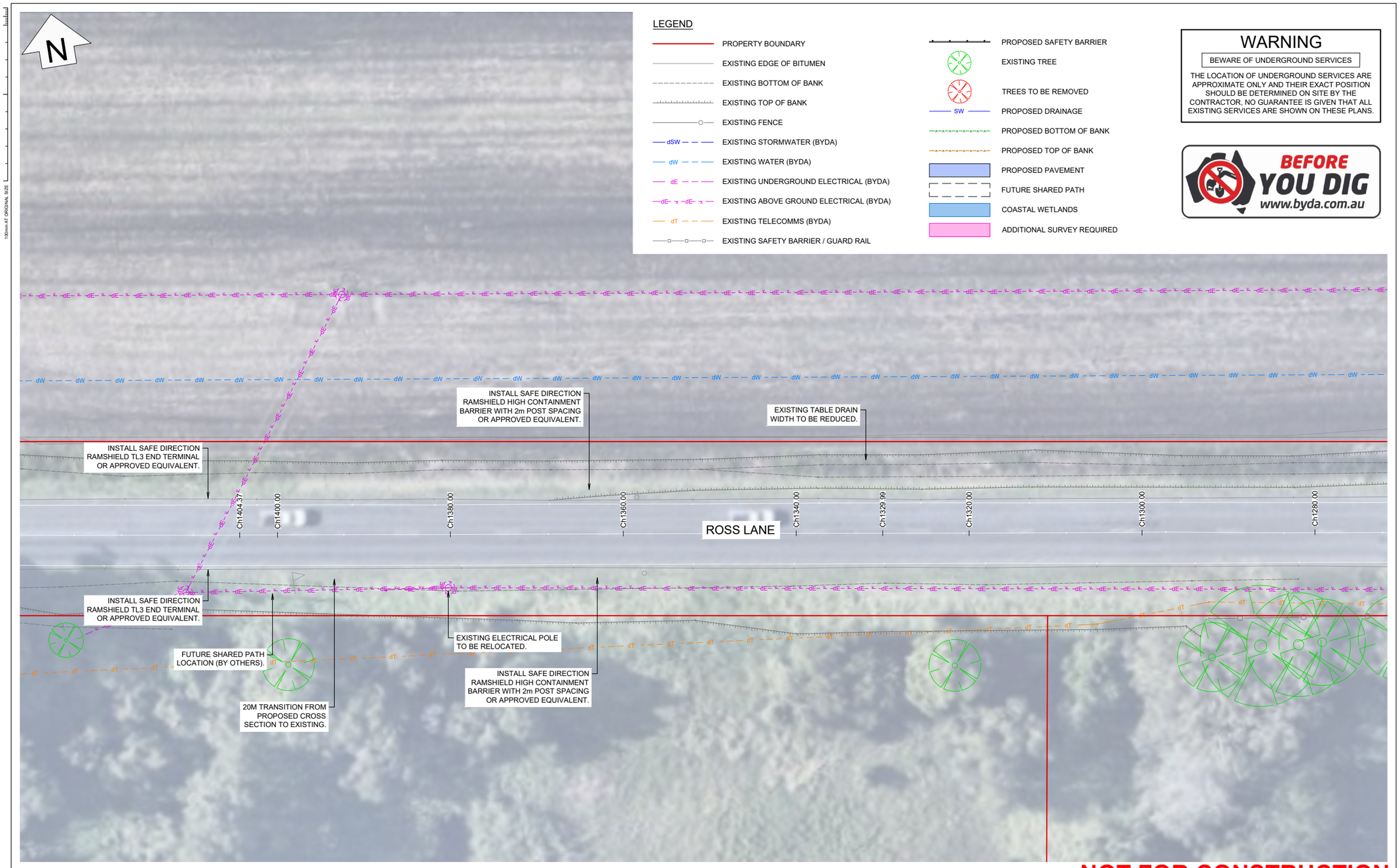
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CLIENT: BALLINA SHIRE COUNCIL
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 1B 20% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 2

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0111	B

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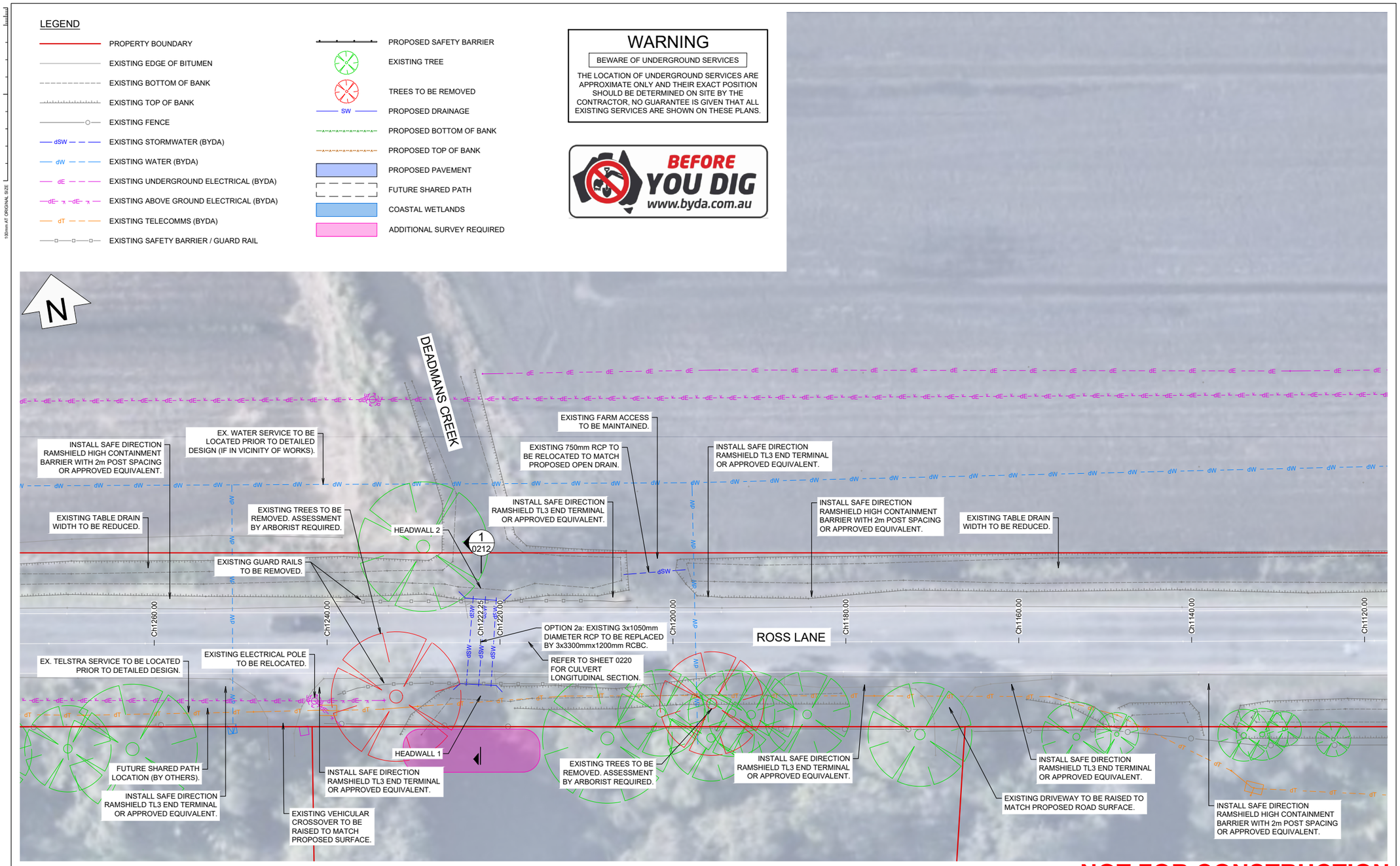
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CLIENT: BALLINA SHIRE COUNCIL
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0150	B

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OPTION 2a - CULVERT UNDER ROAD

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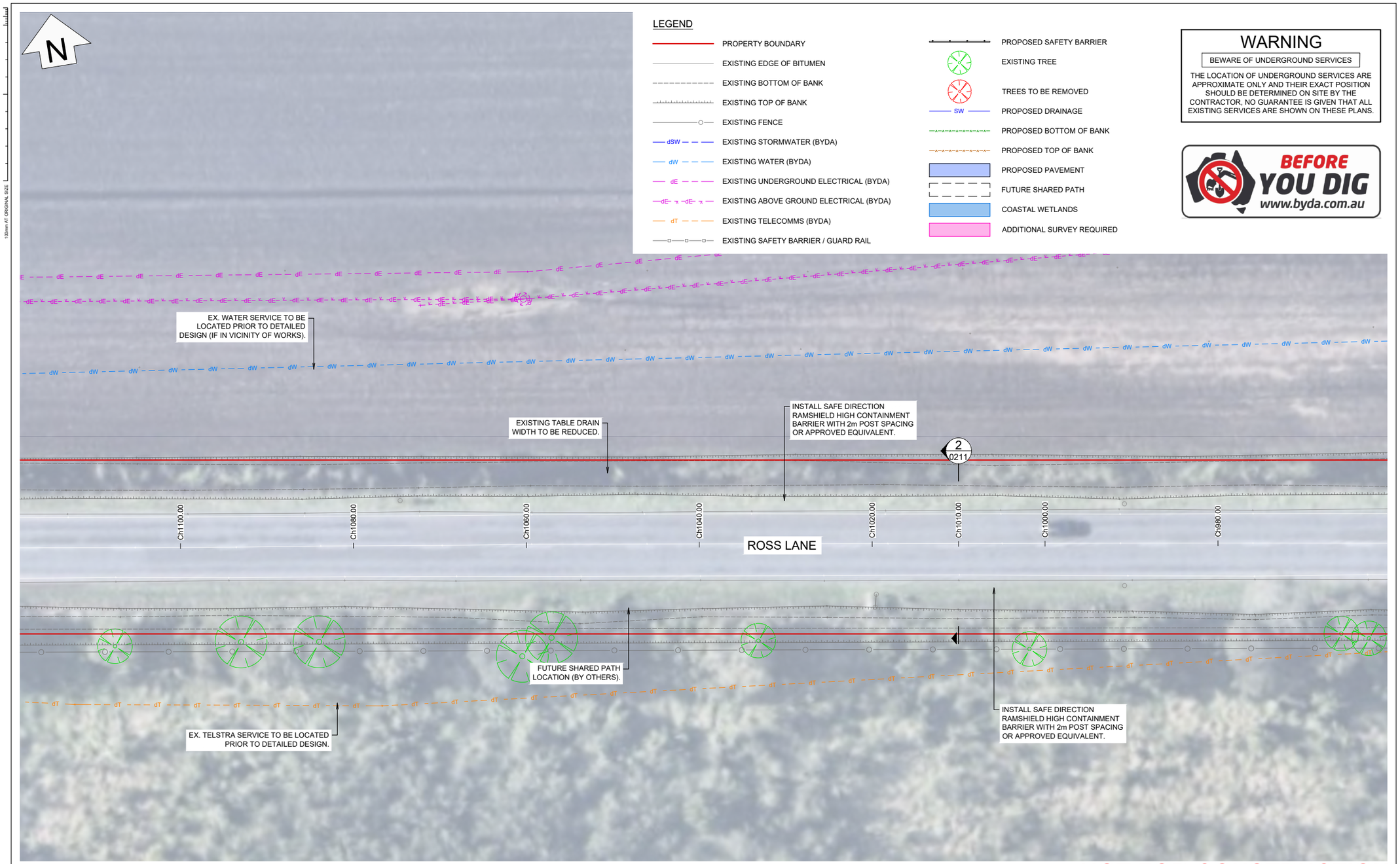
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CLIENT: BALLINA SHIRE COUNCIL
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0151	B

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CLIENT: BALLINA SHIRE COUNCIL
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 3 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0152	B

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100mm AT ORIGINAL SIZE

N

LEGEND

- PROPERTY BOUNDARY
- EXISTING EDGE OF BITUMEN
- EXISTING BOTTOM OF BANK
- EXISTING TOP OF BANK
- EXISTING FENCE
- dSW — EXISTING STORMWATER (BYDA)
- dW — EXISTING WATER (BYDA)
- dE — EXISTING UNDERGROUND ELECTRICAL (BYDA)
- dE — EXISTING ABOVE GROUND ELECTRICAL (BYDA)
- dT — EXISTING TELECOMMS (BYDA)
- EXISTING SAFETY BARRIER / GUARD RAIL
- PROPOSED SAFETY BARRIER
- EXISTING TREE
- TREES TO BE REMOVED
- SW — PROPOSED DRAINAGE
- PROPOSED BOTTOM OF BANK
- PROPOSED TOP OF BANK
- PROPOSED PAVEMENT
- FUTURE SHARED PATH
- COASTAL WETLANDS
- ADDITIONAL SURVEY REQUIRED

WARNING

BEWARE OF UNDERGROUND SERVICES

THE LOCATION OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE DETERMINED ON SITE BY THE CONTRACTOR, NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN ON THESE PLANS.

BEFORE YOU DIG www.byda.com.au

EX. WATER SERVICE TO BE LOCATED PRIOR TO DETAILED DESIGN (IF IN VICINITY OF WORKS).

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

WORKS WITHIN PRIVATE PROPERTY.

EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

Ch960.00 Ch955.16 Ch940.00 Ch920.00 Ch900.00 Ch880.00 Ch860.00 Ch840.00 Ch820.00

ROSS LANE

EXISTING TREES TO BE REMOVED. ASSESSMENT BY ARBORIST REQUIRED.

EX. WATER METER TO BE RAISED TO PROPOSED LEVELS.

EXISTING TABLE DRAIN WIDTH TO BE REDUCED.

EX. TELSTRA SERVICE TO BE LOCATED PRIOR TO DETAILED DESIGN.

EXISTING TREES TO BE REMOVED. ASSESSMENT BY ARBORIST REQUIRED.

EXISTING TREES TO BE REMOVED. ASSESSMENT BY ARBORIST REQUIRED.

FUTURE SHARED PATH LOCATION (BY OTHERS).

INSTALL SAFE DIRECTION RAMSHIELD HIGH CONTAINMENT BARRIER WITH 2m POST SPACING OR APPROVED EQUIVALENT.

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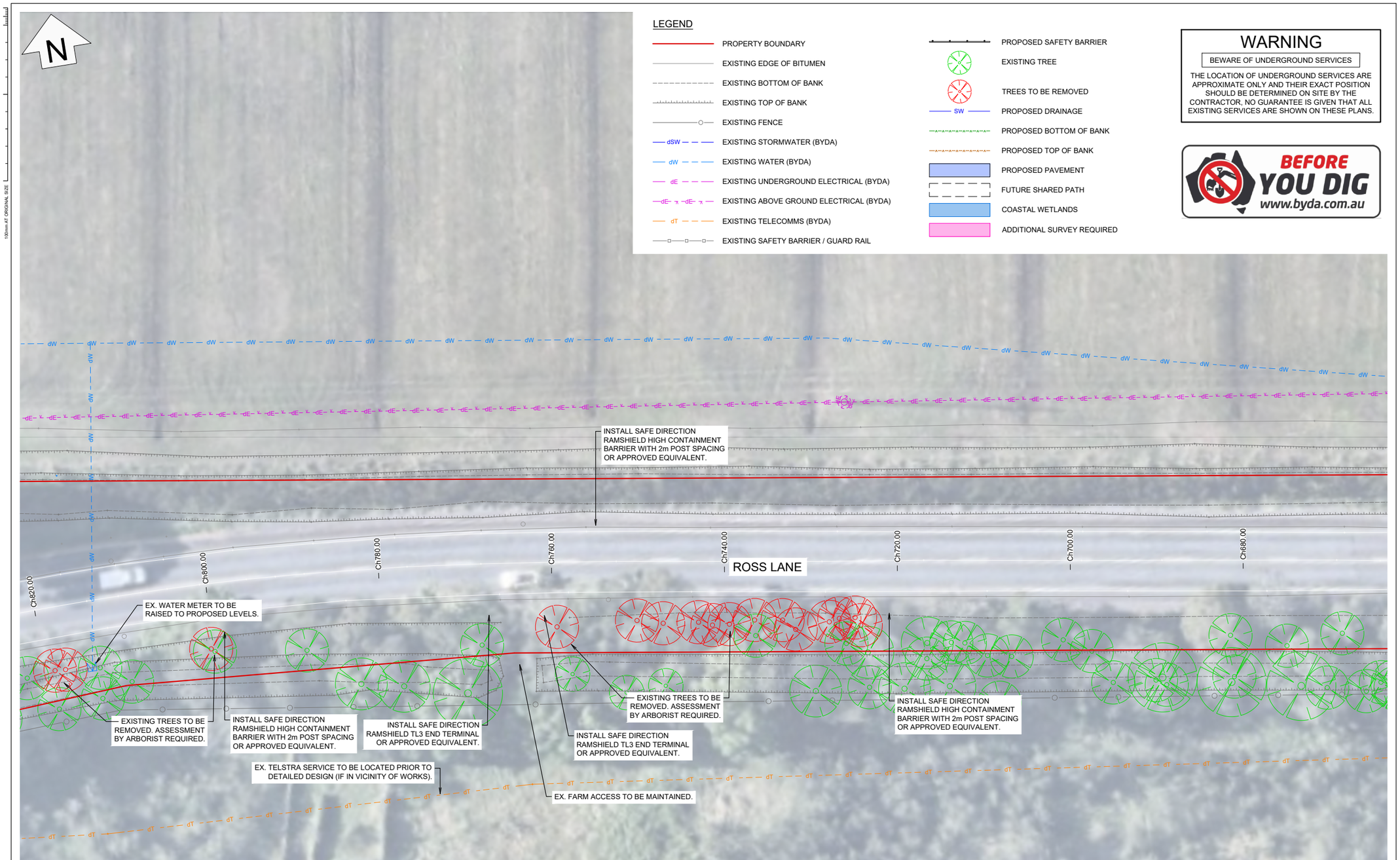
PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 4 OF 9

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0153	B

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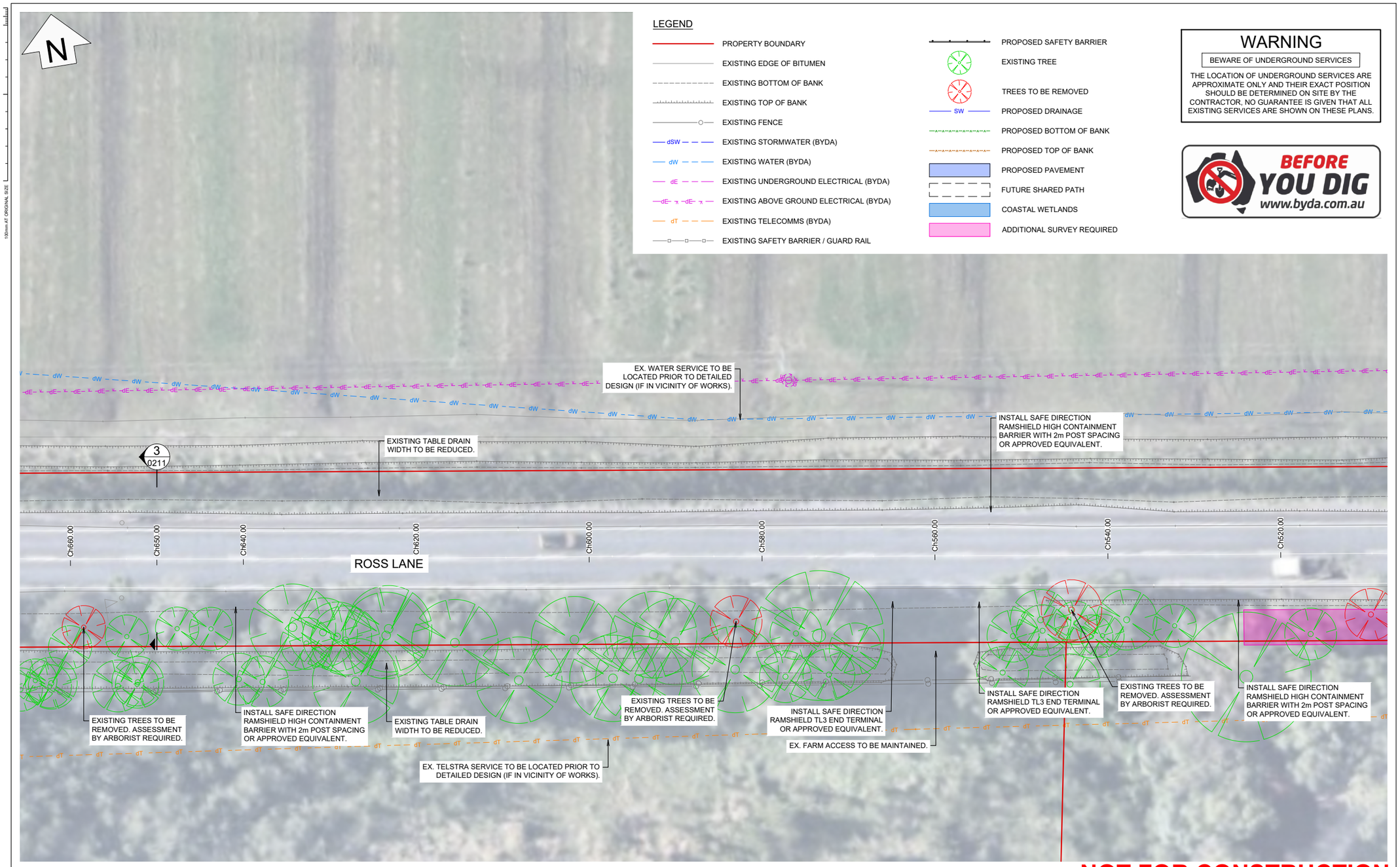
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CLIENT: BALLINA SHIRE COUNCIL
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 5 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0154	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ\8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:32:49 AM



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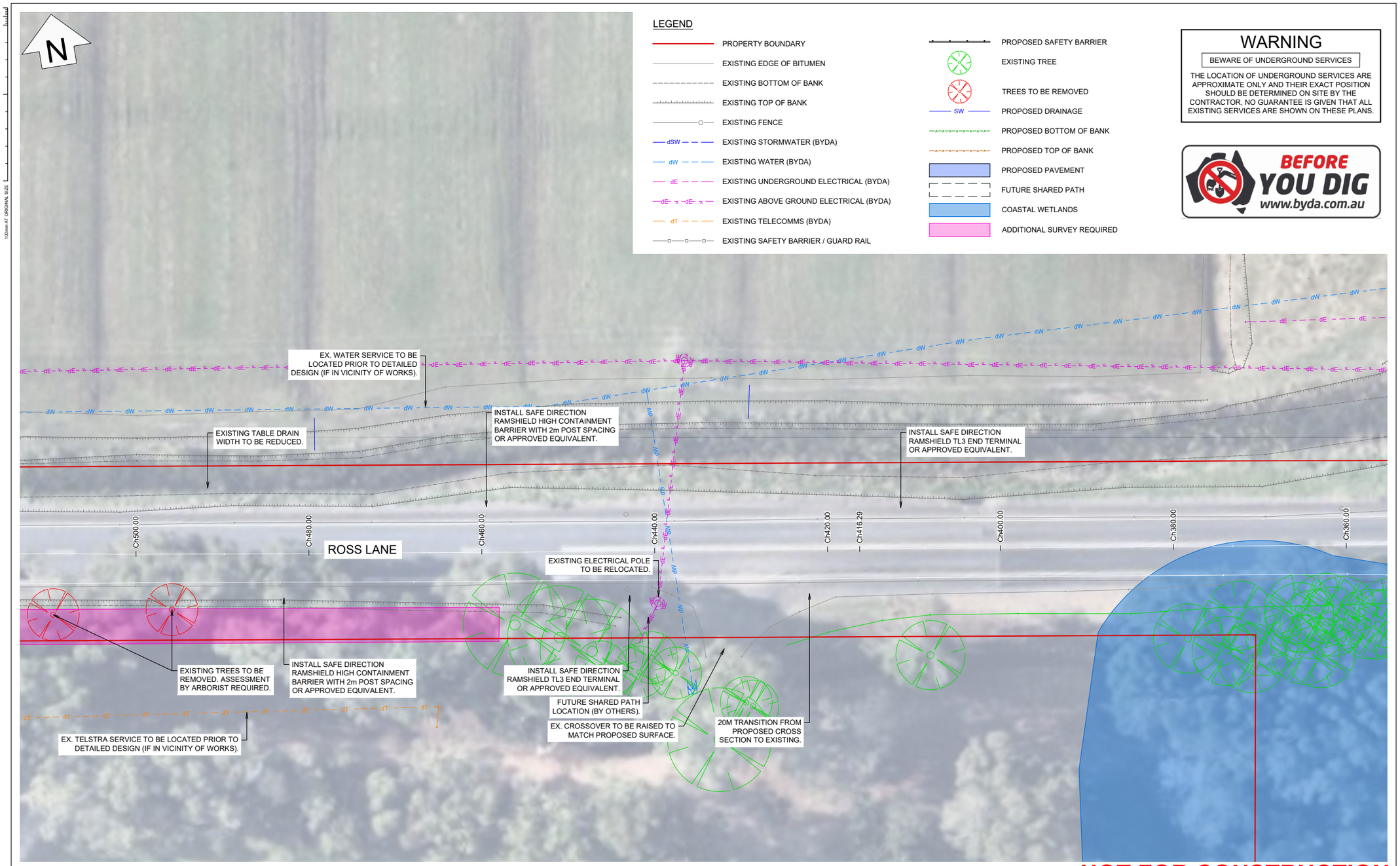
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CLIENT: BALLINA SHIRE COUNCIL
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 6 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0155	B

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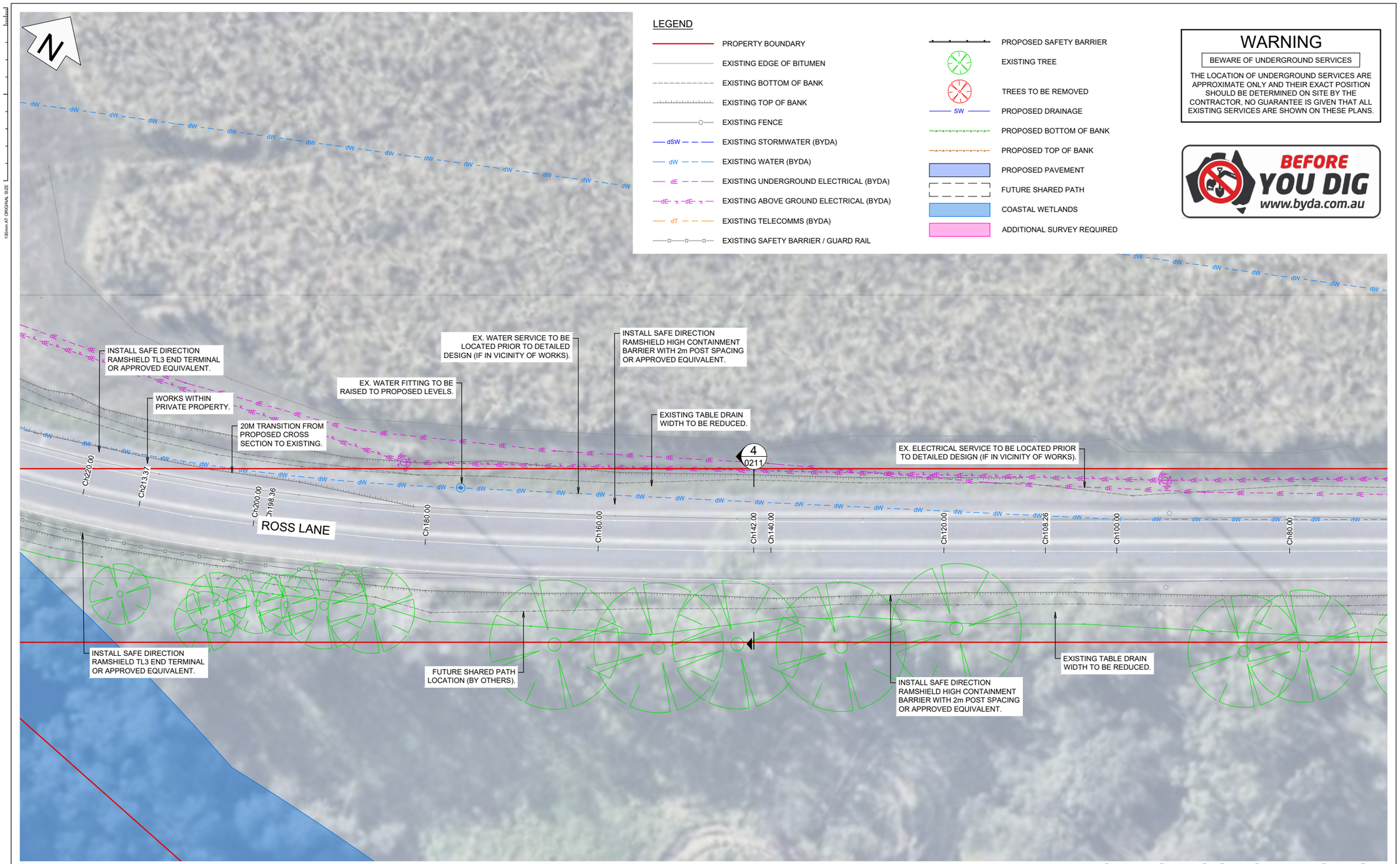
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PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 7 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0156	B

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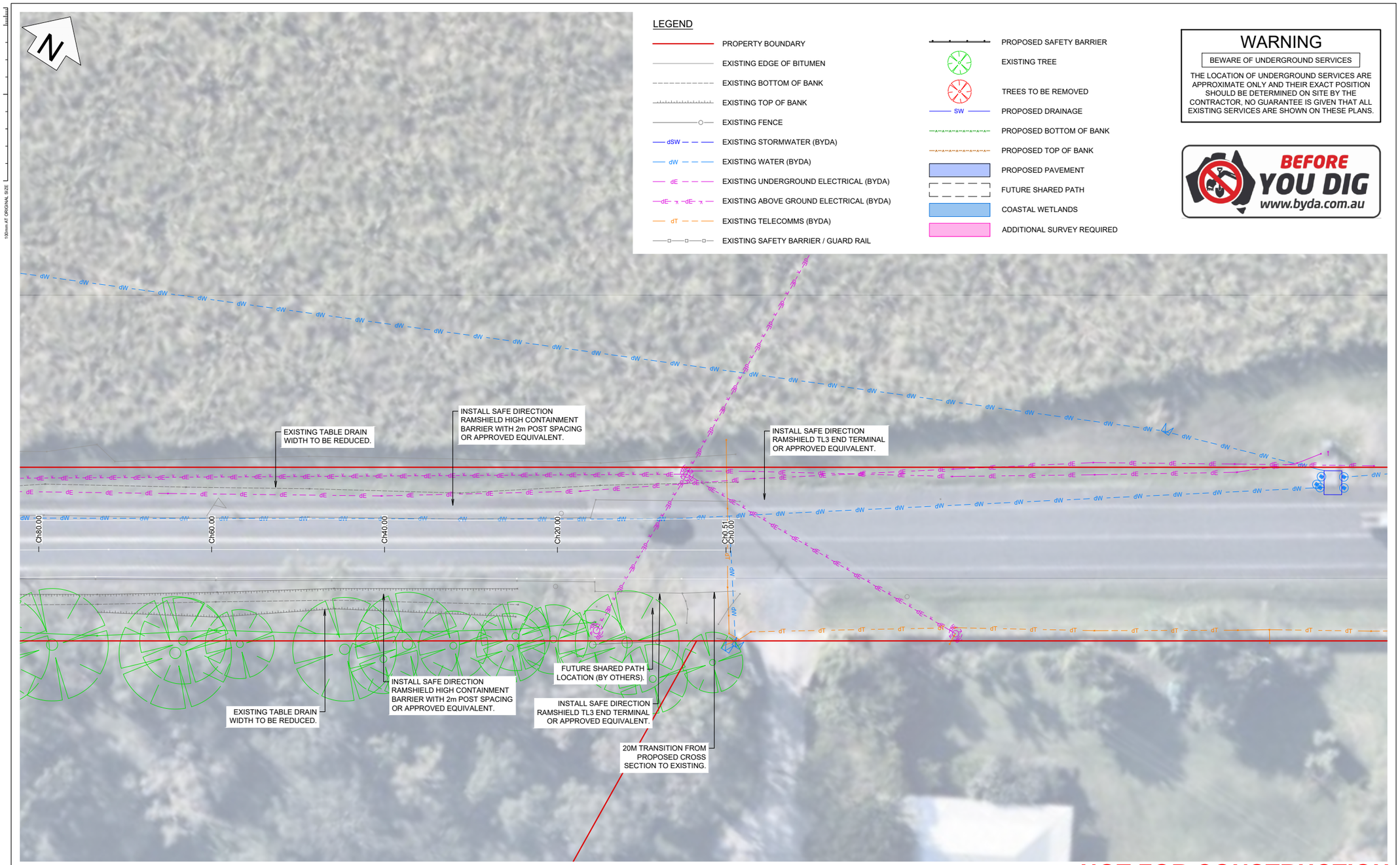
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PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 8 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
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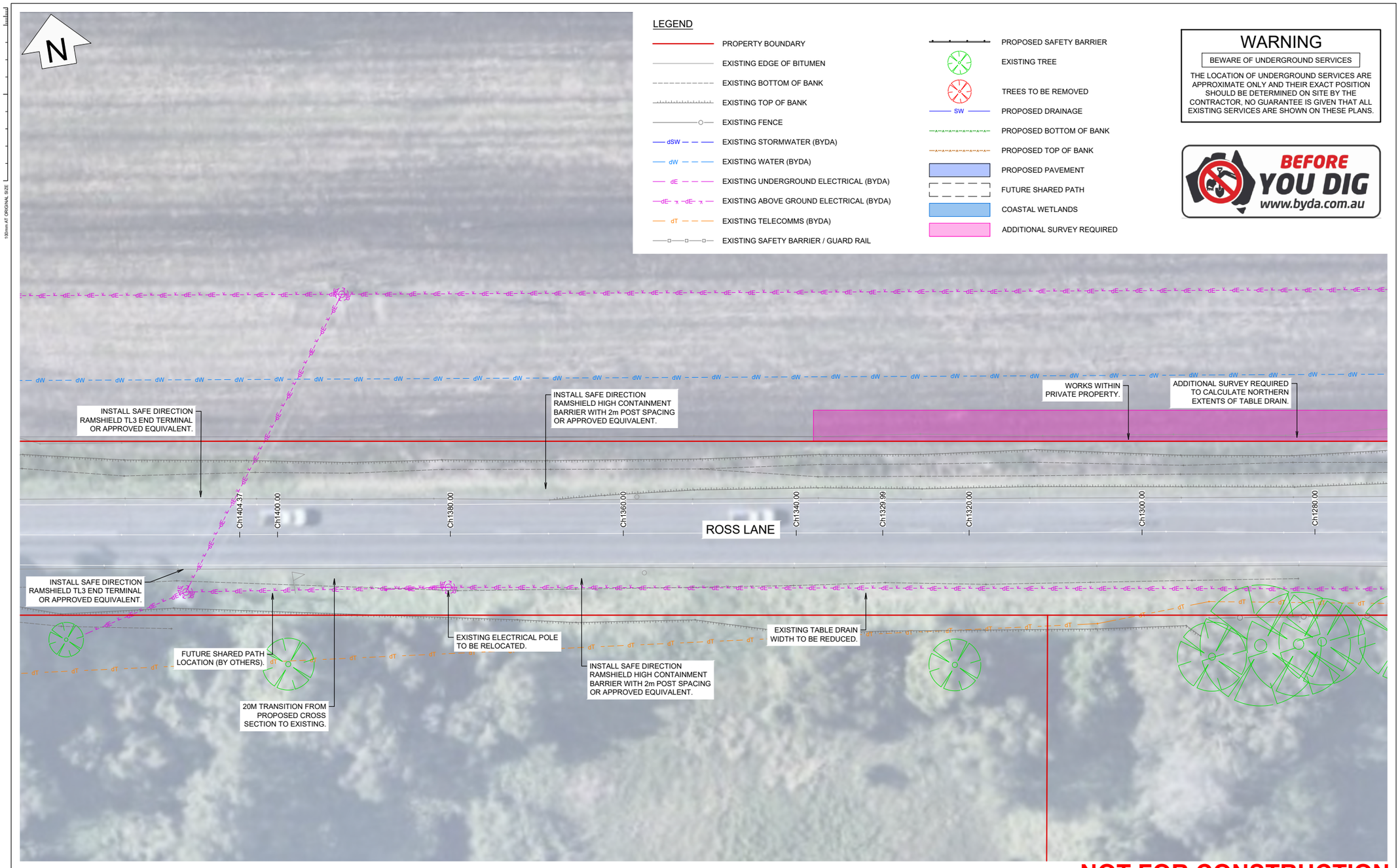
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CLIENT: BALLINA SHIRE COUNCIL
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2A 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 9 OF 9

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0158	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:30:18 AM



100mm AT ORIGINAL SIZE

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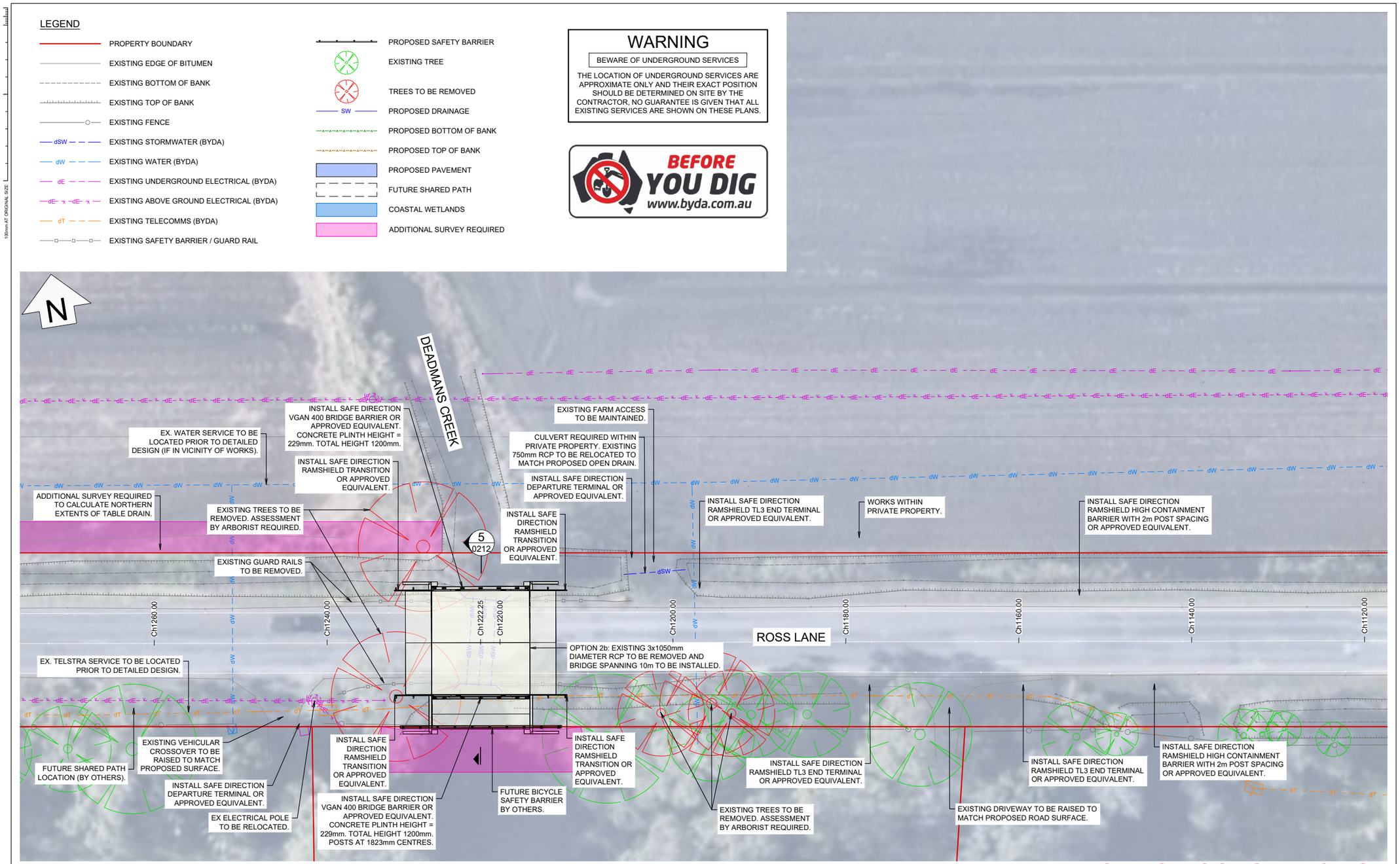
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CLIENT: BALLINA SHIRE COUNCIL
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PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2B 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 1 OF 2

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0160	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0150 - OPTION2 LAYOUTS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:33:46 AM



OPTION 2a - CULVERT UNDER ROAD

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B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 2 4 8 12
Full Size 1:200 ; Half Size 1:400
Scale (m)
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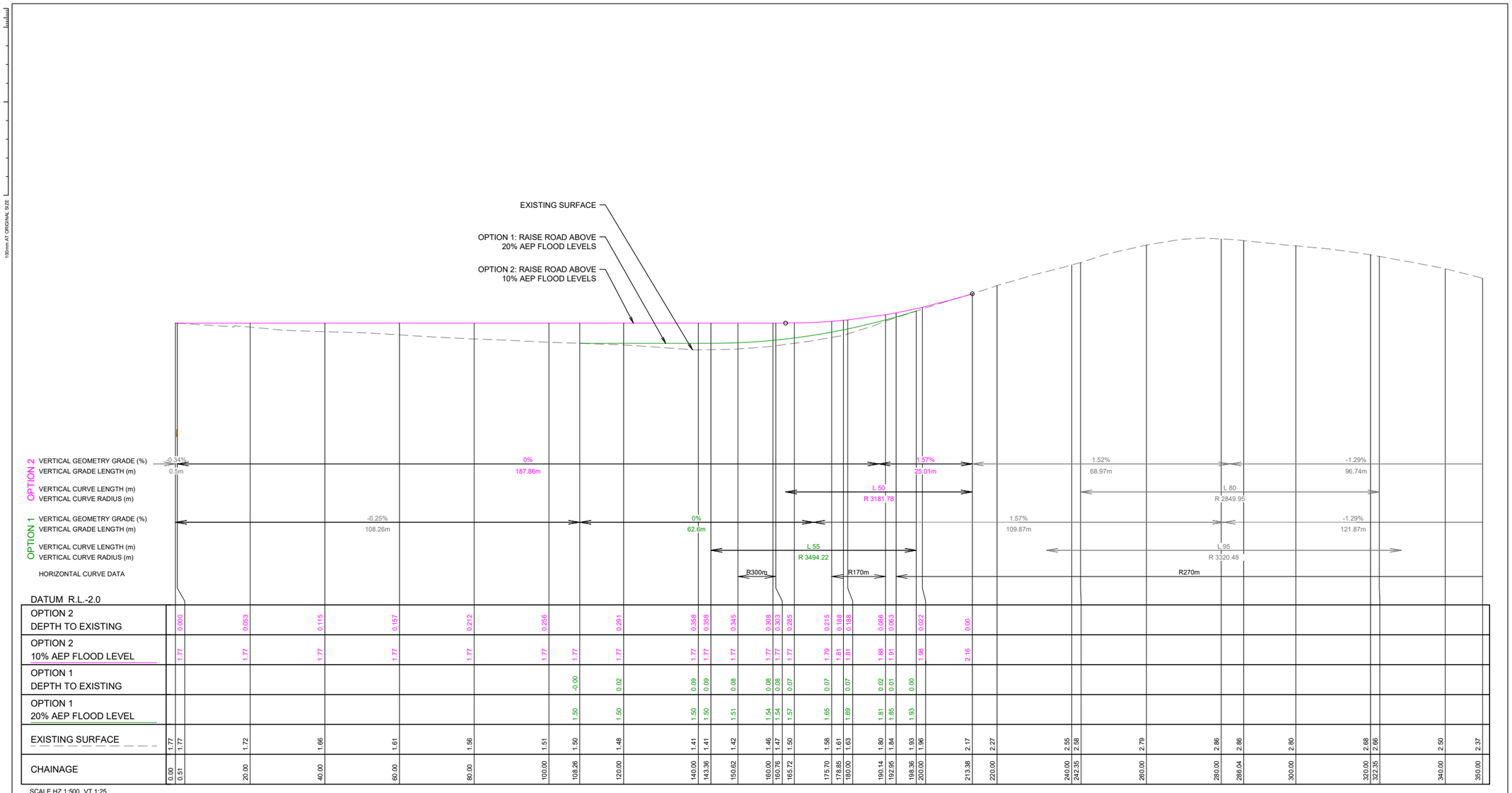
CLIENT: BALLINA SHIRE COUNCIL
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: OPTION 2B 10% AEP FLOOD LEVEL LAYOUT PLAN SHEET 2 OF 2

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
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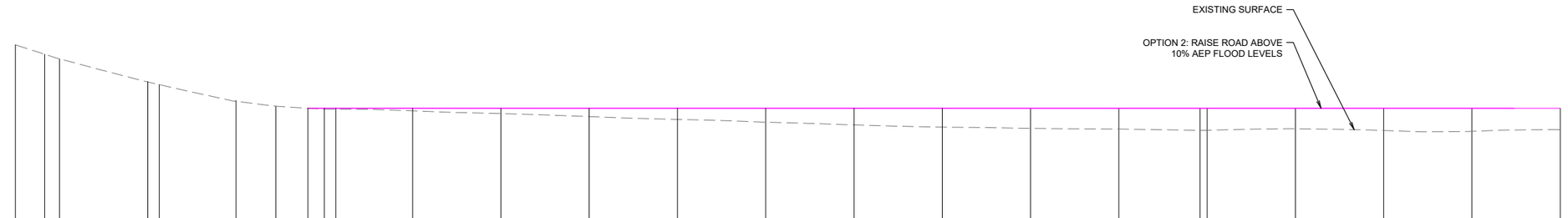
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5.1 Ross Lane Betterment



| | | |

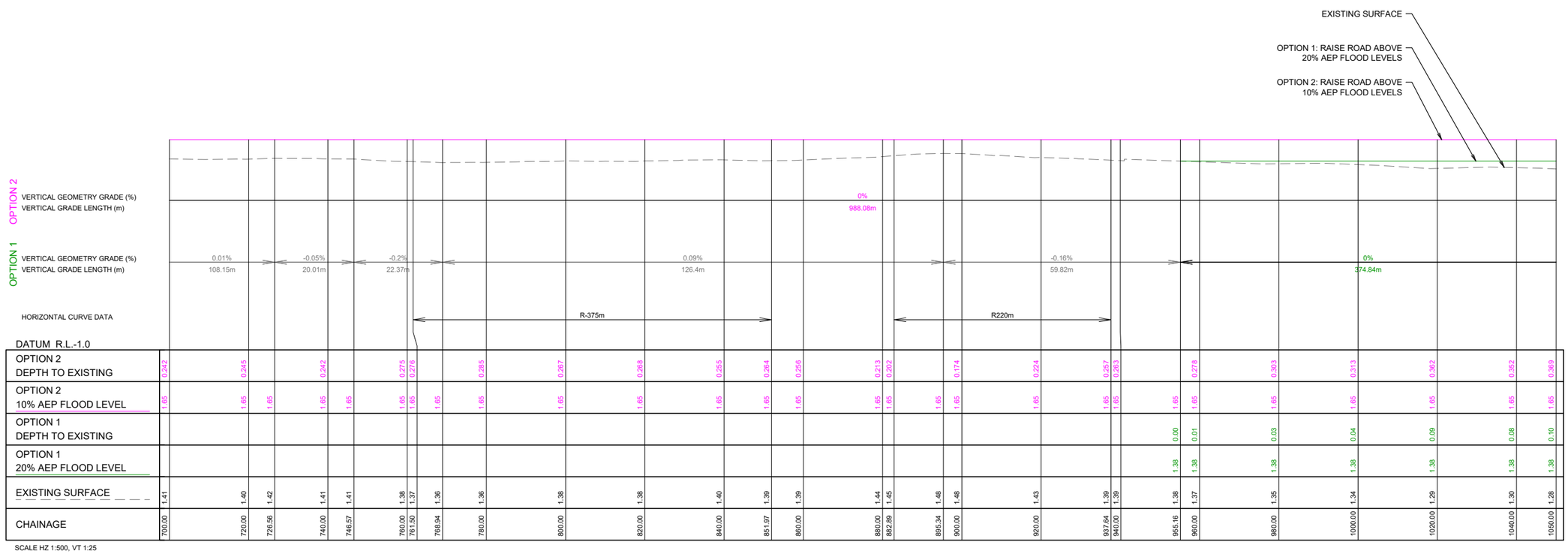
100mm AT ORIGINAL SIZE



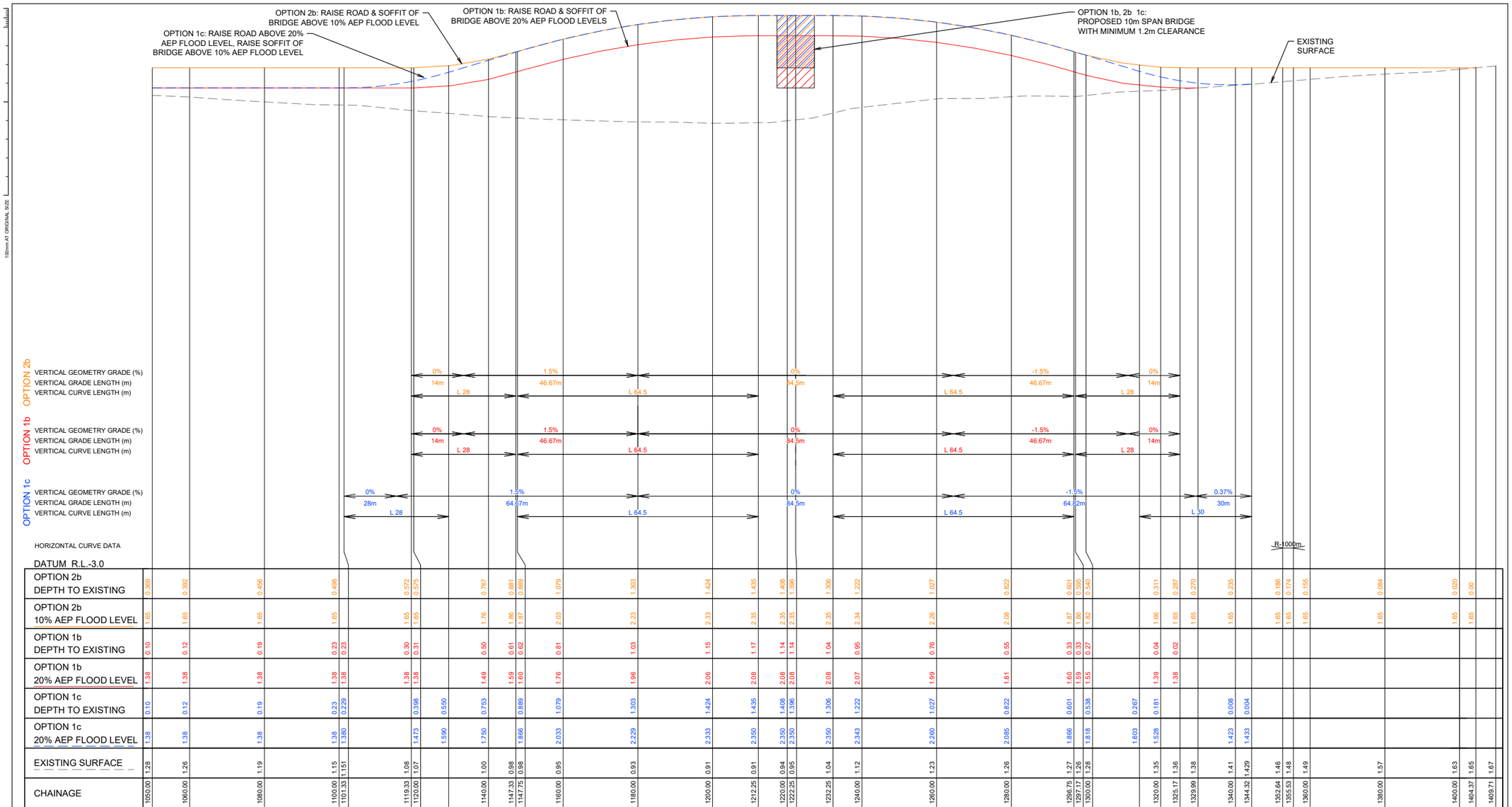
| | | |

5.1 Ross Lane Betterment

100mm AT ORIGINAL SIZE



| | | |



CHAINAGE	1050.00	1060.00	1080.00	1100.00	1101.33	1119.33	1120.00	1140.00	1147.33	1147.75	1160.00	1180.00	1200.00	1212.25	1220.00	1222.25	1232.25	1240.00	1260.00	1280.00	1298.75	1297.17	1300.00	1320.00	1325.17	1329.99	1340.00	1344.32	1352.64	1355.53	1360.00	1380.00	1400.00	1404.37	1409.71
EXISTING SURFACE	1.28	1.26	1.19	1.15	1.151	1.08	1.07	1.00	1.00	0.98	0.98	0.95	0.93	0.91	0.91	0.94	0.95	1.04	1.12	1.23	1.26	1.27	1.26	1.28											
OPTION 2b DEPTH TO EXISTING	0.369	0.392	0.466	0.498		0.572	0.575	0.767	0.861	0.869	1.079	1.303	1.424	1.435	1.408	1.395	1.306	1.222	1.027	0.822	0.601	0.595	0.540	0.311	0.287	0.270	0.235		0.186	0.174	0.155	0.064	0.020	0.00	
OPTION 2b 10% AEP FLOOD LEVEL	1.65	1.65	1.65	1.65		1.65	1.65	1.76	1.86	1.87	2.03	2.23	2.33	2.35	2.35	2.35	2.35	2.34	2.26	2.08	1.87	1.86	1.82	1.66	1.65	1.65	1.65		1.65	1.65	1.65	1.65	1.65	1.65	
OPTION 1b DEPTH TO EXISTING	0.10	0.12	0.19	0.23	0.23	0.30	0.31	0.50	0.61	0.62	0.81	1.03	1.15	1.17	1.14	1.14	1.04	0.95	0.76	0.55	0.33	0.33	0.27	0.04	0.02										
OPTION 1b 20% AEP FLOOD LEVEL	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.49	1.59	1.60	1.76	1.96	2.06	2.08	2.08	2.08	2.08	2.07	1.99	1.81	1.60	1.59	1.55	1.39	1.38										
OPTION 1c DEPTH TO EXISTING	0.10	0.12	0.19	0.23	0.229	0.398	0.550	0.753		0.869	1.079	1.303	1.424	1.435	1.408	1.396	1.306	1.222	1.027	0.822	0.601	0.595	0.538	0.267	0.181			0.008	0.004						
OPTION 1c 20% AEP FLOOD LEVEL	1.38	1.38	1.38	1.38	1.380	1.473	1.590	1.750		1.846	2.033	2.229	2.333	2.350	2.350	2.350	2.350	2.343	2.260	2.085	1.866	1.866	1.818	1.603	1.528			1.423	1.433						

SCALE HZ 1:500, VT 1:25

ROAD CENTRELINE LONGITUDINAL SECTION
(BRIDGE OPTIONS)

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGN	CHECK	APPROVED
A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG
C	OPTION 1D PROVIDED AS PER COUNCIL COMMENTS	07/05/25	DM	IR	JM	CG

SCALES:
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Full Size 1:500 ; Half Size 1:1000
Scale (m)
0 0.25 0.5 1.0 1.5
Full Size 1:25 ; Half Size 1:50
Scale (m)
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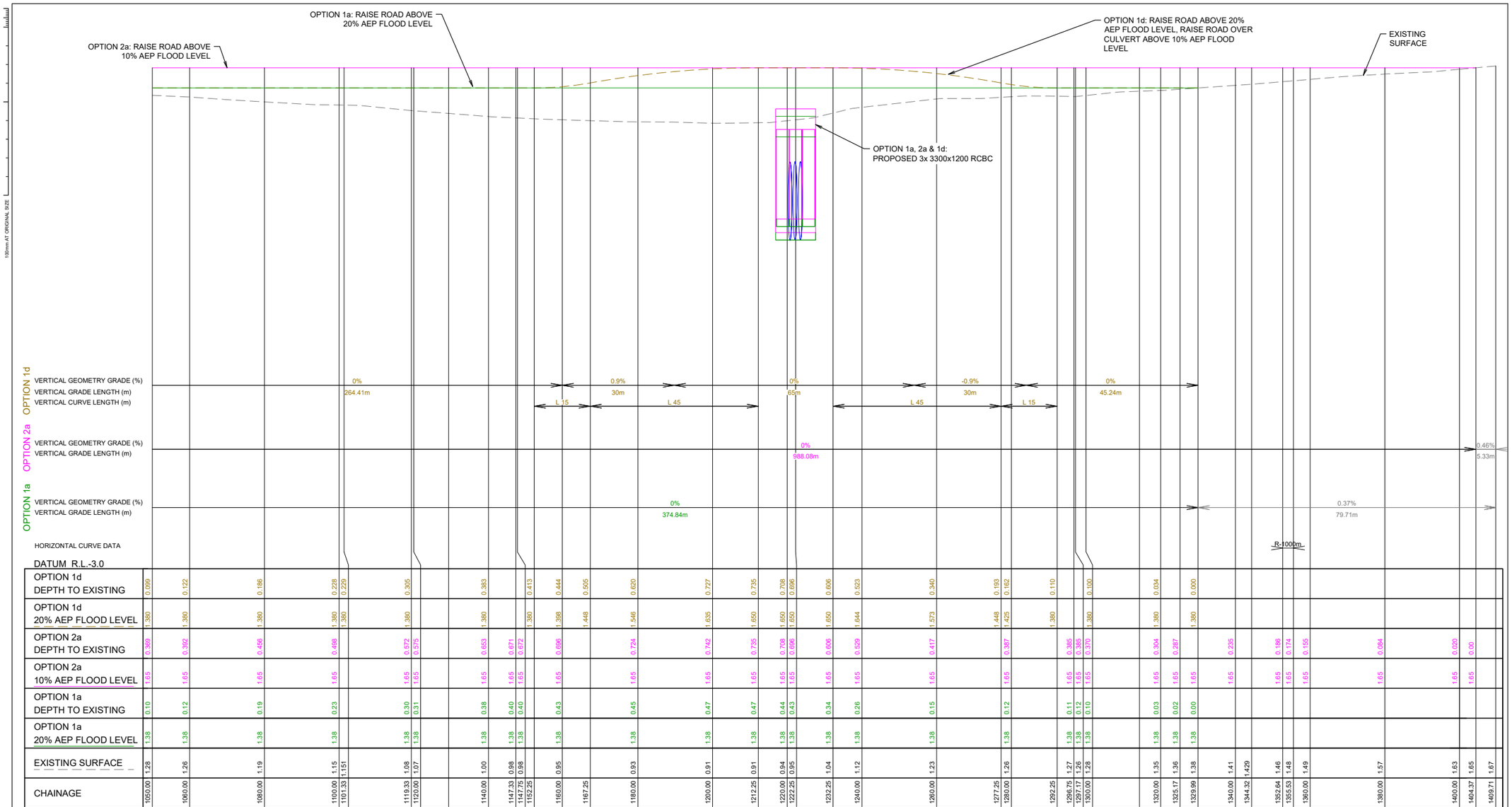
CLIENT: BALLINA SHIRE COUNCIL
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: ROAD LONGITUDINAL SECTION SHEET 4 OF 5

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0203	C

CAD FILE: C:\12DS\DATA\PLANITSYNJ8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0200 - ROAD LS.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:32:54 AM

5.1 Ross Lane Betterment



CHAINAGE	1050.00	1060.00	1080.00	1100.00	1101.33	1119.33	1120.00	1140.00	1147.33	1147.75	1152.25	1160.00	1167.25	1180.00	1200.00	1212.25	1220.00	1222.25	1232.25	1240.00	1260.00	1277.25	1280.00	1292.25	1298.75	1297.17	1300.00	1320.00	1325.17	1329.99	1340.00	1344.32	1352.64	1355.53	1360.00	1380.00	1400.00	1404.37	1409.71
EXISTING SURFACE	1.28	1.26	1.19	1.15	1.151	1.08	1.07	1.00	1.00	0.98	0.98	0.95		0.93	0.91	0.91	0.94	0.95	1.04	1.12	1.23	1.26	1.26		1.27	1.26	1.28	1.35	1.36	1.38	1.41	1.429	1.46	1.48	1.49	1.57	1.63	1.65	1.67
OPTION 1a 20% AEP FLOOD LEVEL	1.38	1.38	1.38	1.38		1.38	1.38	1.38	1.38	1.38	1.38	1.38		1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38		1.38	1.38	1.38	1.38	1.38	1.38										
OPTION 1a DEPTH TO EXISTING	0.10	0.12	0.19	0.23		0.30	0.31	0.38	0.40	0.40		0.43		0.45	0.47	0.47	0.44	0.43	0.34	0.26	0.15	0.12	0.12		0.11	0.12	0.10	0.03	0.02	0.00										
OPTION 2a 10% AEP FLOOD LEVEL	1.65	1.65	1.65	1.65		1.65	1.65	1.65	1.65	1.65		1.65		1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65		1.65	1.65	1.65	1.65	1.65	1.65	1.65		1.65			1.65		1.65		
OPTION 2a DEPTH TO EXISTING	0.369	0.392	0.456	0.498		0.572	0.575	0.653	0.671	0.672		0.686		0.724	0.742	0.735	0.708	0.696	0.606	0.529	0.417	0.387	0.387		0.385	0.385	0.370	0.304	0.287		0.235		0.186	0.174	0.155	0.084		0.020	0.00	
OPTION 1d 20% AEP FLOOD LEVEL	1.380	1.380	1.380	1.380	1.380	1.380		1.380		1.380		1.398	1.448	1.546	1.635	1.650	1.650	1.650	1.650	1.644	1.573	1.448	1.425	1.380			1.380	1.380	1.380	1.380										
OPTION 1d DEPTH TO EXISTING	0.099	0.122	0.186	0.228	0.229	0.305		0.383		0.413		0.444	0.505	0.620	0.727	0.735	0.708	0.696	0.606	0.523	0.340	0.193	0.182	0.110			0.100	0.034		0.000										

SCALE HZ 1:500, VT 1:25

ROAD CENTRELINE LONGITUDINAL SECTION
(CULVERT OPTIONS)

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REV	DESCRIPTION	DATE	DRAWN	DESIGN	CHECK	APPROVED
C	OPTION 1D PROVIDED AS PER COUNCIL COMMENTS	07/05/25	DM	IR	JM	CG

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Scale (m)
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Full Size 1:25 ; Half Size 1:50
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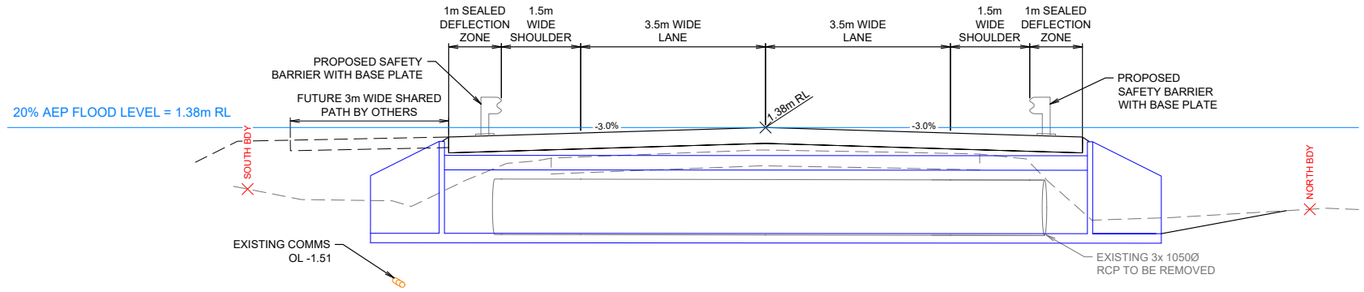
CLIENT: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: ROAD LONGITUDINAL SECTION
SHEET 5 OF 5

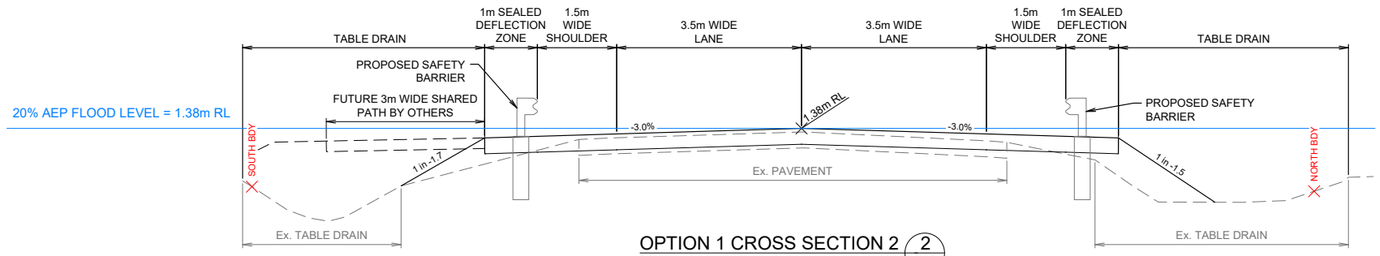
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

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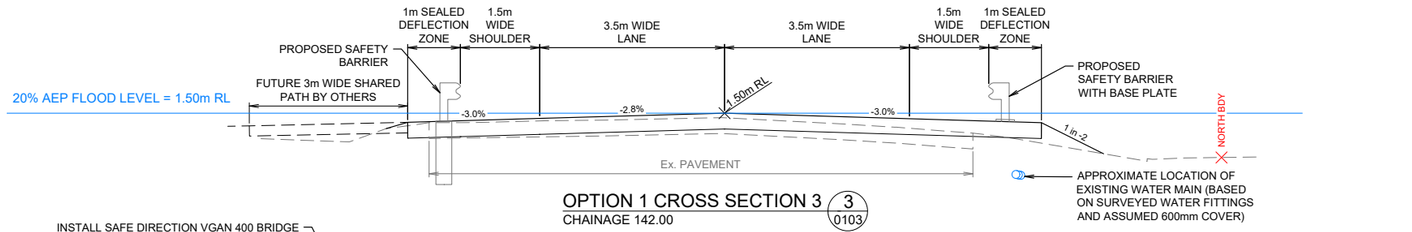
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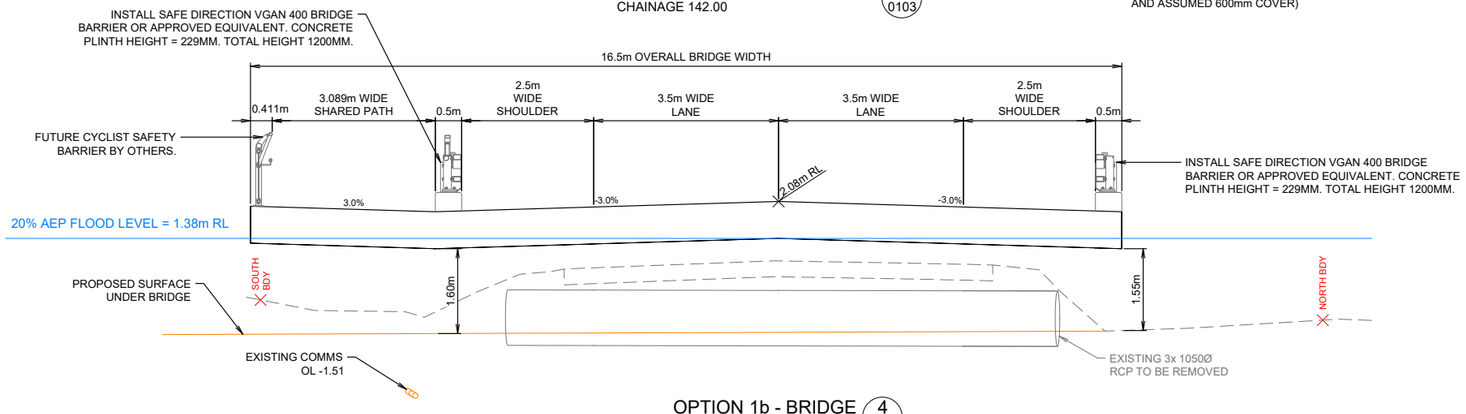
OPTION 1a - CULVERT UNDER ROAD (1 / 0100)
CHAINAGE 1222.25



OPTION 1 CROSS SECTION 2 (2 / 0102)
CHAINAGE 1010.00



OPTION 1 CROSS SECTION 3 (3 / 0103)
CHAINAGE 142.00



OPTION 1b - BRIDGE (4 / 0110)
CHAINAGE 1222.25

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B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

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Scale (m)
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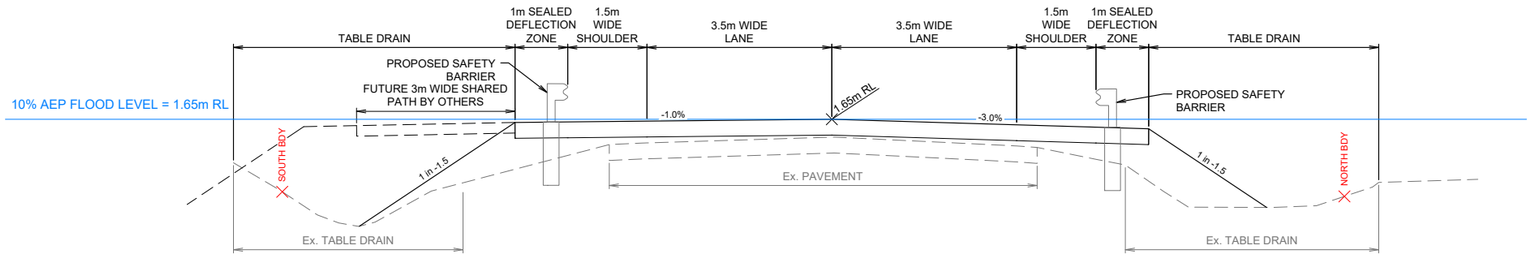
PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: ROAD TYPICAL CROSS-SECTIONS OPTION 1 20% AEP FLOOD EVENT

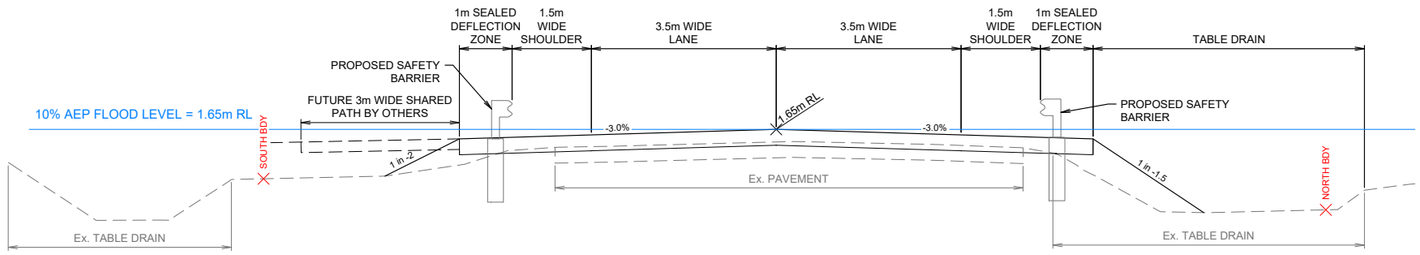
LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0210	B

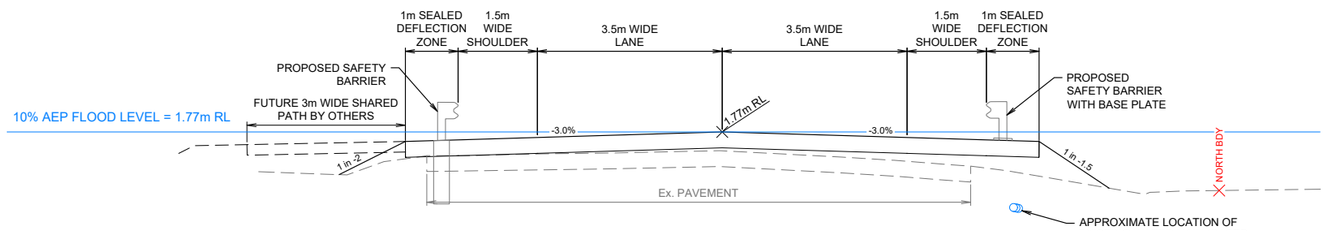
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OPTION 2 CROSS SECTION 2 (2)
CHAINAGE 1010.00 (0152)



OPTION 2 CROSS SECTION 3 (3)
CHAINAGE 650.00 (0155)



OPTION 2 CROSS SECTION 4 (4)
CHAINAGE 142.00 (0157)

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B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

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Full Size 1:50 ; Half Size 1:100
Scale (m)
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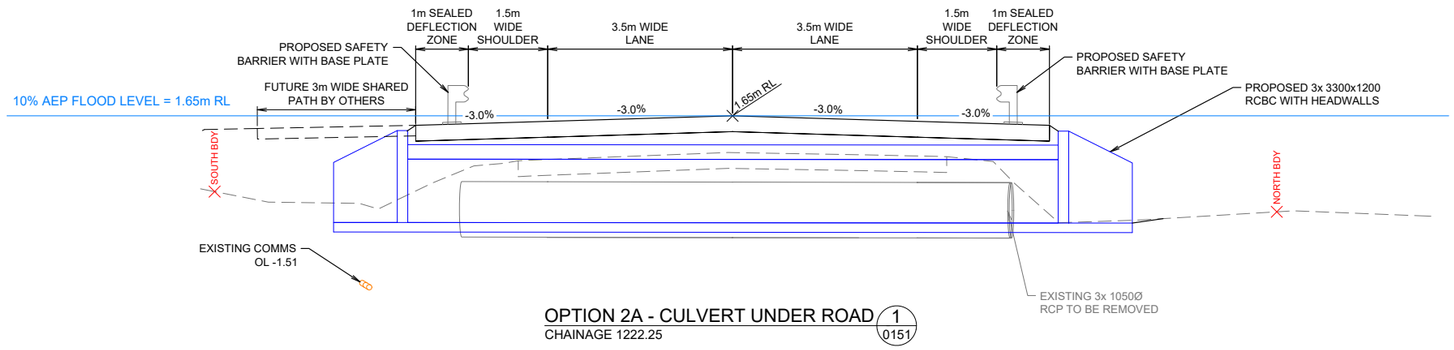
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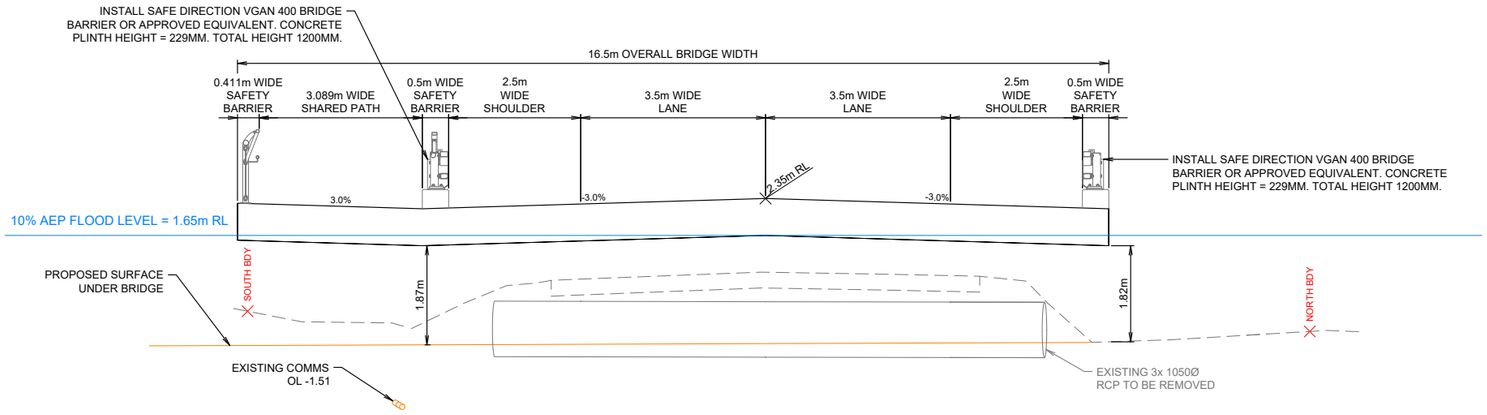
PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: ROAD TYPICAL CROSS-SECTIONS OPTION 2 SHEET 1 OF 2 10% AEP FLOOD EVENT

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0211	B

CAD FILE: C:\12DS\DATA\PLANITSYNJ\8274 - PRELIM DESIGN - ROSS LANE, KINVARA_2193\5. ENGINEERING\3. DRAFTING\0210 - ROAD CROSS-SECTION.DWG PLOTTED BY: ISAAC.RUFF PLOT DATE: 7/05/2025 9:30:50 AM



OPTION 2A - CULVERT UNDER ROAD (1/0151)
CHAINAGE 1222.25



OPTION 2B - BRIDGE (5/0161)
CHAINAGE 1222.25

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A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES: 0 0.5 1 2 3
Full Size 1:50 ; Half Size 1:100
Scale (m)
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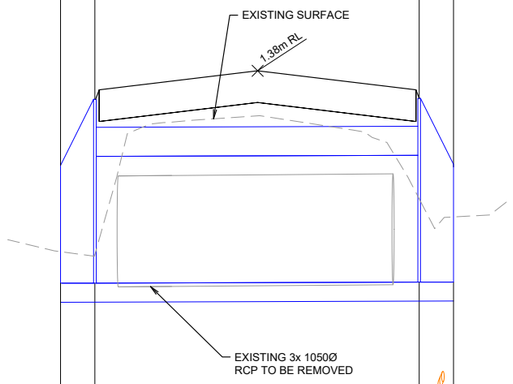
PROJECT: ROAD DESIGN ROSS LANE KINVARA
DRAWING TITLE: ROAD TYPICAL CROSS-SECTIONS
OPTION 2 SHEET 2 OF 2
10% AEP FLOOD EVENT

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
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100mm AT ORIGINAL SIZE

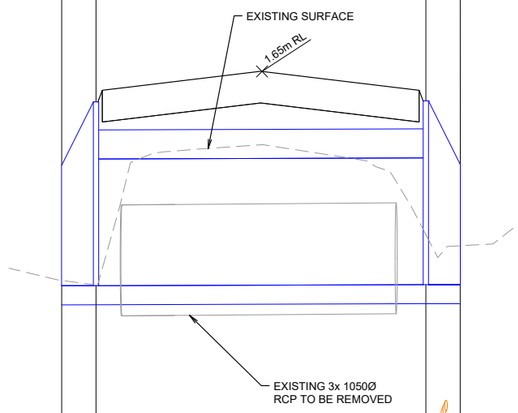
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STRUCTURE NAME	HW 2		HW 1	
STRUCTURE DESCRIPTION	HEADWALL		HEADWALL	



PIPE SIZE (mm)	HEADWALL	(3x)3300x1200 BC		HEADWALL
PIPE CLASS				
PIPE GRADE (%)		0.06%		
PIPE SLOPE (1 in X)		1714.20		
DATUM RL	-4.0			
DEPTH TO INVERT	0.855 / 0.855 / 1.740 / 1.740		0.620 / 0.620 / 0.873	
INVERT LEVEL	-0.630 / -0.630 / -0.630 / -0.630		-0.620 / -0.620 / -0.620	
FINISHED SURFACE LEVEL	0.225 / 1.110		0.000 / 0.253	
CHAINAGE	0.000 / 1.300		13.582 / 14.882	

OPTION 1 CULVERT

SETOUT CO-ORDINATES	E554088.126 N8815446.944	E554087.919 N8815445.661	E554085.157 N8815428.511	E554084.950 N8815427.227
STRUCTURE NAME	HW 2		HW 1	
STRUCTURE DESCRIPTION	HEADWALL		HEADWALL	



PIPE SIZE (mm)	HEADWALL	(3x)3300x1200 BC		HEADWALL
PIPE CLASS				
PIPE GRADE (%)		0.06%		
PIPE SLOPE (1 in X)		1737.10		
DATUM RL	-4.0			
DEPTH TO INVERT	1.200 / 1.200 / 1.740 / 1.740		1.740 / 1.740 / 1.200	
INVERT LEVEL	-0.380 / -0.380 / -0.380 / -0.380		-0.370 / -0.370 / -0.370	
FINISHED SURFACE LEVEL	0.820 / 1.360		1.370 / 0.830	
CHAINAGE	0.000 / 1.300		13.791 / 15.091	

OPTION 2 CULVERT

NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGN	CHECK	APPROVED
A	PRELIMINARY ISSUE	19/11/24	DM	JM	CG	CG
B	UPDATED AS PER COUNCIL COMMENTS	21/01/25	DM	JM	JM	CG

SCALES:
HORIZONTAL 0 1 2 4 6
Full Size 1:100 ; Half Size 1:200
Scale (m)
VERTICAL 0 0.25 0.5 1.0 1.5
Full Size 1:25 ; Half Size 1:50
Scale (m)
DO NOT SCALE FROM DRAWING

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APPROVED BY:
DATE:
THIS DRAWING MUST NOT BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED

PLANIT CONSULTING
SUITE 9A, 80-84 BALLINA STREET
PO BOX 161
LENNOX HEAD NSW 2478
PH: 02 6687 4666
ABN: 20 099 261 711
administration@planitconsulting.com.au

PLANIT CONSULTING

CLIENT: BALLINA SHIRE COUNCIL

LOCAL GOVERNMENT AUTHORITY: BALLINA SHIRE COUNCIL

PROJECT: ROAD DESIGN ROSS LANE KINVARA

DRAWING TITLE: CULVERT LONGITUDINAL SECTION

ORIGINAL SIZE:	PLANIT JOB No.:	DRAWING No.:	REV:
A1	J8274	0220	B

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Annex C Peak Flood Level Impacts (Critical Events)

© BMT 2025

5.1 Ross Lane Betterment

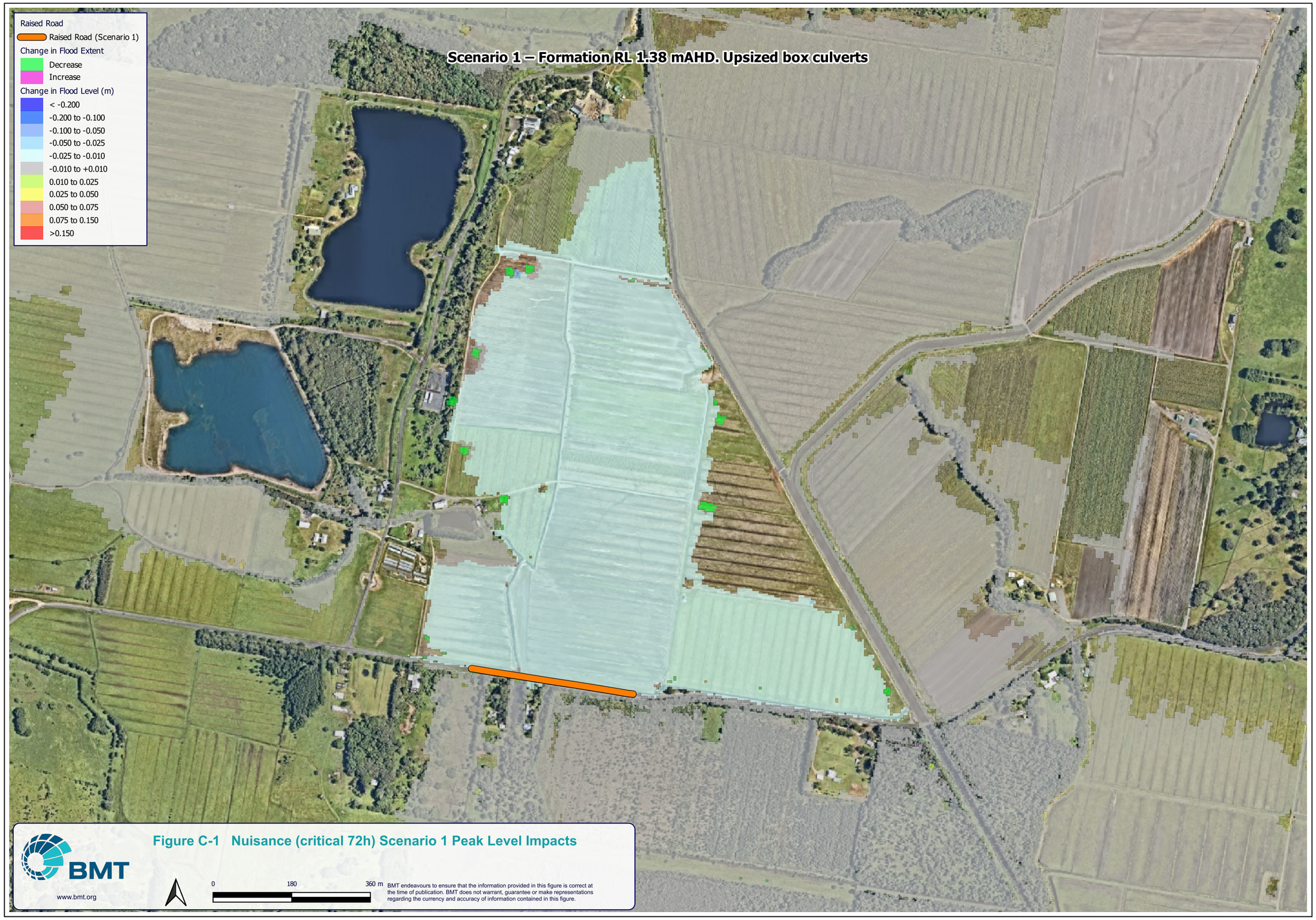


Figure C-1 Nuisance (critical 72h) Scenario 1 Peak Level Impacts

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5.1 Ross Lane Betterment

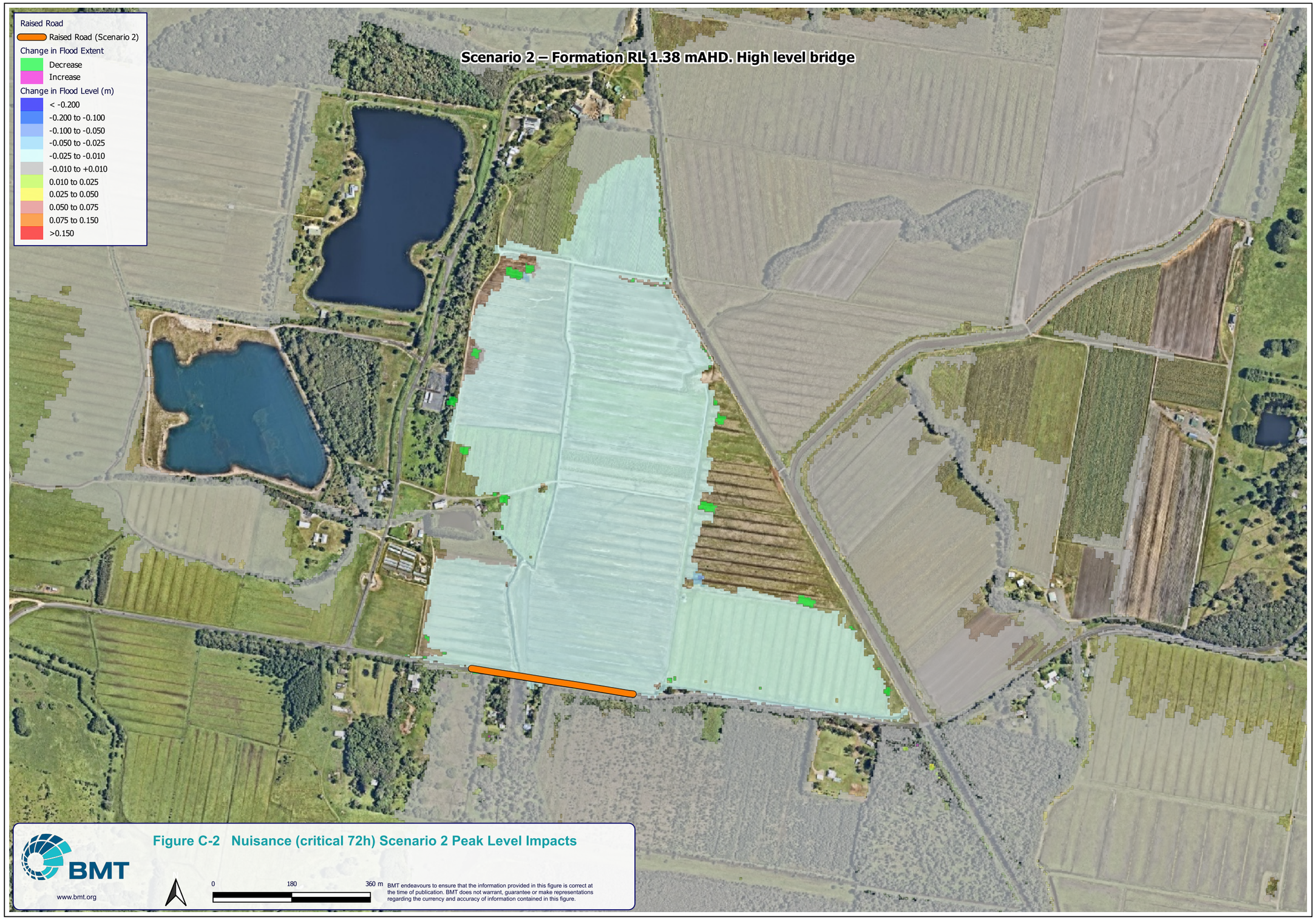


Figure C-2 Nuisance (critical 72h) Scenario 2 Peak Level Impacts

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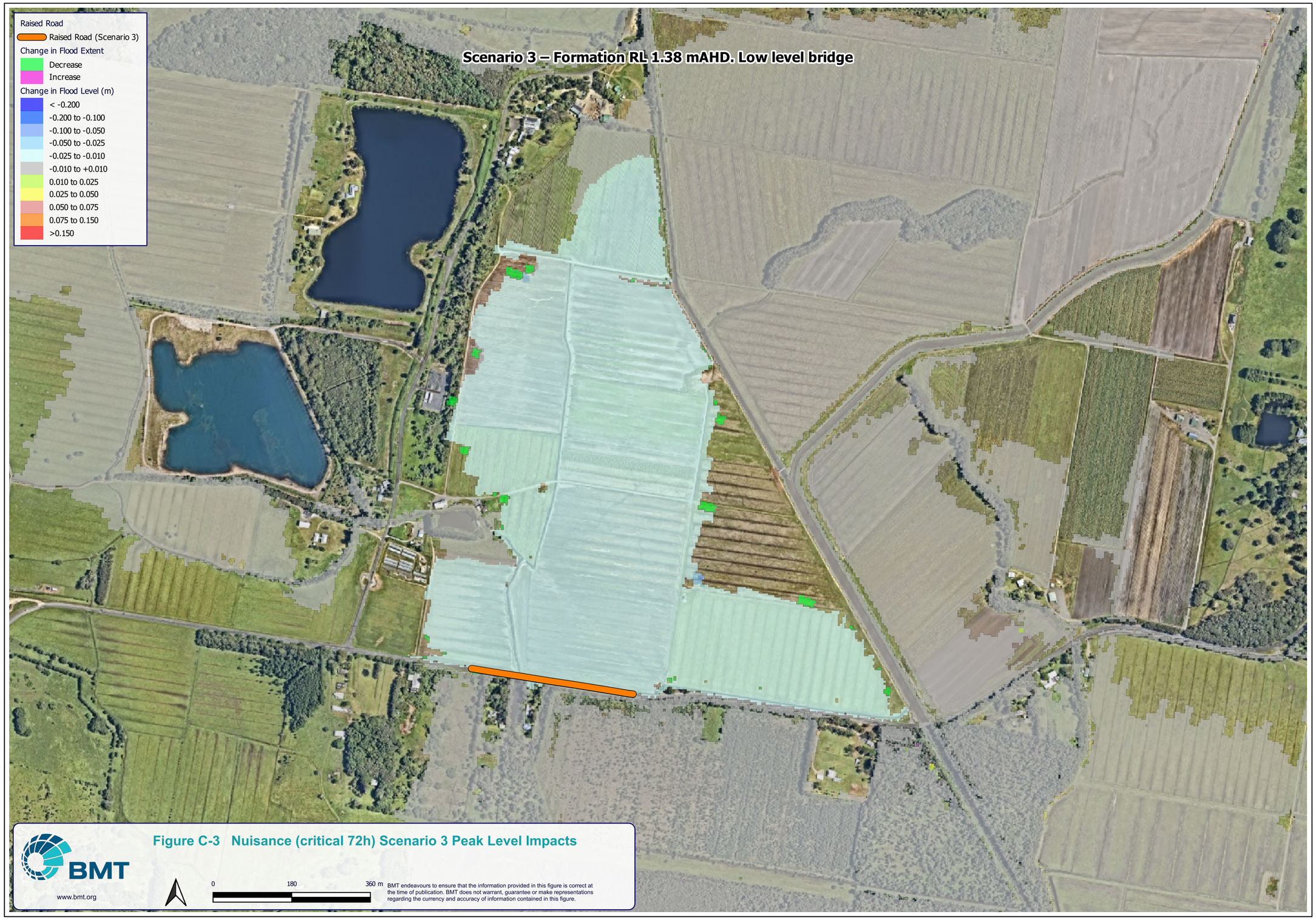


Figure C-3 Nuisance (critical 72h) Scenario 3 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure C-4 Nuisance (critical 72h) Scenario 4 Peak Level Impacts

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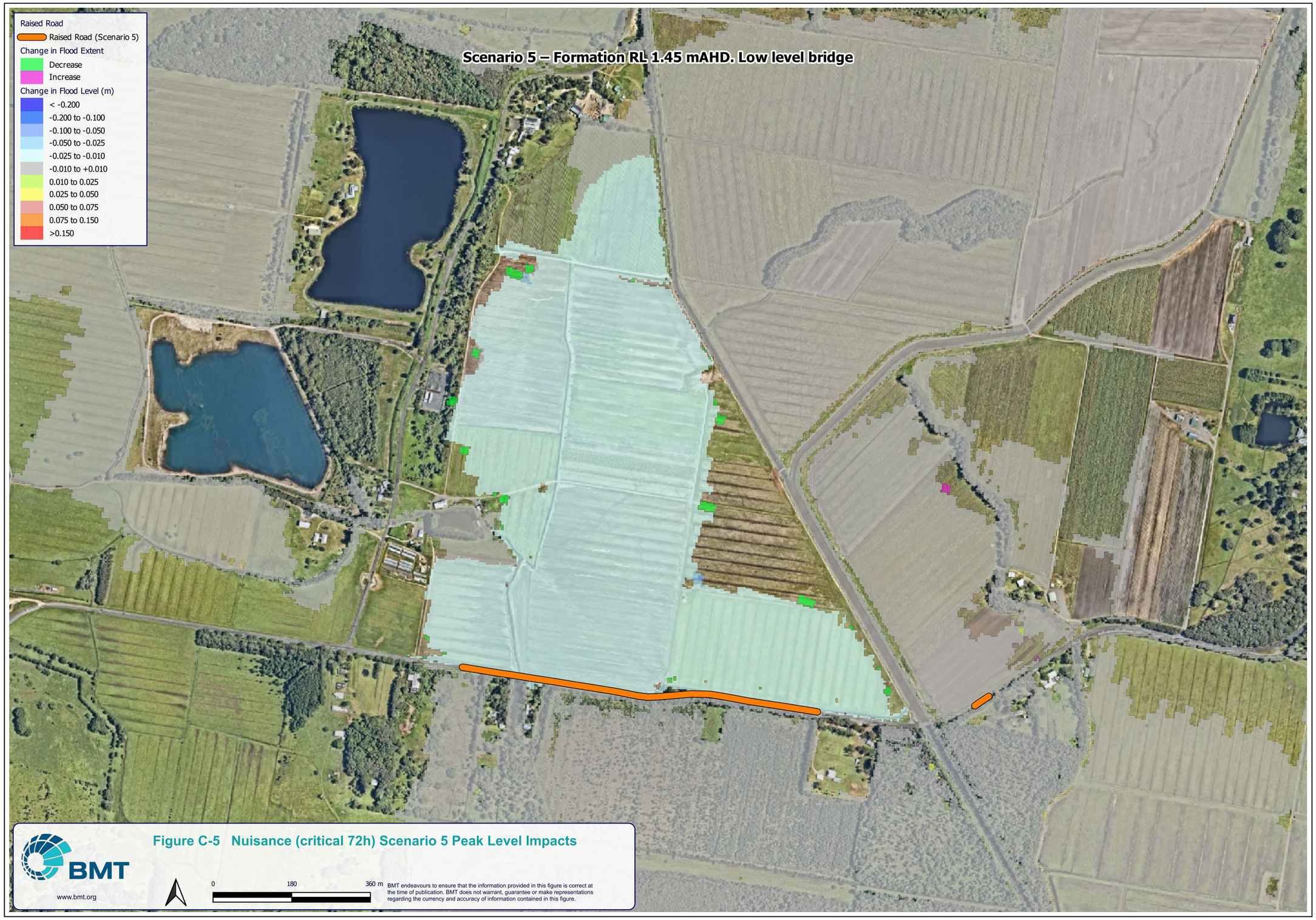


Figure C-5 Nuisance (critical 72h) Scenario 5 Peak Level Impacts

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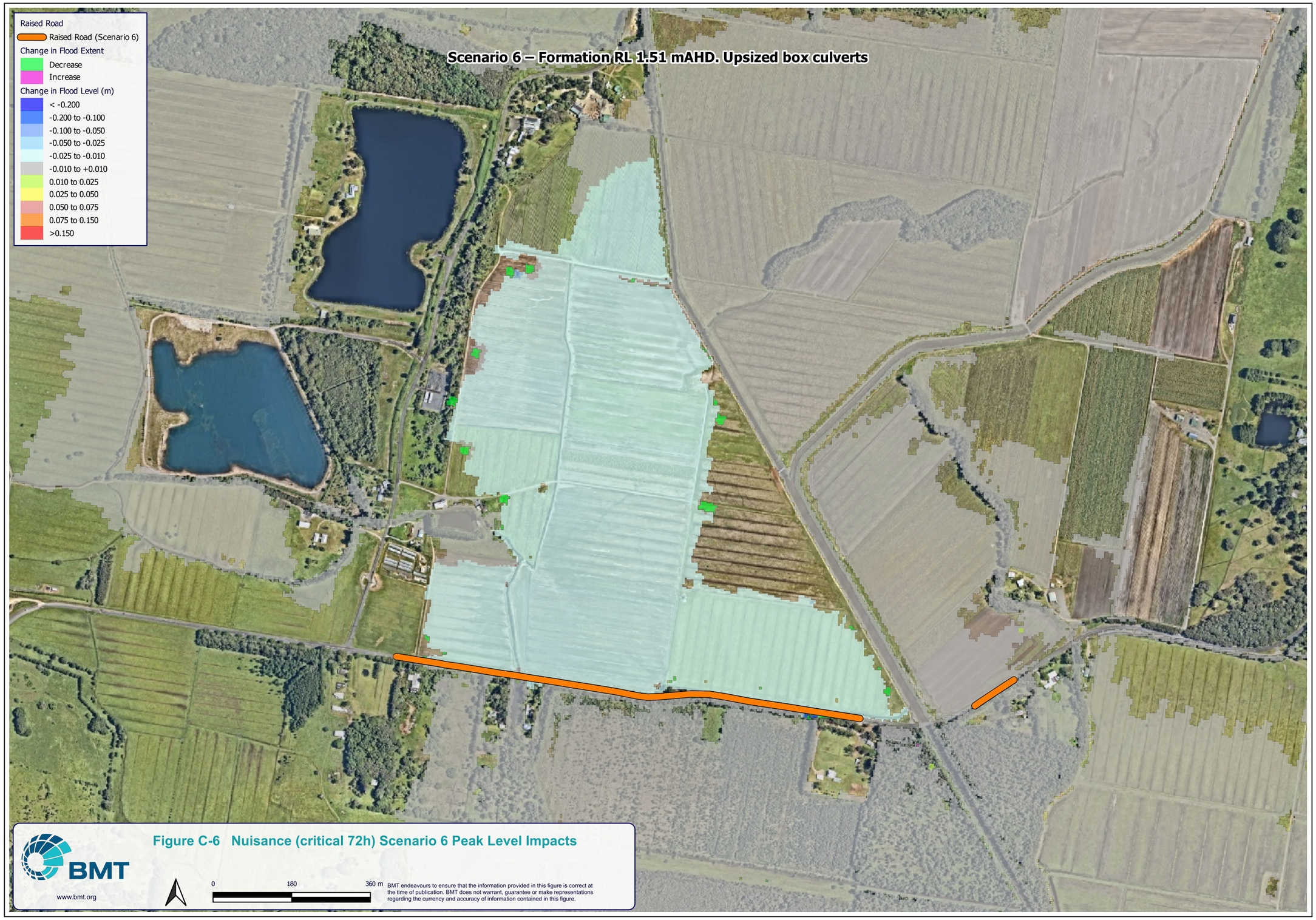


Figure C-6 Nuisance (critical 72h) Scenario 6 Peak Level Impacts

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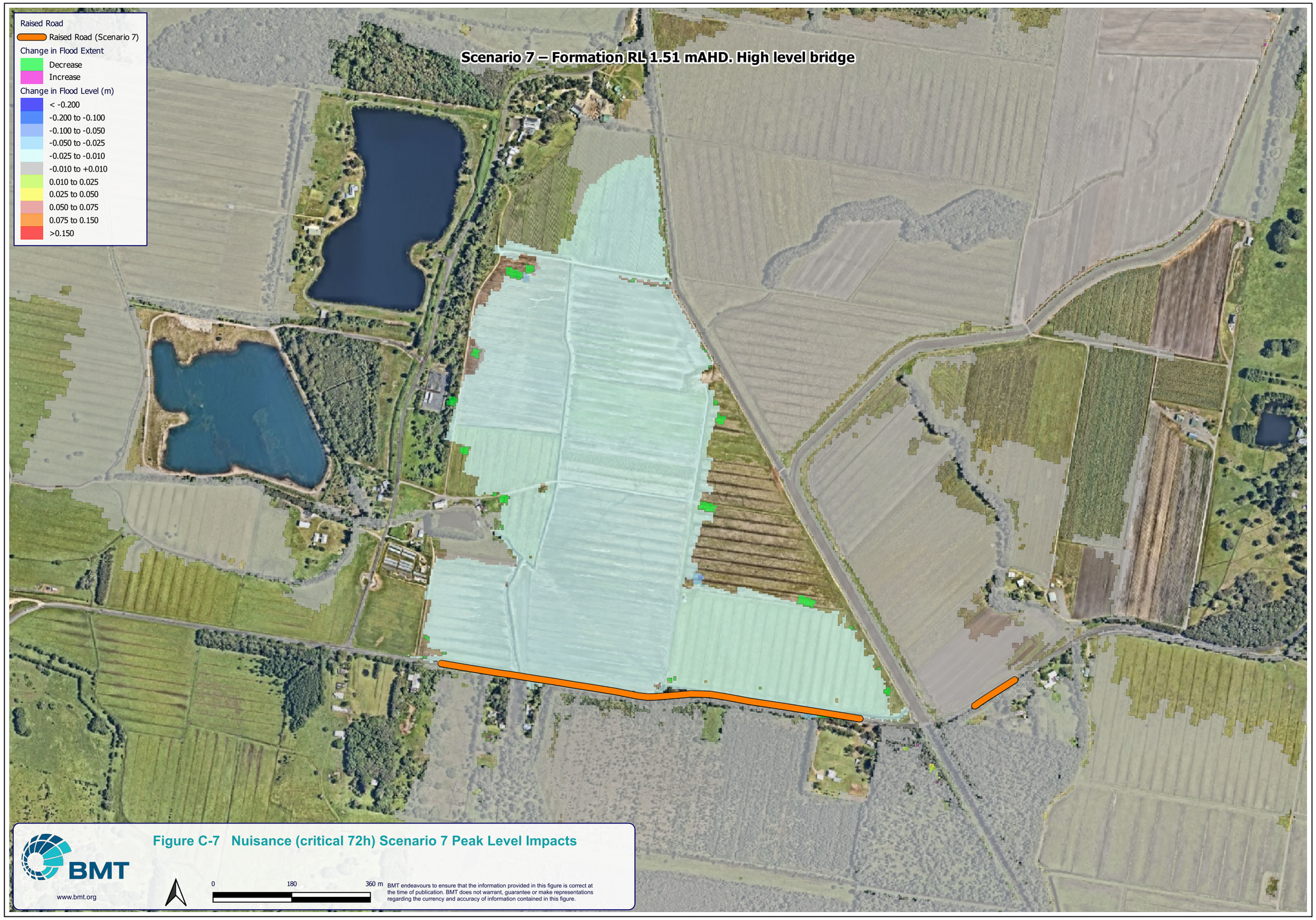


Figure C-7 Nuisance (critical 72h) Scenario 7 Peak Level Impacts

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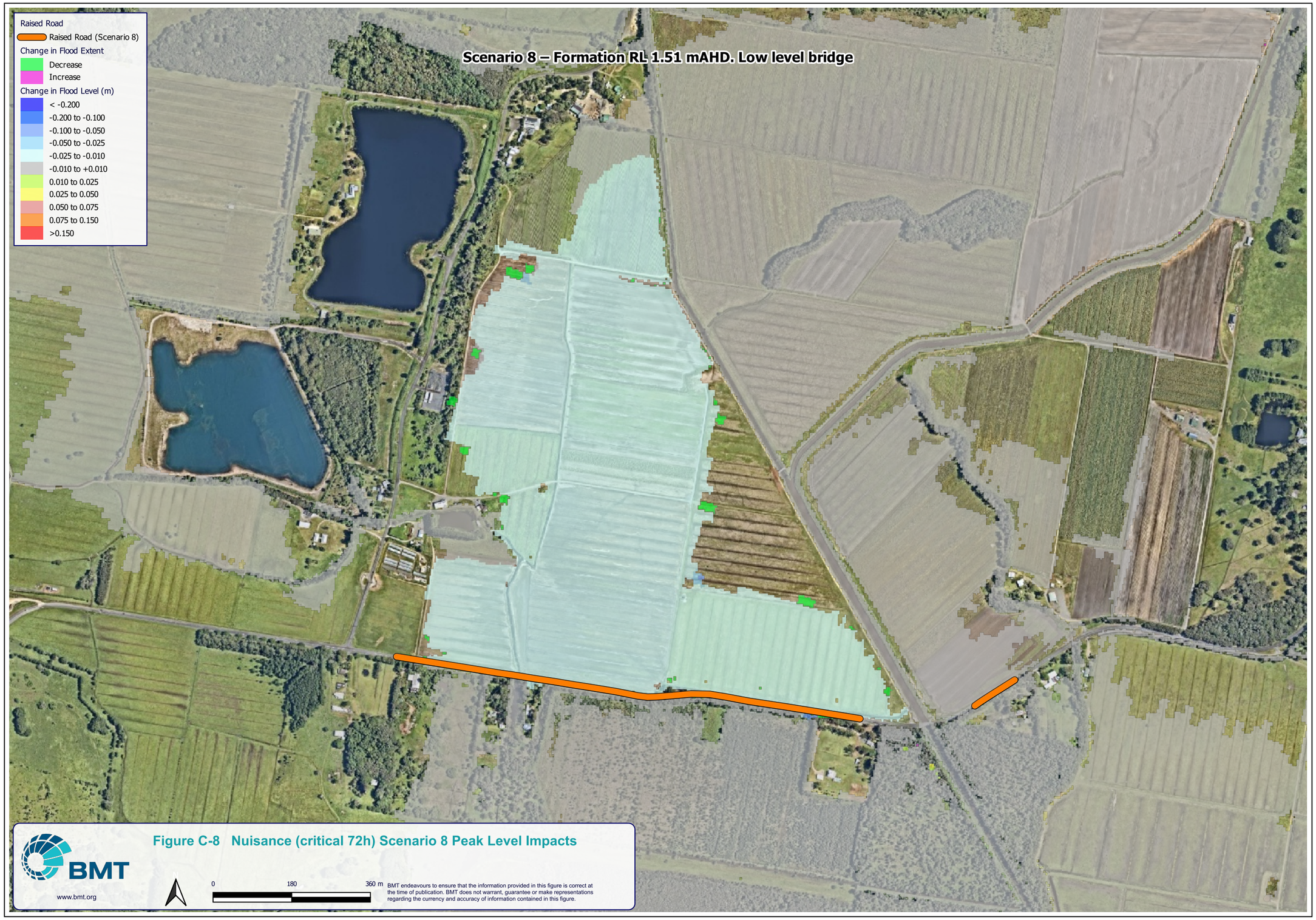


Figure C-8 Nuisance (critical 72h) Scenario 8 Peak Level Impacts

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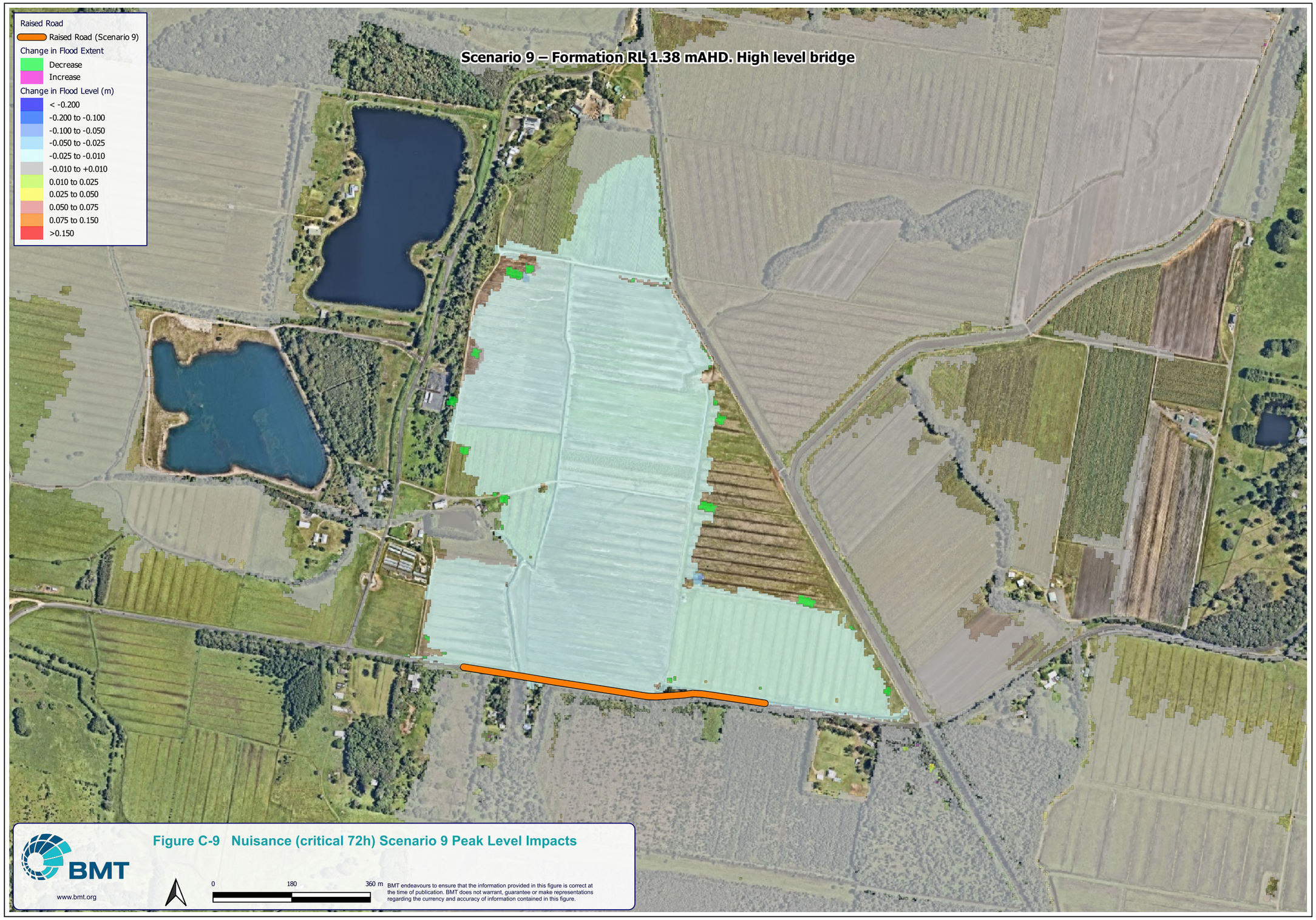


Figure C-9 Nuisance (critical 72h) Scenario 9 Peak Level Impacts

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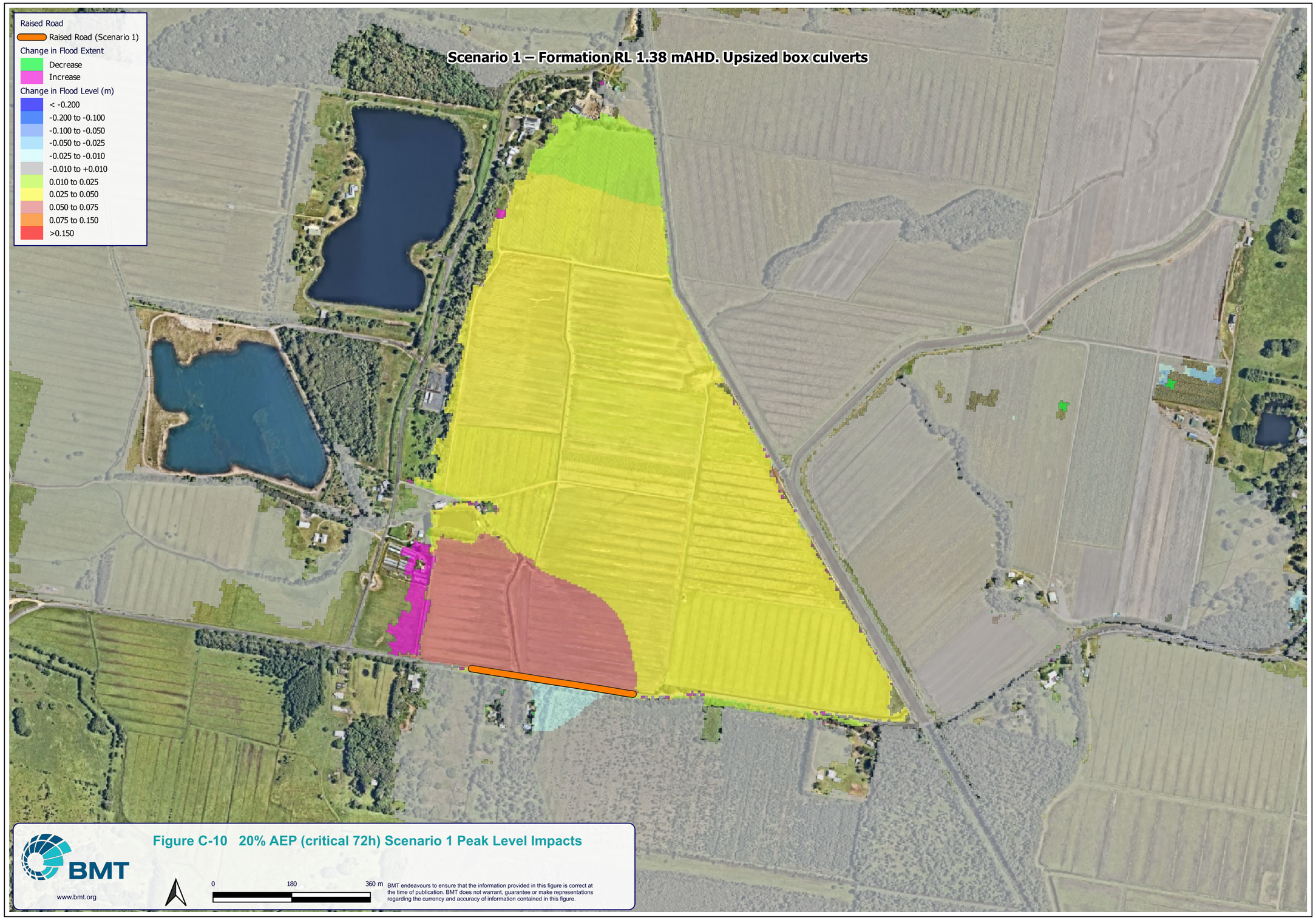


Figure C-10 20% AEP (critical 72h) Scenario 1 Peak Level Impacts

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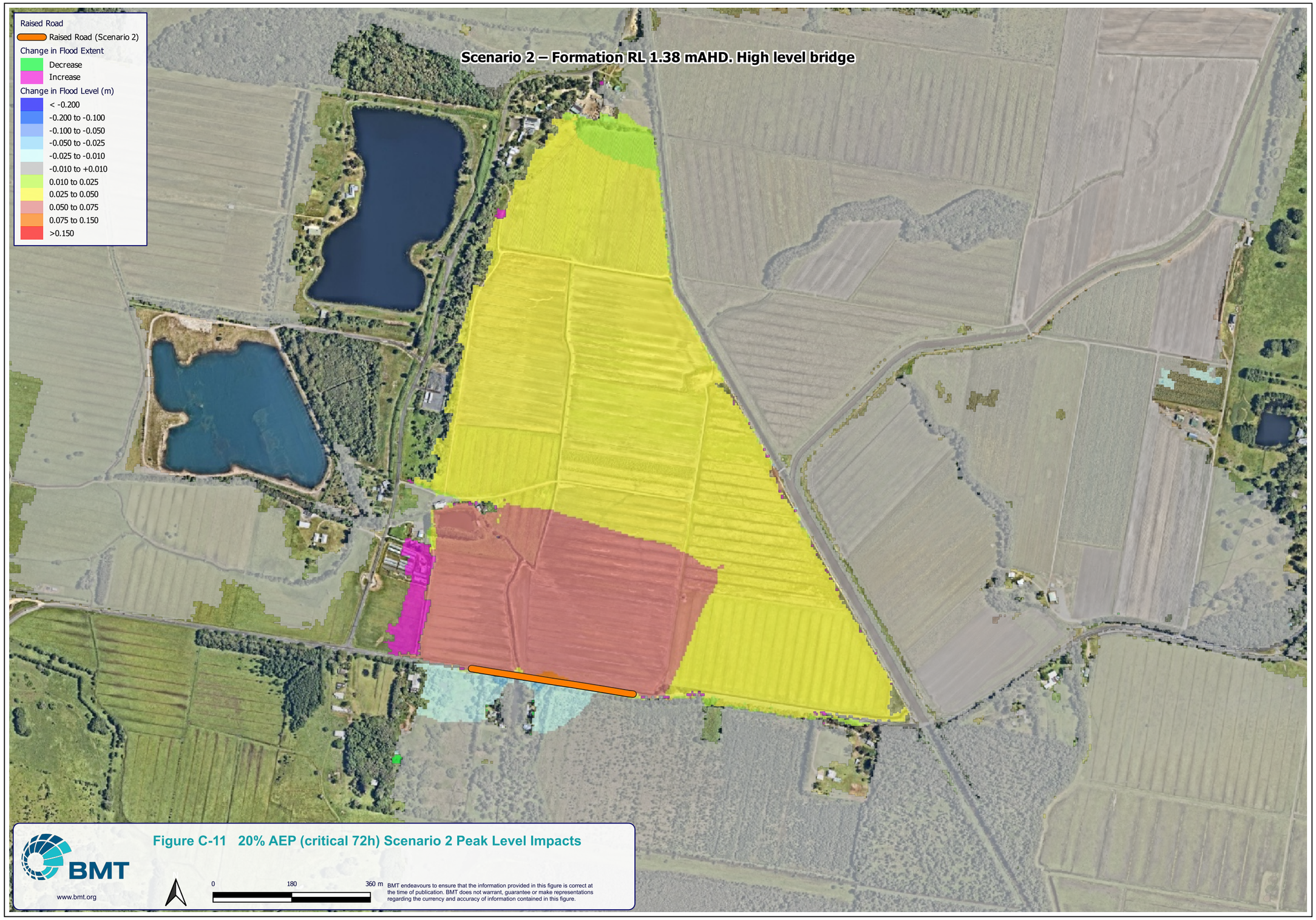


Figure C-11 20% AEP (critical 72h) Scenario 2 Peak Level Impacts

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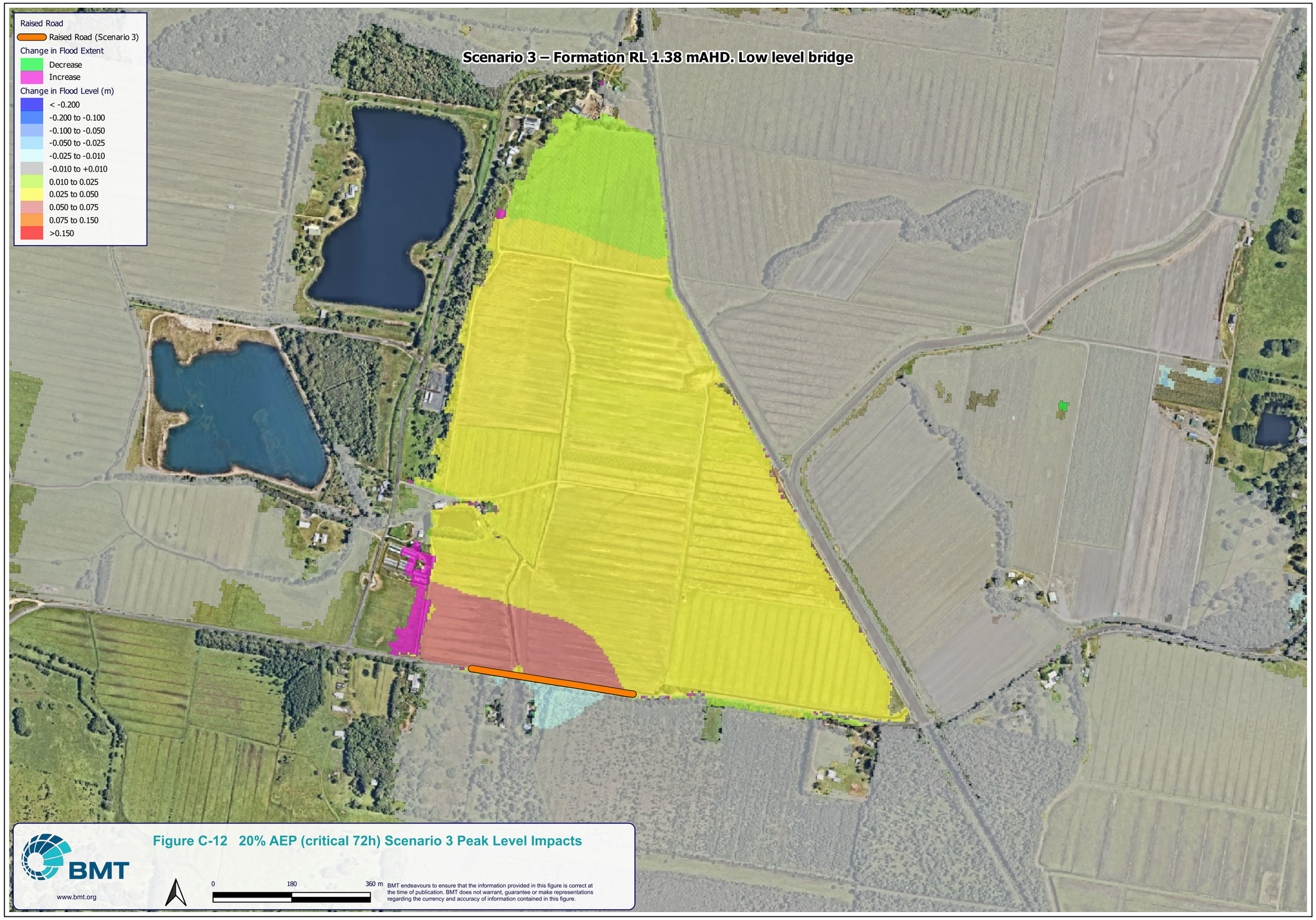


Figure C-12 20% AEP (critical 72h) Scenario 3 Peak Level Impacts

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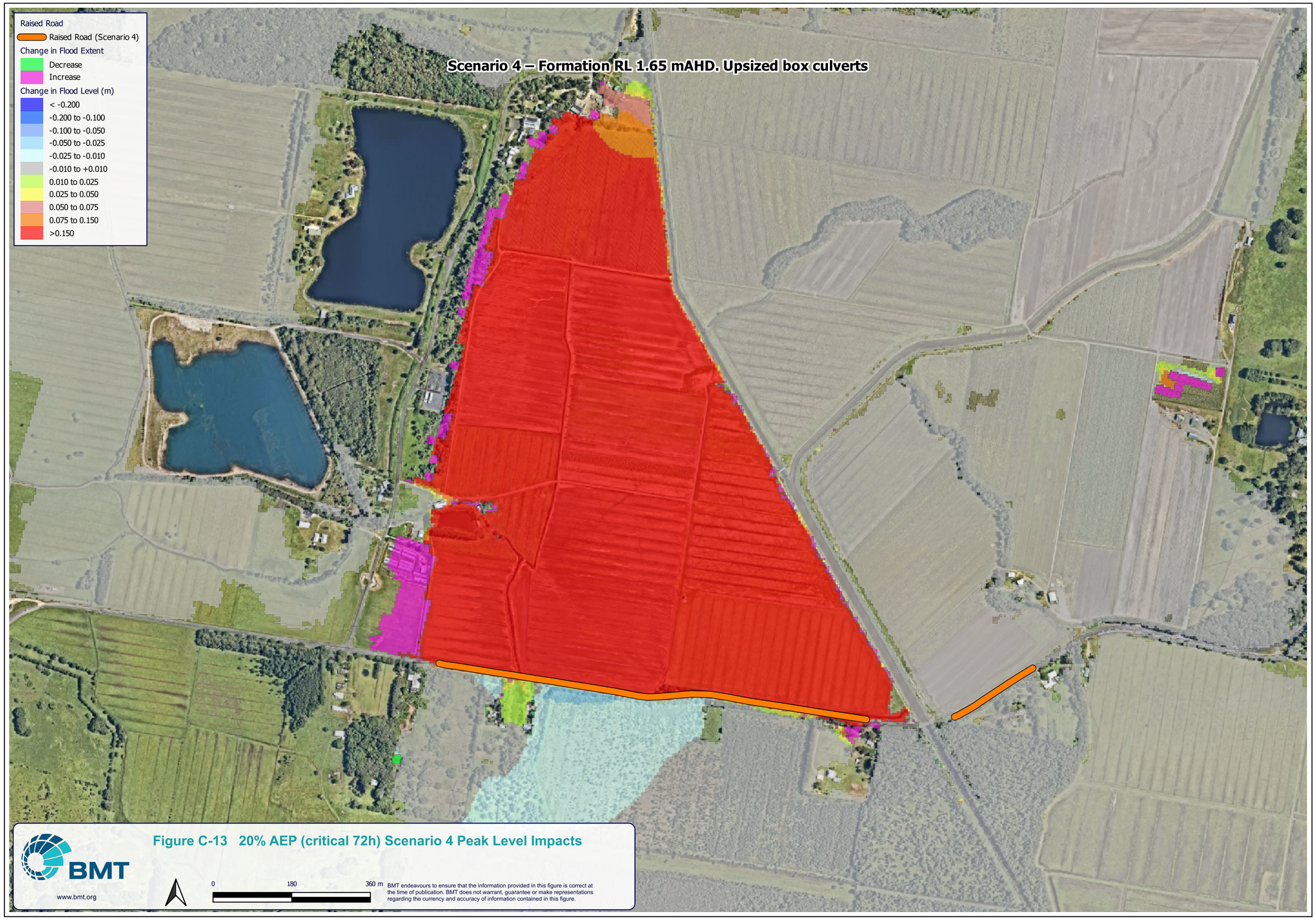


Figure C-13 20% AEP (critical 72h) Scenario 4 Peak Level Impacts

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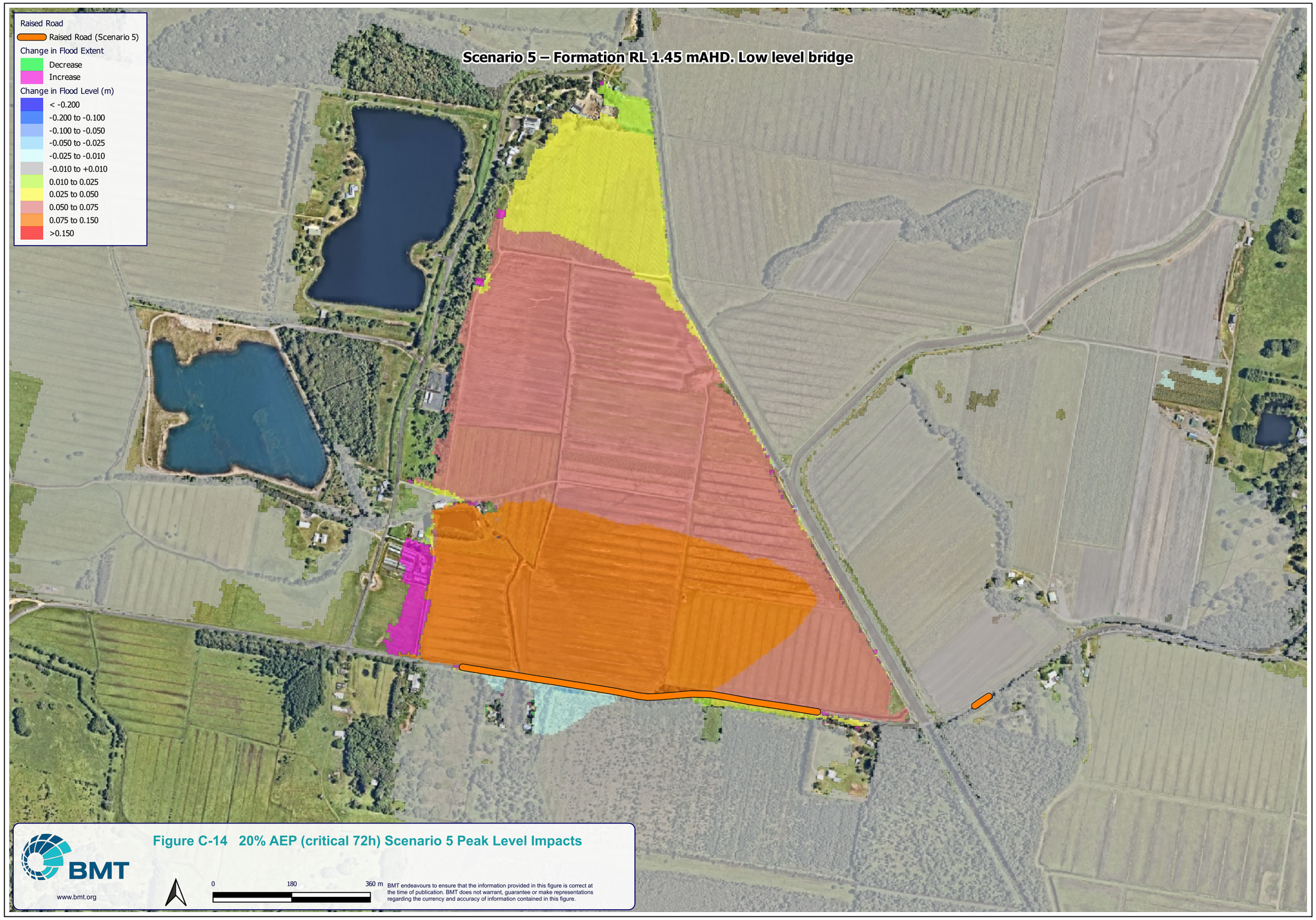


Figure C-14 20% AEP (critical 72h) Scenario 5 Peak Level Impacts

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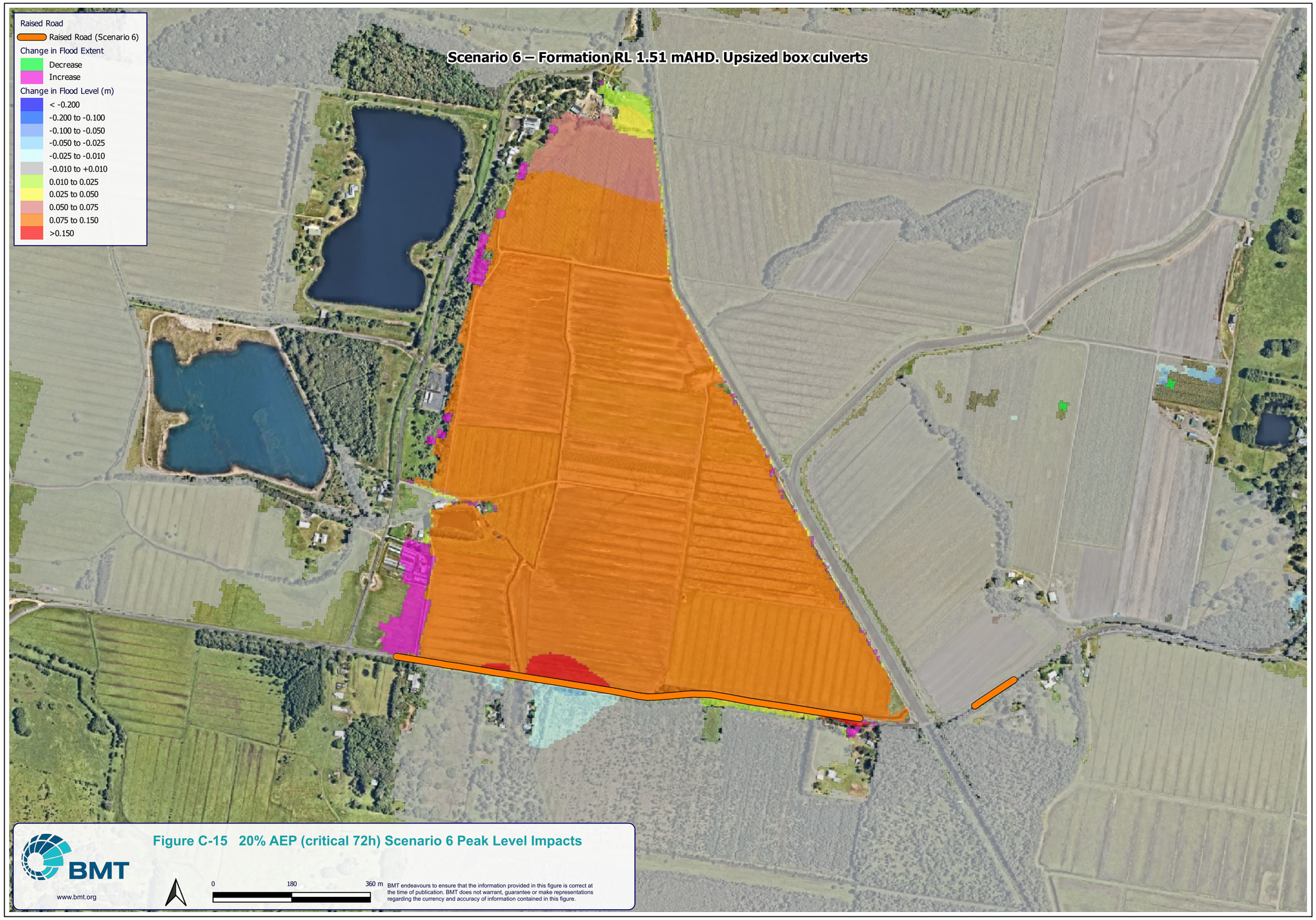


Figure C-15 20% AEP (critical 72h) Scenario 6 Peak Level Impacts

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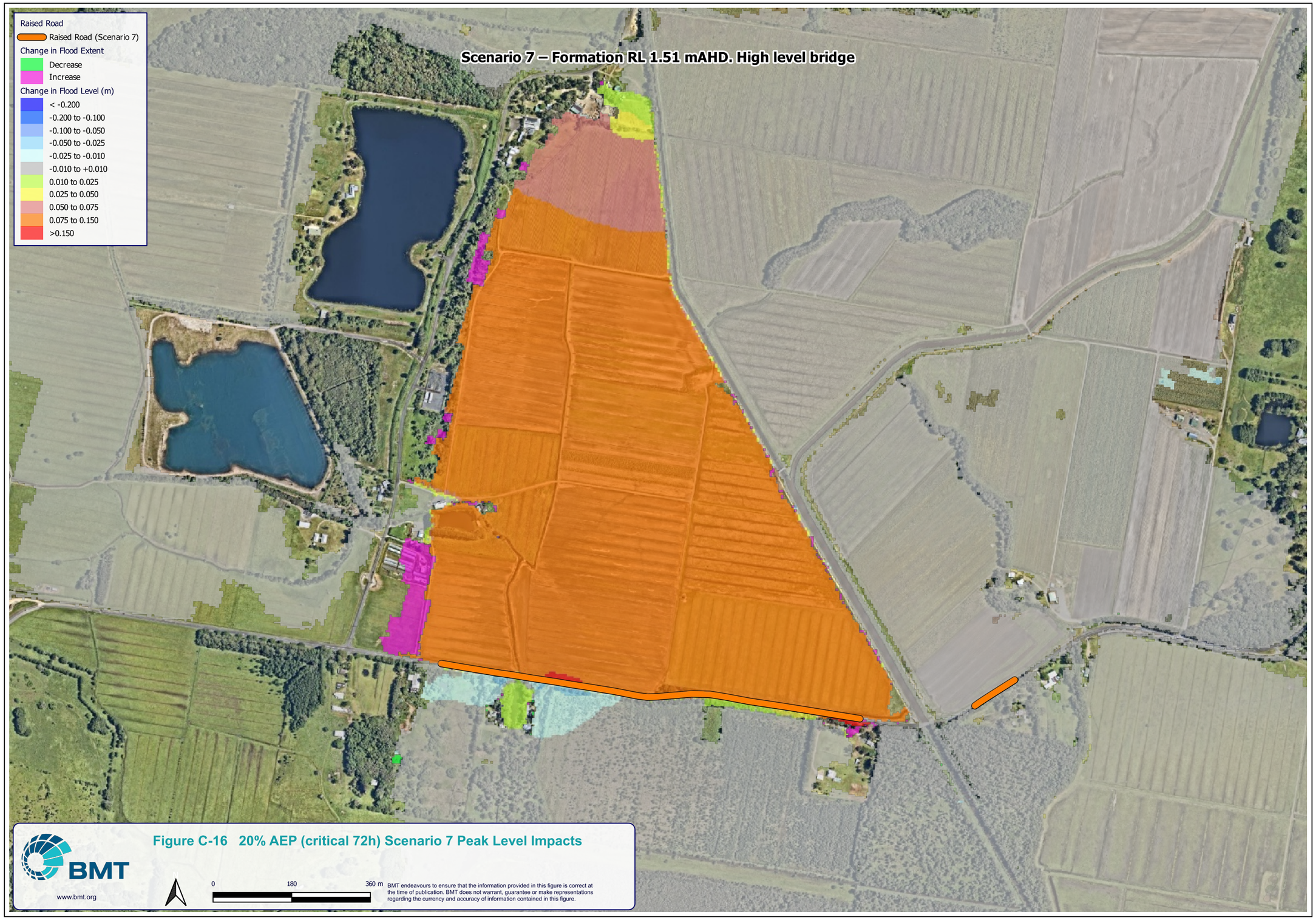


Figure C-16 20% AEP (critical 72h) Scenario 7 Peak Level Impacts

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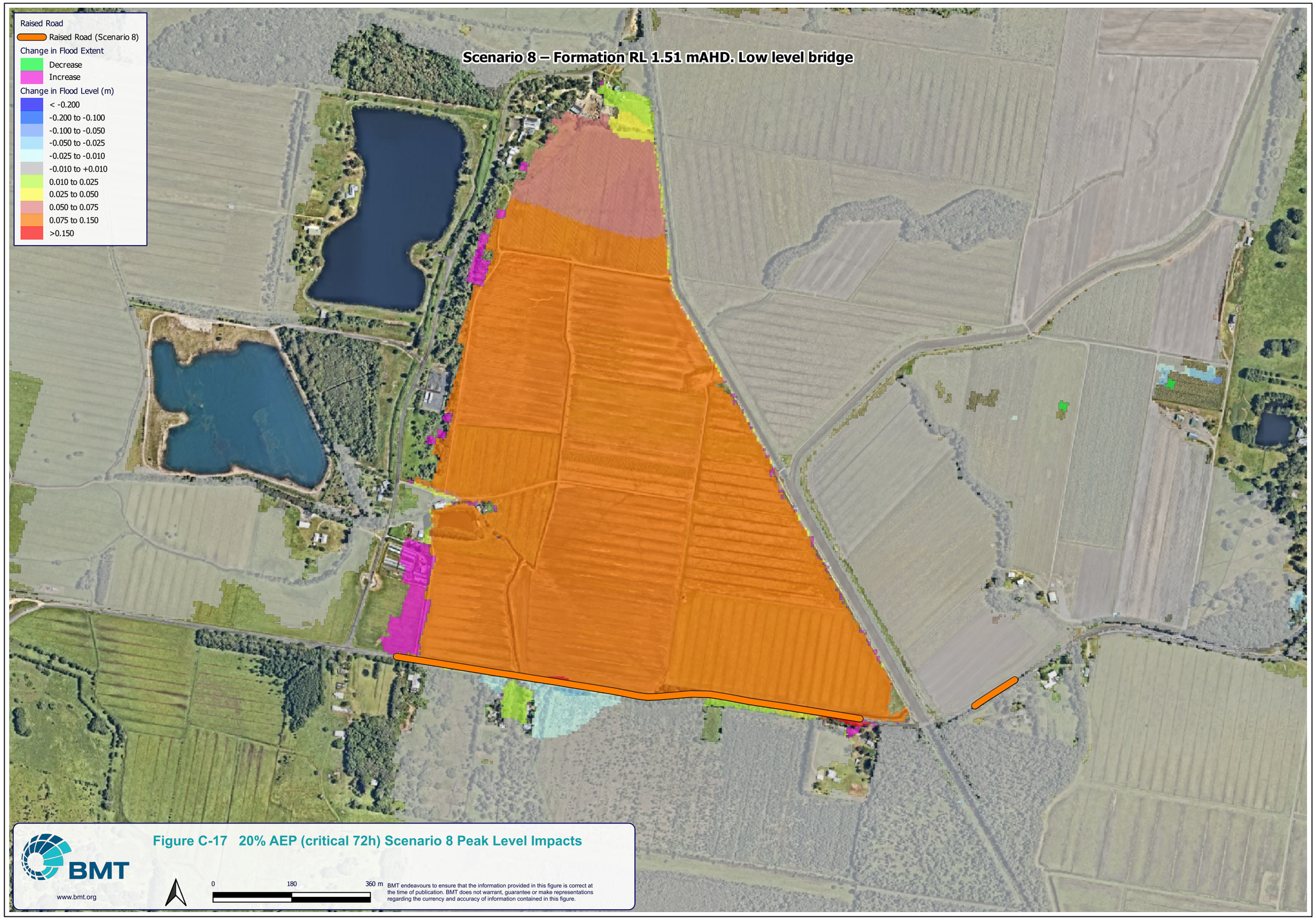


Figure C-17 20% AEP (critical 72h) Scenario 8 Peak Level Impacts

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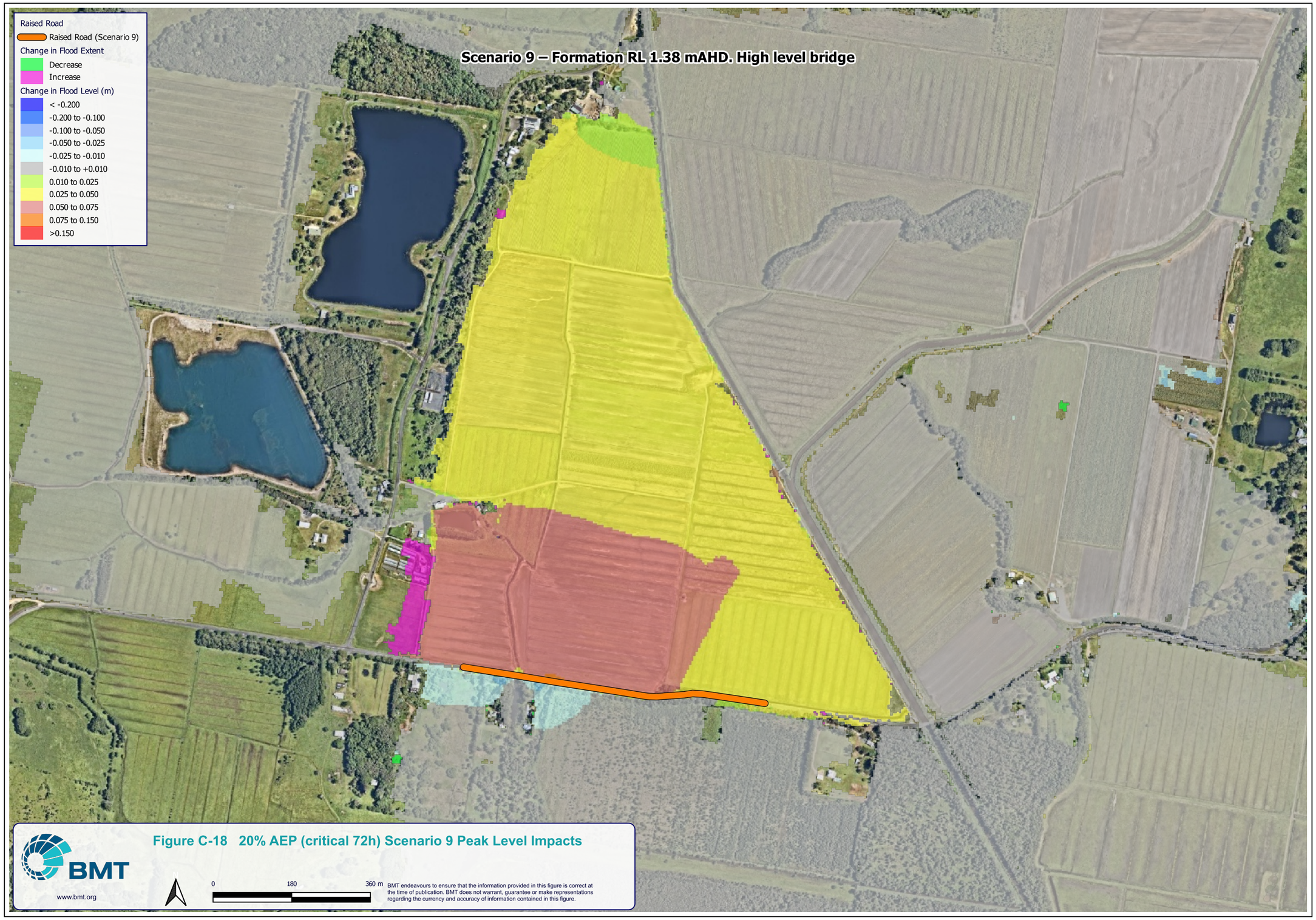


Figure C-18 20% AEP (critical 72h) Scenario 9 Peak Level Impacts

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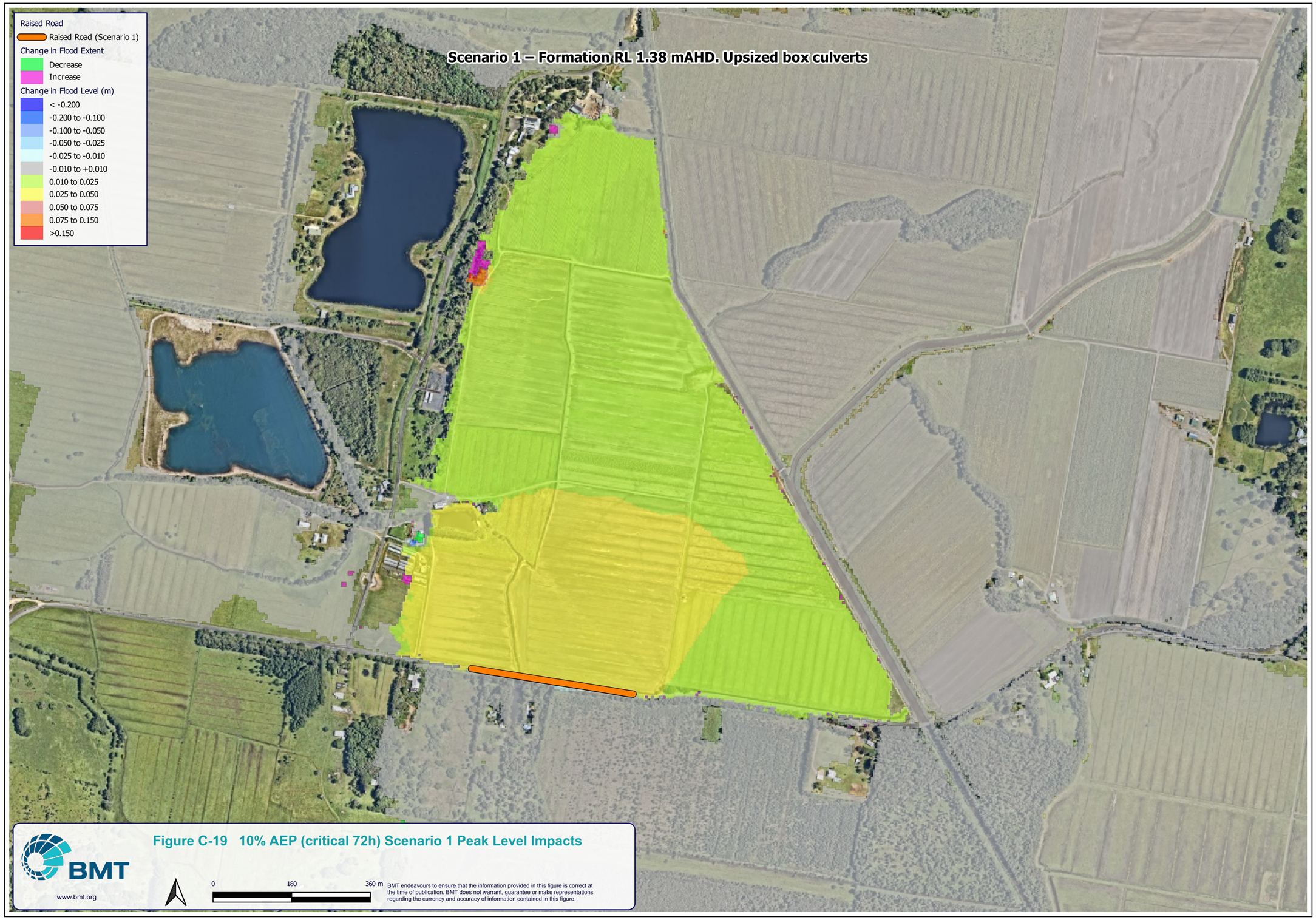


Figure C-19 10% AEP (critical 72h) Scenario 1 Peak Level Impacts

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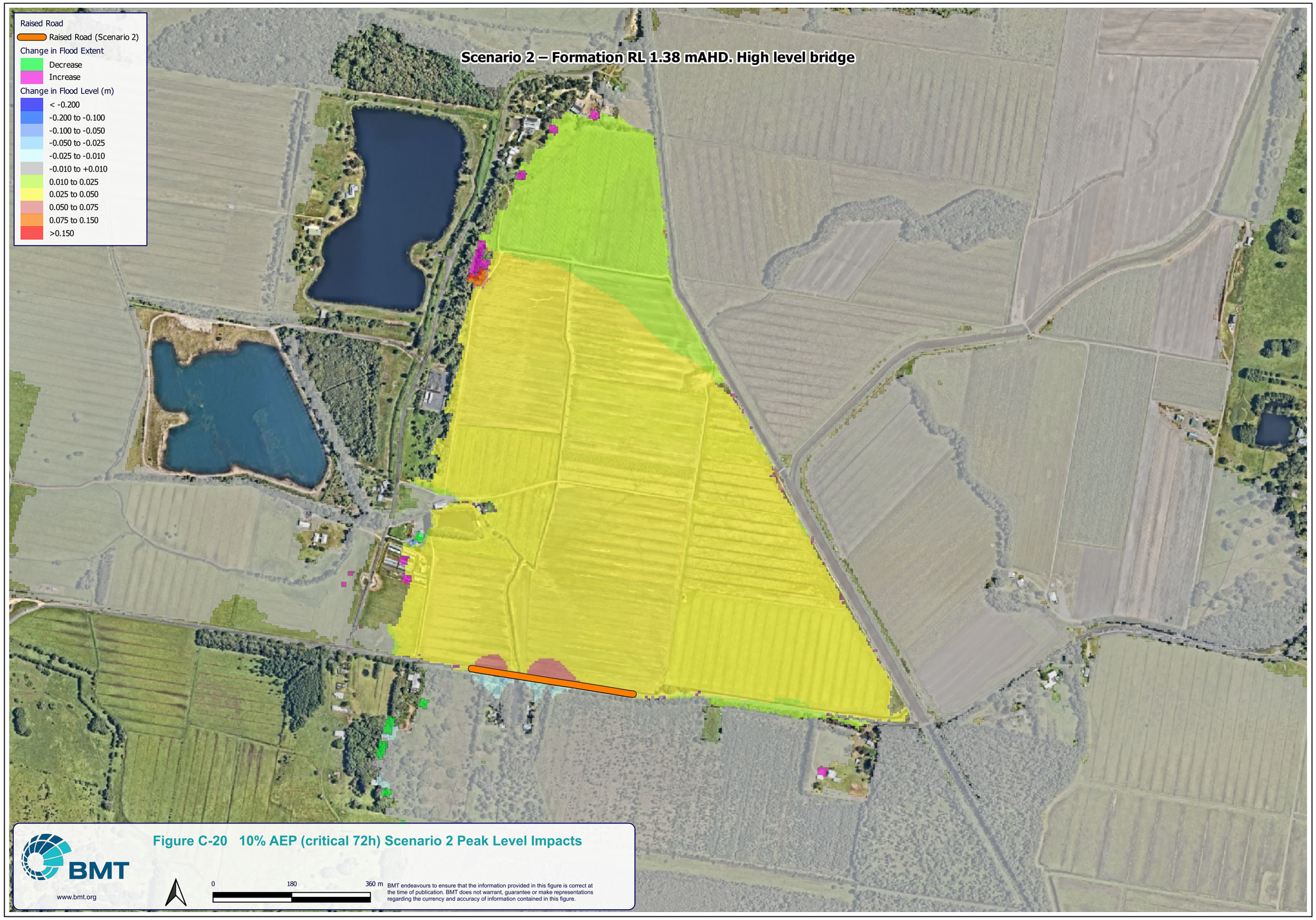


Figure C-20 10% AEP (critical 72h) Scenario 2 Peak Level Impacts

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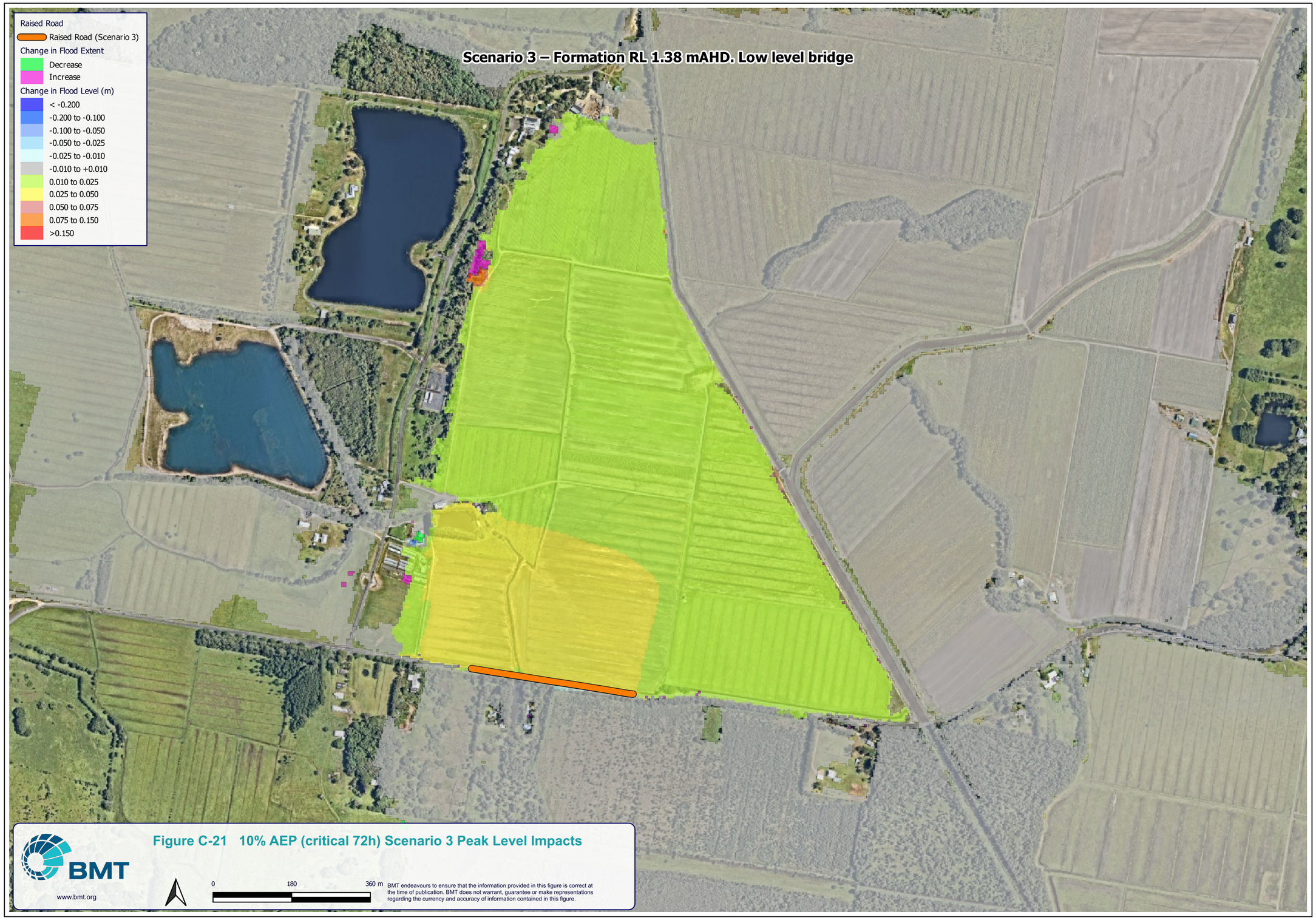


Figure C-21 10% AEP (critical 72h) Scenario 3 Peak Level Impacts

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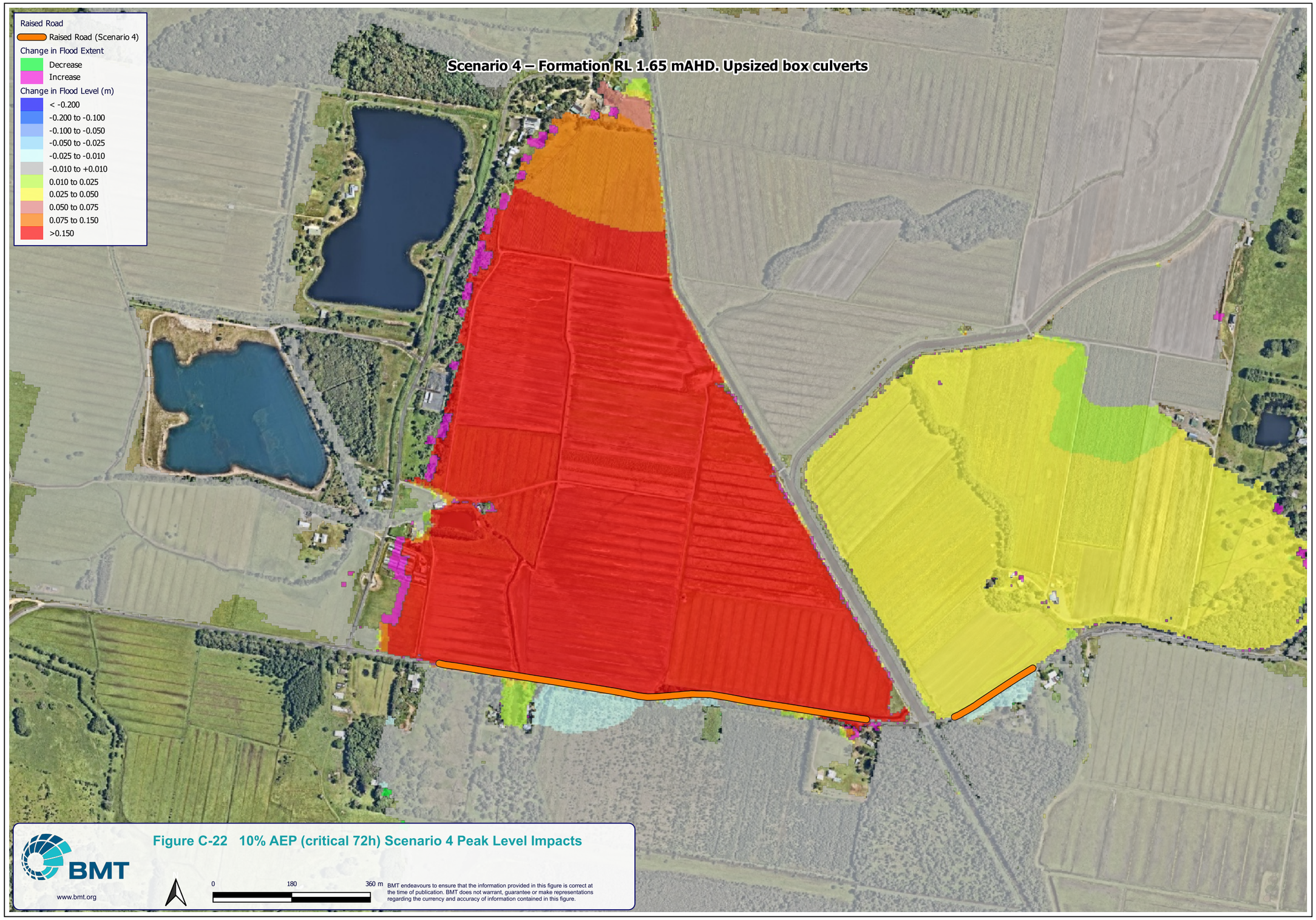


Figure C-22 10% AEP (critical 72h) Scenario 4 Peak Level Impacts

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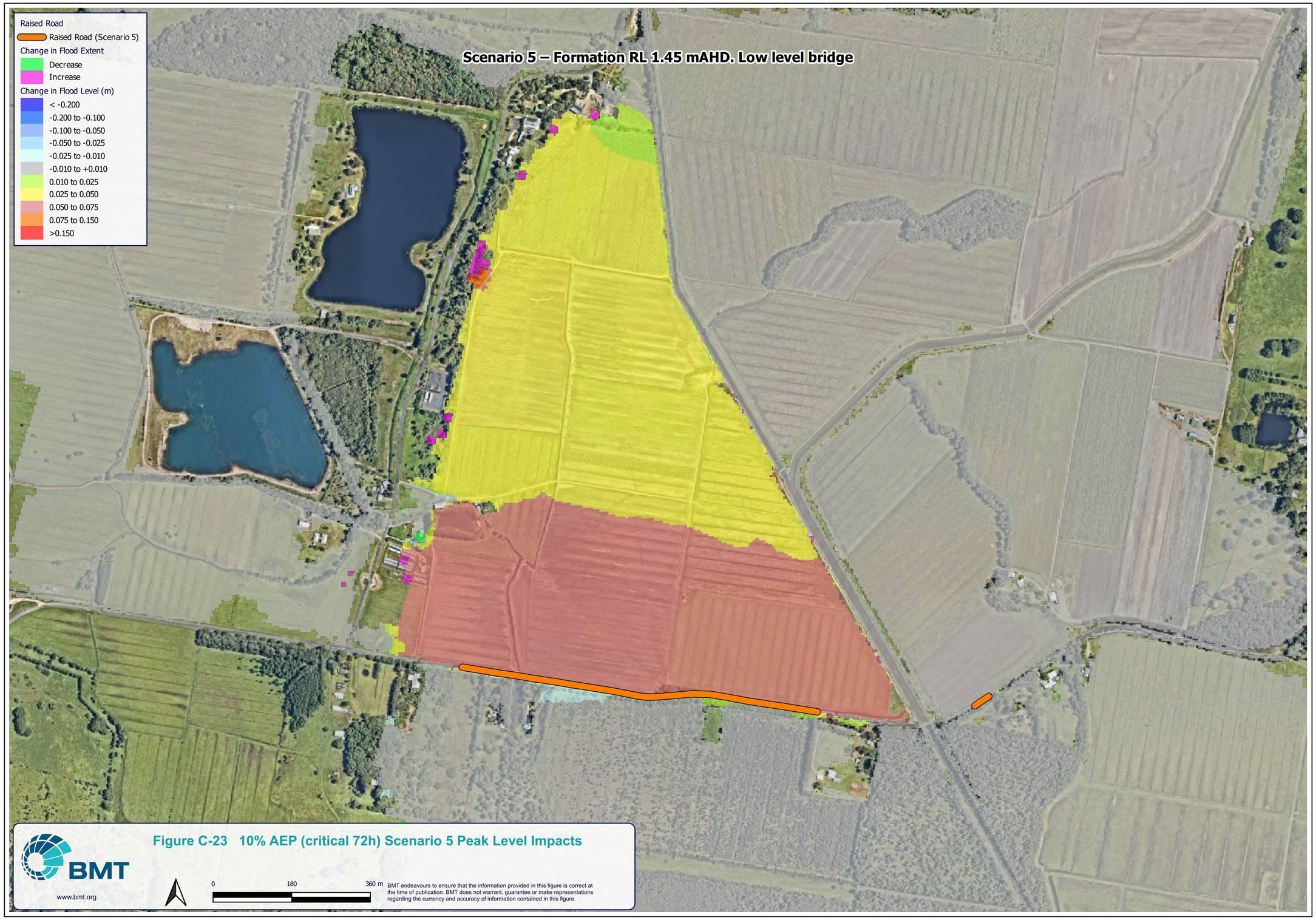


Figure C-23 10% AEP (critical 72h) Scenario 5 Peak Level Impacts

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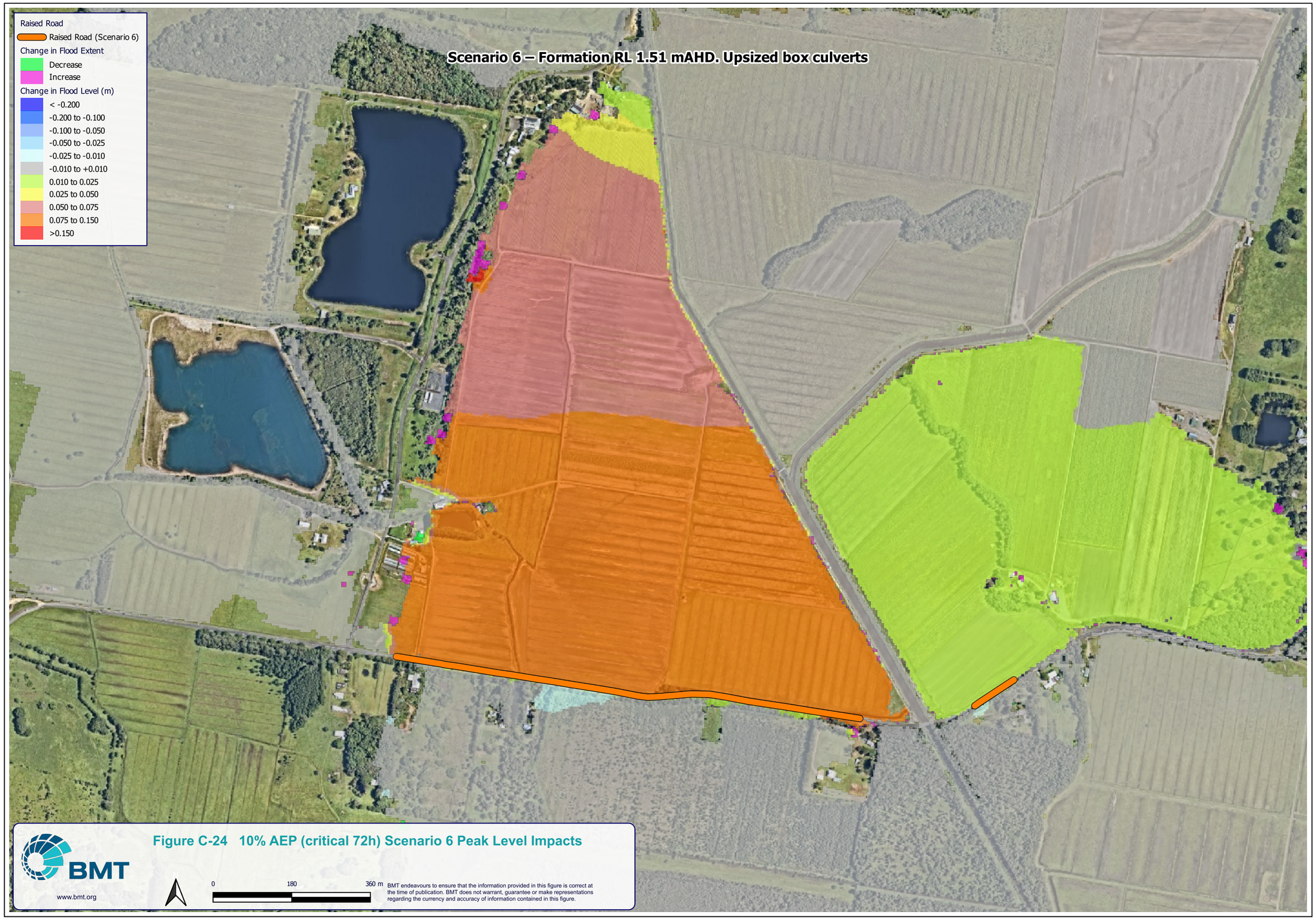


Figure C-24 10% AEP (critical 72h) Scenario 6 Peak Level Impacts

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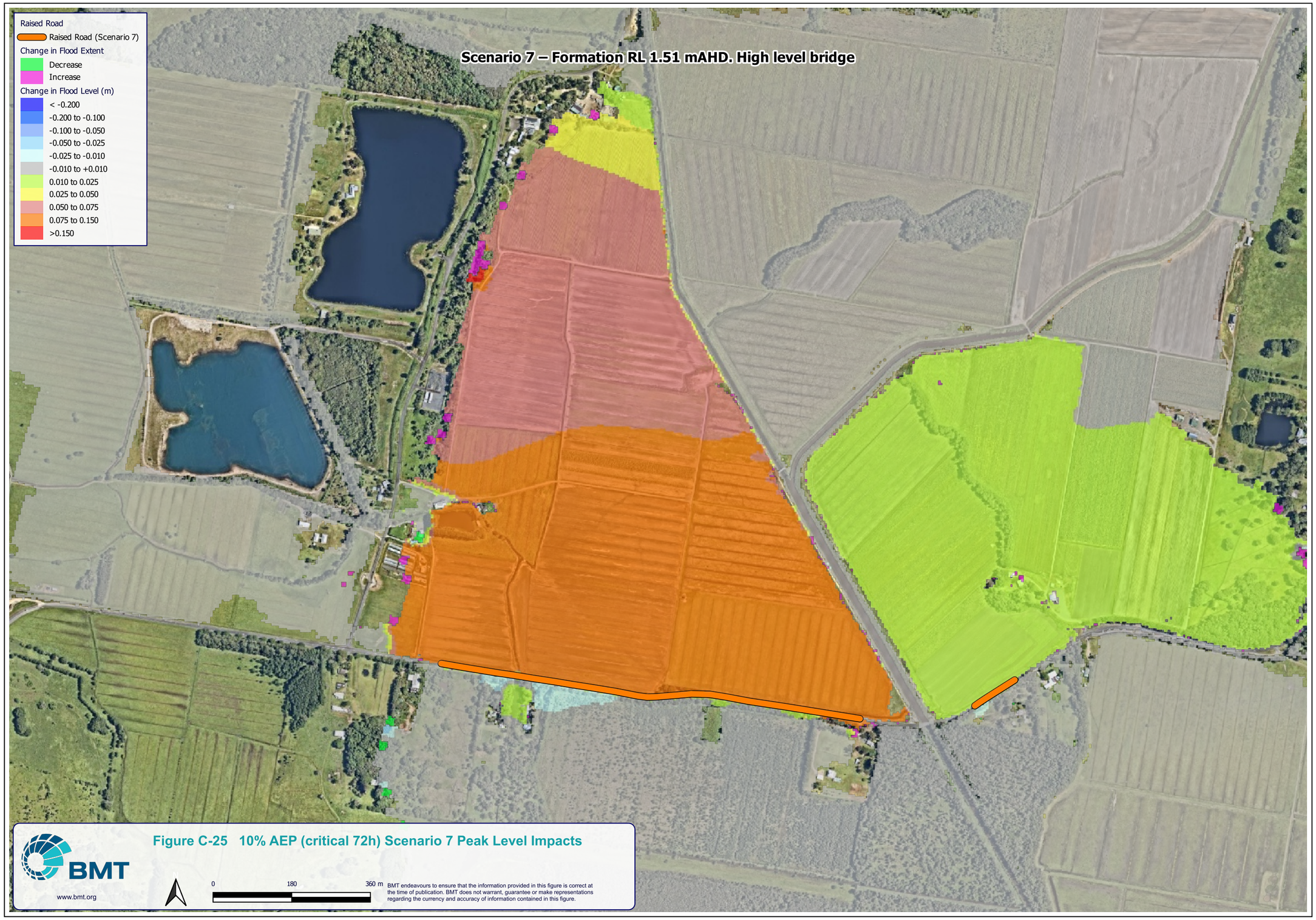


Figure C-25 10% AEP (critical 72h) Scenario 7 Peak Level Impacts

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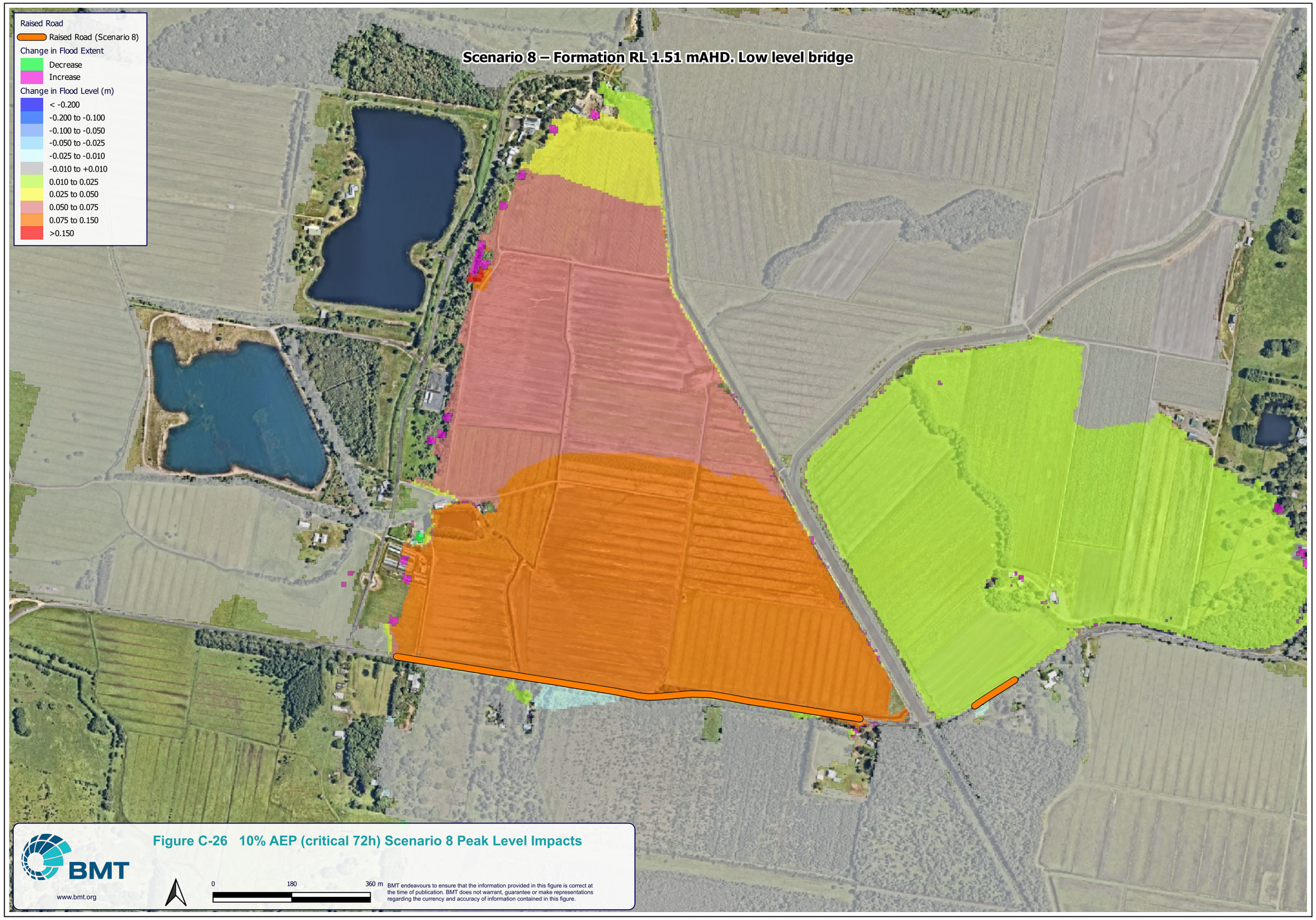


Figure C-26 10% AEP (critical 72h) Scenario 8 Peak Level Impacts

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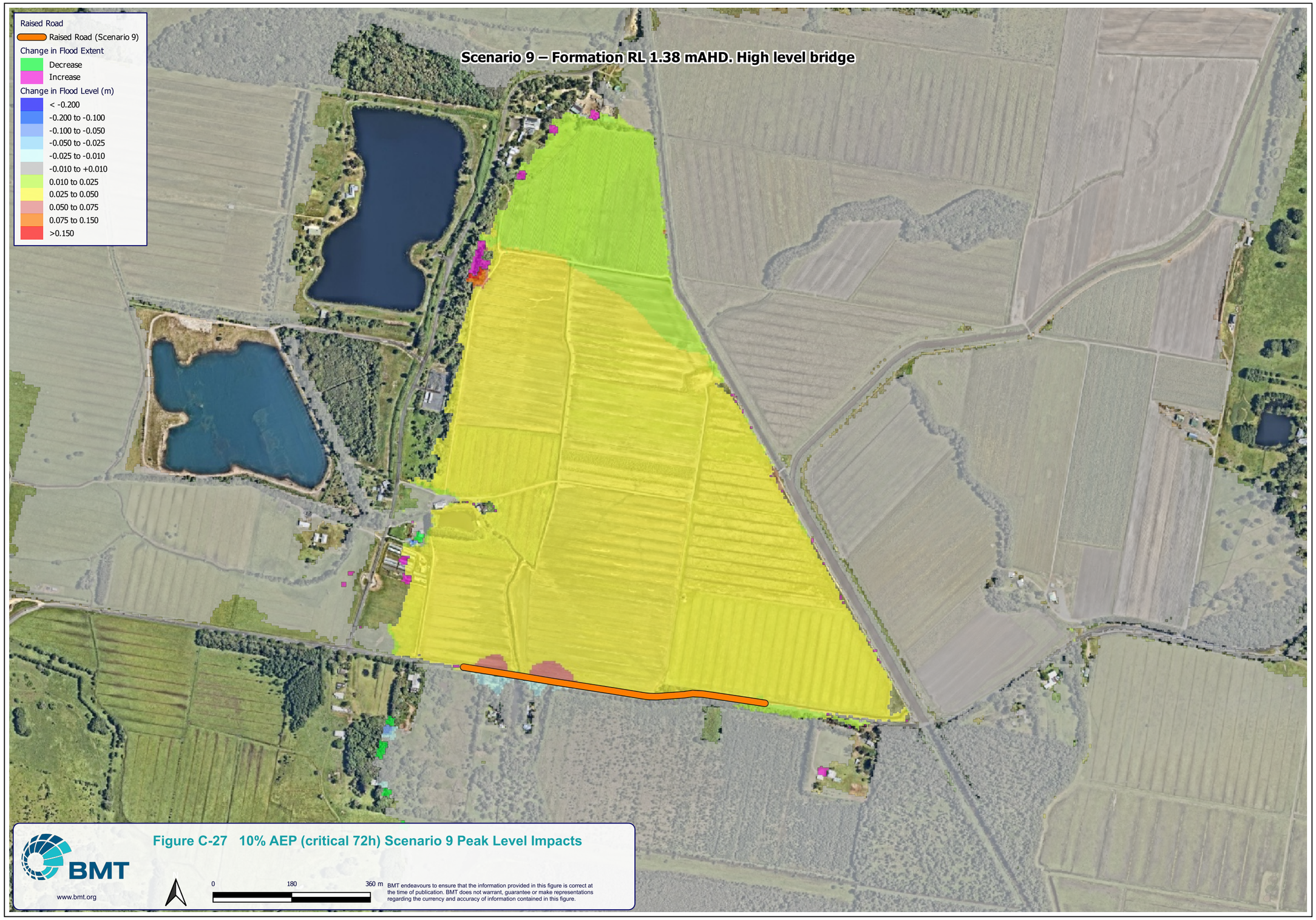


Figure C-27 10% AEP (critical 72h) Scenario 9 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure C-28 5% AEP (critical 72h) Scenario 1 Peak Level Impacts

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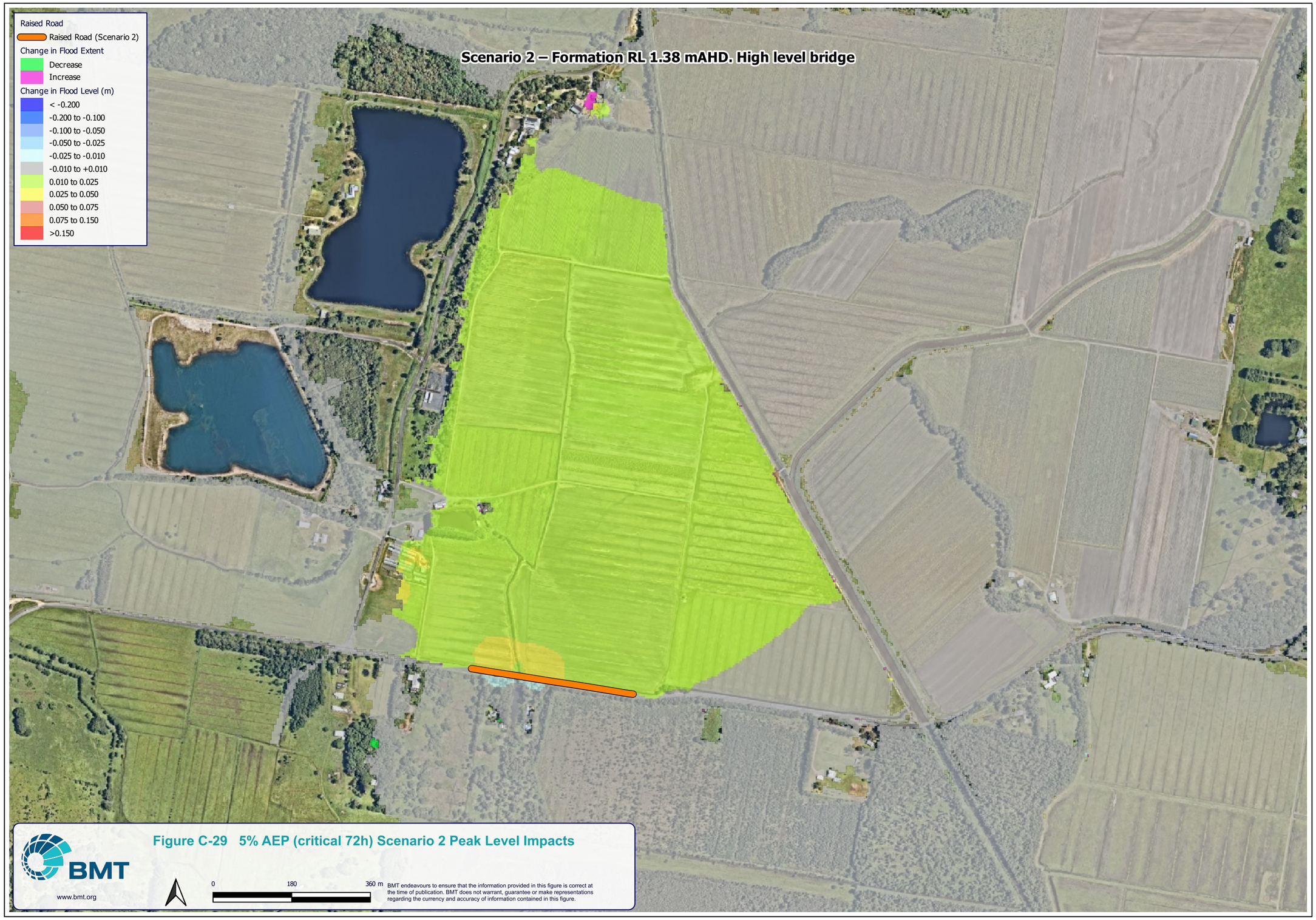


Figure C-29 5% AEP (critical 72h) Scenario 2 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure C-30 5% AEP (critical 72h) Scenario 3 Peak Level Impacts

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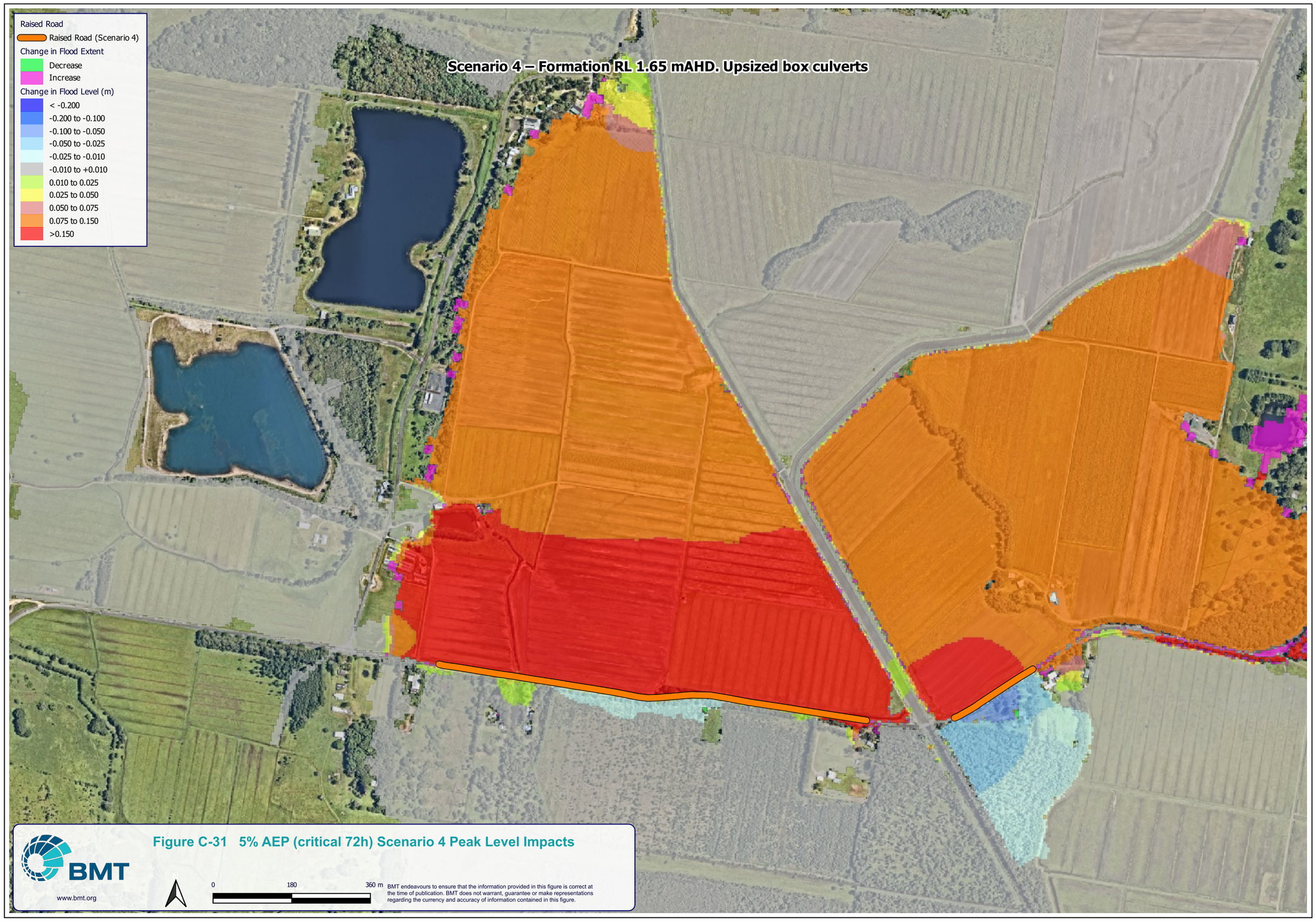


Figure C-31 5% AEP (critical 72h) Scenario 4 Peak Level Impacts

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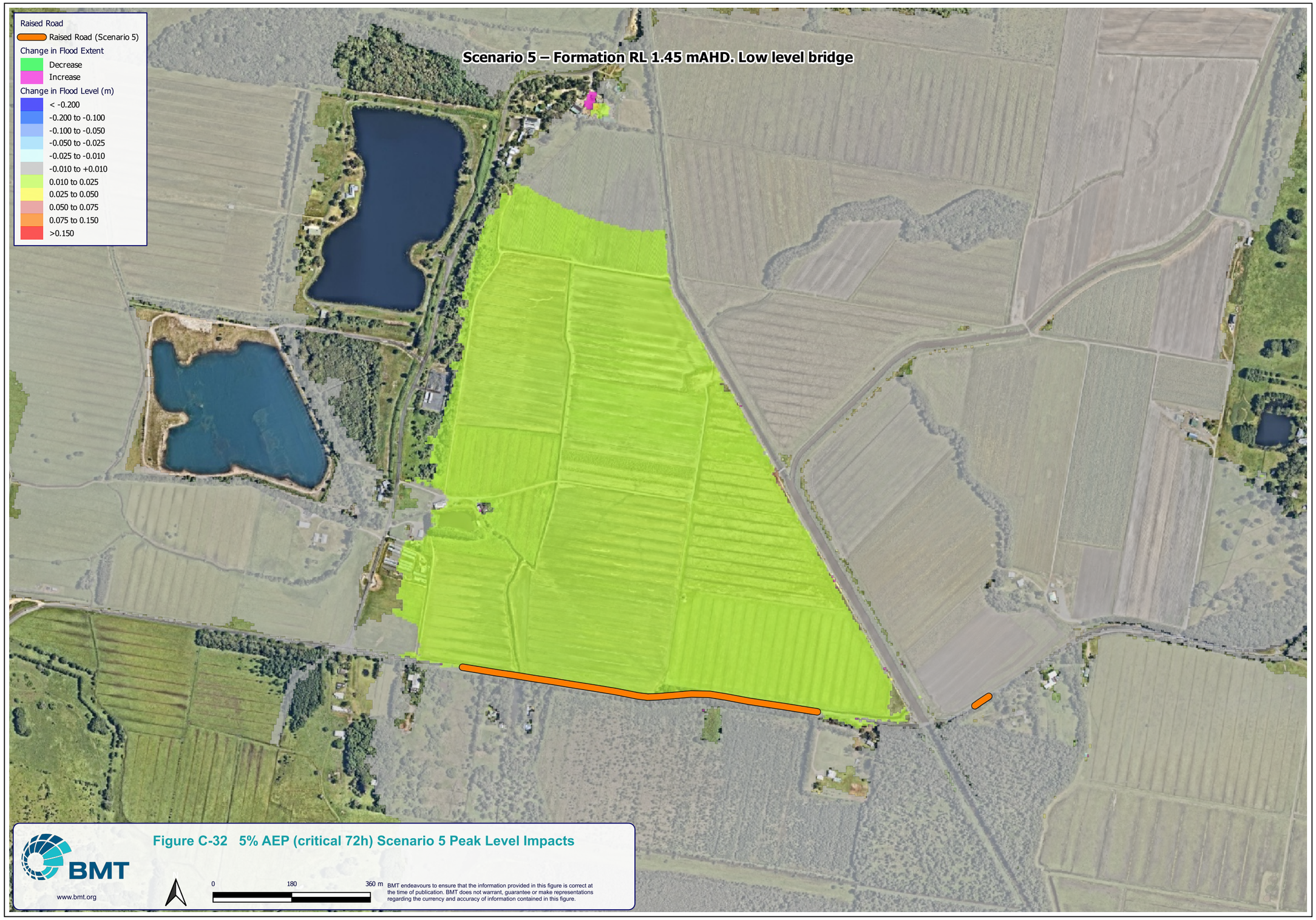


Figure C-32 5% AEP (critical 72h) Scenario 5 Peak Level Impacts

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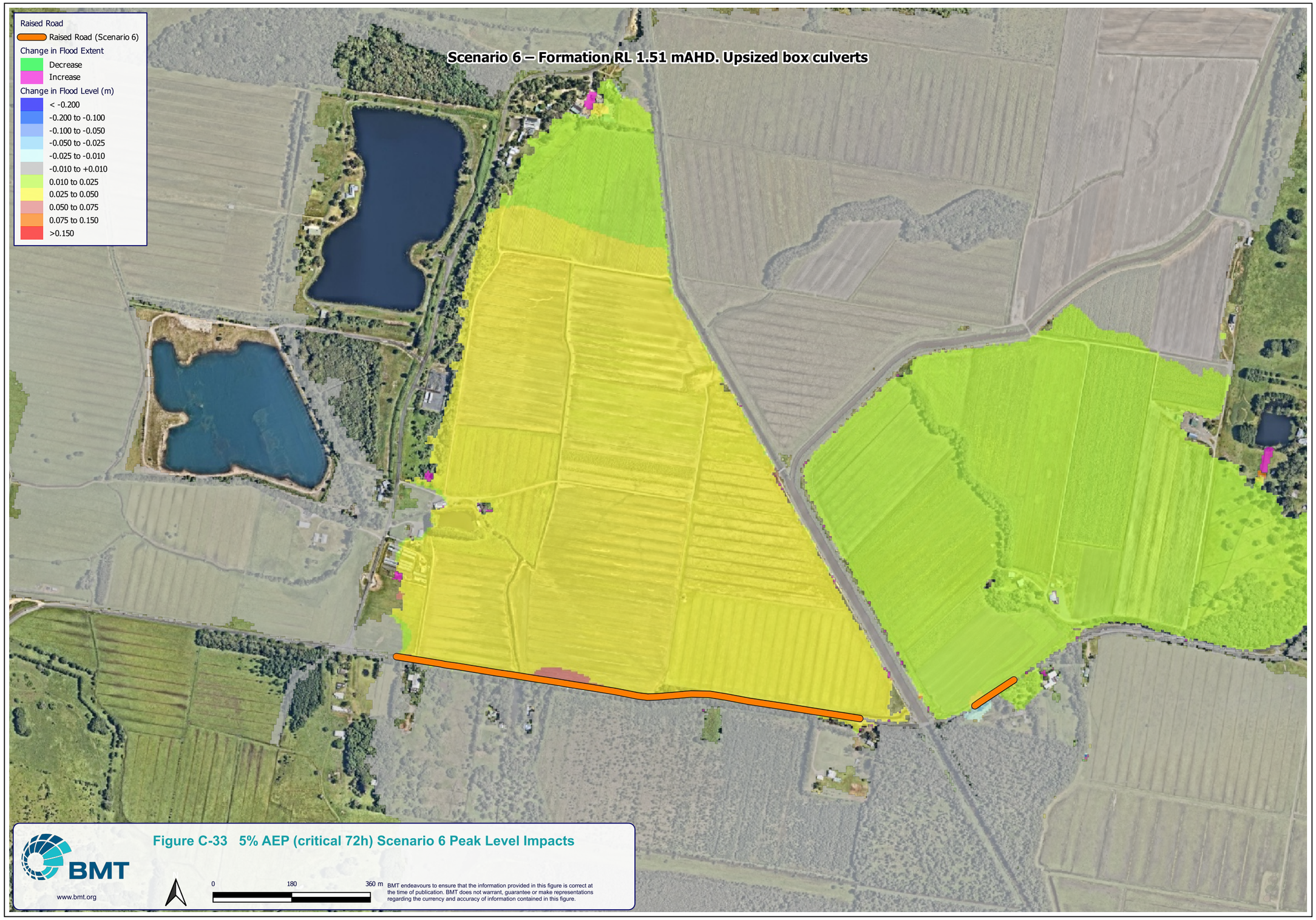


Figure C-33 5% AEP (critical 72h) Scenario 6 Peak Level Impacts

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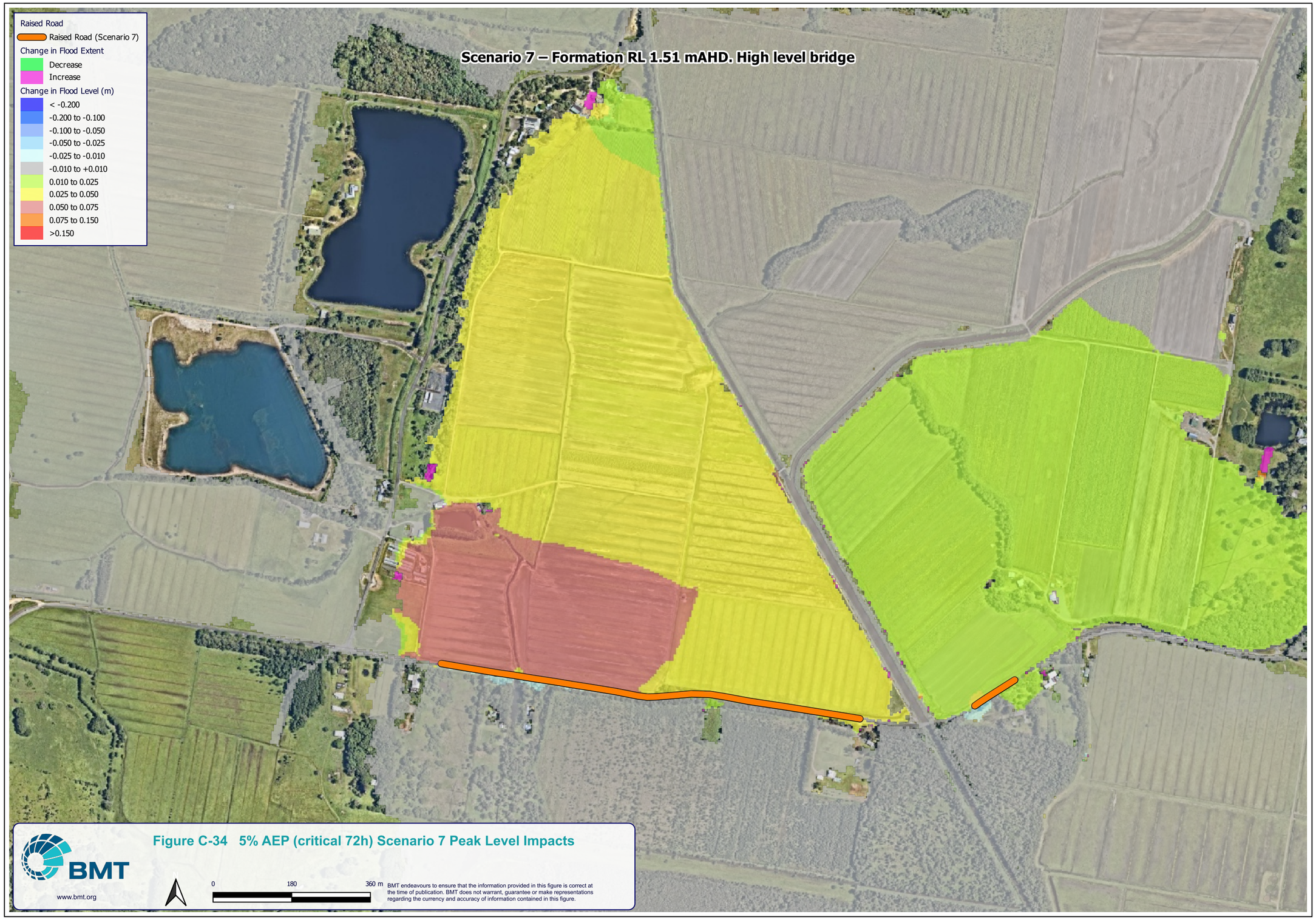


Figure C-34 5% AEP (critical 72h) Scenario 7 Peak Level Impacts

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5.1 Ross Lane Betterment

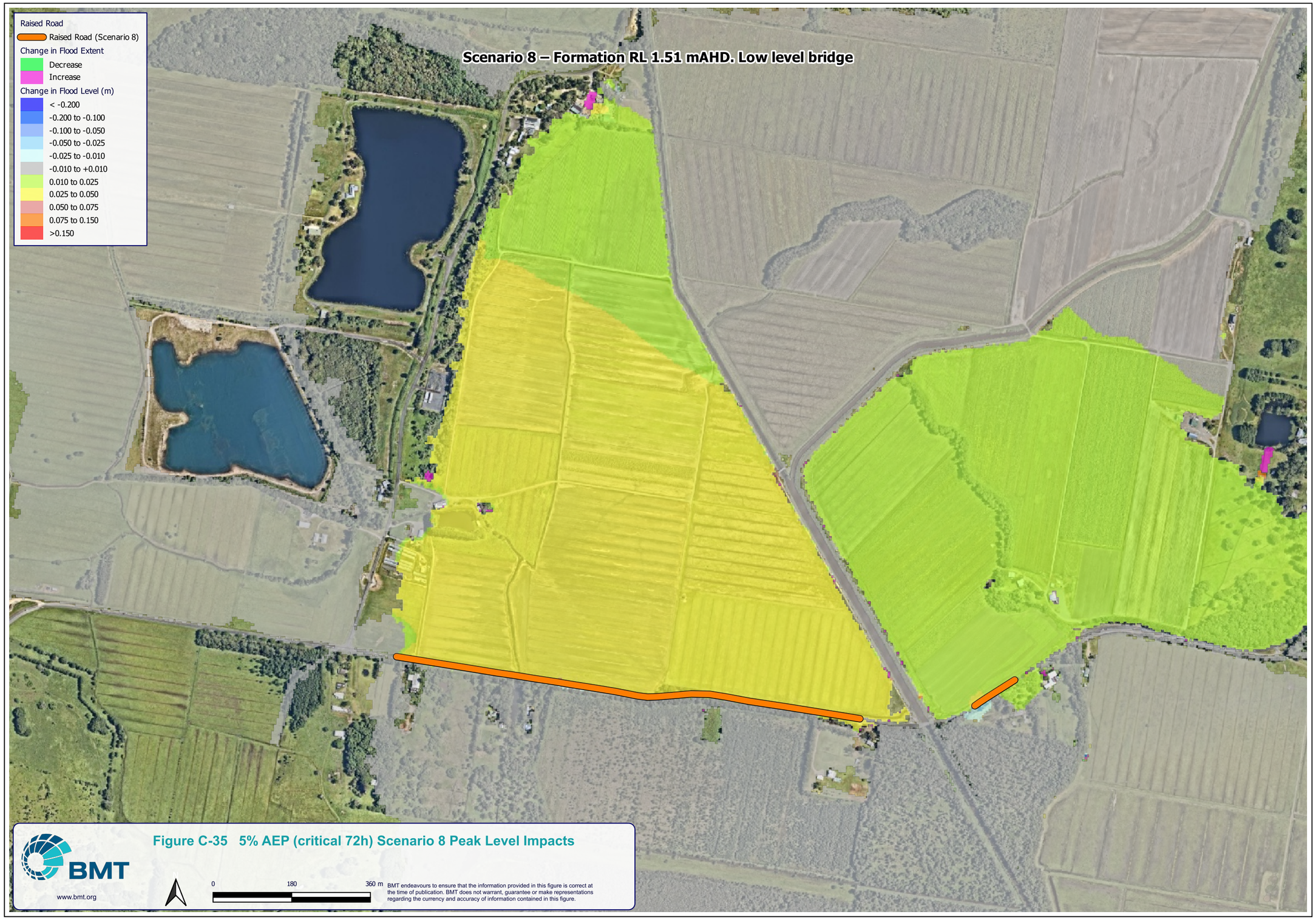


Figure C-35 5% AEP (critical 72h) Scenario 8 Peak Level Impacts

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5.1 Ross Lane Betterment

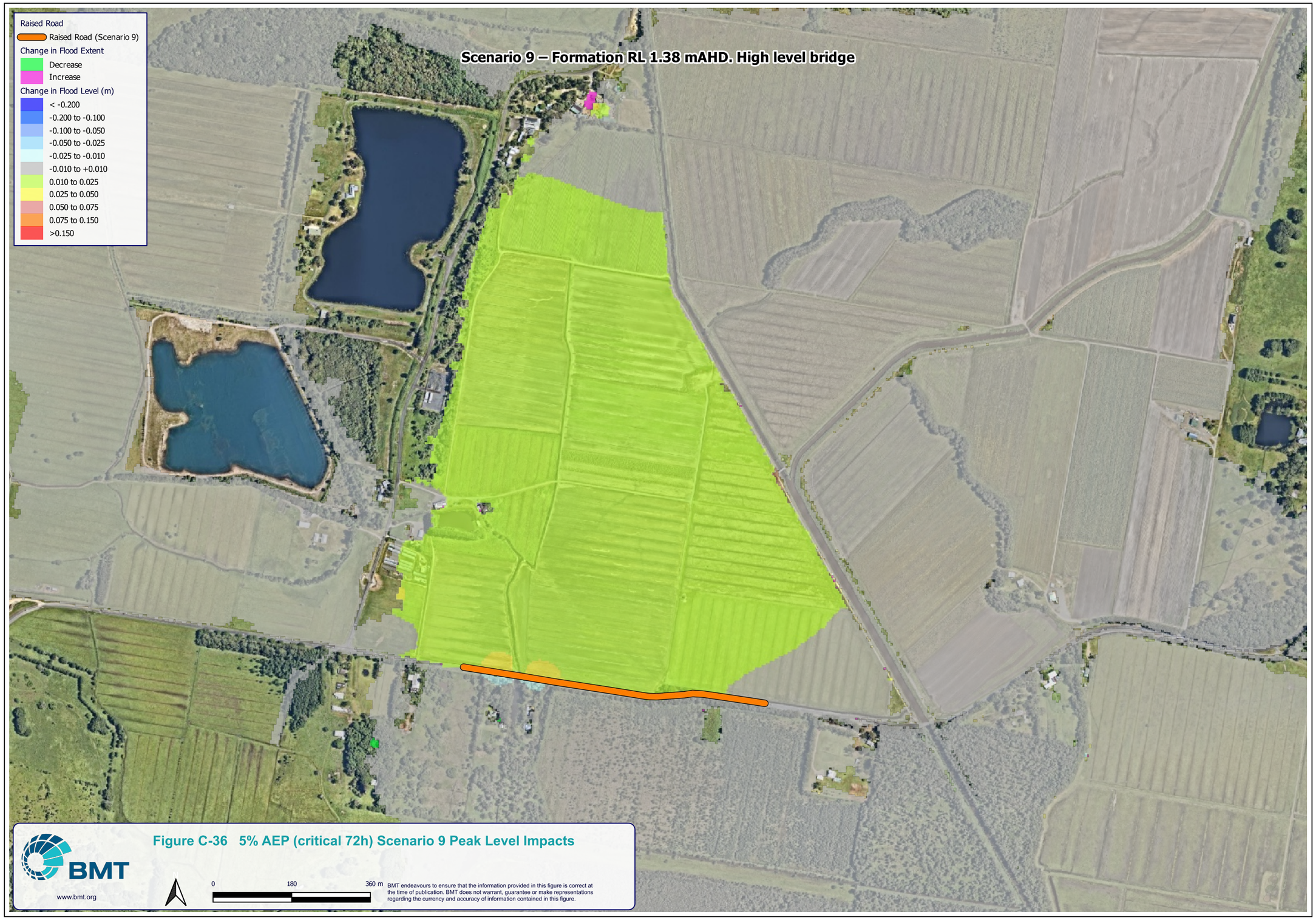


Figure C-36 5% AEP (critical 72h) Scenario 9 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure C-37 1% AEP (critical 18h) Scenario 1 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure C-38 1% AEP (critical 18h) Scenario 2 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure C-39 1% AEP (critical 18h) Scenario 3 Peak Level Impacts

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5.1 Ross Lane Betterment

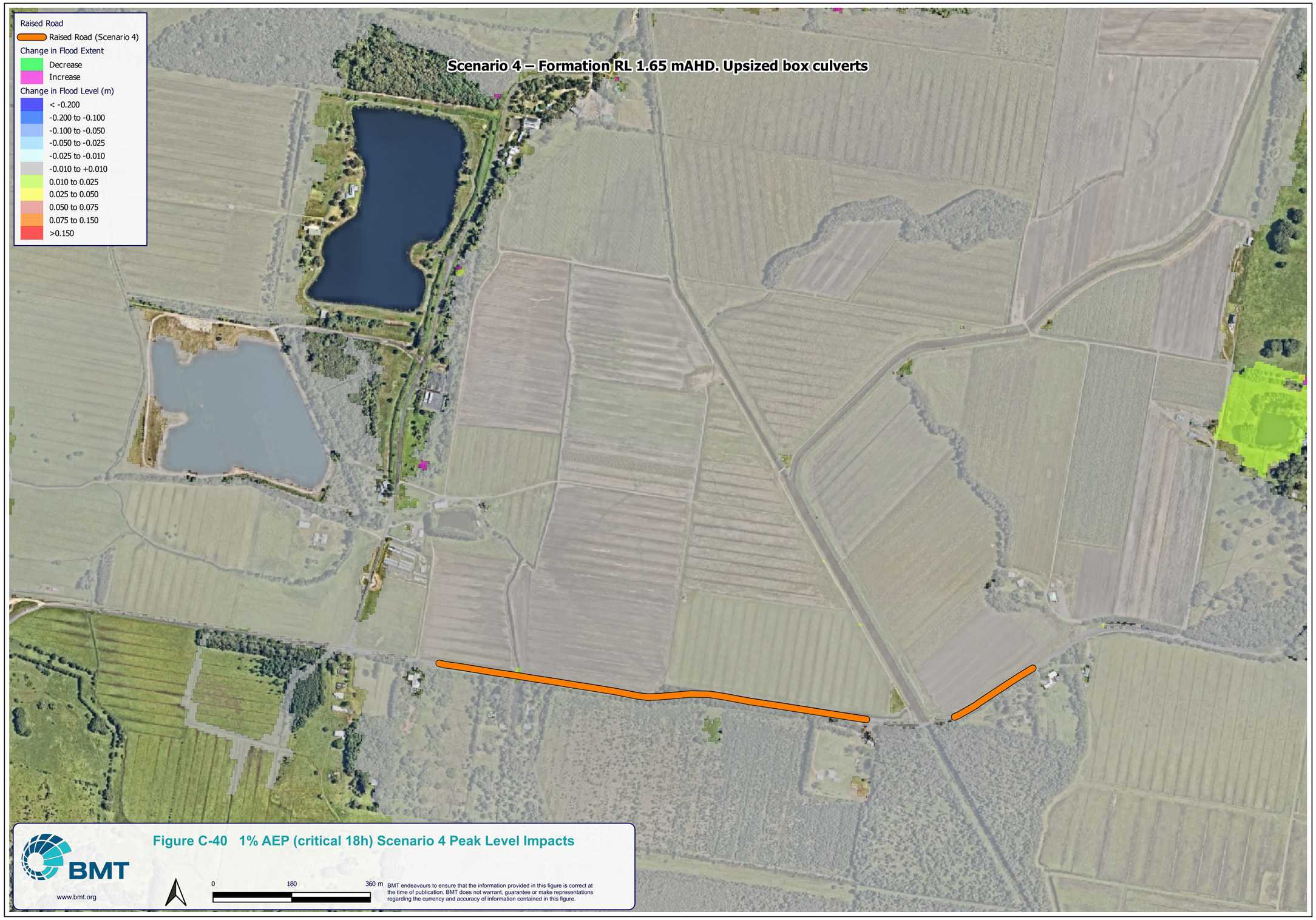


Figure C-40 1% AEP (critical 18h) Scenario 4 Peak Level Impacts

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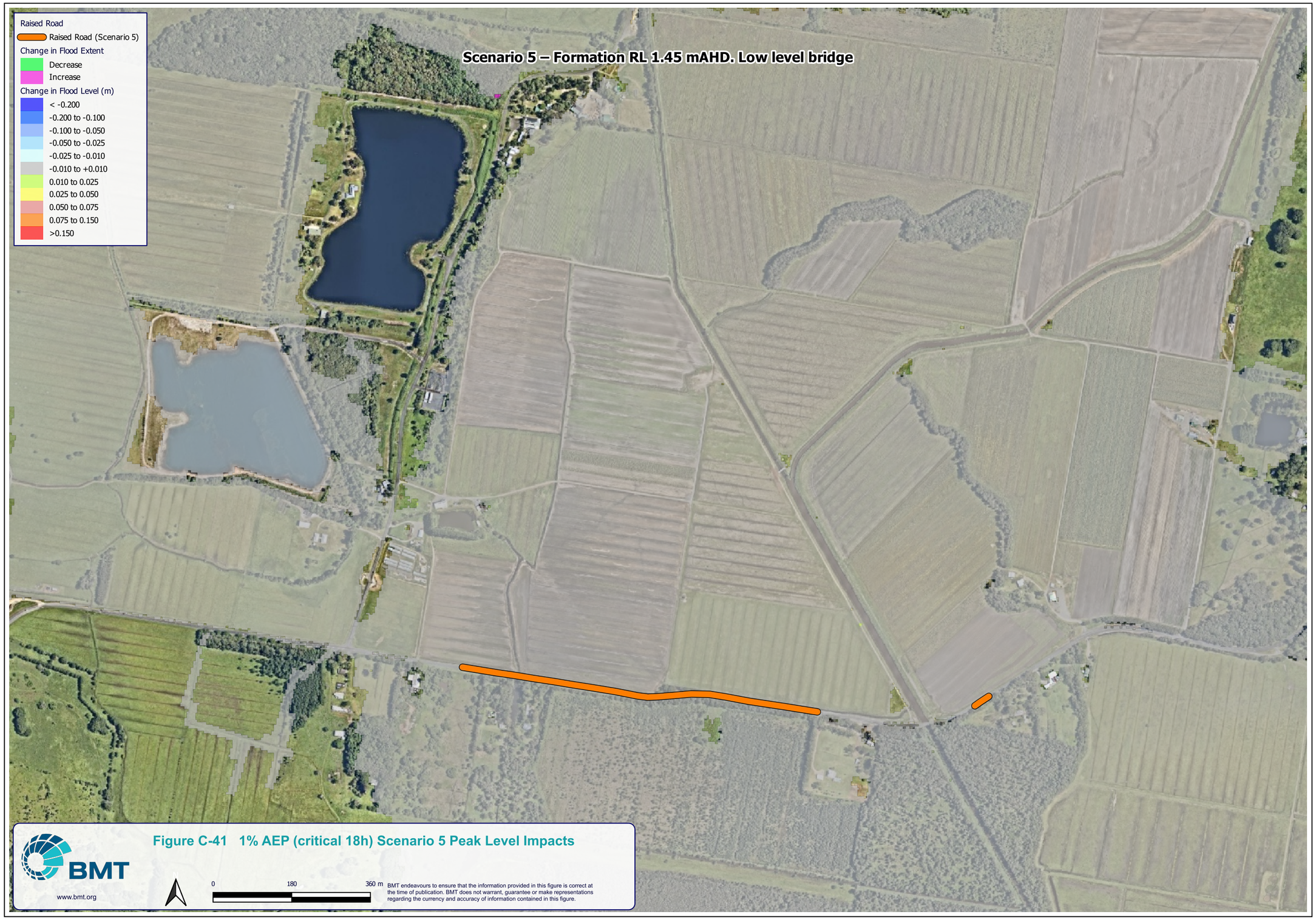


Figure C-41 1% AEP (critical 18h) Scenario 5 Peak Level Impacts

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5.1 Ross Lane Betterment

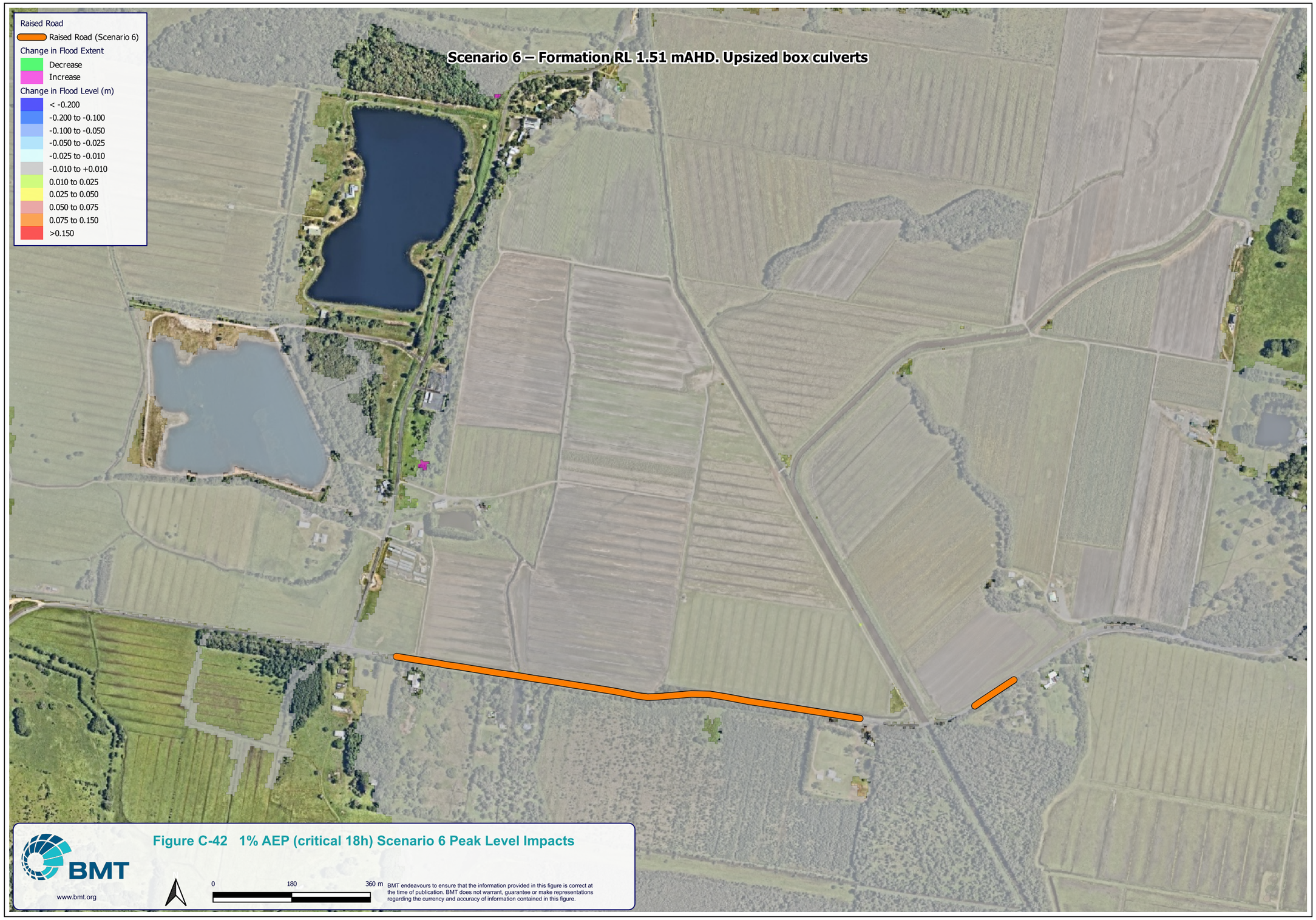


Figure C-42 1% AEP (critical 18h) Scenario 6 Peak Level Impacts

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5.1 Ross Lane Betterment

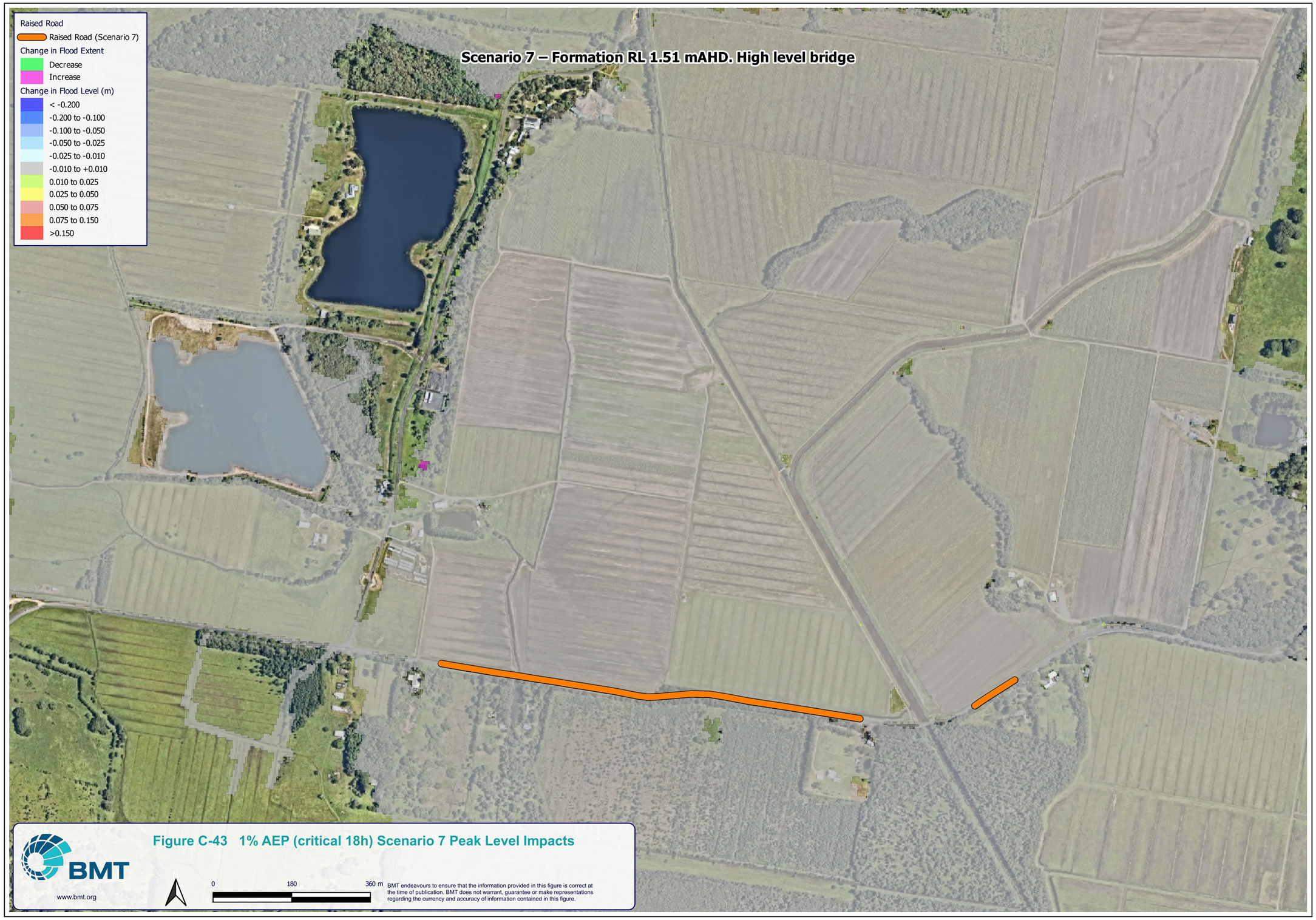


Figure C-43 1% AEP (critical 18h) Scenario 7 Peak Level Impacts

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5.1 Ross Lane Betterment

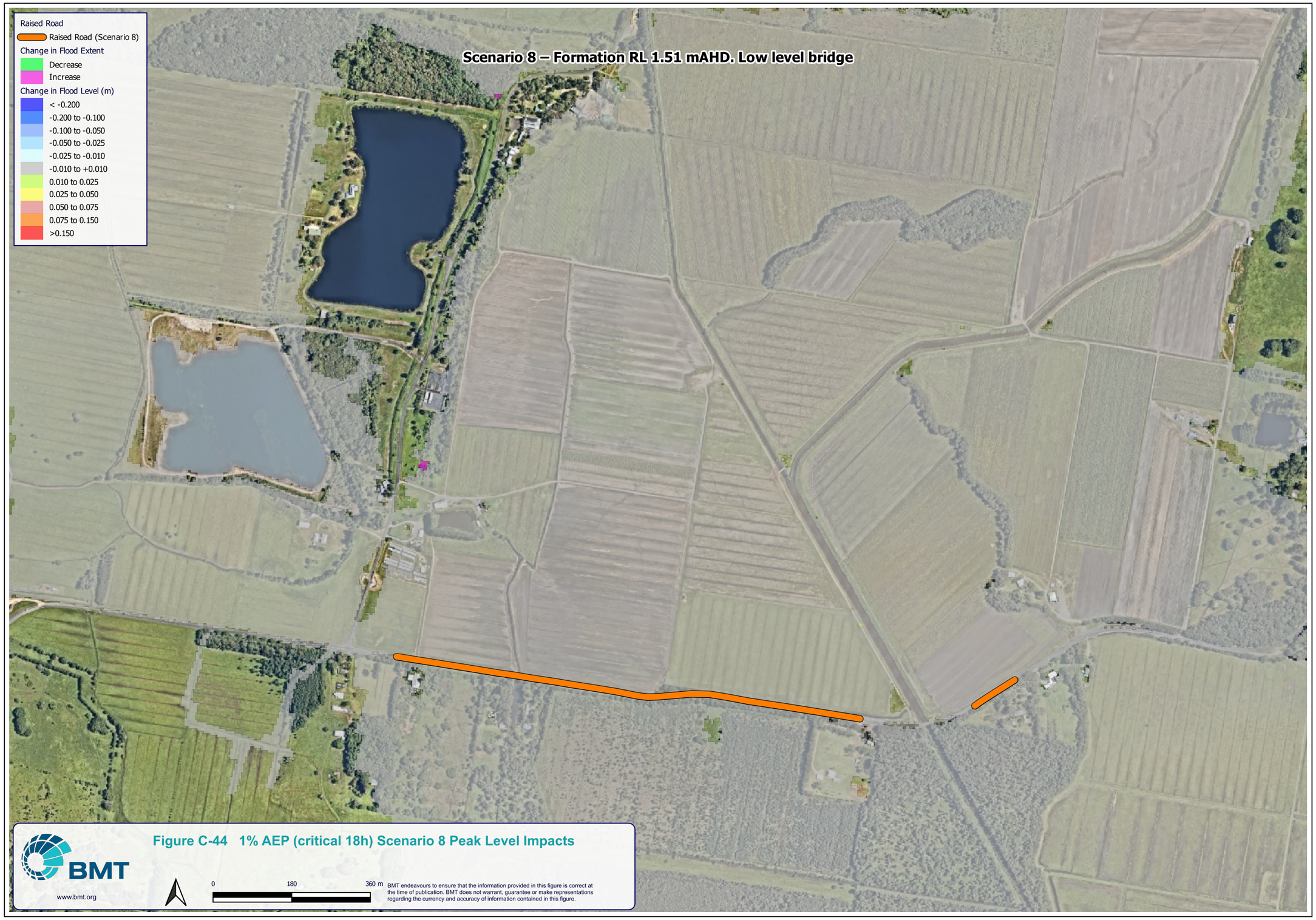


Figure C-44 1% AEP (critical 18h) Scenario 8 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure C-45 1% AEP (critical 18h) Scenario 9 Peak Level Impacts

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Annex D Peak Flood Velocity Impacts (Critical Events)

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5.1 Ross Lane Betterment



Figure D-1 Nuisance (critical 72h) Scenario 1 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-2 Nuisance (critical 72h) Scenario 2 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-3 Nuisance (critical 72h) Scenario 3 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-4 Nuisance (critical 72h) Scenario 4 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-5 Nuisance (critical 72h) Scenario 5 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-6 Nuisance (critical 72h) Scenario 6 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-7 Nuisance (critical 72h) Scenario 7 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-8 Nuisance (critical 72h) Scenario 8 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-9 Nuisance (critical 72h) Scenario 9 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-10 20% AEP (critical 72h) Scenario 1 Peak Velocity Impacts

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Figure D-11 20% AEP (critical 72h) Scenario 2 Peak Velocity Impacts

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Figure D-12 20% AEP (critical 72h) Scenario 3 Peak Velocity Impacts

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5.1 Ross Lane Betterment

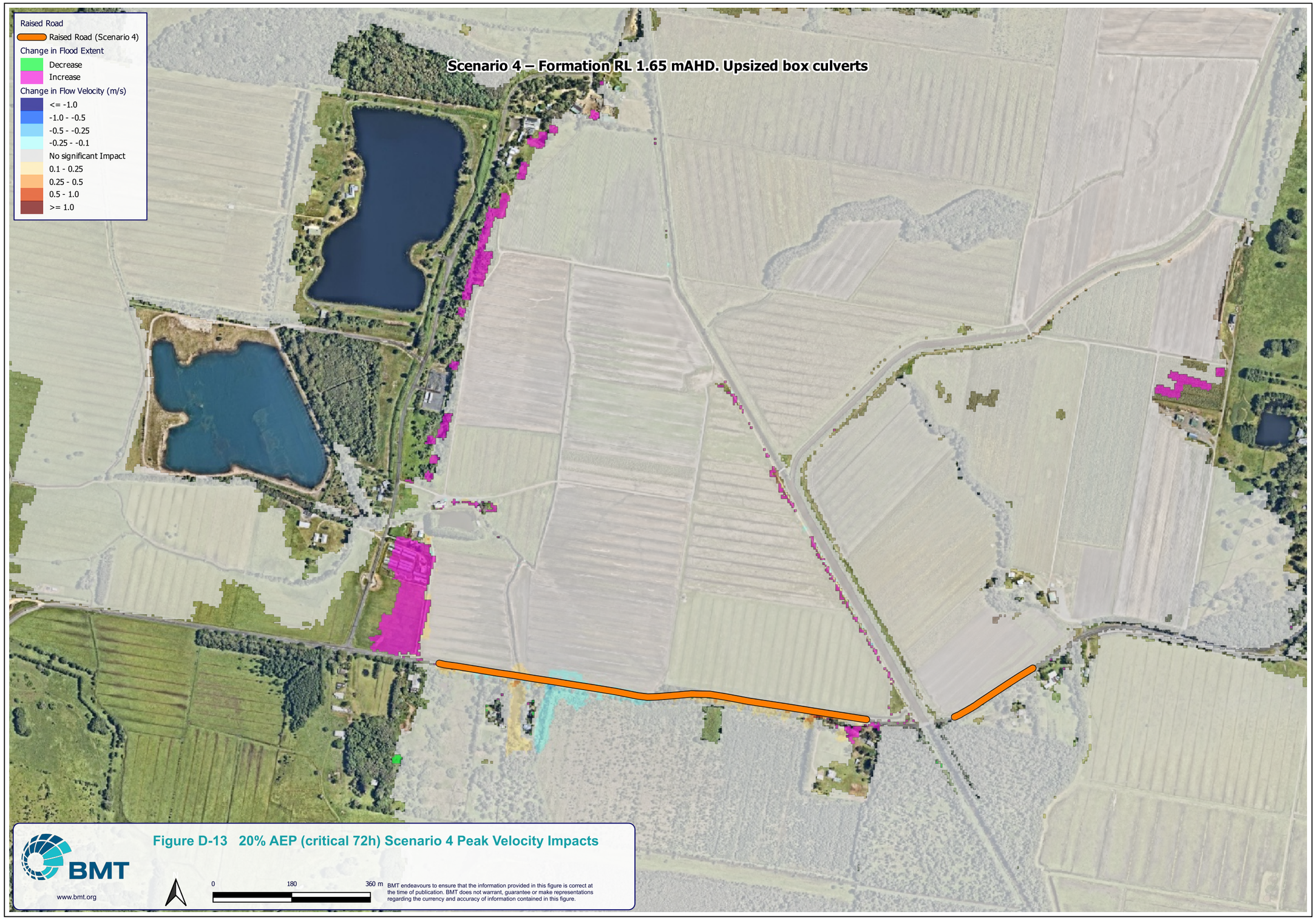


Figure D-13 20% AEP (critical 72h) Scenario 4 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-14 20% AEP (critical 72h) Scenario 5 Peak Velocity Impacts

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5.1 Ross Lane Betterment

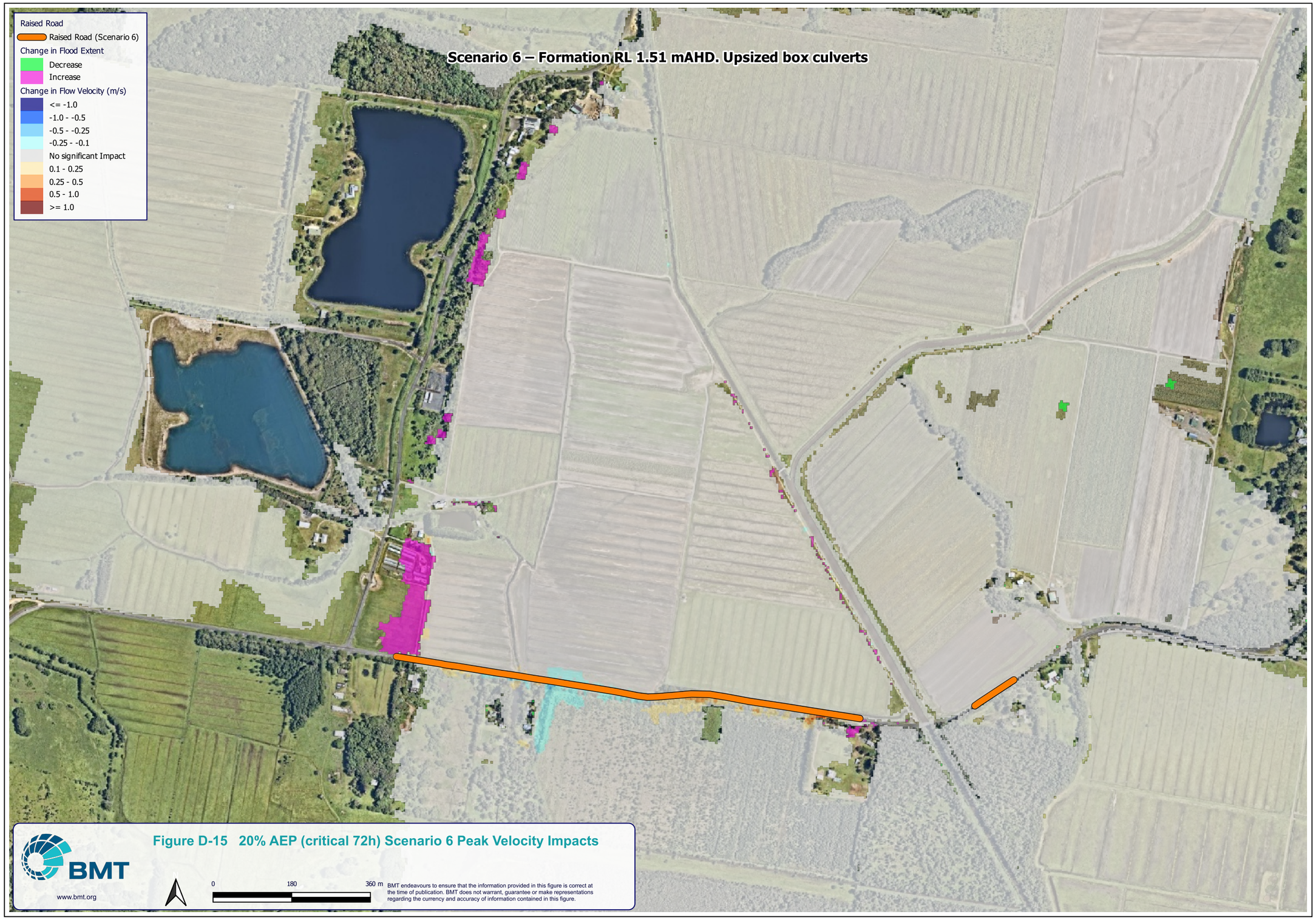


Figure D-15 20% AEP (critical 72h) Scenario 6 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-16 20% AEP (critical 72h) Scenario 7 Peak Velocity Impacts

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5.1 Ross Lane Betterment

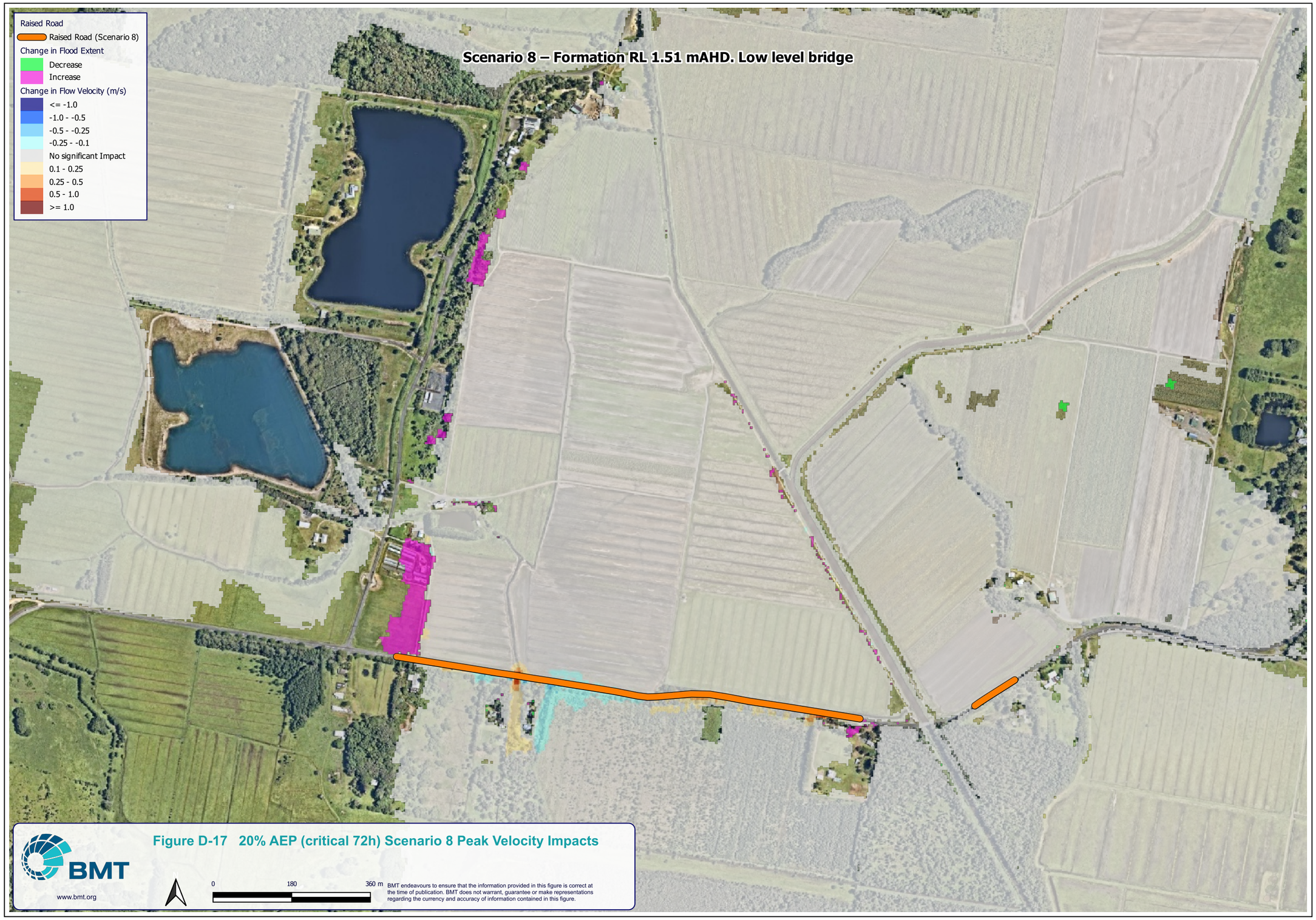


Figure D-17 20% AEP (critical 72h) Scenario 8 Peak Velocity Impacts

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Figure D-18 20% AEP (critical 72h) Scenario 9 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-19 10% AEP (critical 72h) Scenario 1 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-20 10% AEP (critical 72h) Scenario 2 Peak Velocity Impacts

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Figure D-21 10% AEP (critical 72h) Scenario 3 Peak Velocity Impacts

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5.1 Ross Lane Betterment

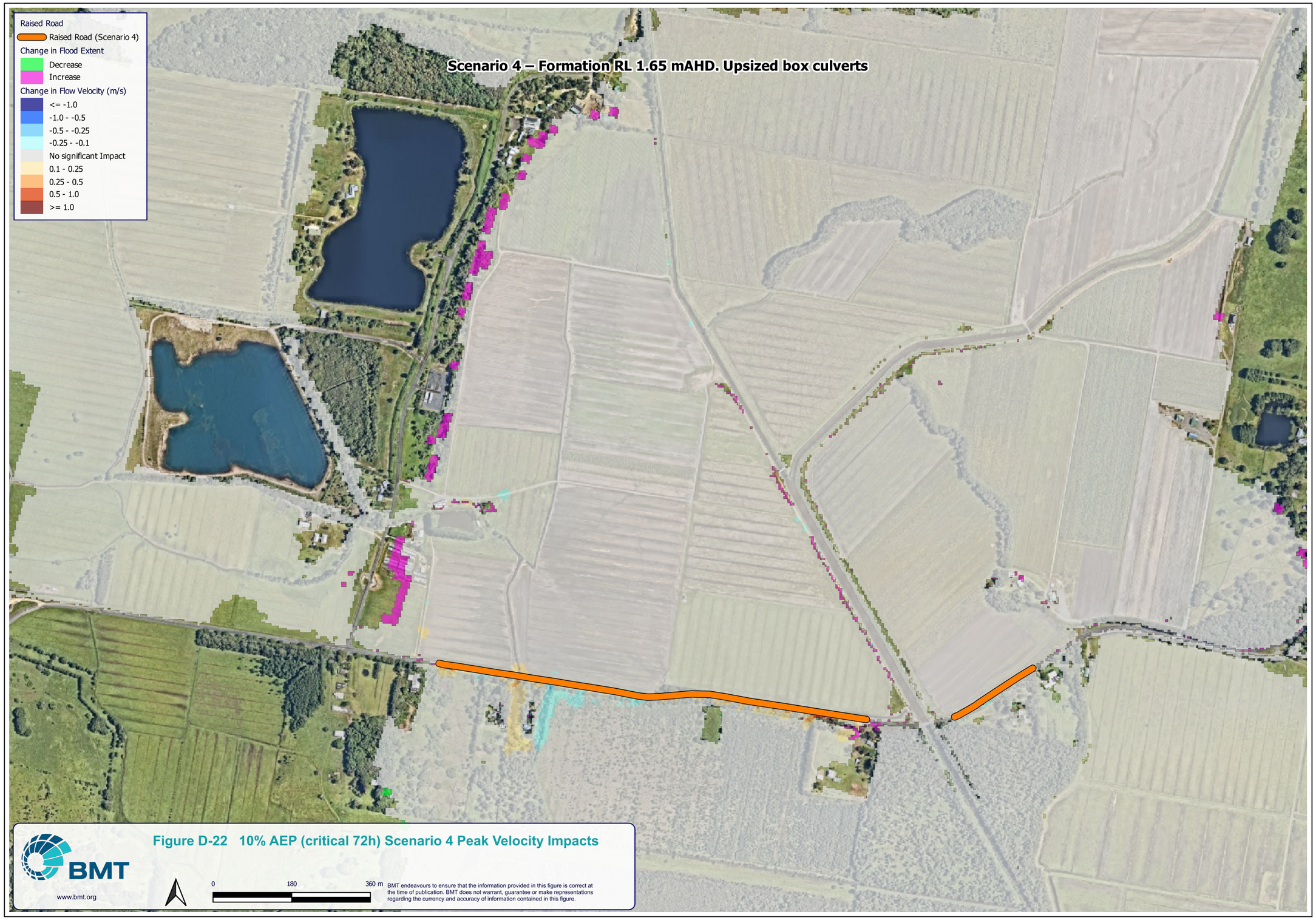


Figure D-22 10% AEP (critical 72h) Scenario 4 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-23 10% AEP (critical 72h) Scenario 5 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-24 10% AEP (critical 72h) Scenario 6 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-25 10% AEP (critical 72h) Scenario 7 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-26 10% AEP (critical 72h) Scenario 8 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-27 10% AEP (critical 72h) Scenario 9 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-28 5% AEP (critical 72h) Scenario 1 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-29 5% AEP (critical 72h) Scenario 2 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-30 5% AEP (critical 72h) Scenario 3 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-31 5% AEP (critical 72h) Scenario 4 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-32 5% AEP (critical 72h) Scenario 5 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-33 5% AEP (critical 72h) Scenario 6 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-34 5% AEP (critical 72h) Scenario 7 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-35 5% AEP (critical 72h) Scenario 8 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-36 5% AEP (critical 72h) Scenario 9 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-37 1% AEP (critical 18h) Scenario 1 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-38 1% AEP (critical 18h) Scenario 2 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-39 1% AEP (critical 18h) Scenario 3 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-40 1% AEP (critical 18h) Scenario 4 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-41 1% AEP (critical 18h) Scenario 5 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-42 1% AEP (critical 18h) Scenario 6 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-43 1% AEP (critical 18h) Scenario 7 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-44 1% AEP (critical 18h) Scenario 8 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure D-45 1% AEP (critical 18h) Scenario 9 Peak Velocity Impacts

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Annex E Peak Flood Level Impacts (Non-critical Events)

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5.1 Ross Lane Betterment



Figure E-1 Nuisance (non-critical 12h) Scenario 1 Peak Level Impacts

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5.1 Ross Lane Betterment

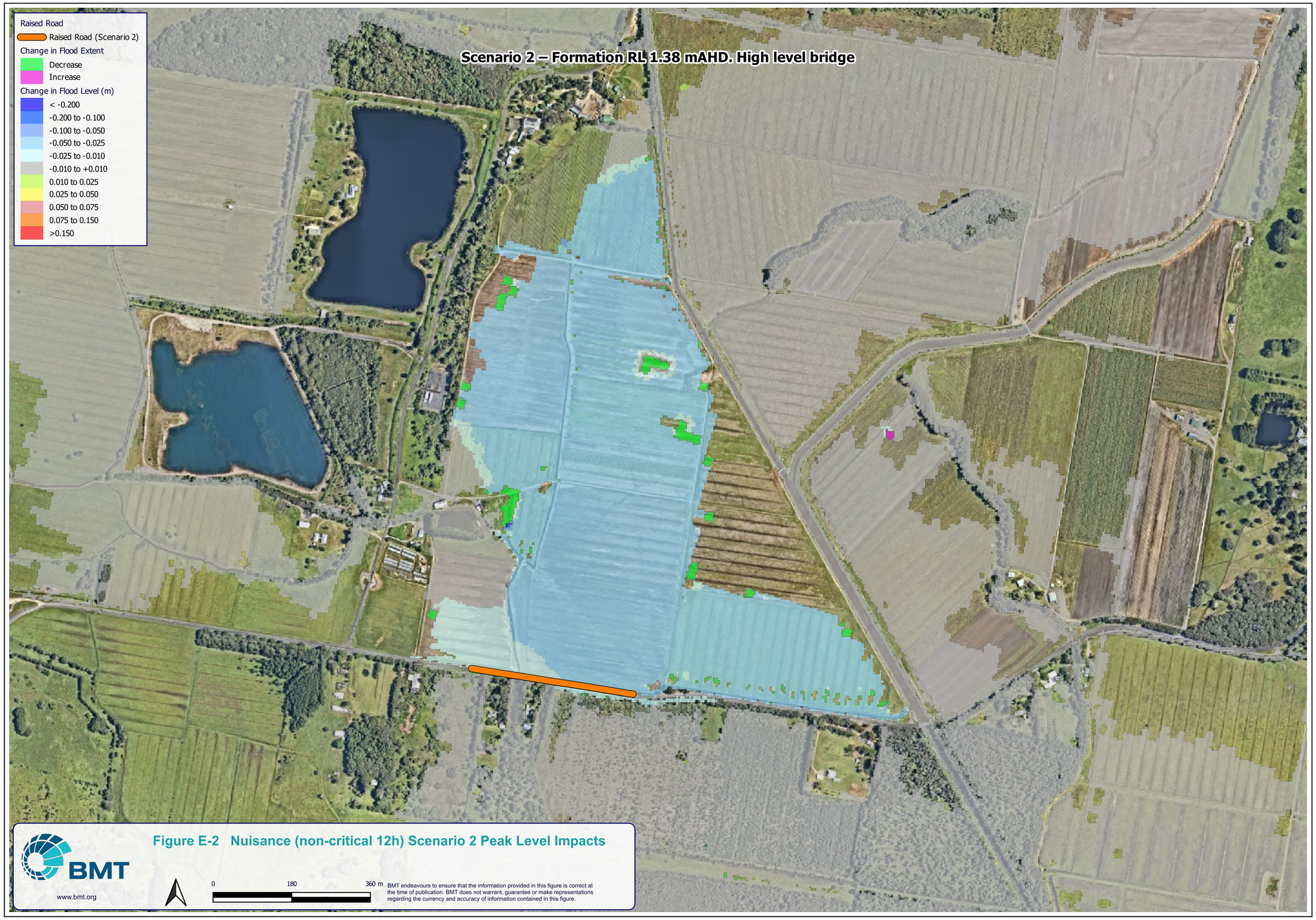


Figure E-2 Nuisance (non-critical 12h) Scenario 2 Peak Level Impacts

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5.1 Ross Lane Betterment

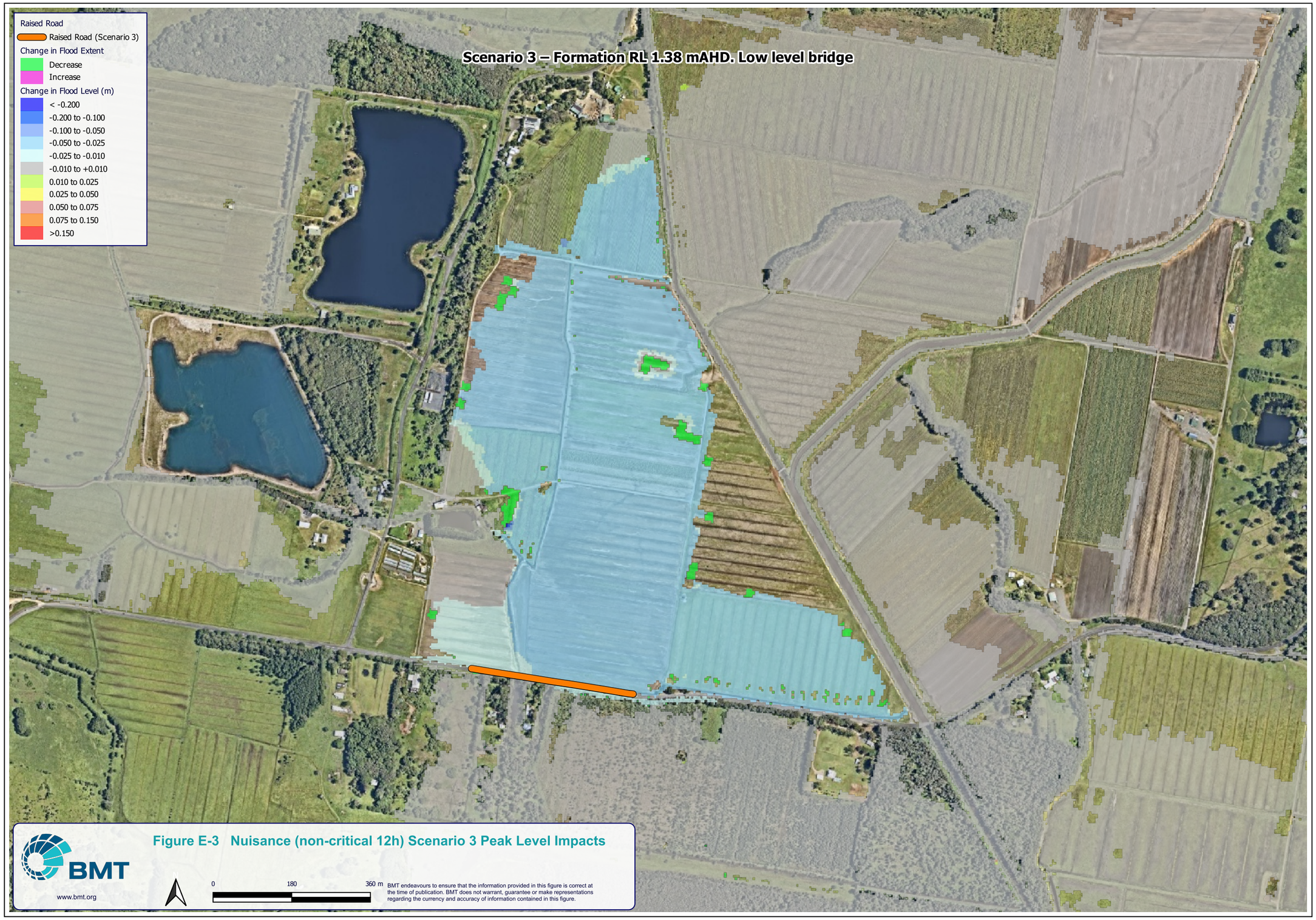


Figure E-3 Nuisance (non-critical 12h) Scenario 3 Peak Level Impacts

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5.1 Ross Lane Betterment

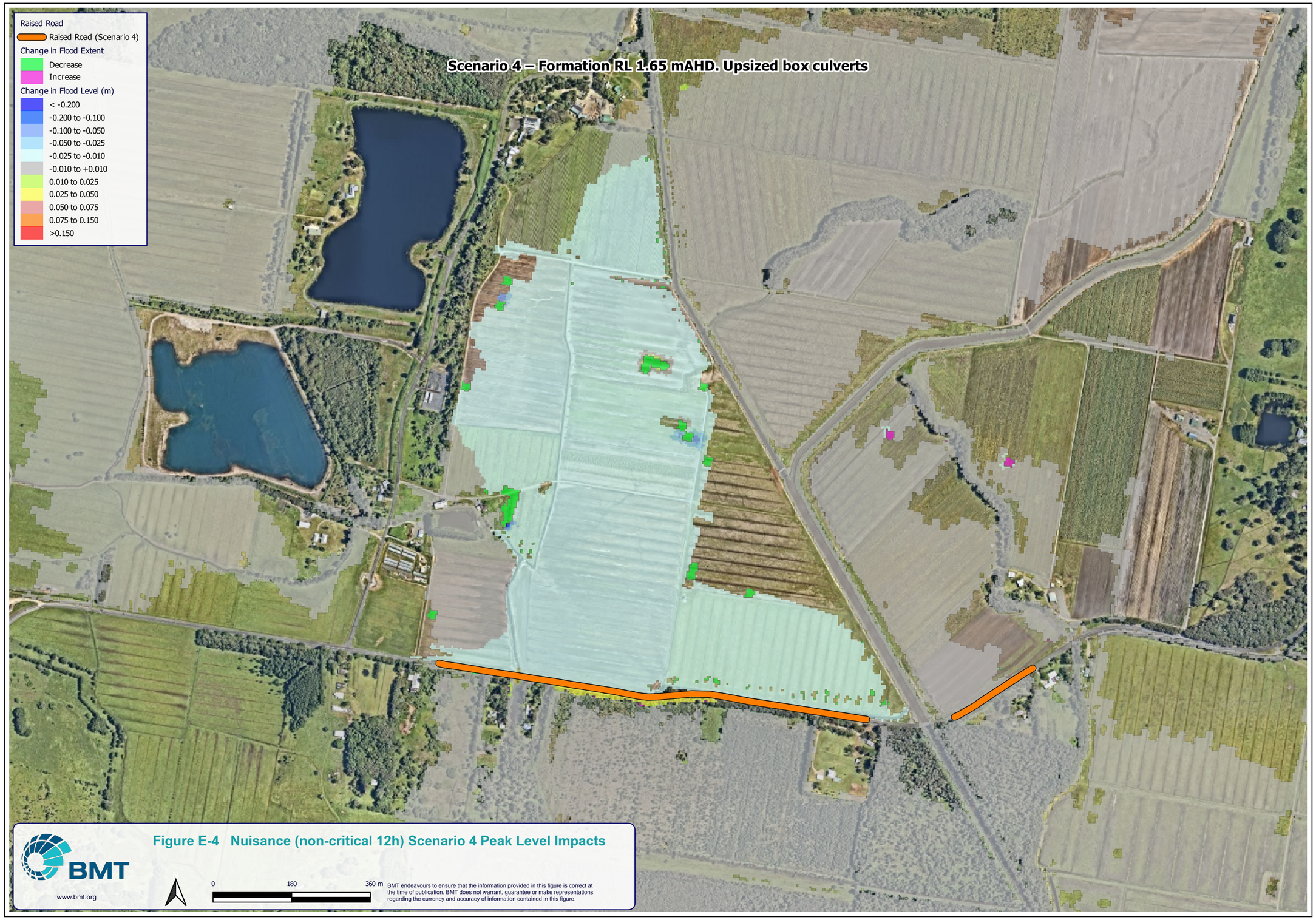


Figure E-4 Nuisance (non-critical 12h) Scenario 4 Peak Level Impacts

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5.1 Ross Lane Betterment

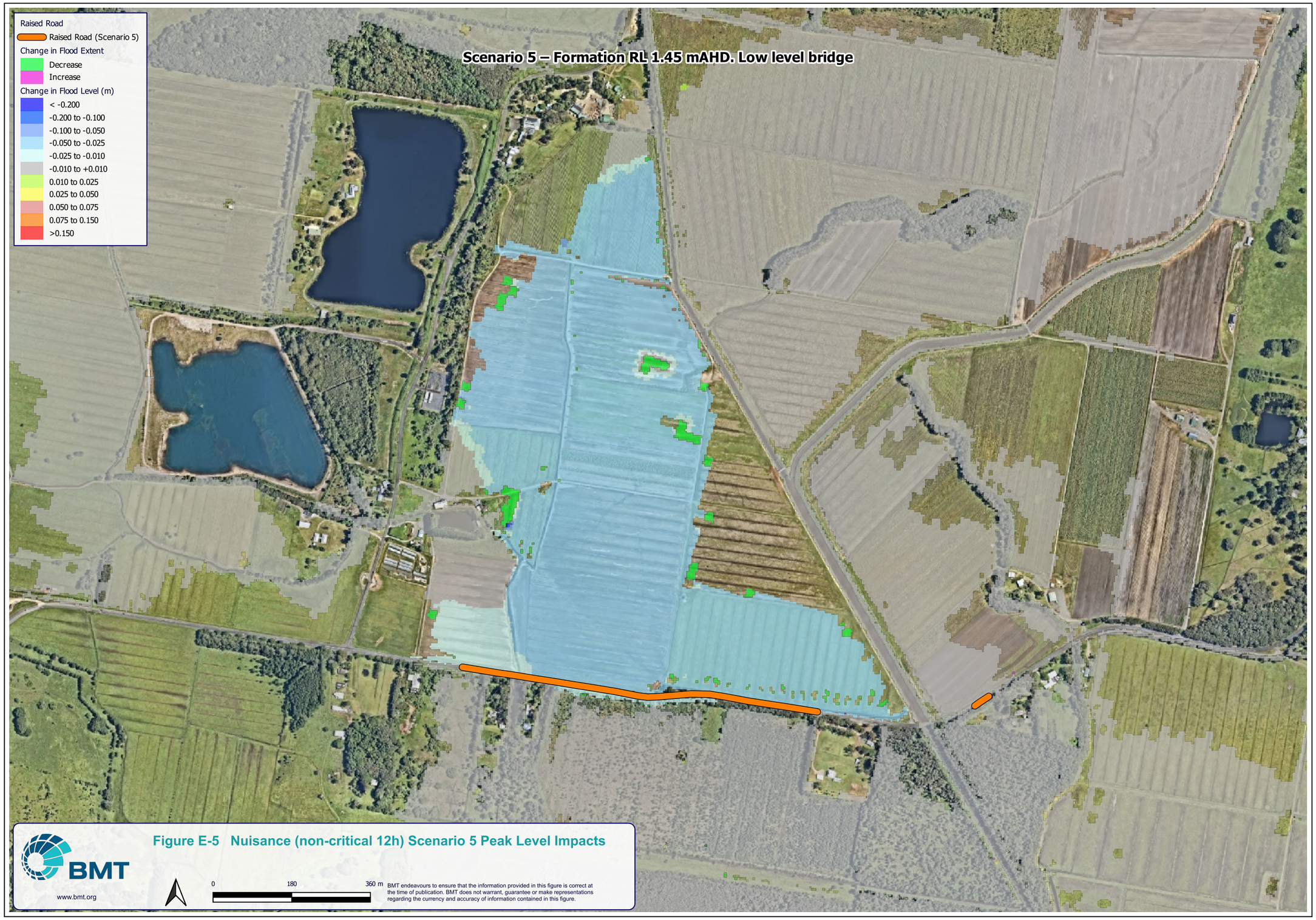


Figure E-5 Nuisance (non-critical 12h) Scenario 5 Peak Level Impacts

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5.1 Ross Lane Betterment

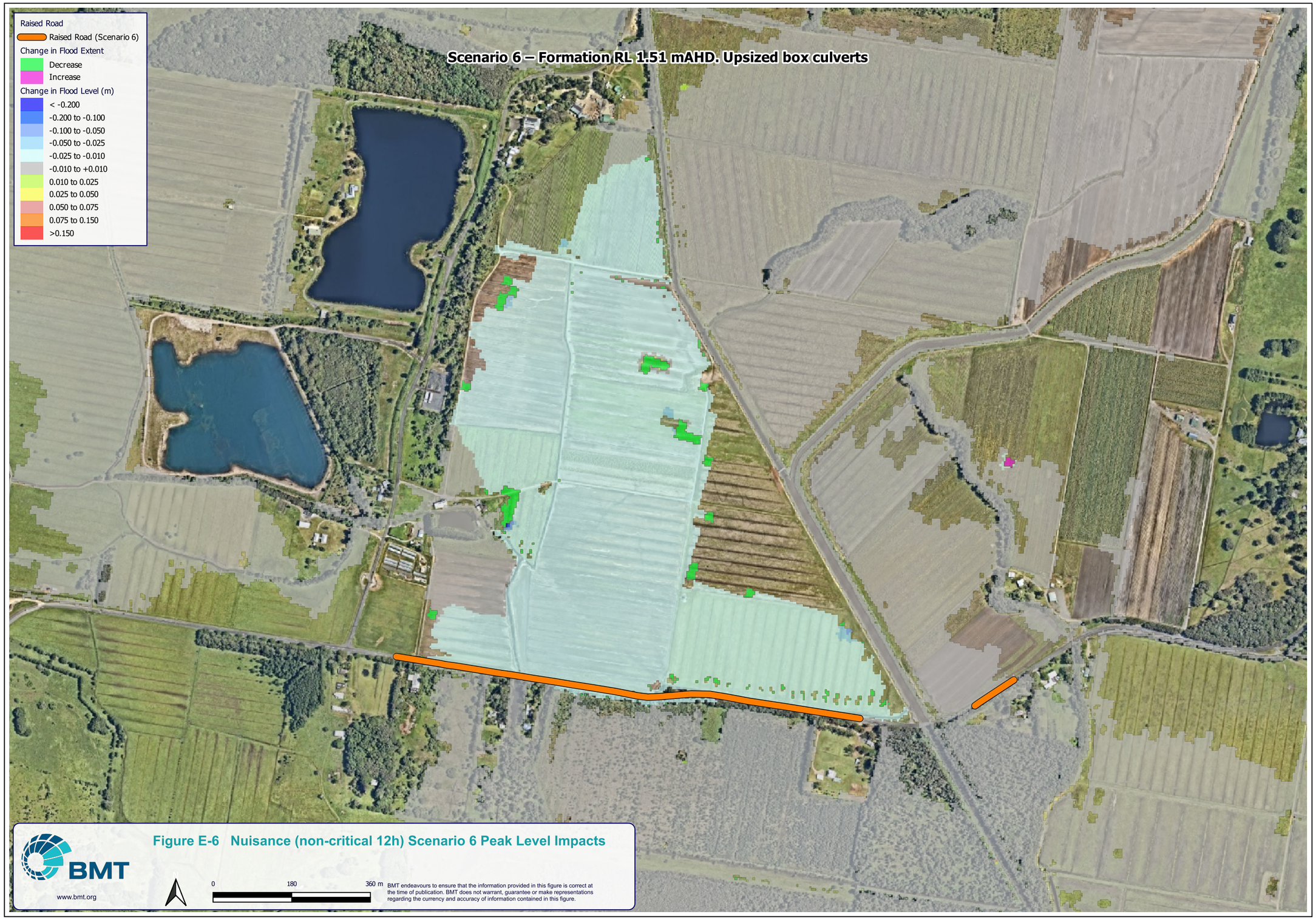


Figure E-6 Nuisance (non-critical 12h) Scenario 6 Peak Level Impacts

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5.1 Ross Lane Betterment

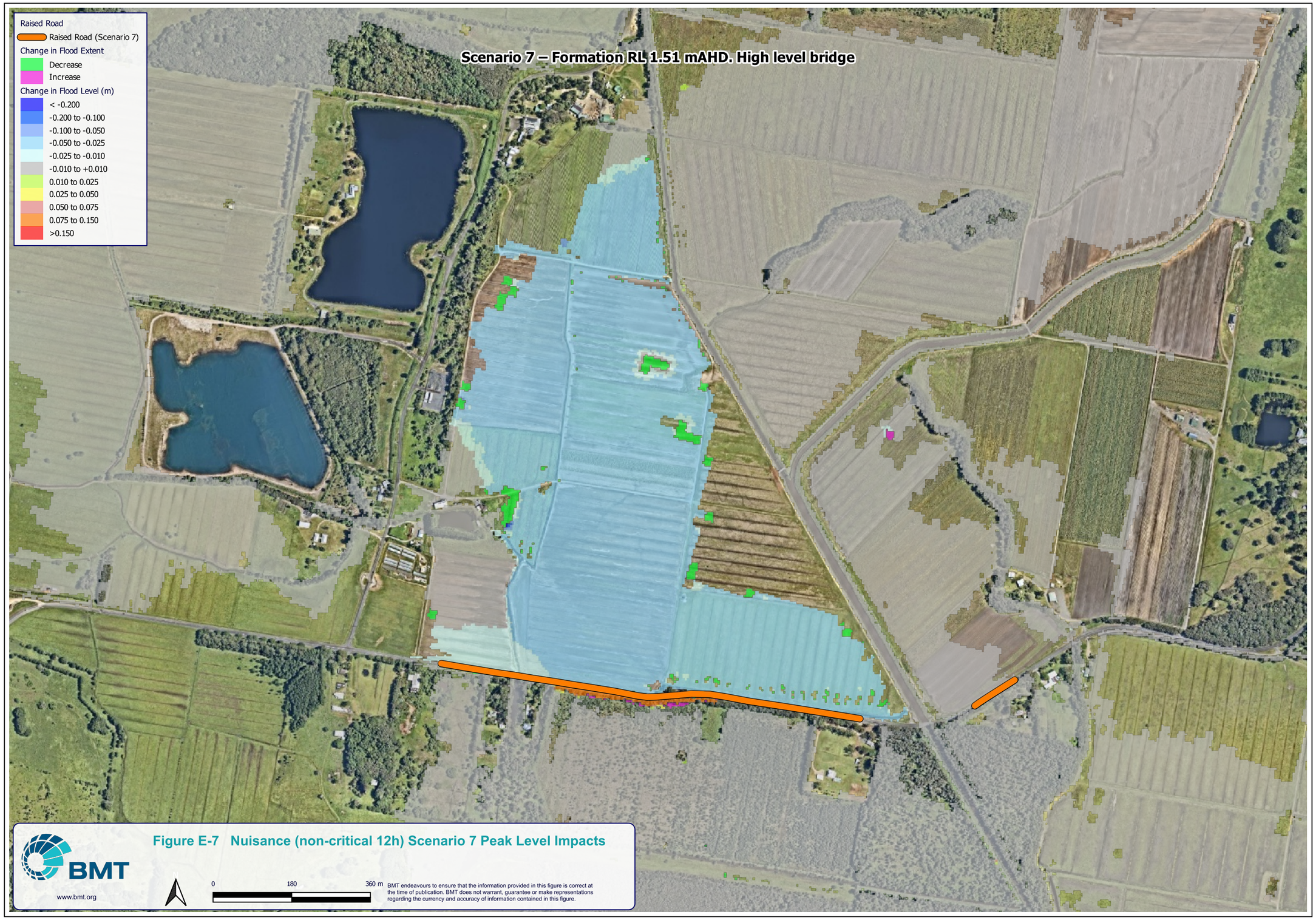


Figure E-7 Nuisance (non-critical 12h) Scenario 7 Peak Level Impacts

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5.1 Ross Lane Betterment

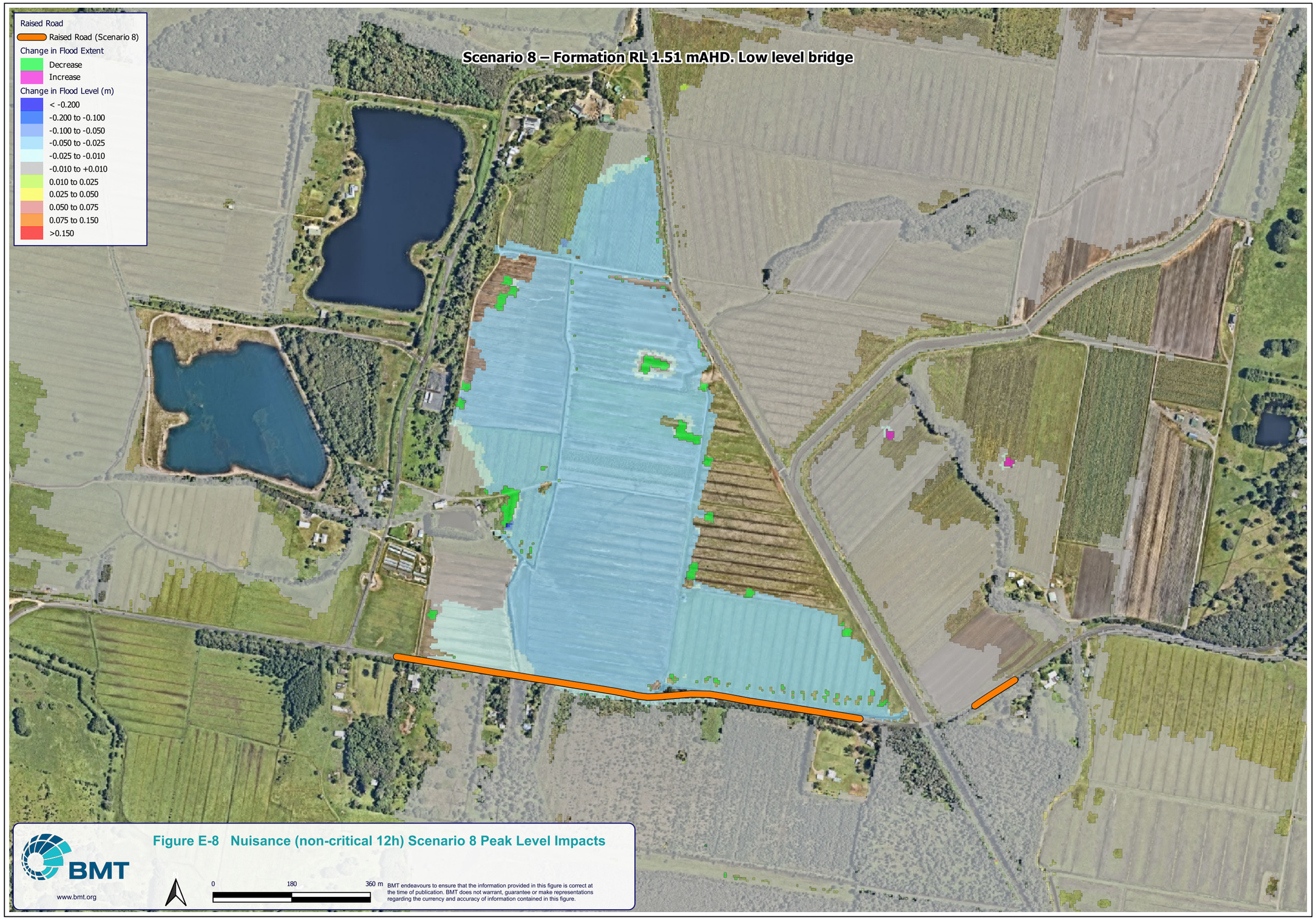


Figure E-8 Nuisance (non-critical 12h) Scenario 8 Peak Level Impacts

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5.1 Ross Lane Betterment

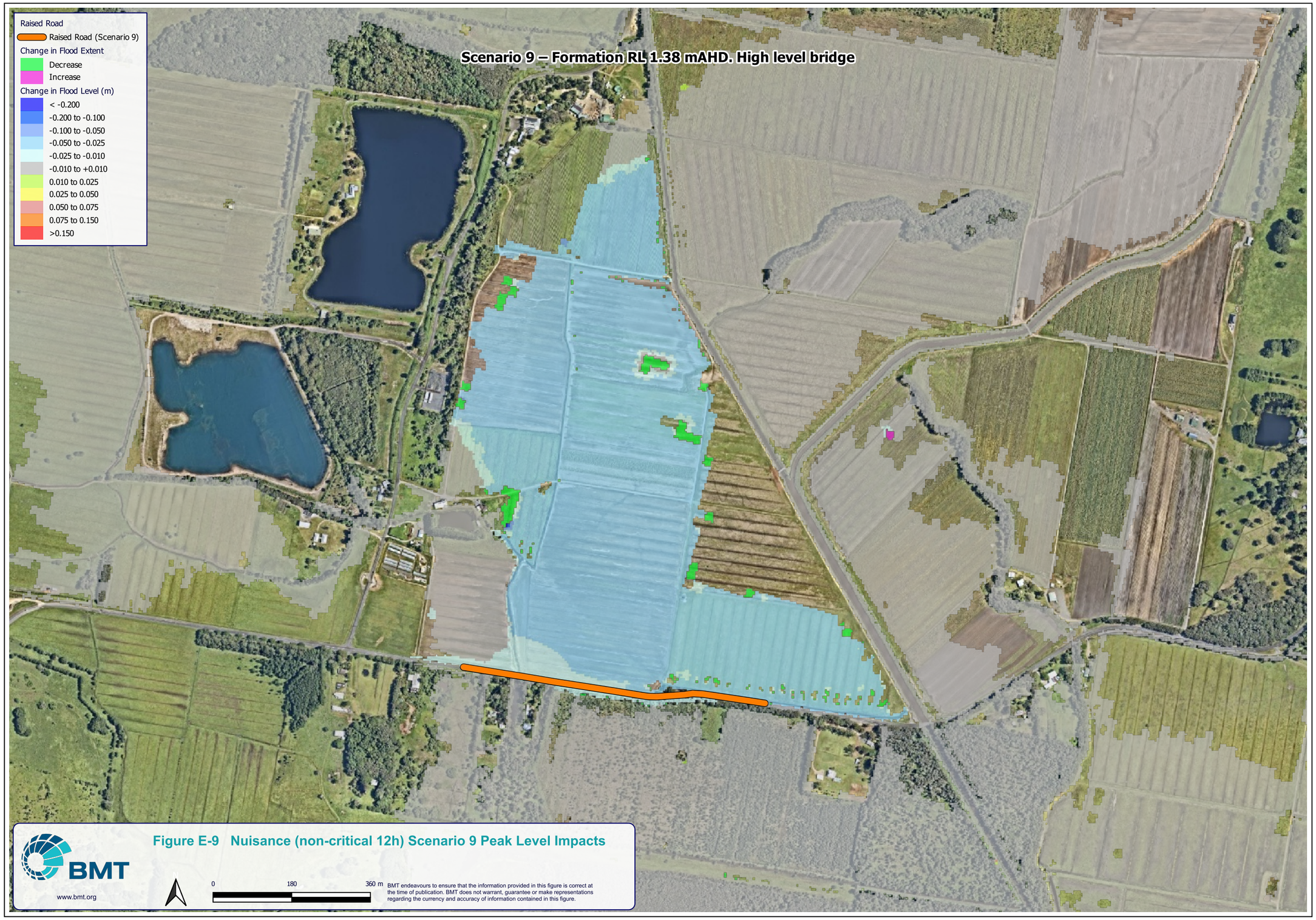


Figure E-9 Nuisance (non-critical 12h) Scenario 9 Peak Level Impacts

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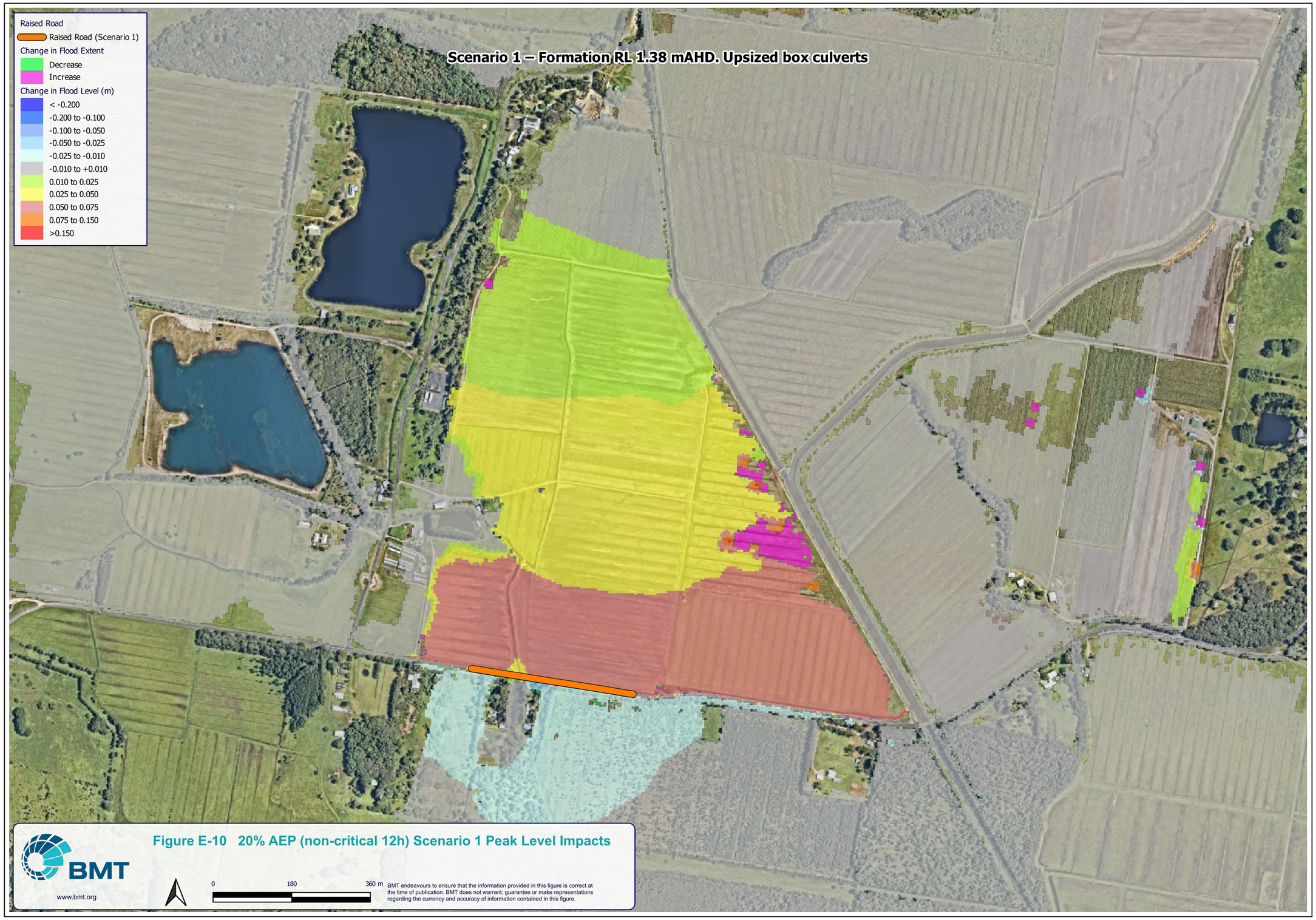


Figure E-10 20% AEP (non-critical 12h) Scenario 1 Peak Level Impacts

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5.1 Ross Lane Betterment

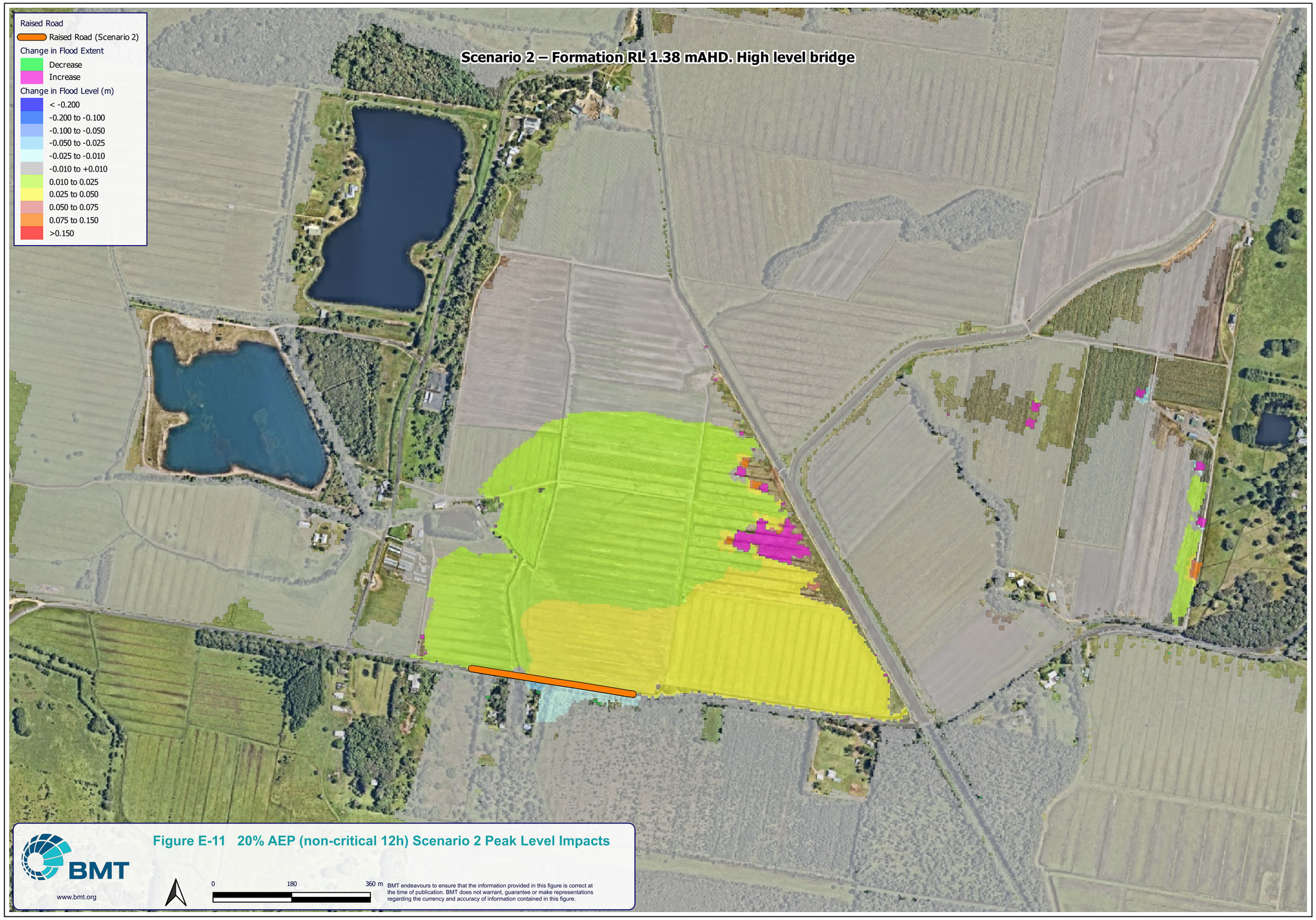


Figure E-11 20% AEP (non-critical 12h) Scenario 2 Peak Level Impacts

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5.1 Ross Lane Betterment

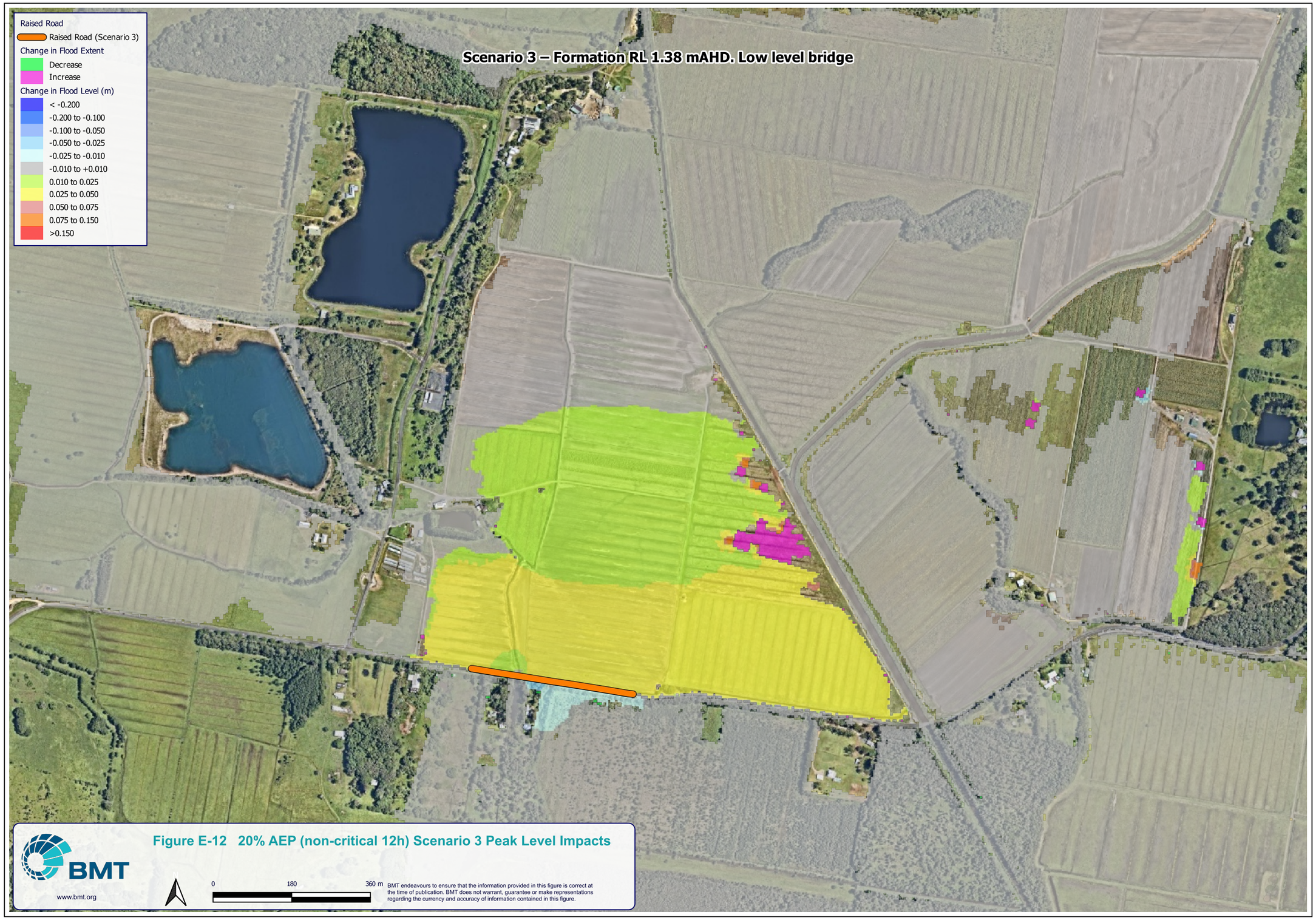


Figure E-12 20% AEP (non-critical 12h) Scenario 3 Peak Level Impacts

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5.1 Ross Lane Betterment

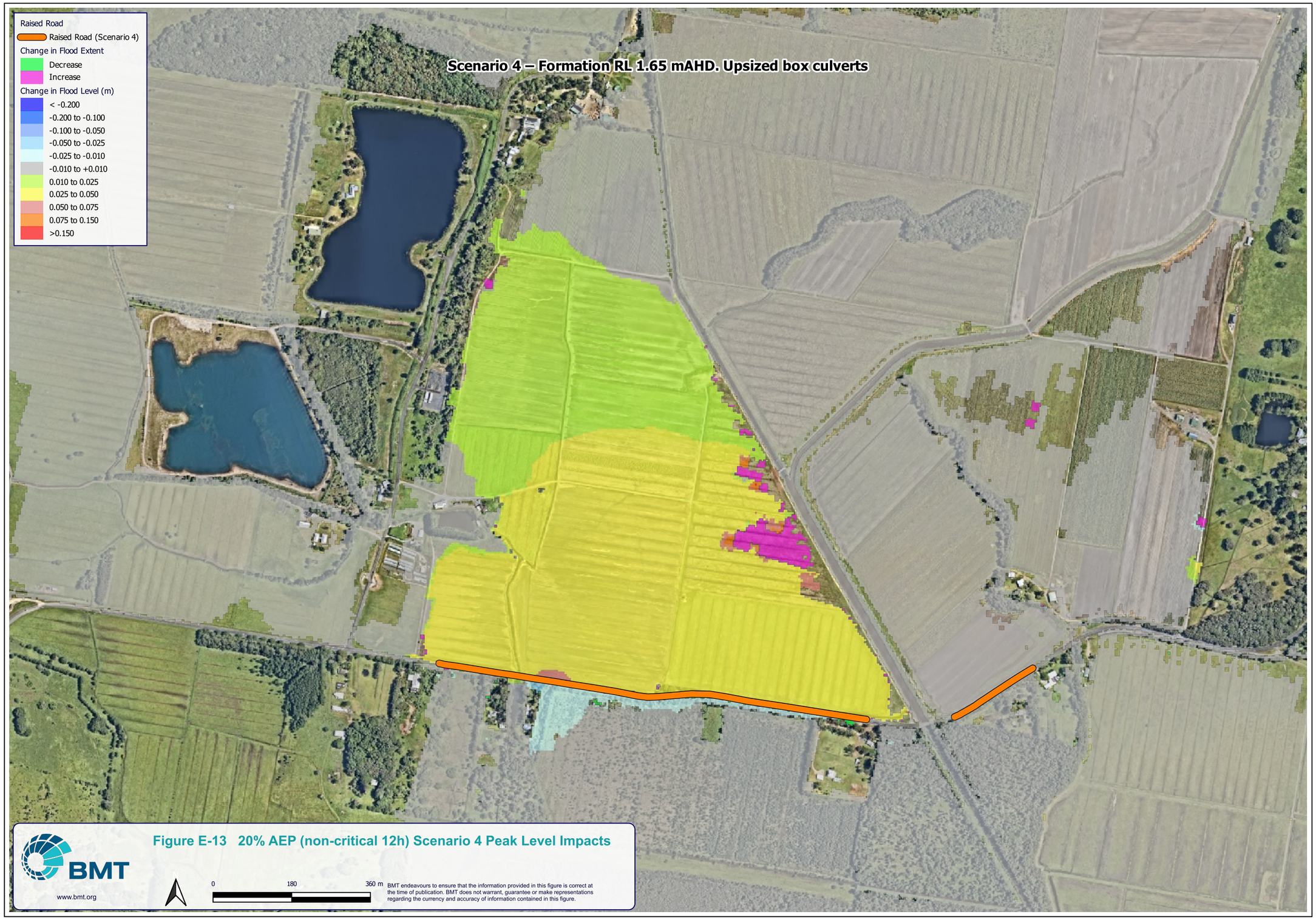


Figure E-13 20% AEP (non-critical 12h) Scenario 4 Peak Level Impacts

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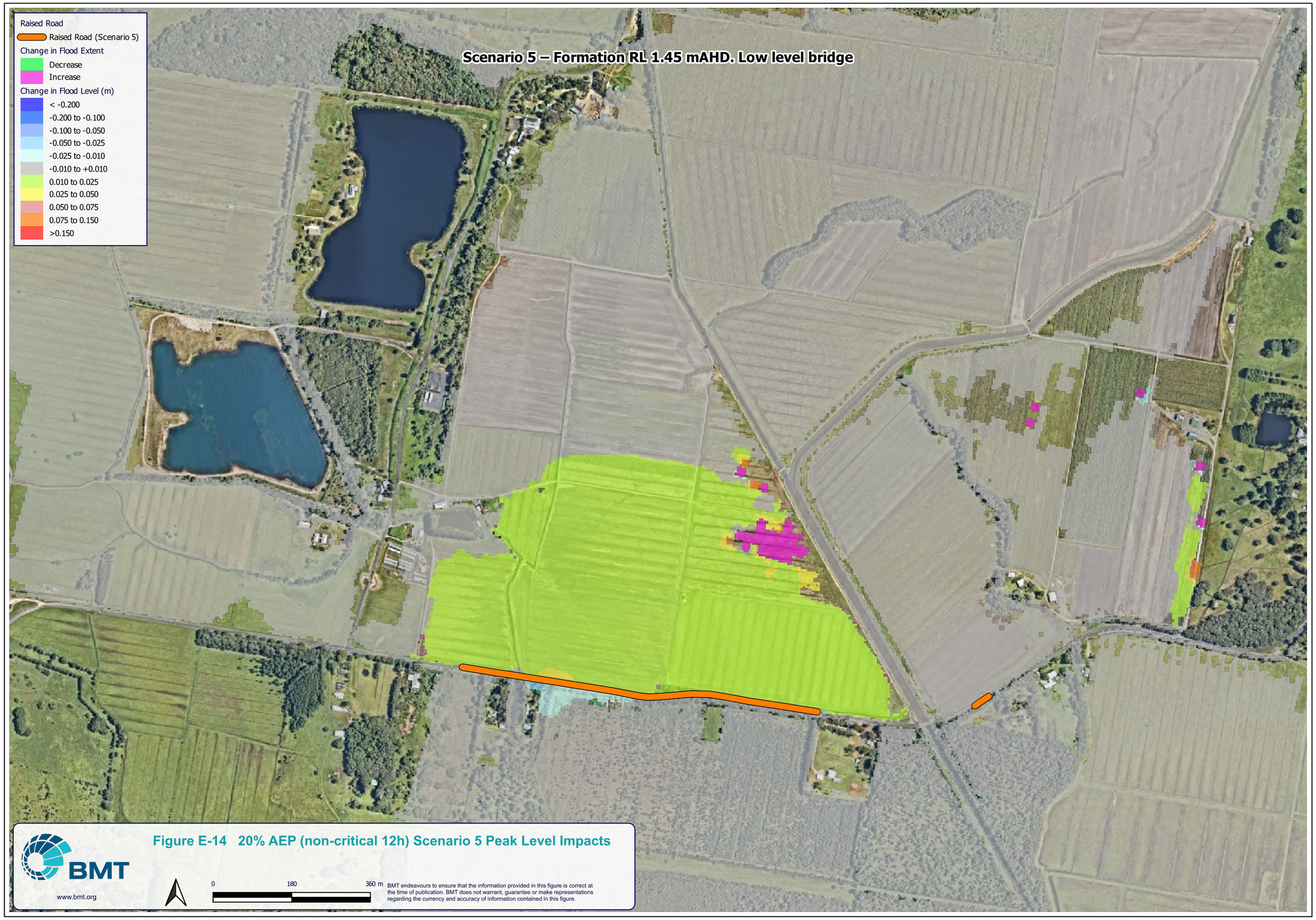


Figure E-14 20% AEP (non-critical 12h) Scenario 5 Peak Level Impacts

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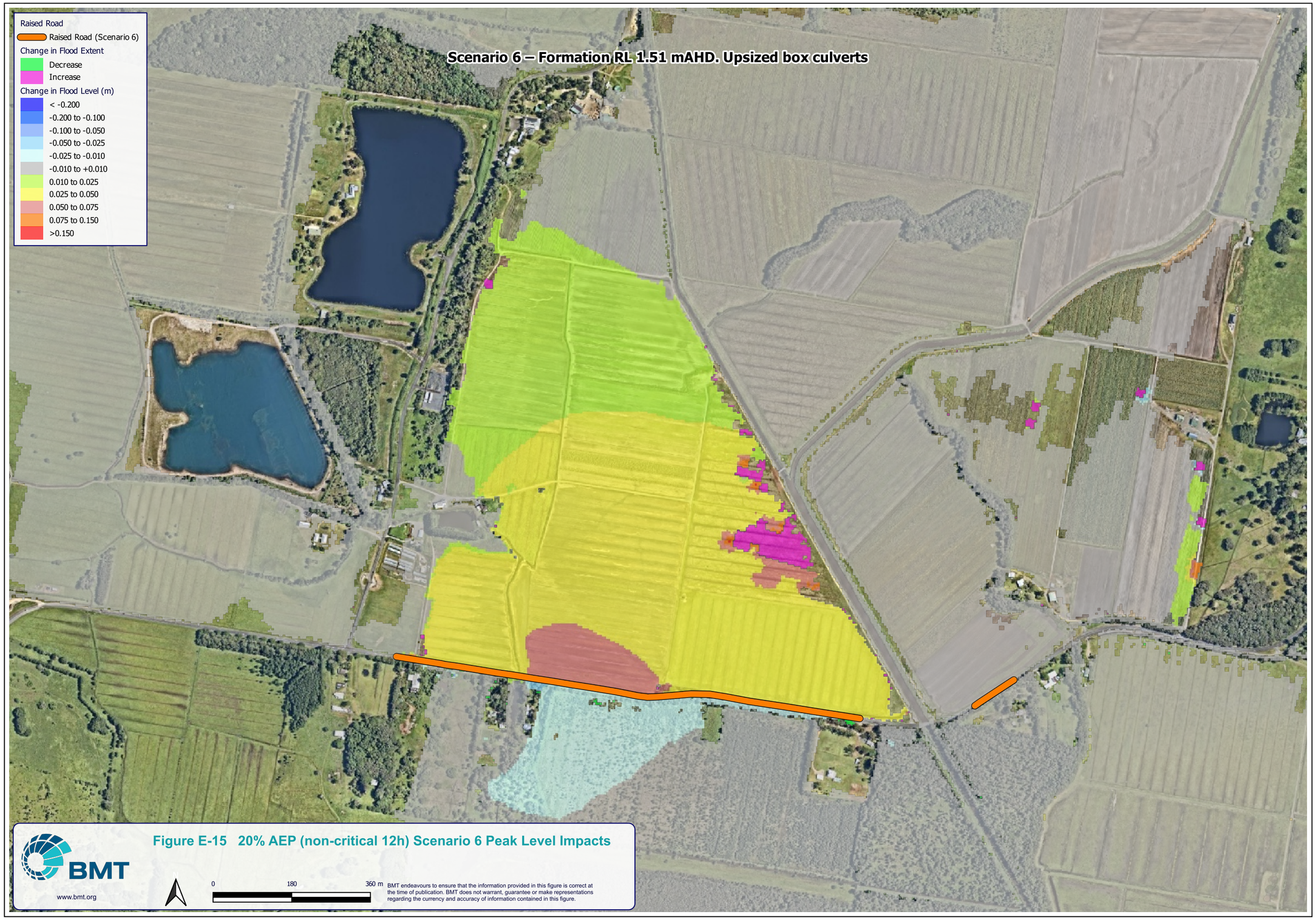


Figure E-15 20% AEP (non-critical 12h) Scenario 6 Peak Level Impacts

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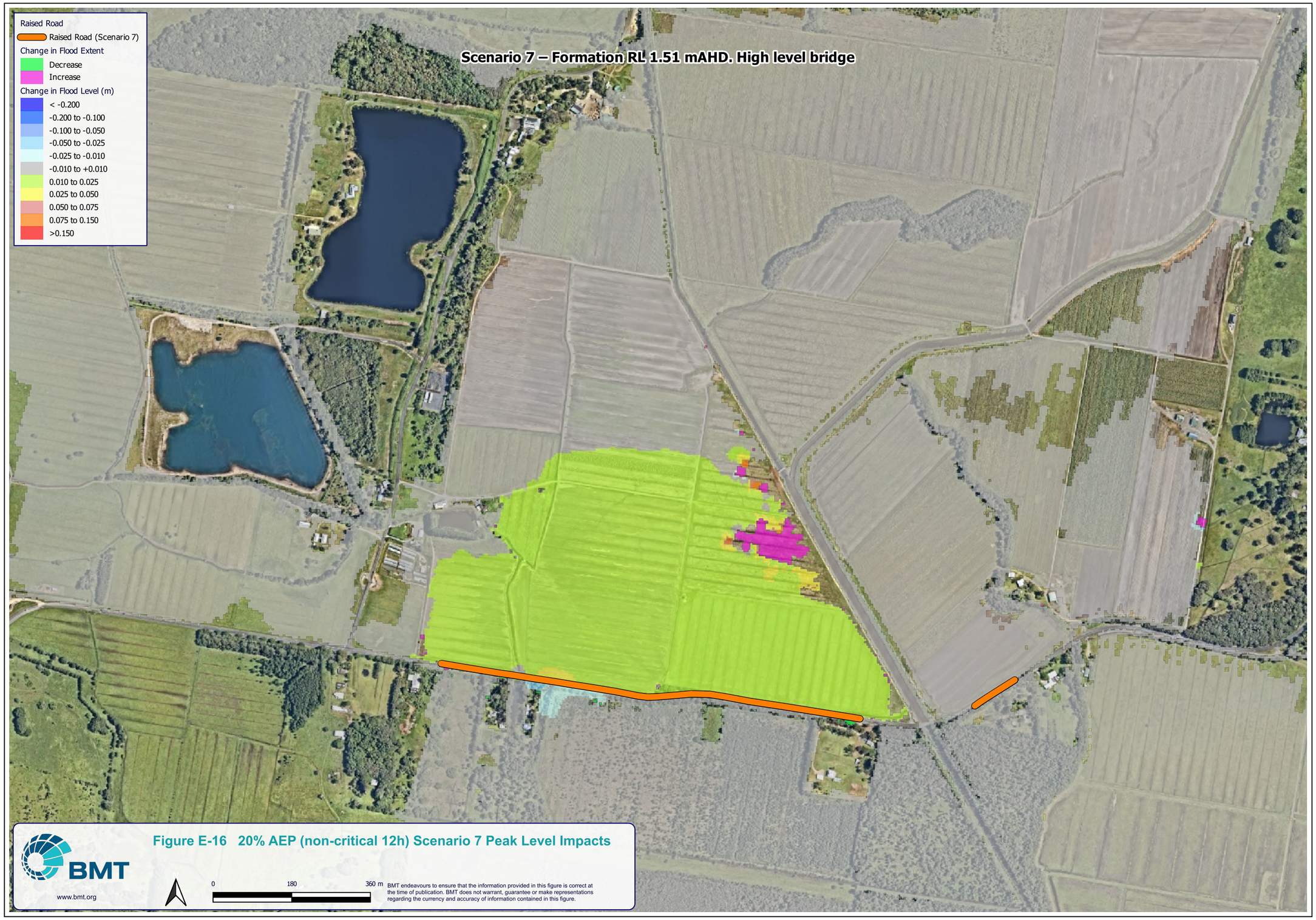


Figure E-16 20% AEP (non-critical 12h) Scenario 7 Peak Level Impacts

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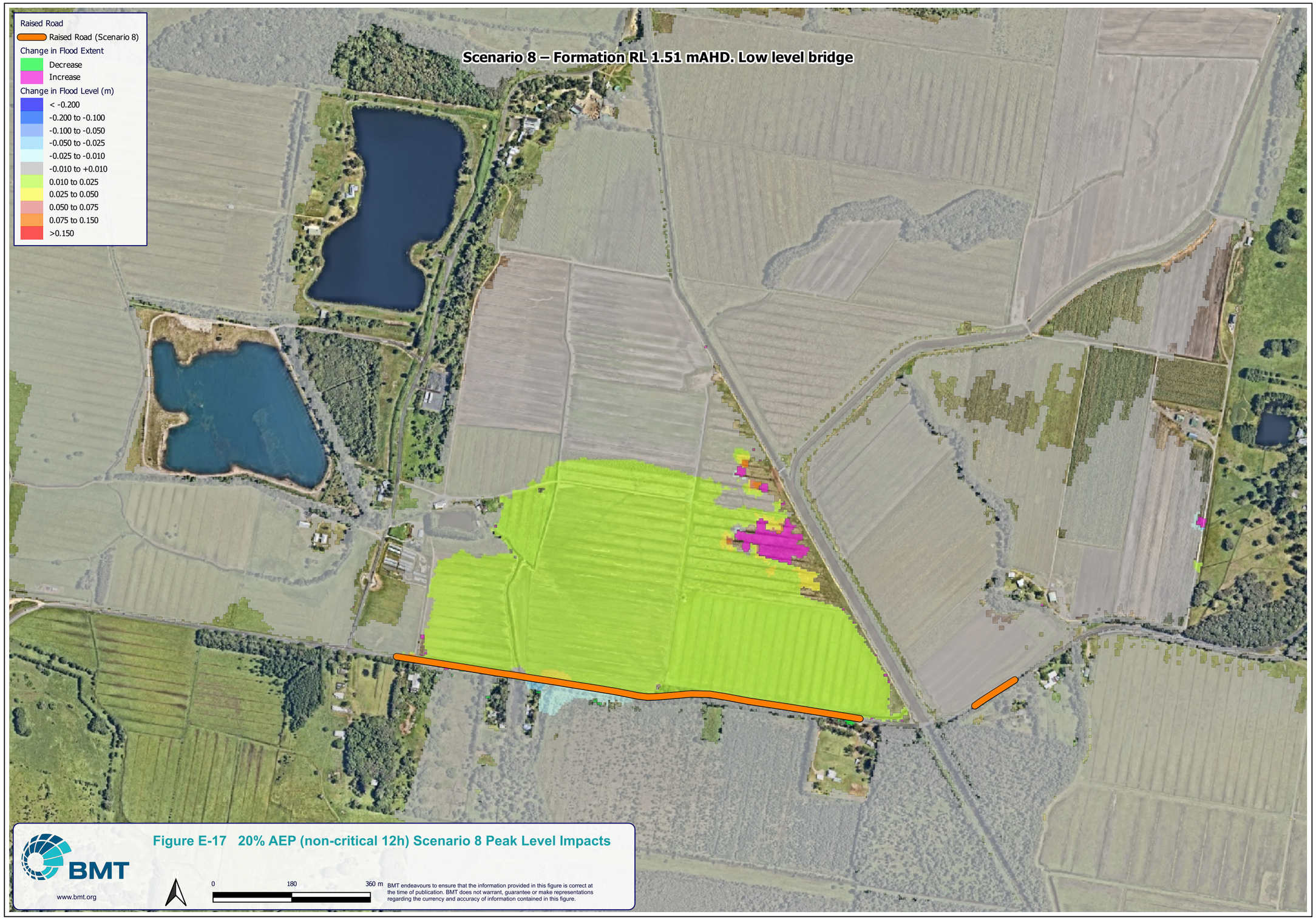


Figure E-17 20% AEP (non-critical 12h) Scenario 8 Peak Level Impacts

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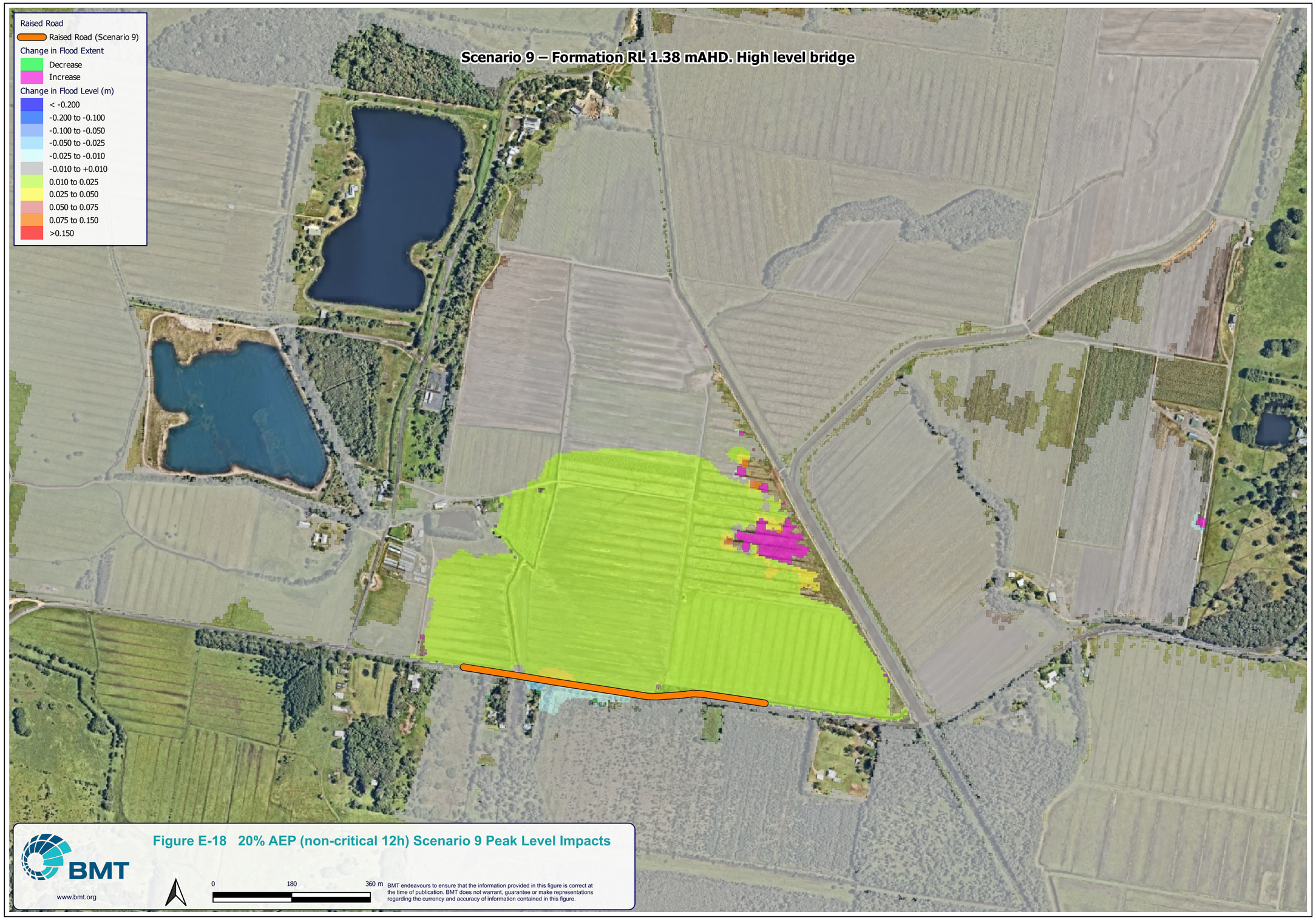


Figure E-18 20% AEP (non-critical 12h) Scenario 9 Peak Level Impacts

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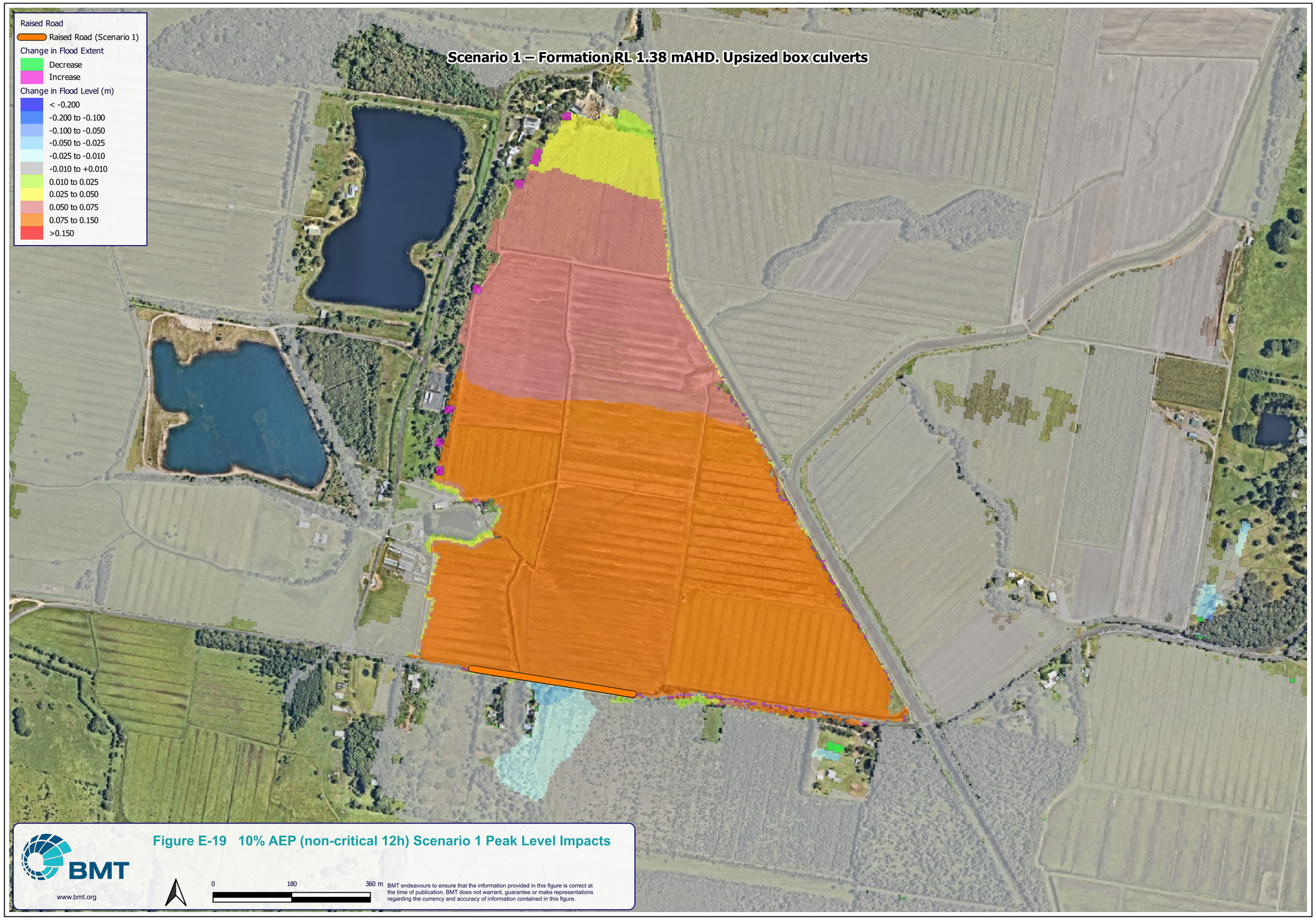


Figure E-19 10% AEP (non-critical 12h) Scenario 1 Peak Level Impacts

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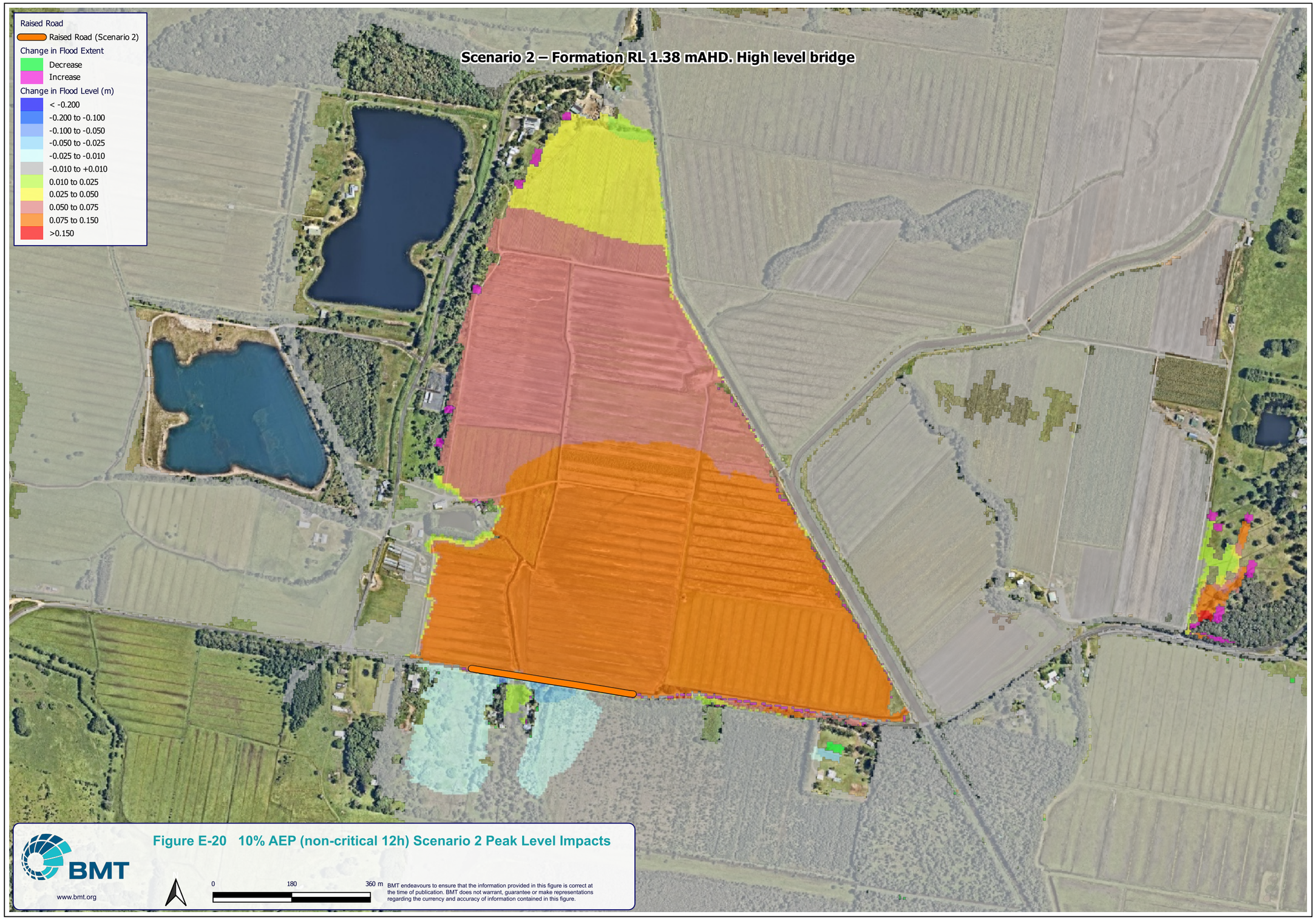


Figure E-20 10% AEP (non-critical 12h) Scenario 2 Peak Level Impacts

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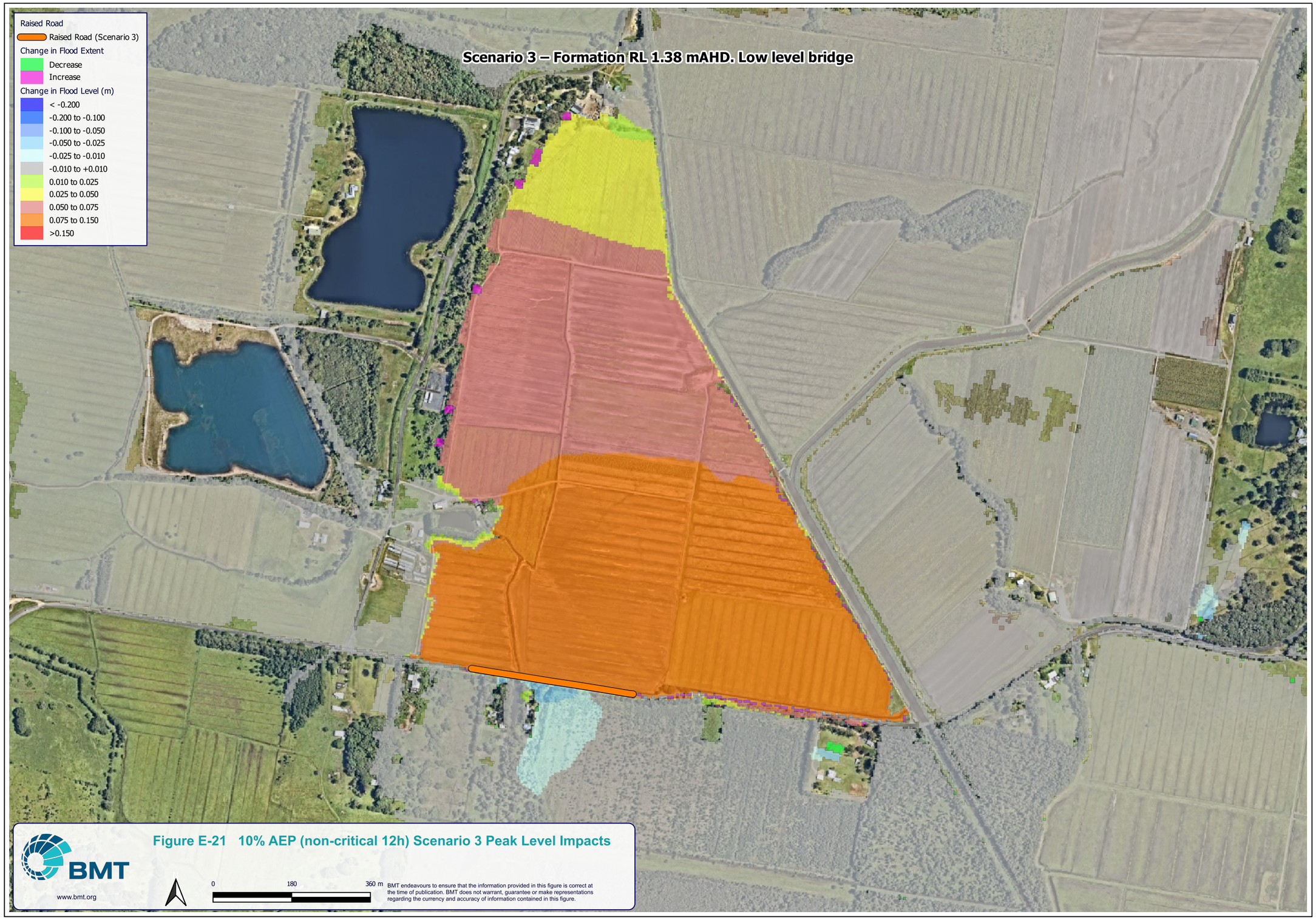


Figure E-21 10% AEP (non-critical 12h) Scenario 3 Peak Level Impacts

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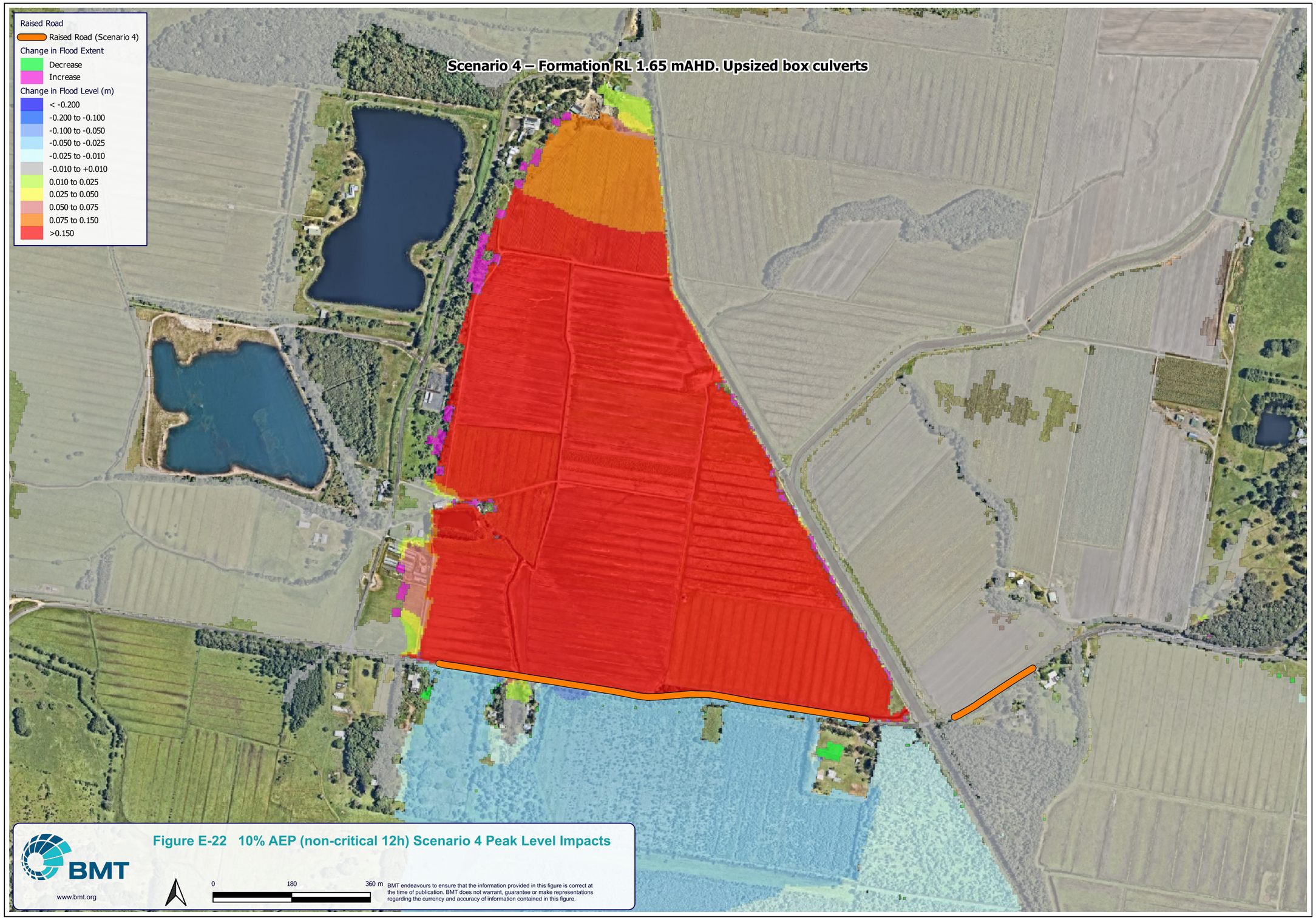


Figure E-22 10% AEP (non-critical 12h) Scenario 4 Peak Level Impacts

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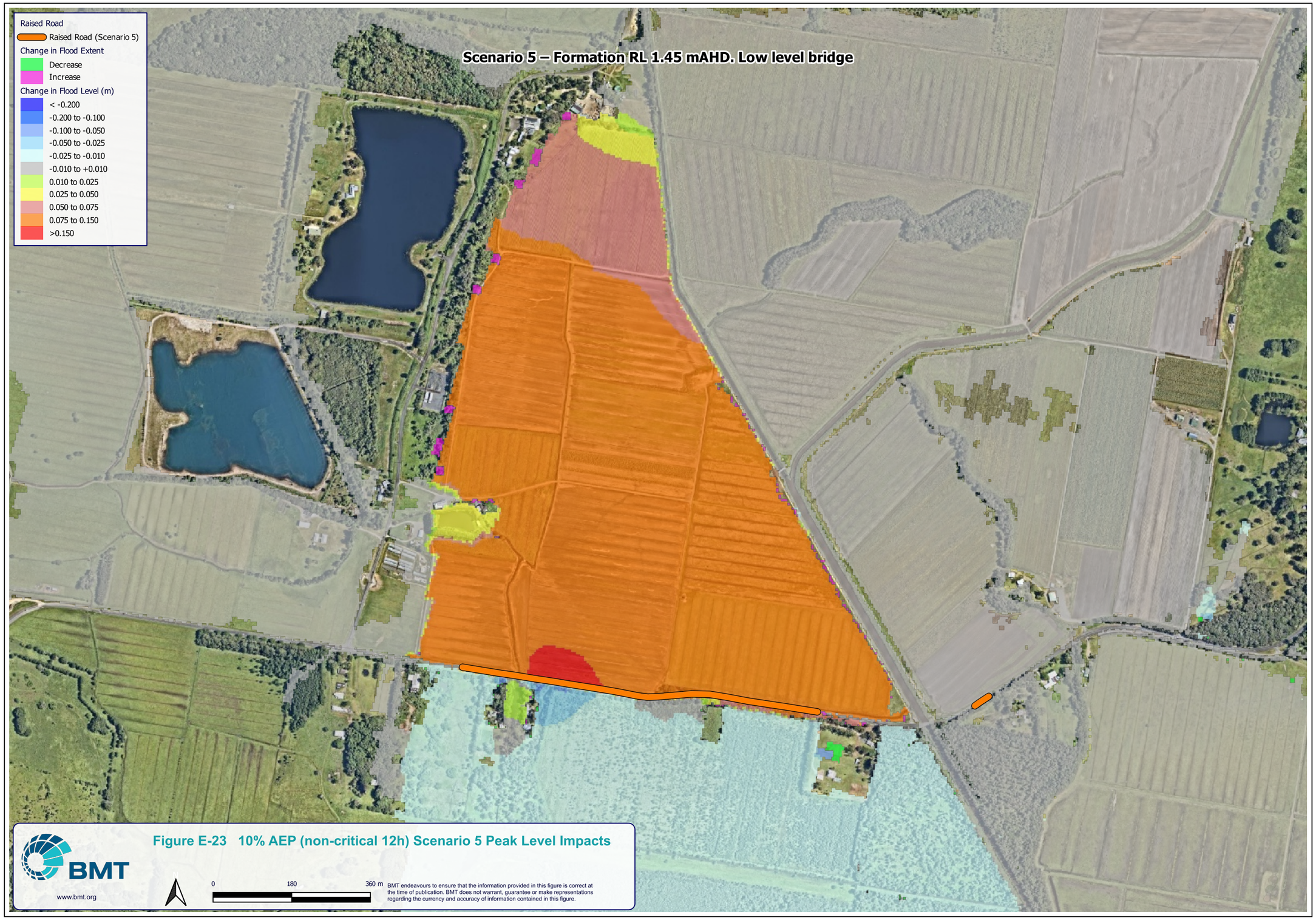


Figure E-23 10% AEP (non-critical 12h) Scenario 5 Peak Level Impacts

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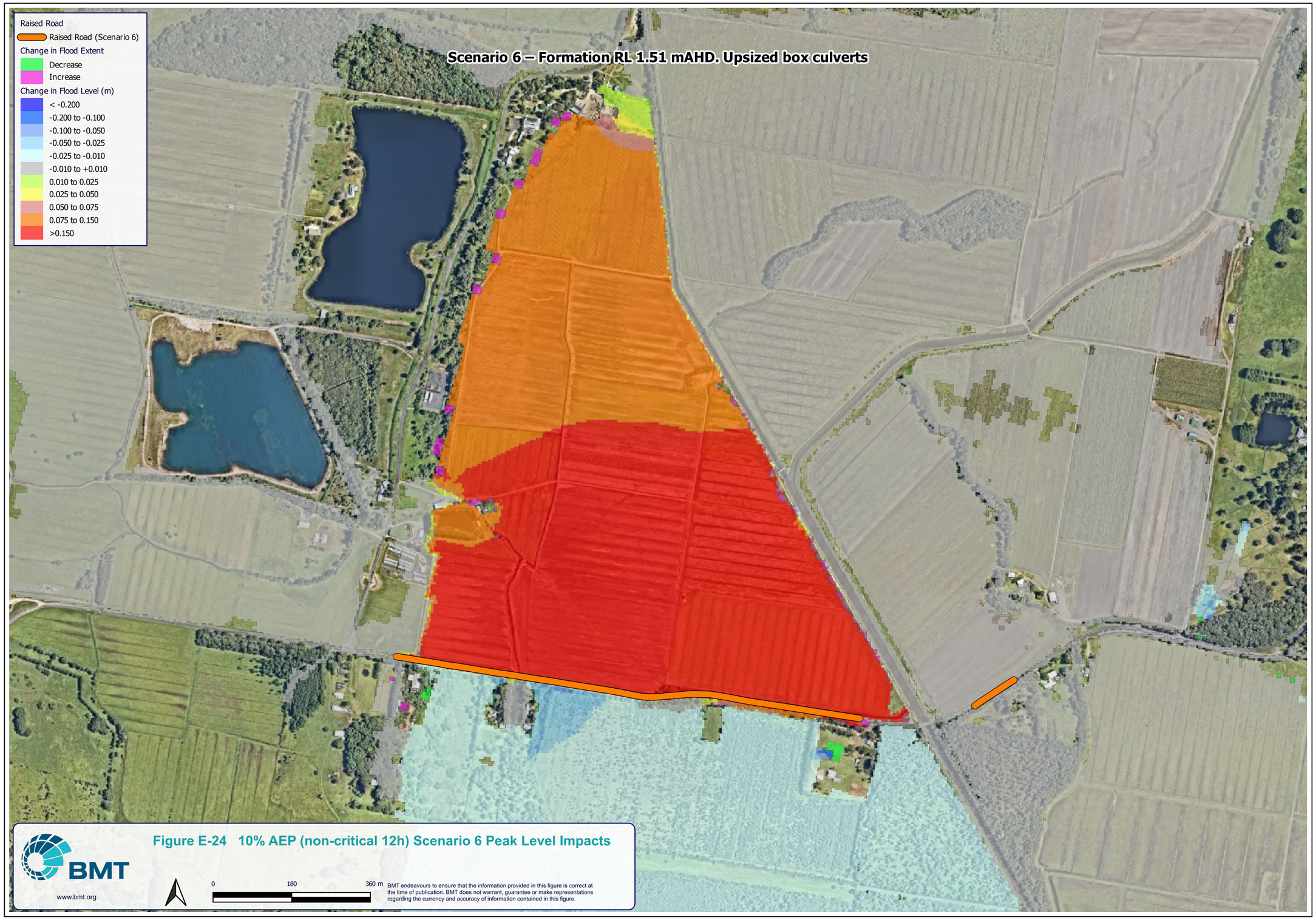


Figure E-24 10% AEP (non-critical 12h) Scenario 6 Peak Level Impacts

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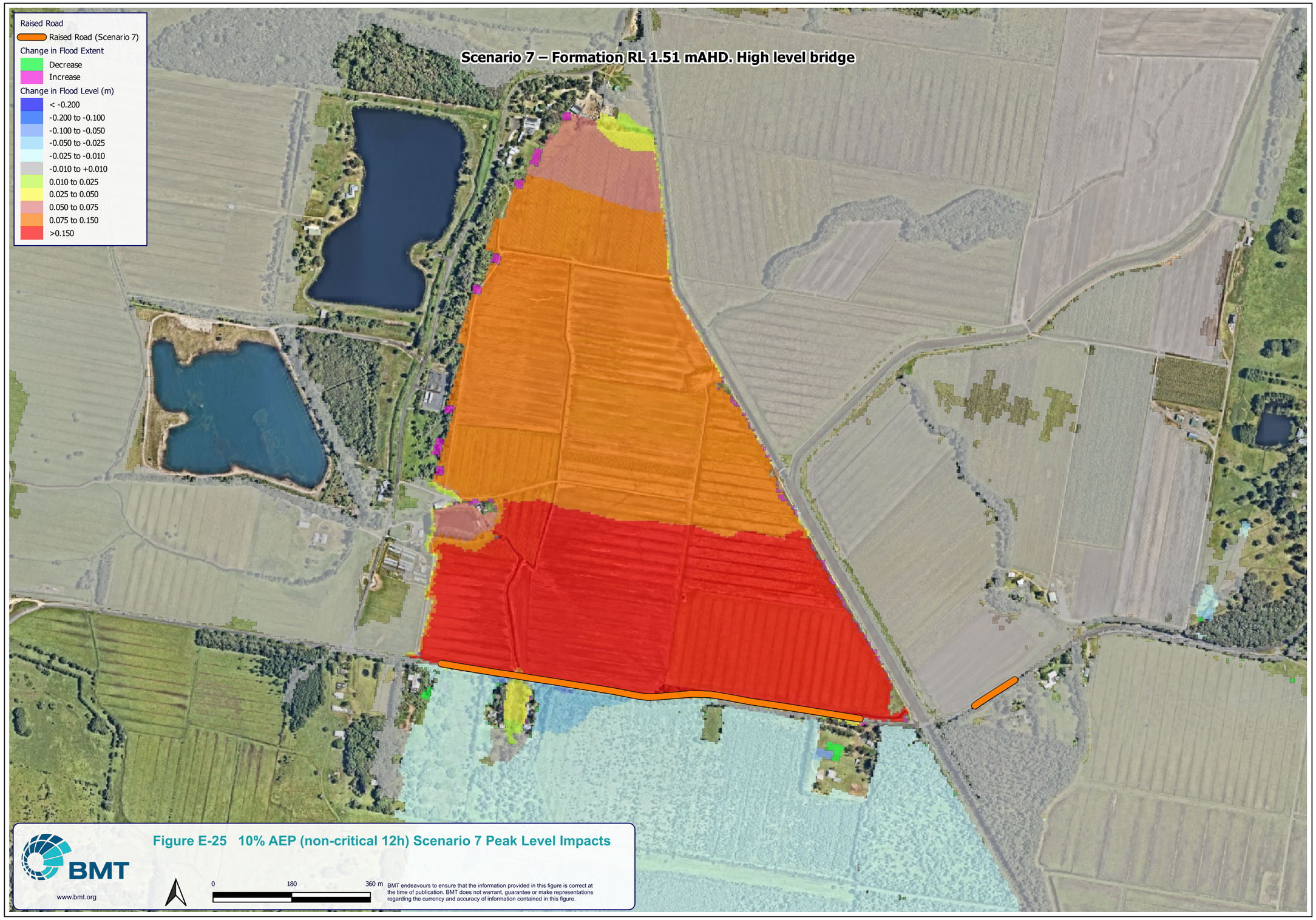


Figure E-25 10% AEP (non-critical 12h) Scenario 7 Peak Level Impacts

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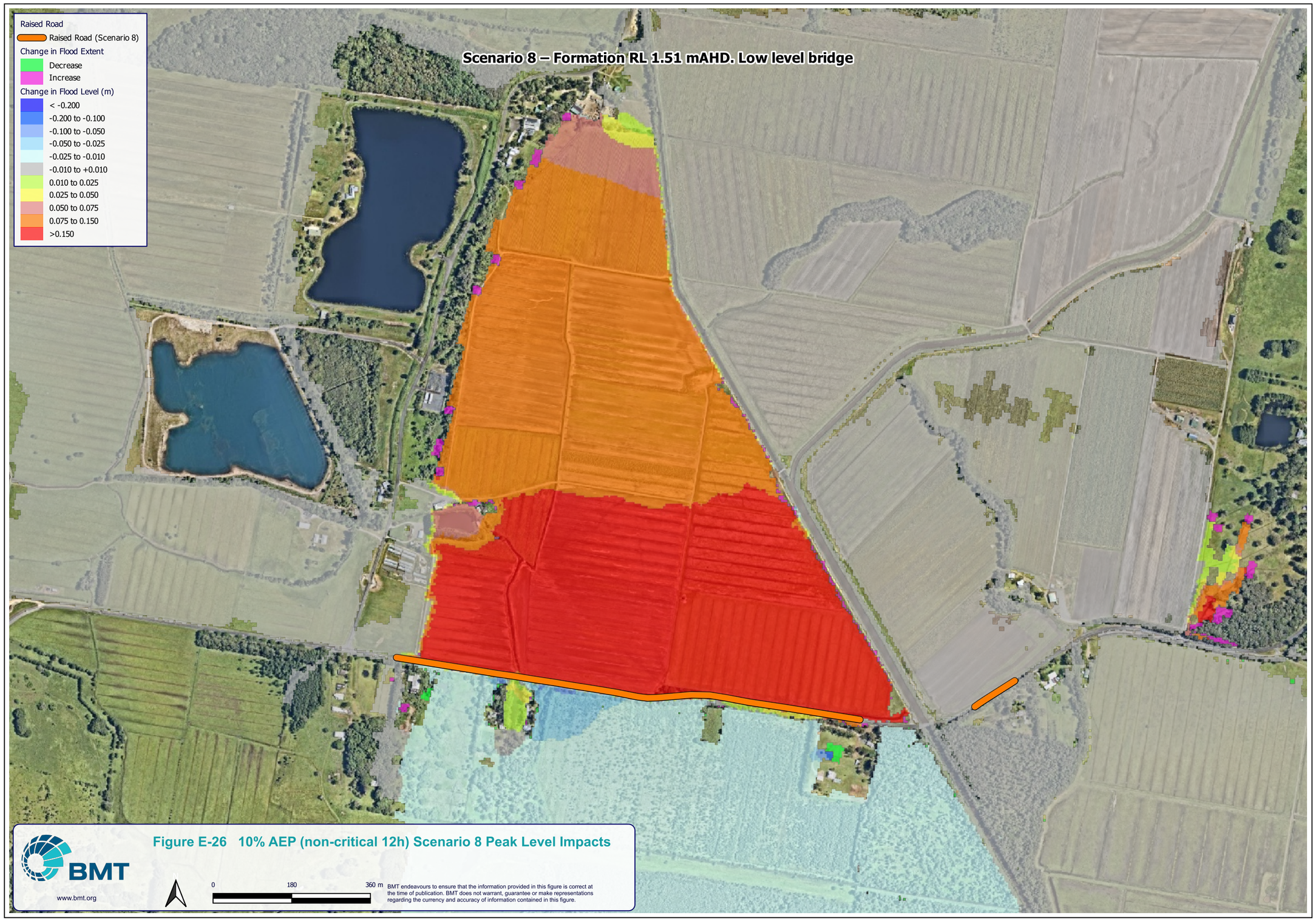


Figure E-26 10% AEP (non-critical 12h) Scenario 8 Peak Level Impacts

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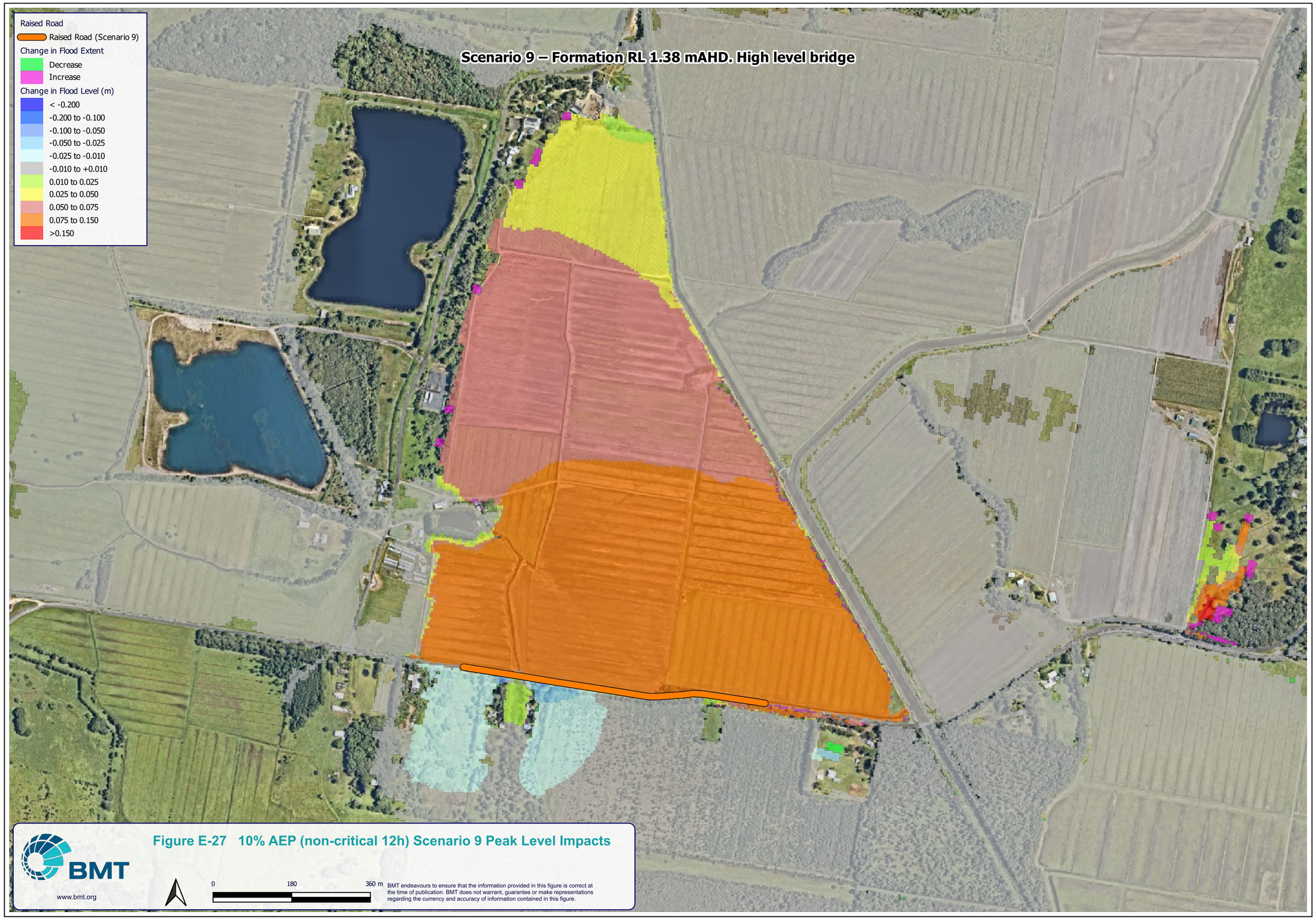


Figure E-27 10% AEP (non-critical 12h) Scenario 9 Peak Level Impacts

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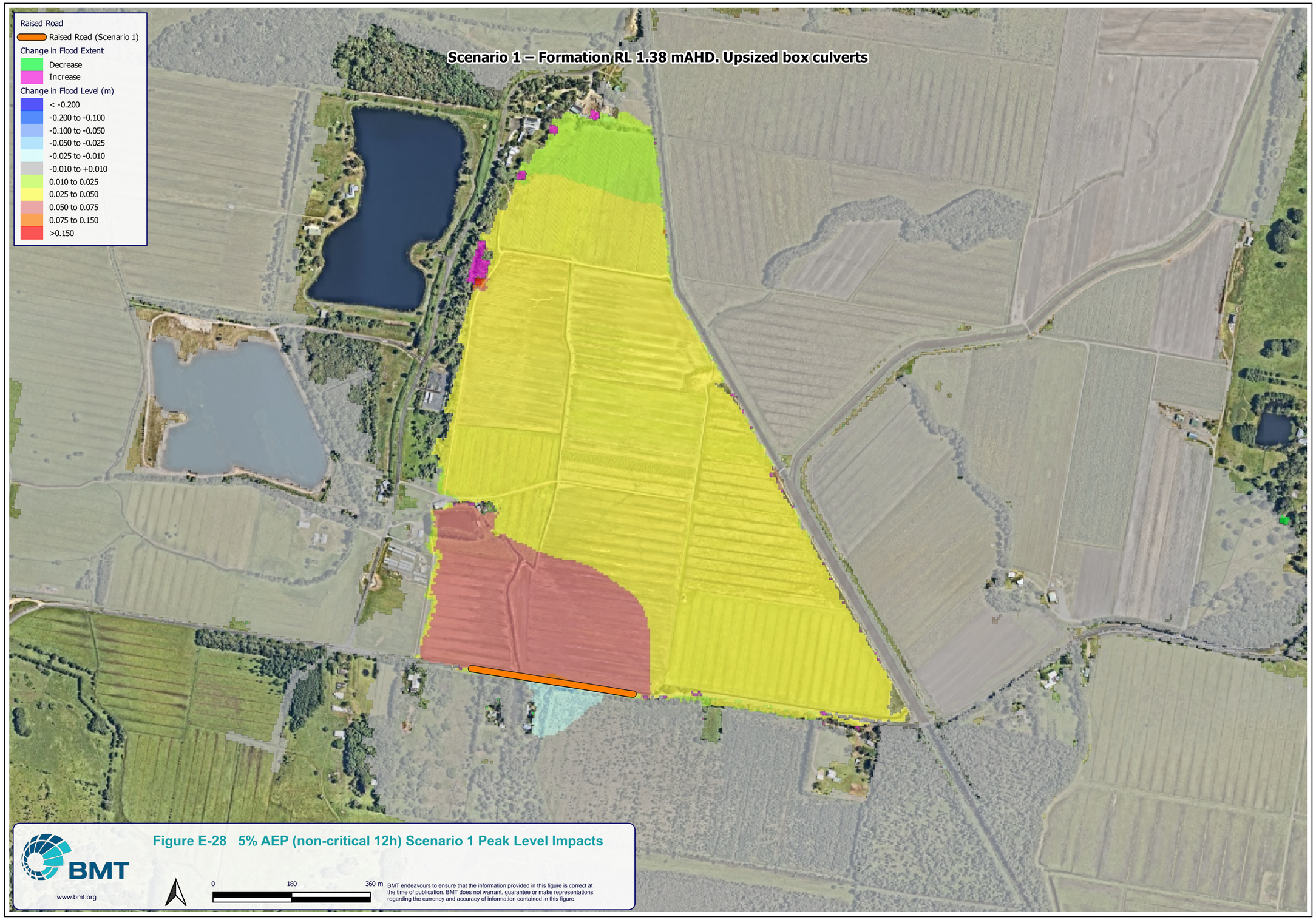


Figure E-28 5% AEP (non-critical 12h) Scenario 1 Peak Level Impacts

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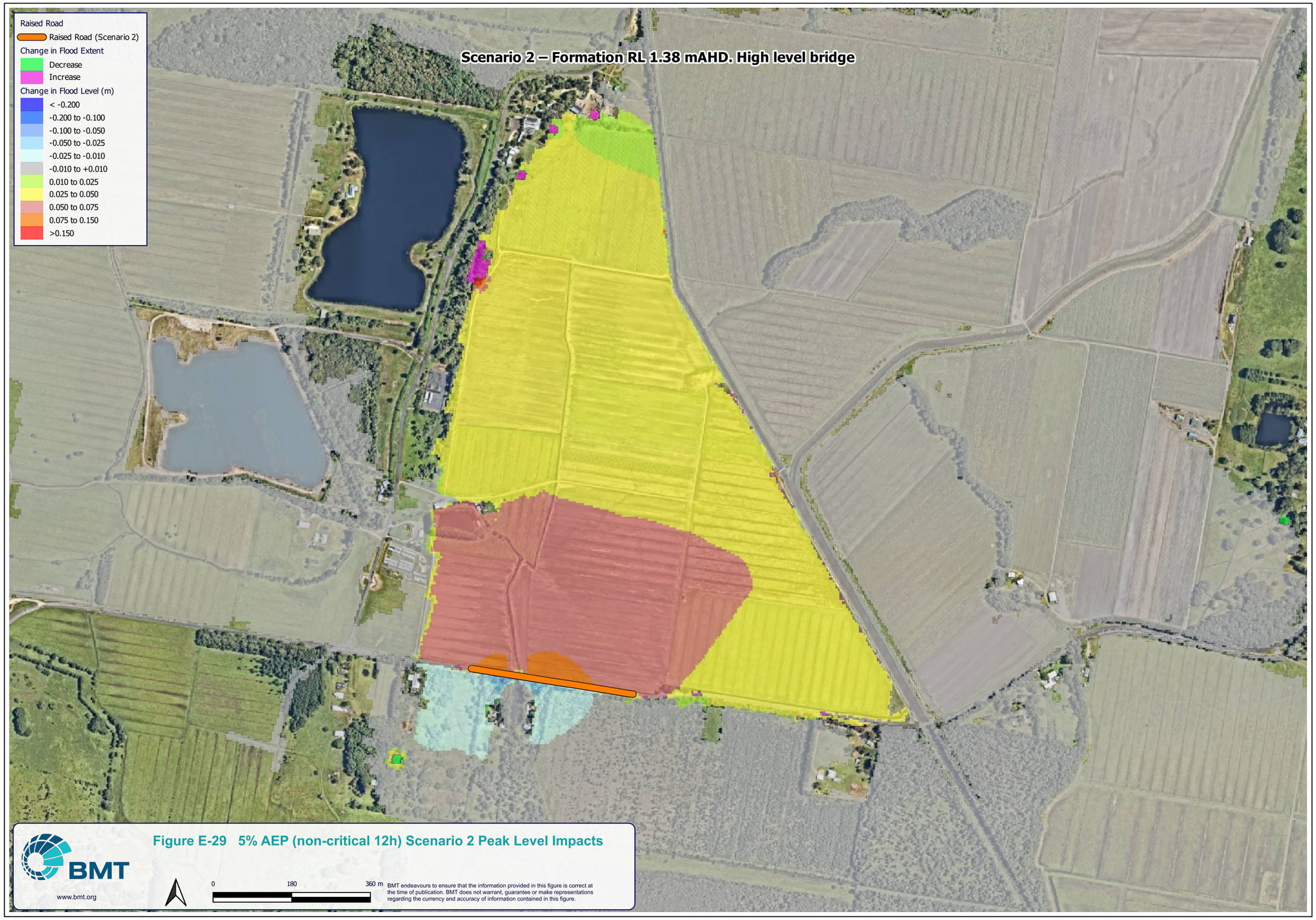


Figure E-29 5% AEP (non-critical 12h) Scenario 2 Peak Level Impacts

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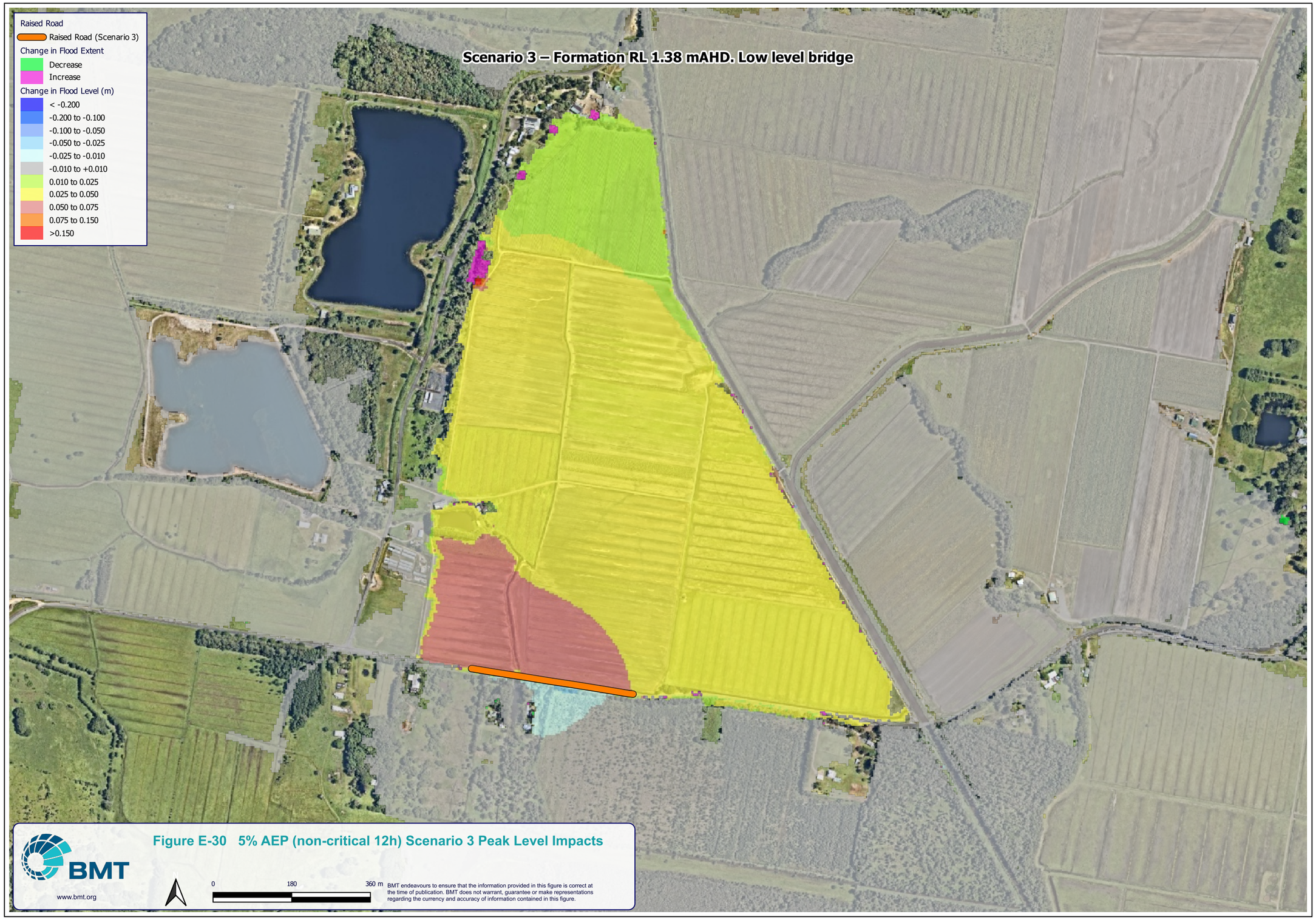


Figure E-30 5% AEP (non-critical 12h) Scenario 3 Peak Level Impacts

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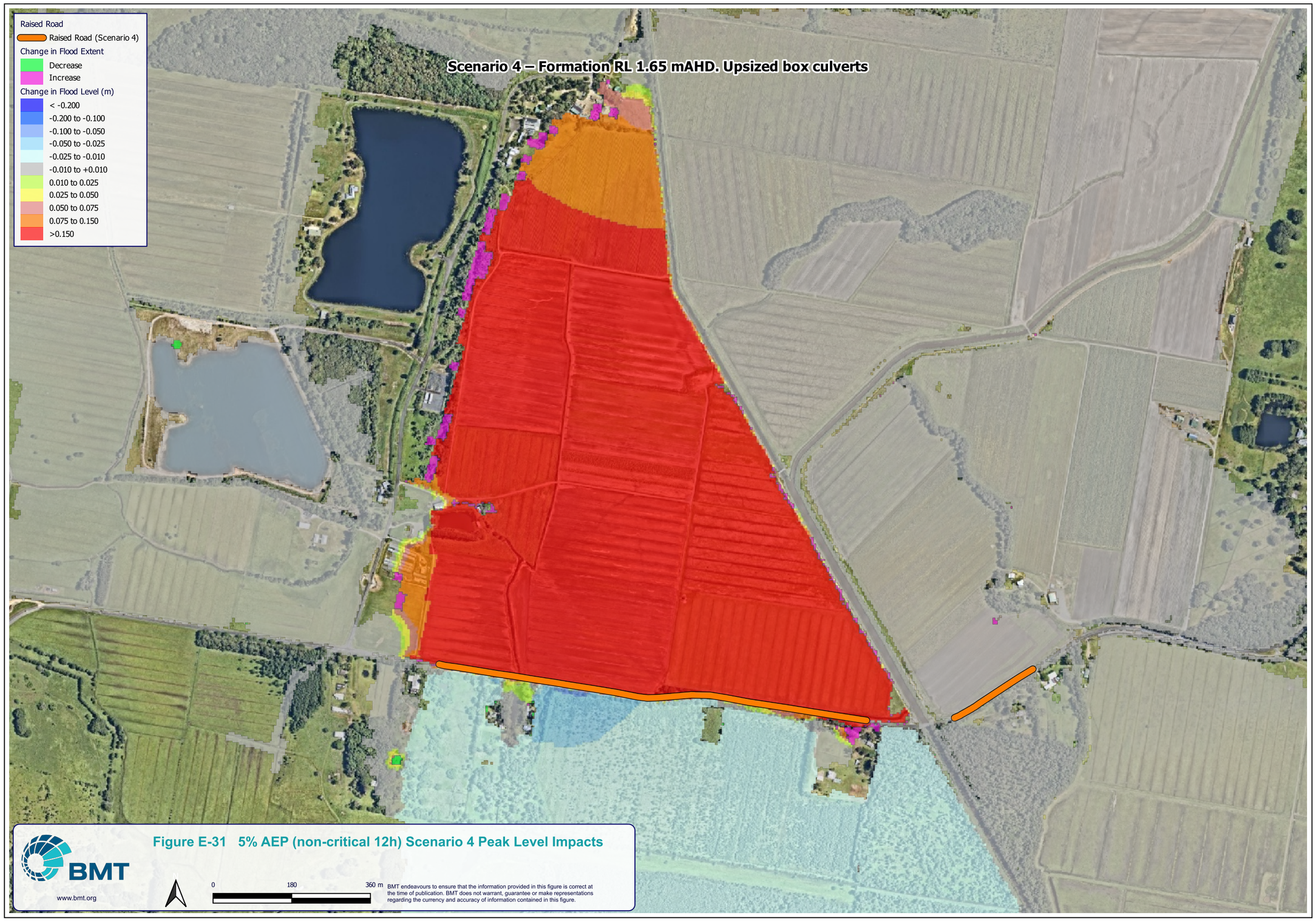


Figure E-31 5% AEP (non-critical 12h) Scenario 4 Peak Level Impacts

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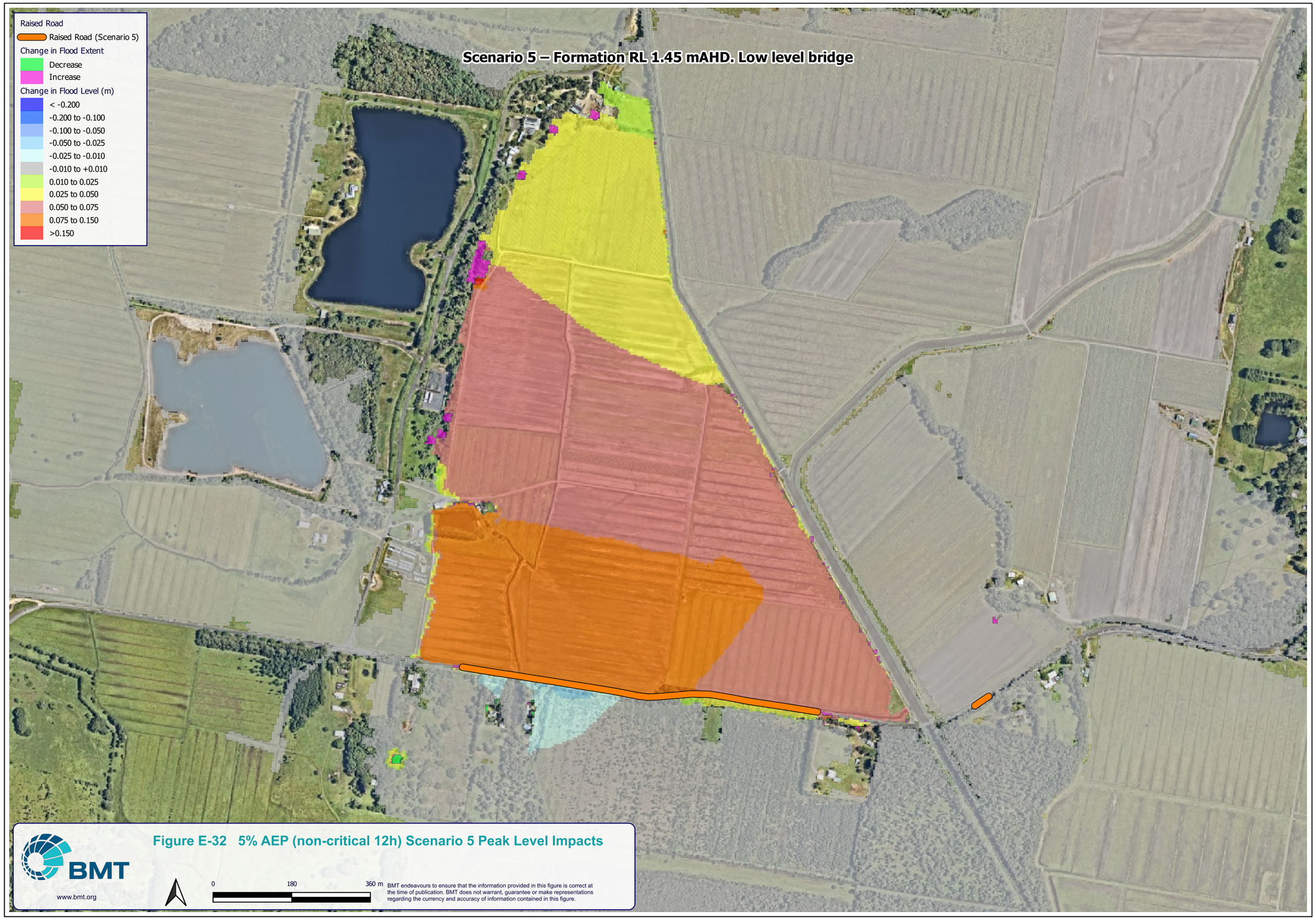


Figure E-32 5% AEP (non-critical 12h) Scenario 5 Peak Level Impacts

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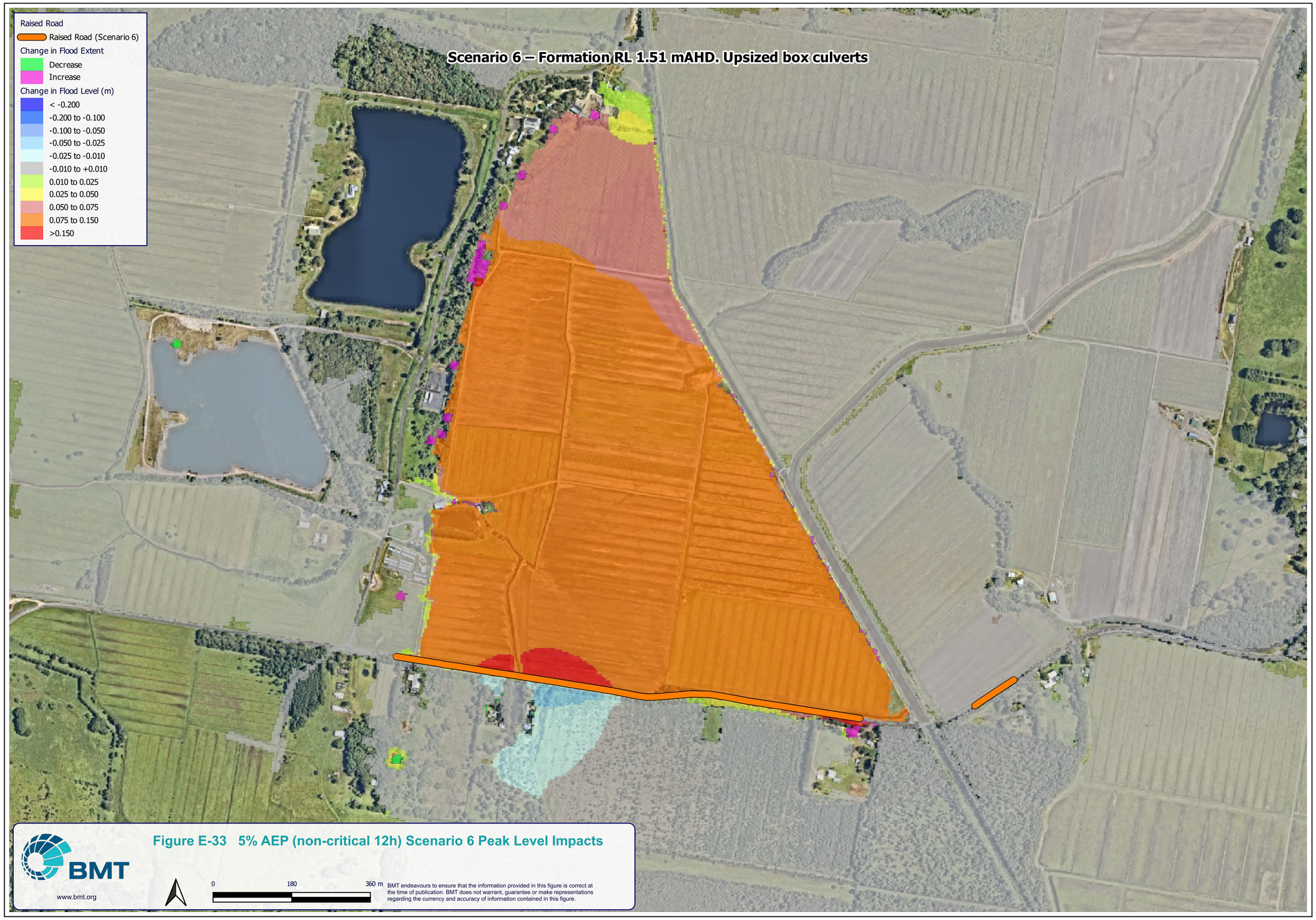


Figure E-33 5% AEP (non-critical 12h) Scenario 6 Peak Level Impacts

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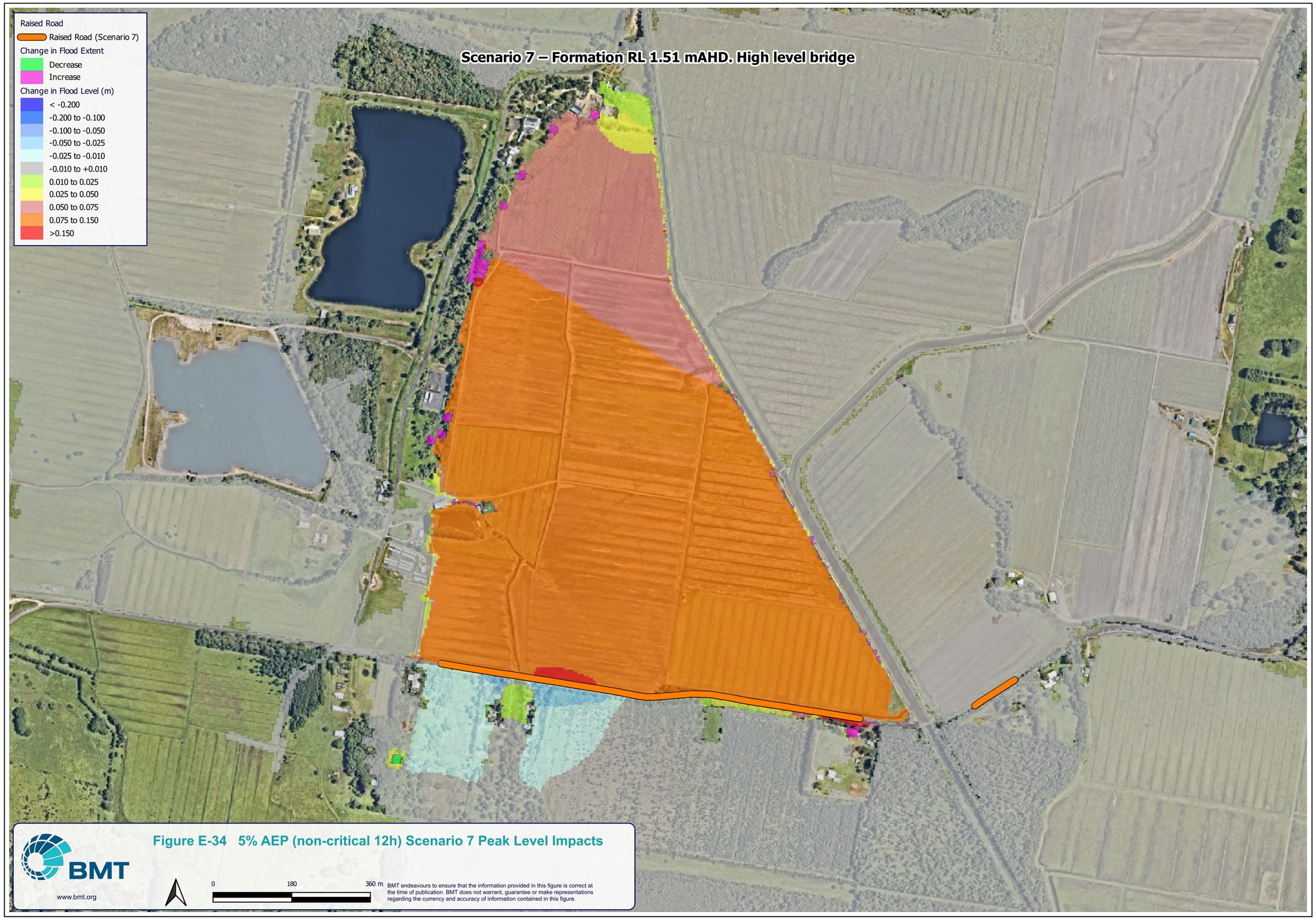


Figure E-34 5% AEP (non-critical 12h) Scenario 7 Peak Level Impacts

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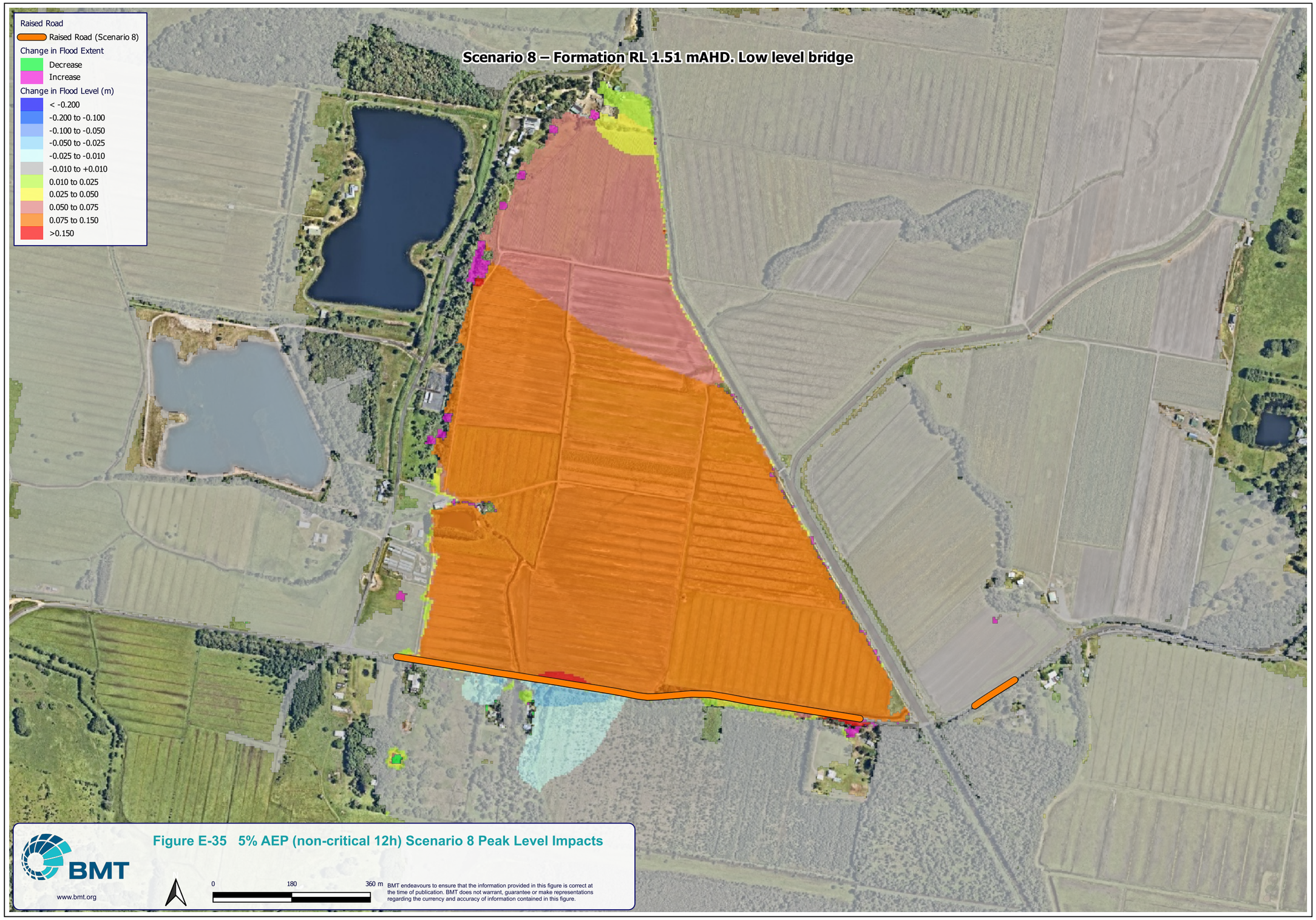


Figure E-35 5% AEP (non-critical 12h) Scenario 8 Peak Level Impacts

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5.1 Ross Lane Betterment

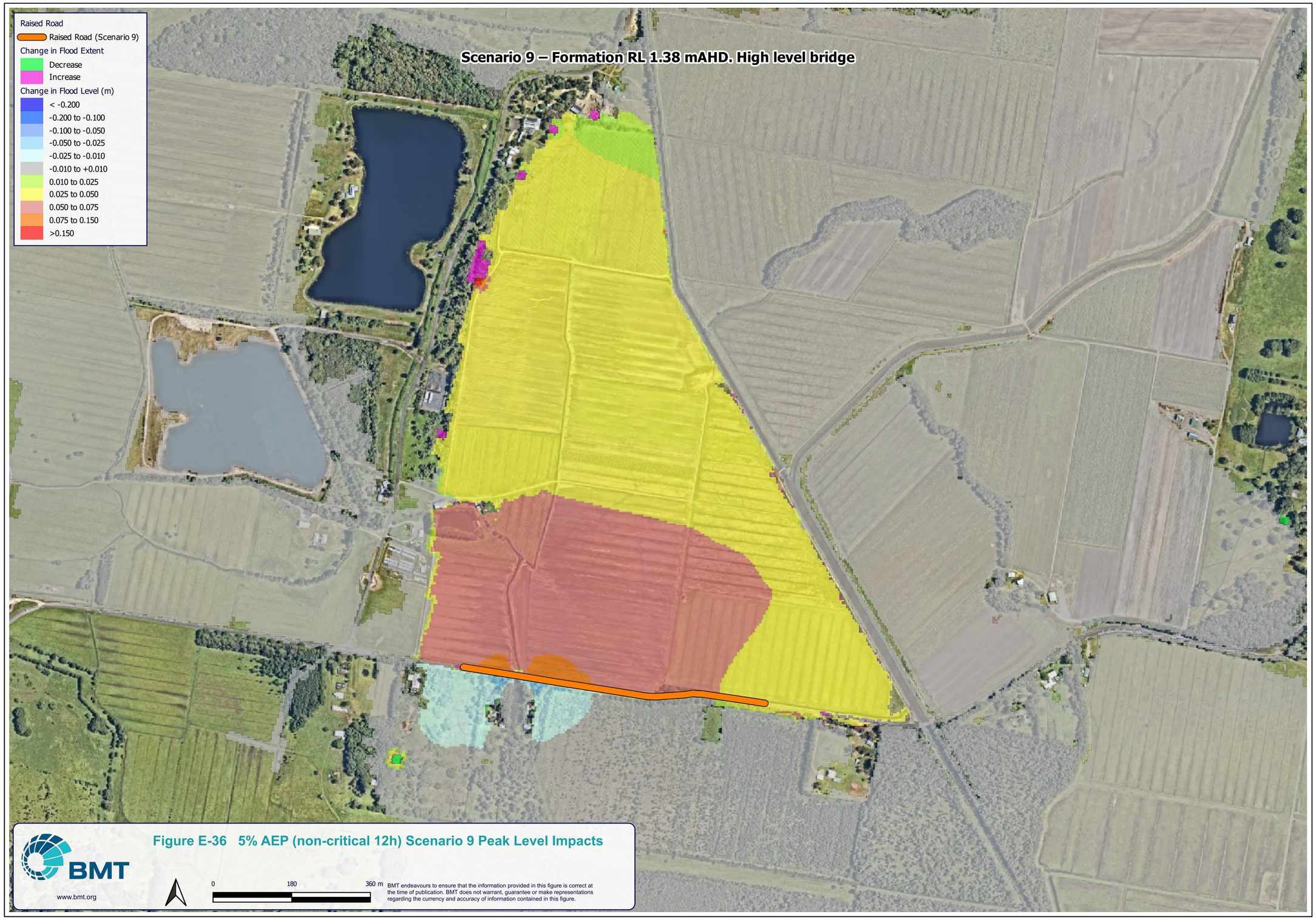


Figure E-36 5% AEP (non-critical 12h) Scenario 9 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure E-37 1% AEP (non-critical 12h) Scenario 1 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure E-38 1% AEP (non-critical 12h) Scenario 2 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure E-39 1% AEP (non-critical 12h) Scenario 3 Peak Level Impacts

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5.1 Ross Lane Betterment

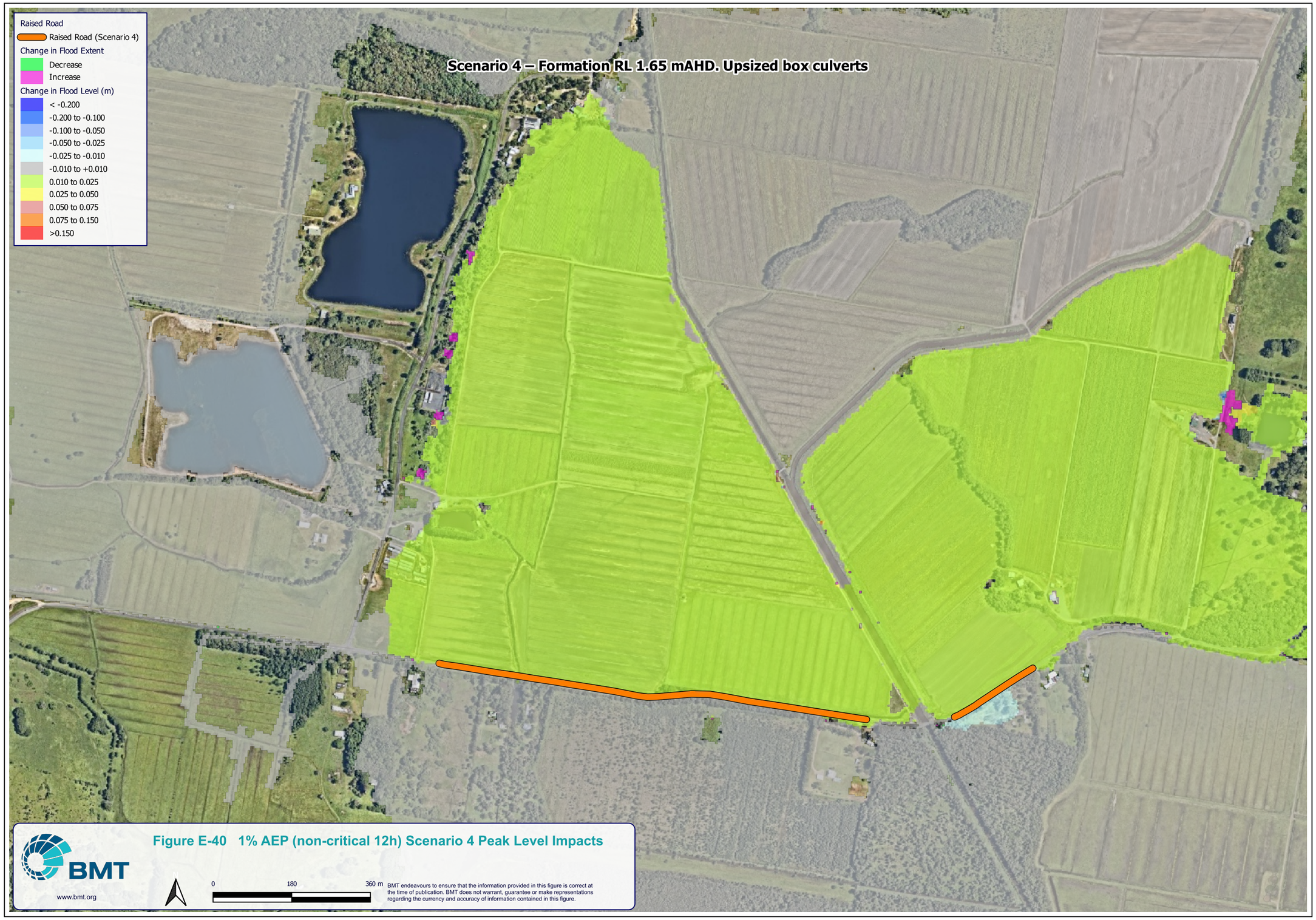


Figure E-40 1% AEP (non-critical 12h) Scenario 4 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure E-41 1% AEP (non-critical 12h) Scenario 5 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure E-42 1% AEP (non-critical 12h) Scenario 6 Peak Level Impacts

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5.1 Ross Lane Betterment

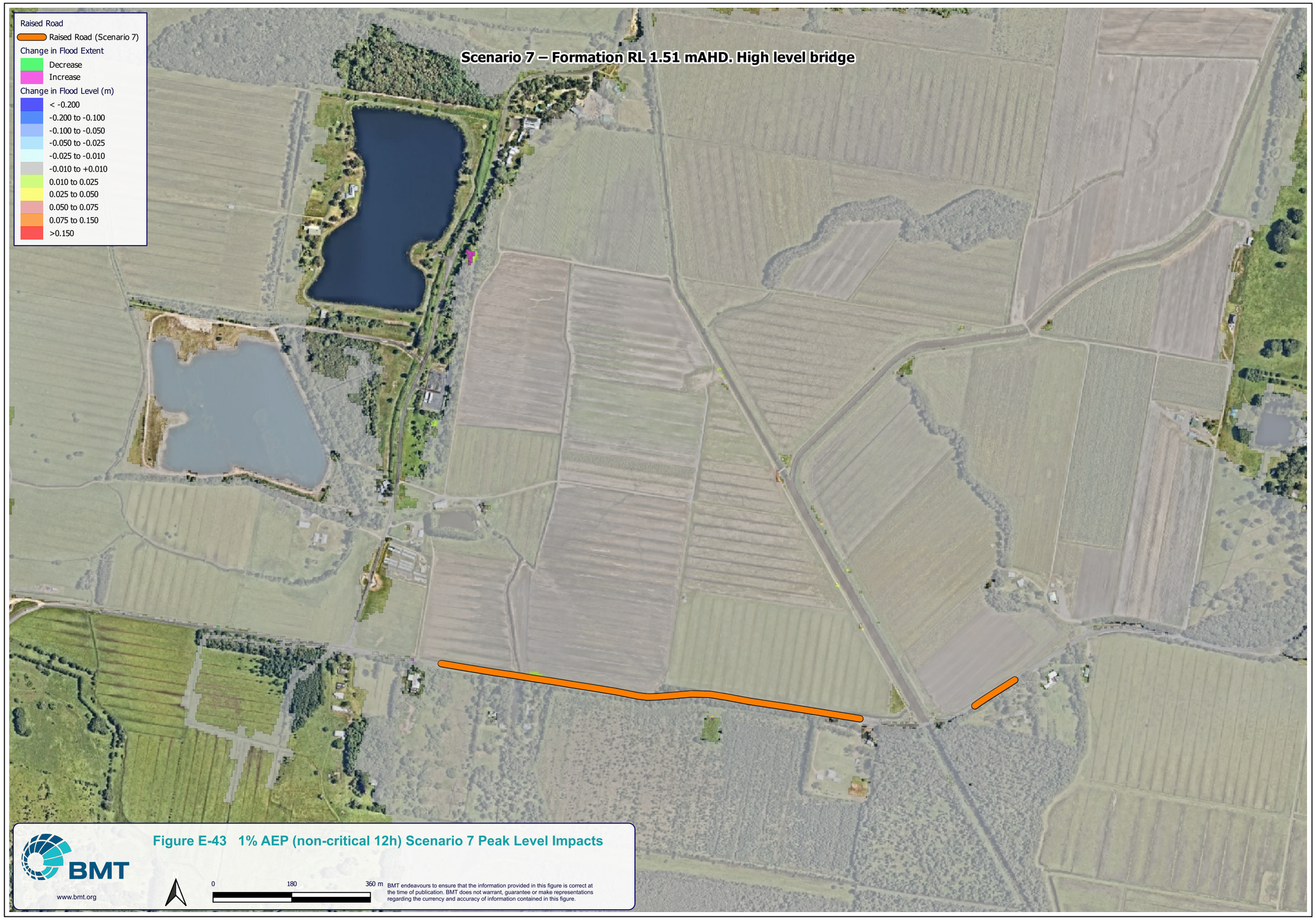


Figure E-43 1% AEP (non-critical 12h) Scenario 7 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure E-44 1% AEP (non-critical 12h) Scenario 8 Peak Level Impacts

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5.1 Ross Lane Betterment



Figure E-45 1% AEP (non-critical 12h) Scenario 9 Peak Level Impacts

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Annex F Peak Flood Velocity Impacts (Non-critical Events)

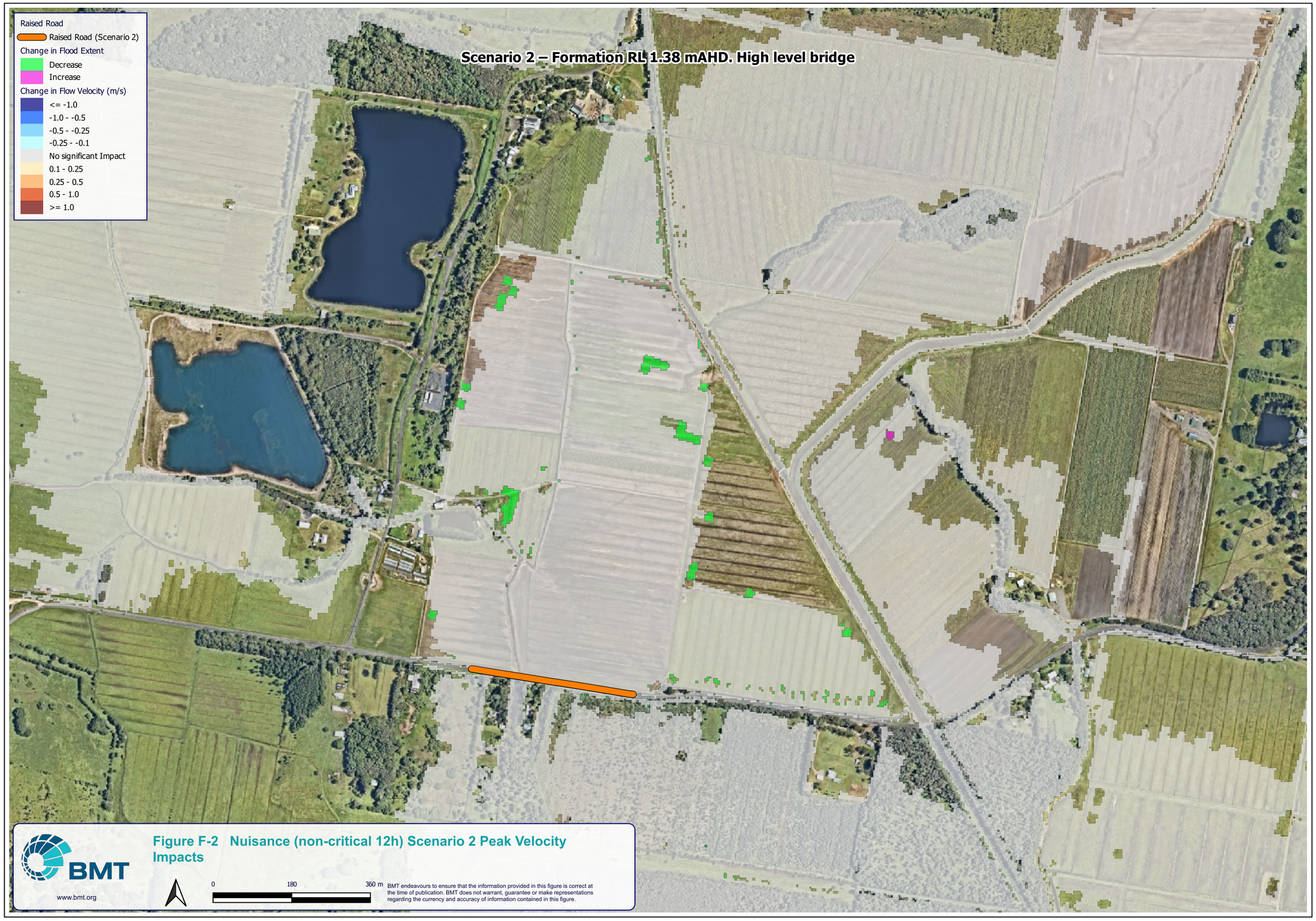
© BMT 2025

5.1 Ross Lane Betterment



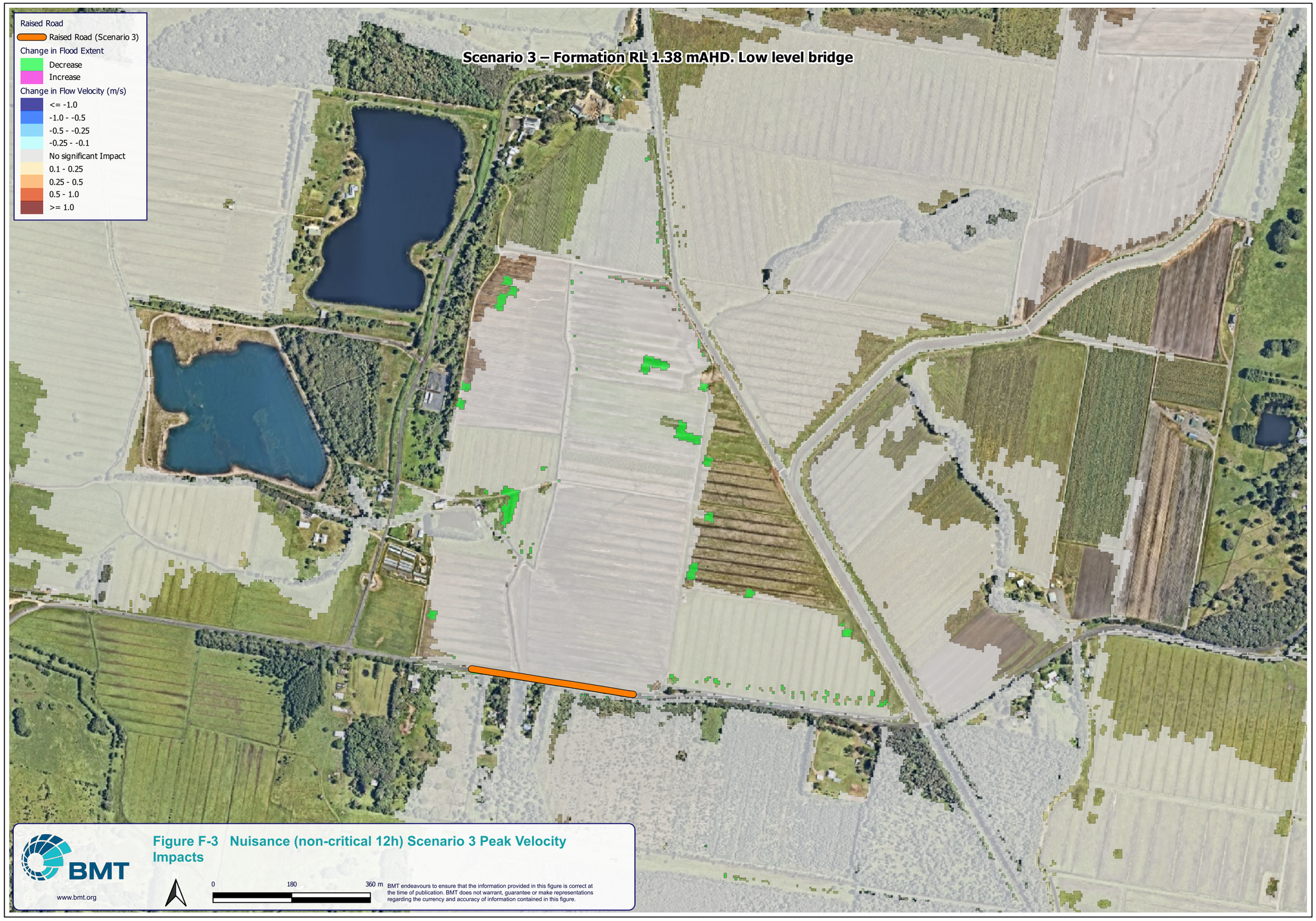
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5.1 Ross Lane Betterment



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5.1 Ross Lane Betterment



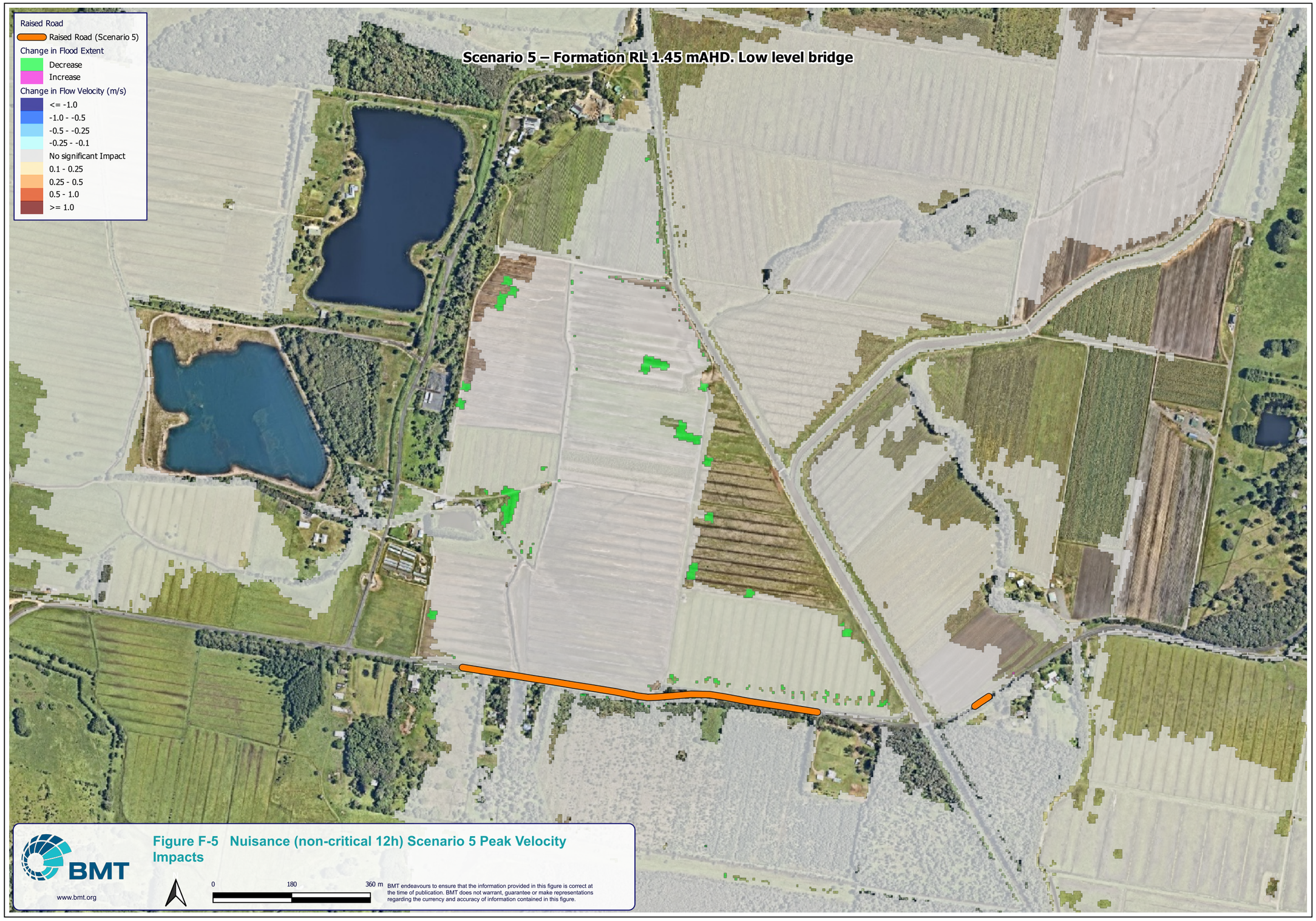
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5.1 Ross Lane Betterment



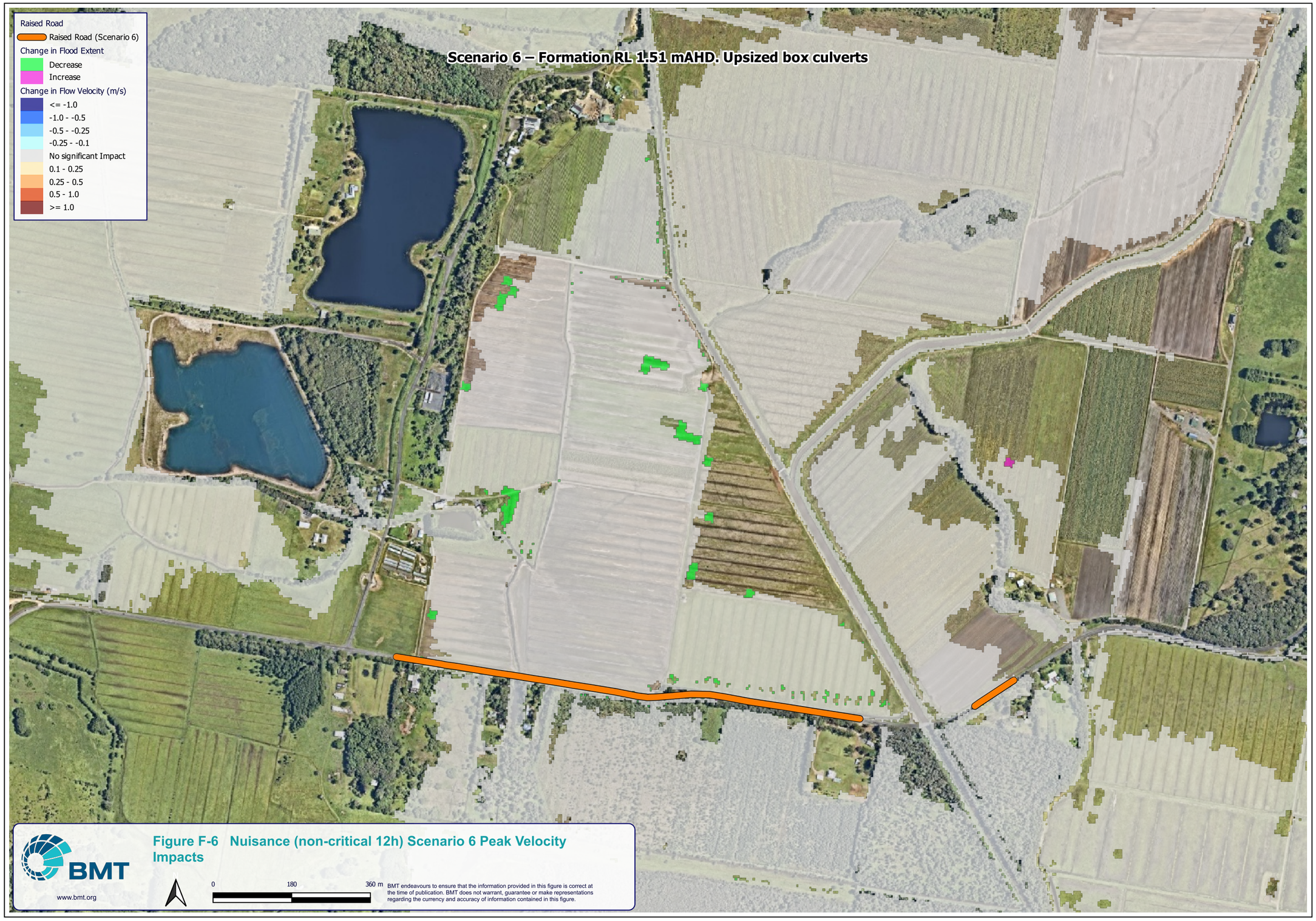
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5.1 Ross Lane Betterment



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5.1 Ross Lane Betterment



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5.1 Ross Lane Betterment



Figure F-7 Nuisance (non-critical 12h) Scenario 7 Peak Velocity Impacts

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5.1 Ross Lane Betterment

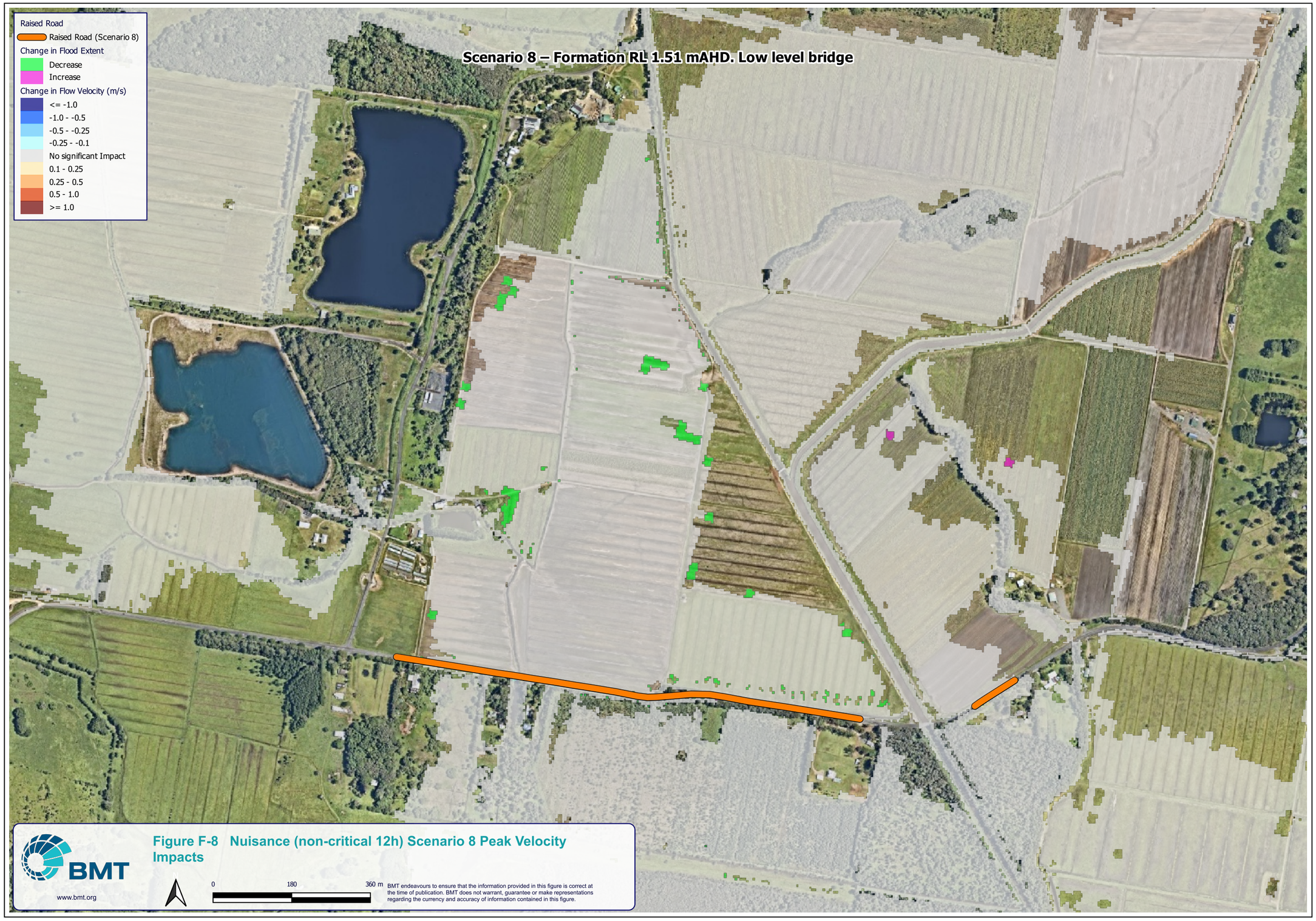
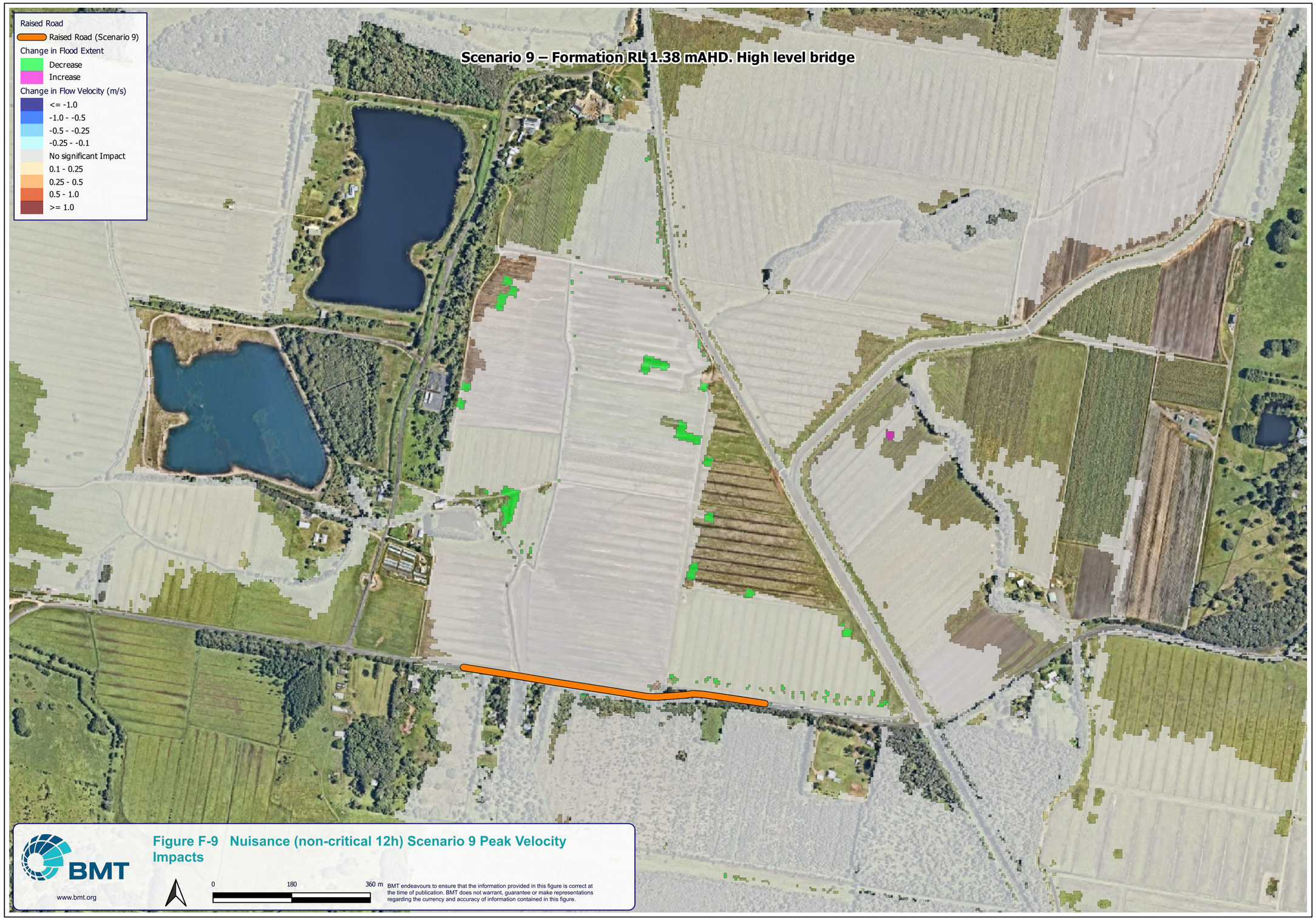


Figure F-8 Nuisance (non-critical 12h) Scenario 8 Peak Velocity Impacts

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5.1 Ross Lane Betterment



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5.1 Ross Lane Betterment



Figure F-10 20% AEP (non-critical 12h) Scenario 1 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure F-11 20% AEP (non-critical 12h) Scenario 2 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure F-12 20% AEP (non-critical 12h) Scenario 3 Peak Velocity Impacts

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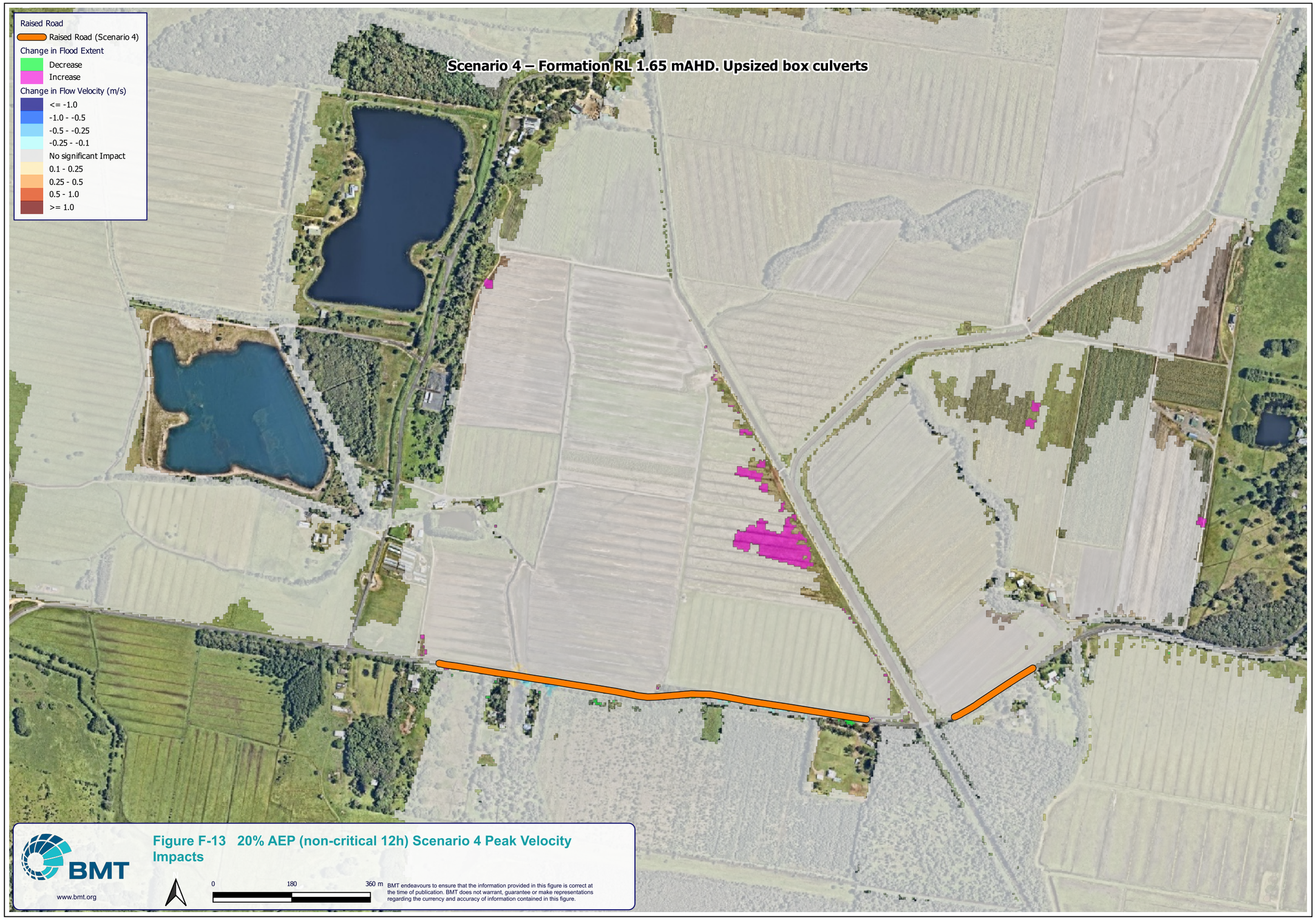


Figure F-13 20% AEP (non-critical 12h) Scenario 4 Peak Velocity Impacts

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5.1 Ross Lane Betterment

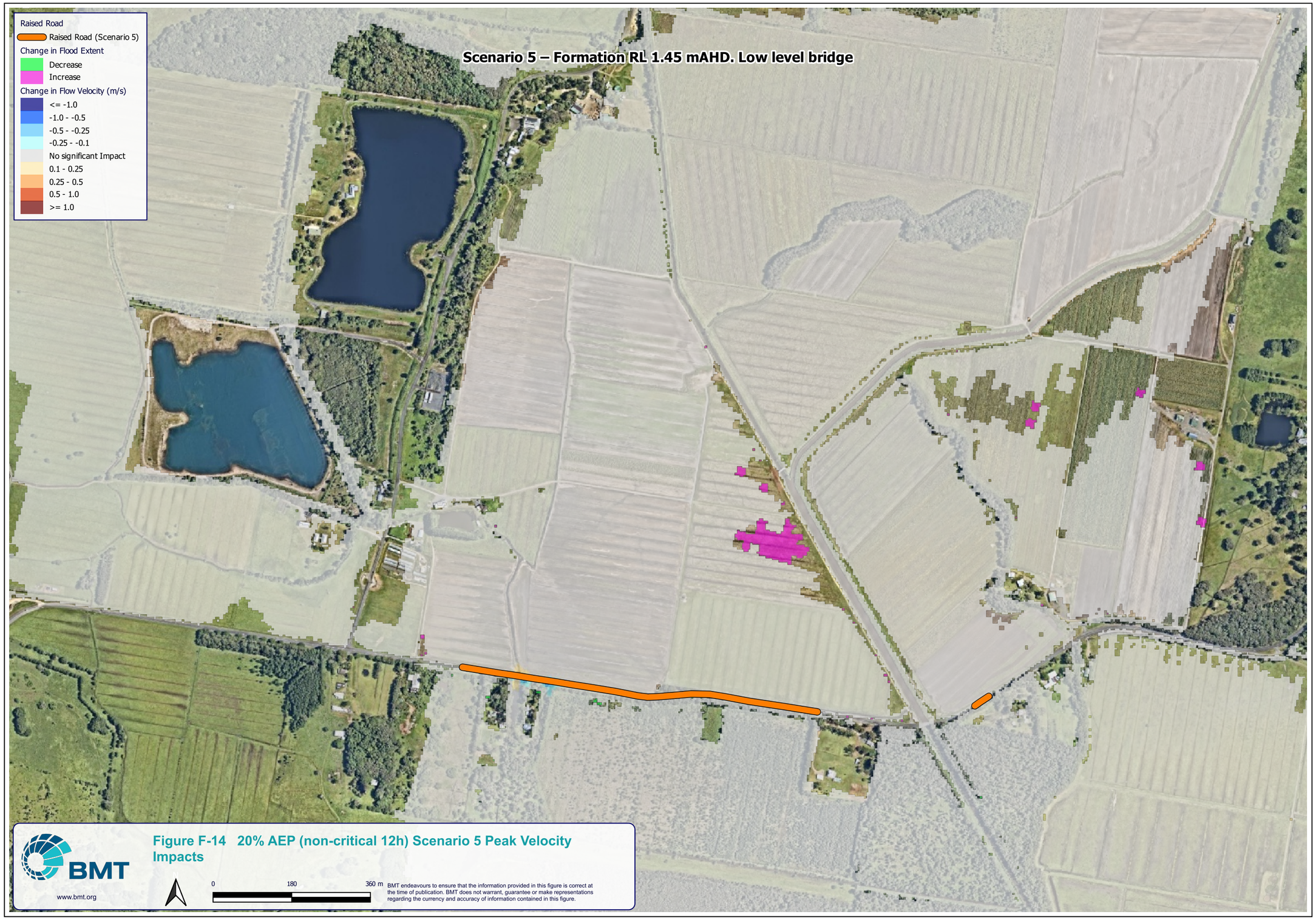


Figure F-14 20% AEP (non-critical 12h) Scenario 5 Peak Velocity Impacts

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5.1 Ross Lane Betterment

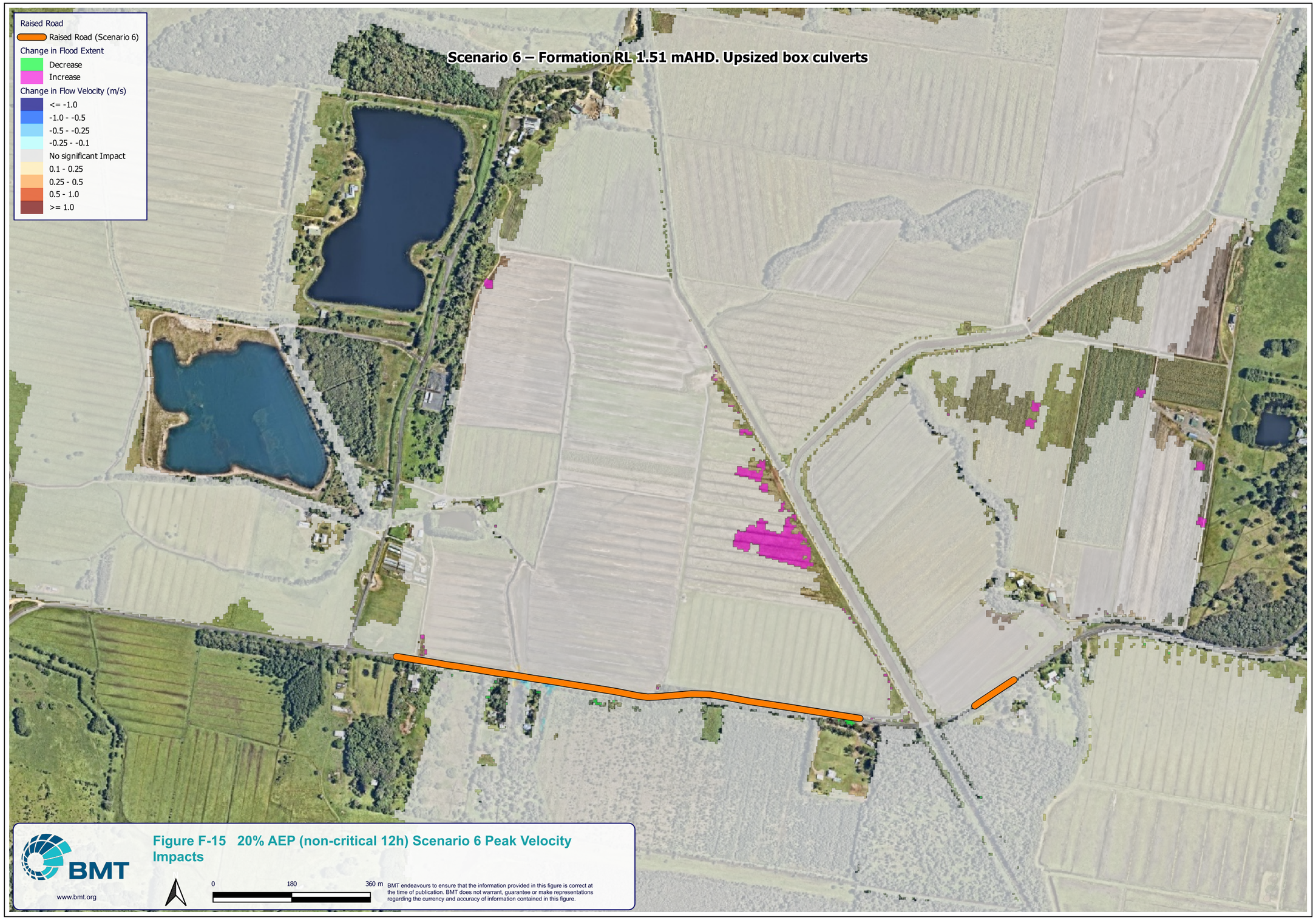


Figure F-15 20% AEP (non-critical 12h) Scenario 6 Peak Velocity Impacts

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5.1 Ross Lane Betterment



Figure F-16 20% AEP (non-critical 12h) Scenario 7 Peak Velocity Impacts

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5.1 Ross Lane Betterment

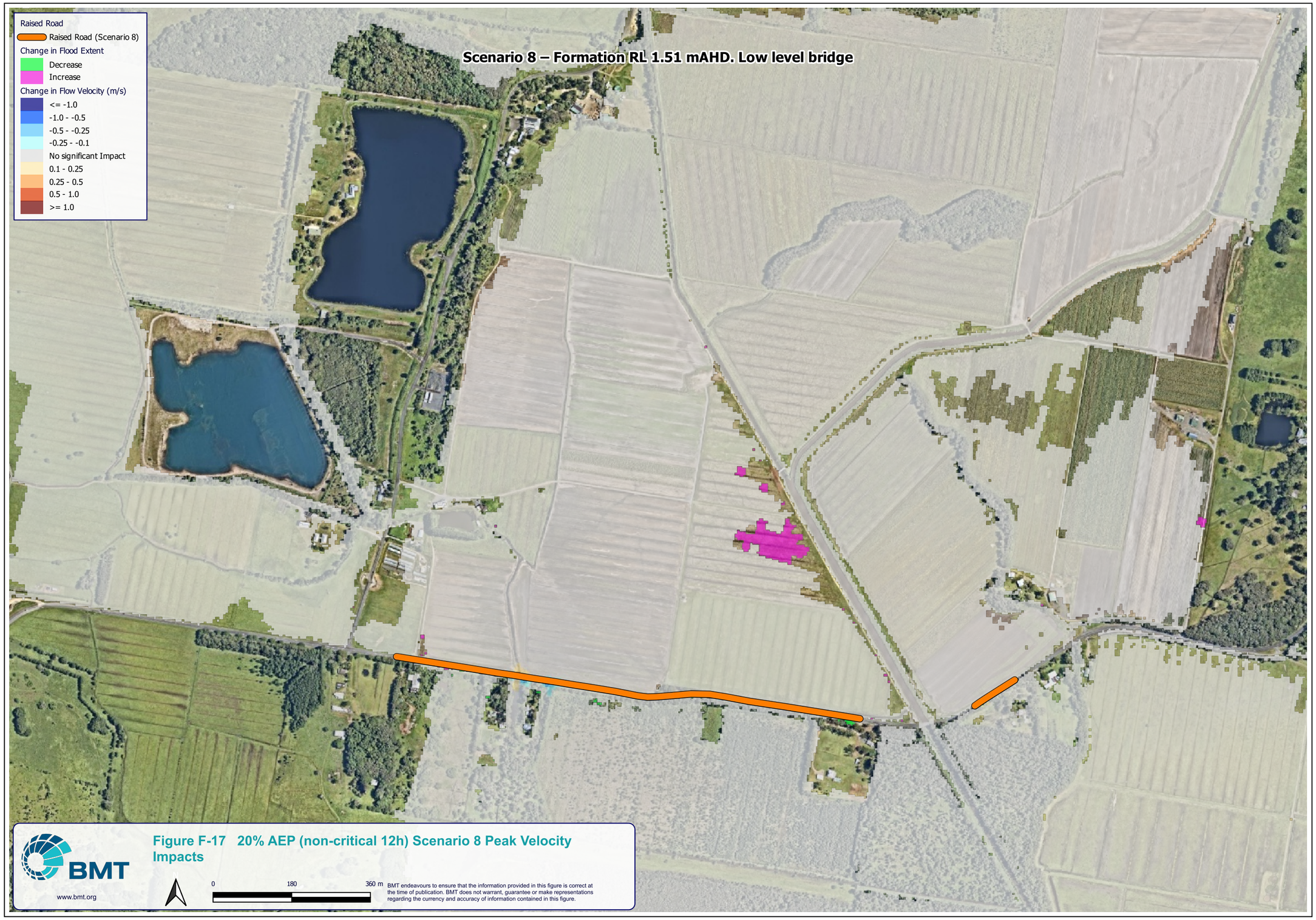


Figure F-17 20% AEP (non-critical 12h) Scenario 8 Peak Velocity Impacts

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Figure F-18 20% AEP (non-critical 12h) Scenario 9 Peak Velocity Impacts

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Figure F-19 10% AEP (non-critical 12h) Scenario 1 Peak Velocity Impacts

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Figure F-20 10% AEP (non-critical 12h) Scenario 2 Peak Velocity Impacts

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Figure F-21 10% AEP (non-critical 12h) Scenario 3 Peak Velocity Impacts

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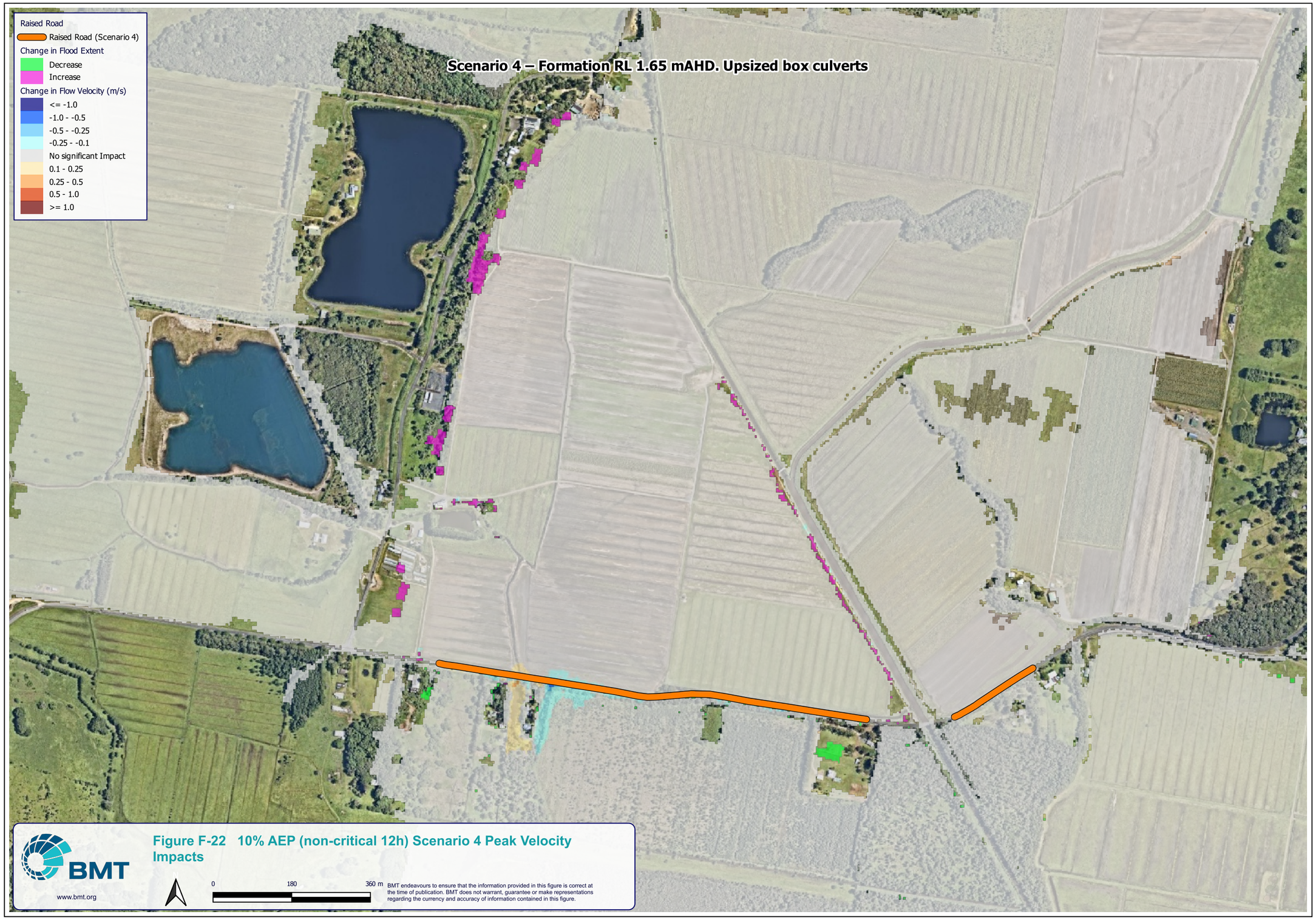


Figure F-22 10% AEP (non-critical 12h) Scenario 4 Peak Velocity Impacts

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Figure F-23 10% AEP (non-critical 12h) Scenario 5 Peak Velocity Impacts

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Figure F-24 10% AEP (non-critical 12h) Scenario 6 Peak Velocity Impacts

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Figure F-25 10% AEP (non-critical 12h) Scenario 7 Peak Velocity Impacts

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Figure F-26 10% AEP (non-critical 12h) Scenario 8 Peak Velocity Impacts

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Figure F-27 10% AEP (non-critical 12h) Scenario 9 Peak Velocity Impacts

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Figure F-28 5% AEP (non-critical 12h) Scenario 1 Peak Velocity Impacts

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Figure F-29 5% AEP (non-critical 12h) Scenario 2 Peak Velocity Impacts

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Figure F-30 5% AEP (non-critical 12h) Scenario 3 Peak Velocity Impacts

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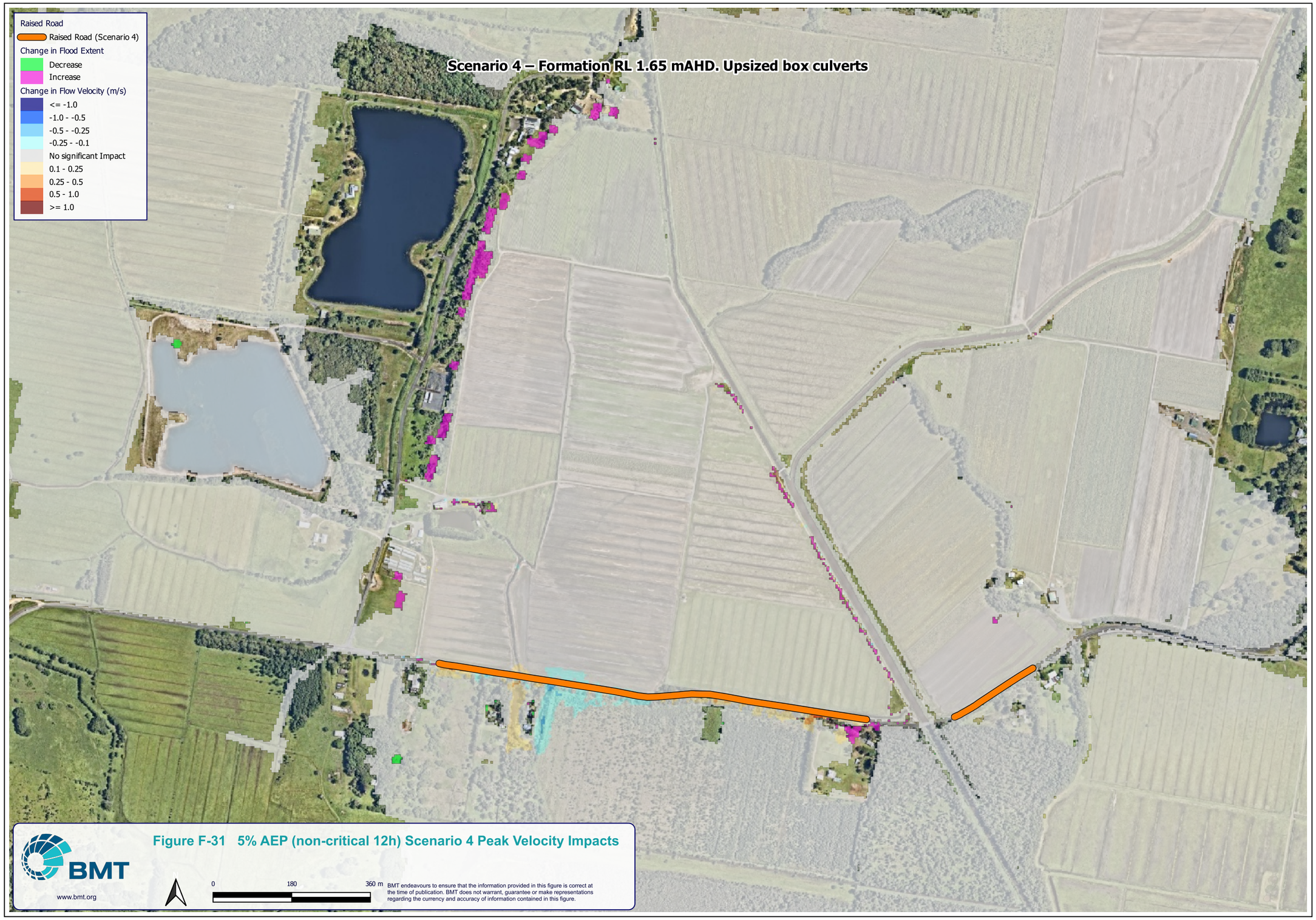


Figure F-31 5% AEP (non-critical 12h) Scenario 4 Peak Velocity Impacts

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Figure F-32 5% AEP (non-critical 12h) Scenario 5 Peak Velocity Impacts

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Figure F-33 5% AEP (non-critical 12h) Scenario 6 Peak Velocity Impacts

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Figure F-34 5% AEP (non-critical 12h) Scenario 7 Peak Velocity Impacts

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Figure F-35 5% AEP (non-critical 12h) Scenario 8 Peak Velocity Impacts

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Figure F-36 5% AEP (non-critical 12h) Scenario 9 Peak Velocity Impacts

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Figure F-37 1% AEP (non-critical 12h) Scenario 1 Peak Velocity Impacts

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Figure F-38 1% AEP (non-critical 12h) Scenario 2 Peak Velocity Impacts

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Figure F-39 1% AEP (non-critical 12h) Scenario 3 Peak Velocity Impacts

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Figure F-40 1% AEP (non-critical 12h) Scenario 4 Peak Velocity Impacts

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Figure F-41 1% AEP (non-critical 12h) Scenario 5 Peak Velocity Impacts

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Figure F-42 1% AEP (non-critical 12h) Scenario 6 Peak Velocity Impacts

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Figure F-43 1% AEP (non-critical 12h) Scenario 7 Peak Velocity Impacts

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Figure F-44 1% AEP (non-critical 12h) Scenario 8 Peak Velocity Impacts

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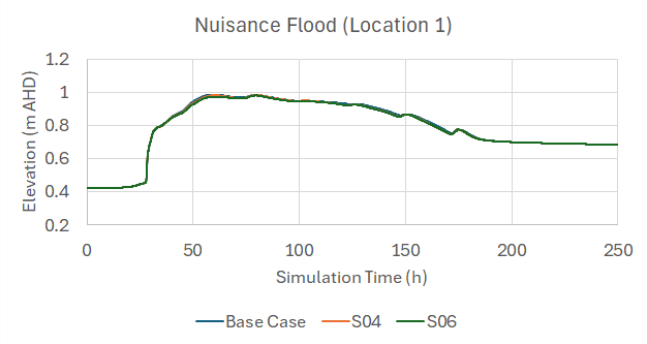
Figure F-45 1% AEP (non-critical 12h) Scenario 9 Peak Velocity Impacts

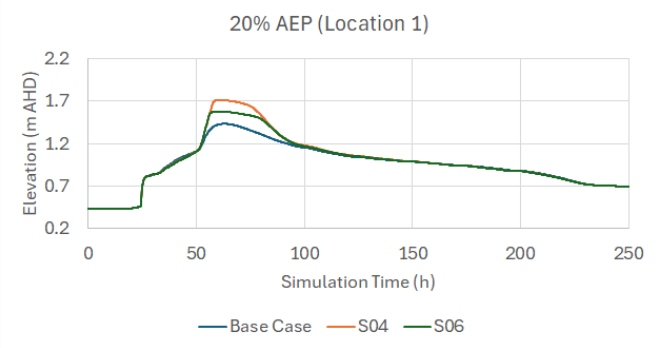
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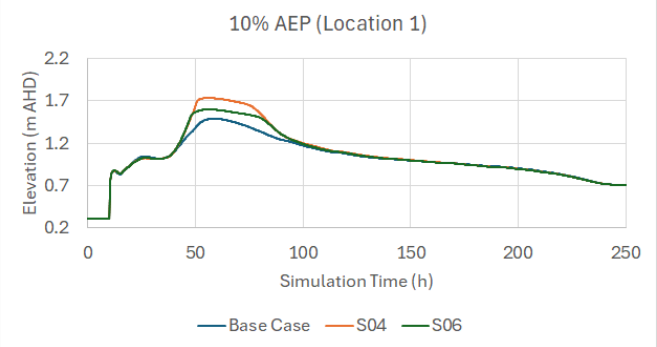
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Annex G Flood Duration Plots

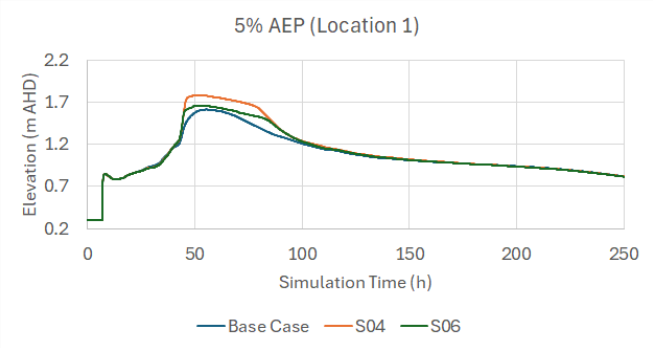


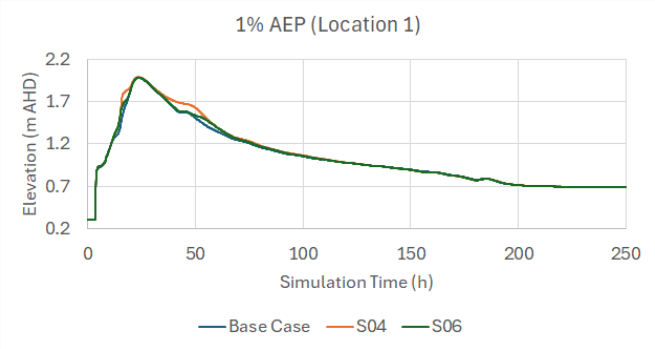


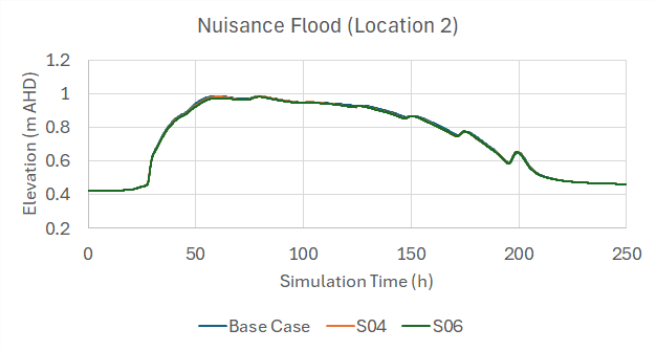


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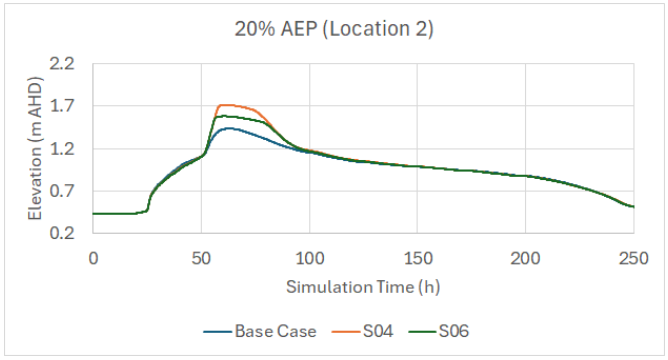


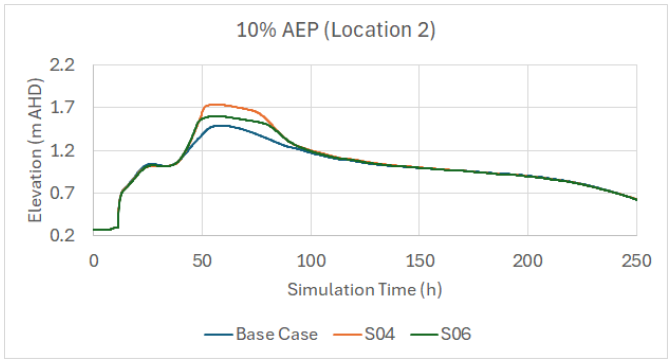


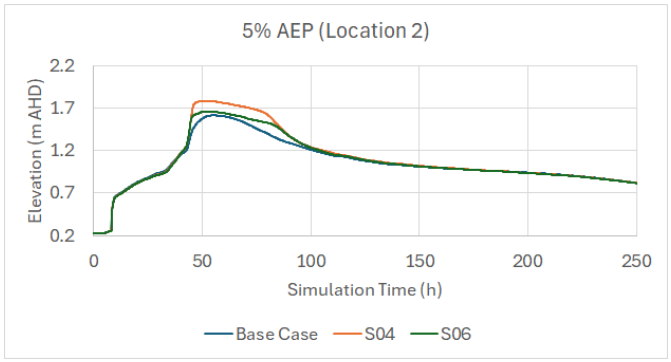


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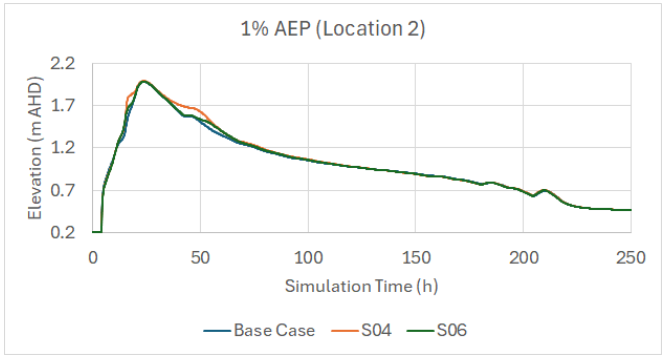


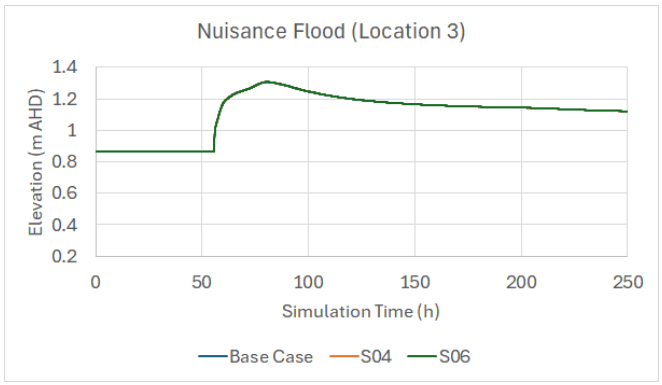


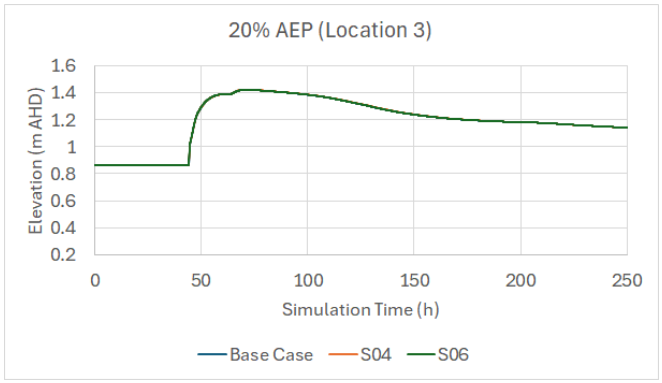


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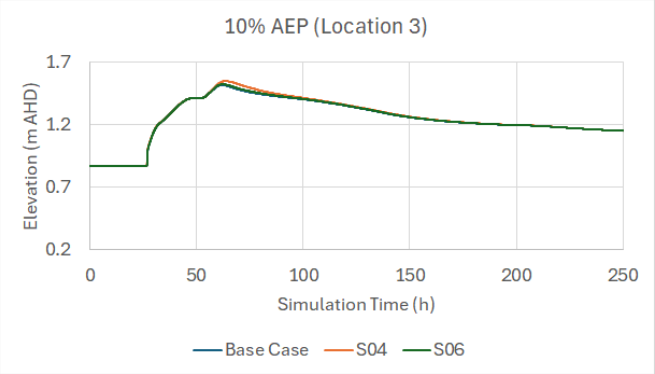


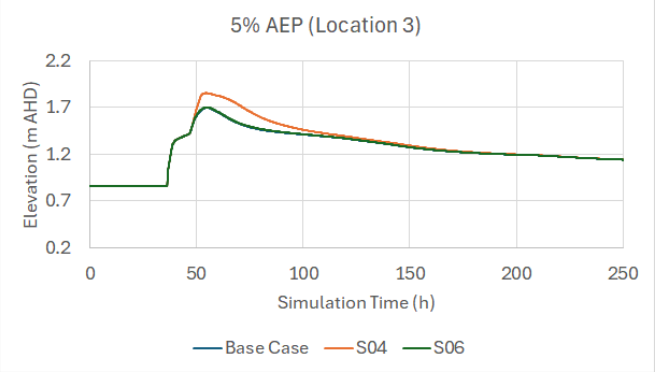


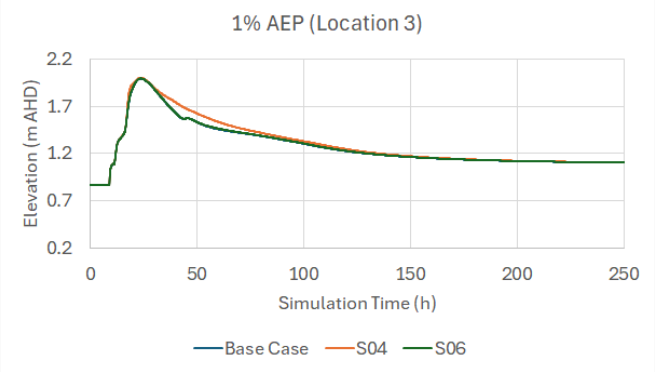


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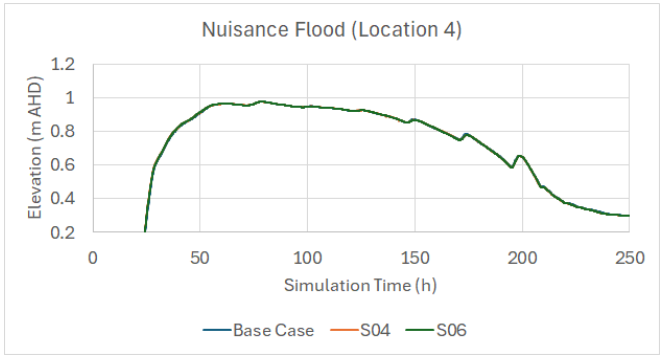


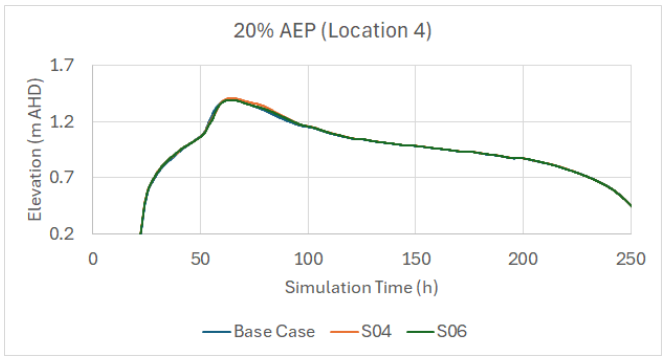


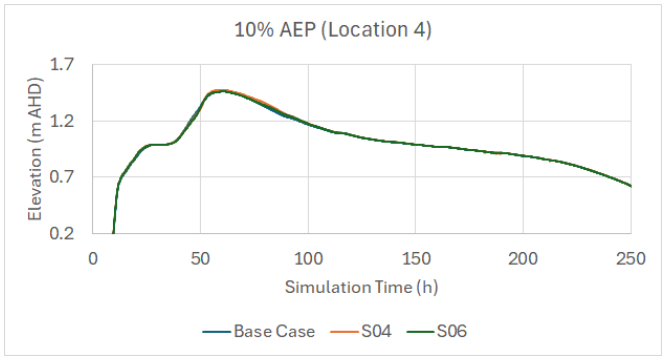


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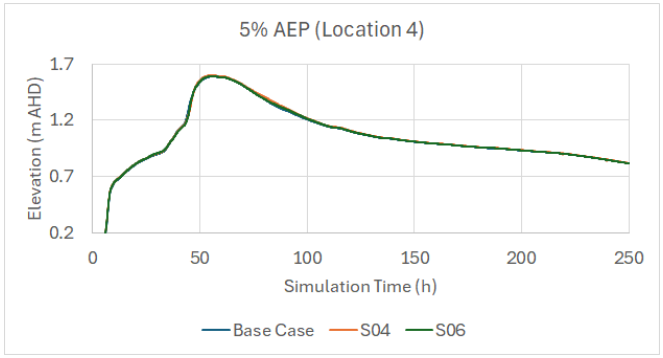


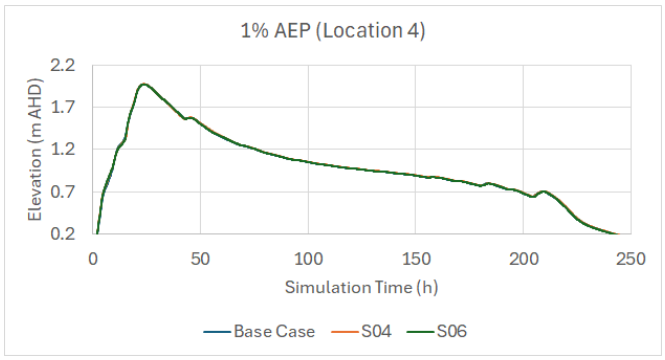




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Annex H Floor Level Analysis

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Annex I ARR Blockage Assessment Form

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BLOCKAGE ASSESMENT FORM

STRUCTURE : DEADMANS CREEK @ ROSS LANE

OPENING WIDTH: 9.9 m (3 x 3.3m) (PROPOSED)

Australian Rainfall & Runoff

DEBRIS TYPE/MATERIAL/L_{10}/SOURCE AREA - *There may be more than one material type to consider!*

Debris Type/Material	L_{10}	Source Area	How Assessed
FLOATING	2m	6.2KM²	DESK BASED

DEBRIS AVAILABILITY (HML) – *for the selected debris type/size and its source area*

Availability	Typical Source Area Characteristics	Notes
High	• *Dense forest, thick vegetation, extensive canopy, difficult to walk through with considerable fallen limbs, leaves and high levels of floor litter.* • *Streams with boulder/cobble beds and steep bed slopes and banks showing signs of substantial past bed/bank movements.* • *Arid areas, where loose vegetation and exposed loose soils occur and vegetation is sparse.* • *Urban areas that are not well maintained and/or old paling fences, sheds, cars and/or stored loose material etc., are present on the floodplain close to the water course.*	
Medium	• *State forest areas with clear understory, grazing land with stands of trees* • *Source areas generally falling between the High and Low categories.*	
Low	• *Well maintained rural lands and paddocks, with minimal outbuildings* • *Streams with moderate to flat slopes and stable beds and banks.* • *Arid areas where vegetation is deep rooted and soils resistant to scour* • *Urban areas that are well maintained with limited debris present in the source area.*	RURAL LAND

DEBRIS MOBILITY (HML) - *for the selected debris type/size and its source area*

Mobility	Typical Source Area Characteristics	Notes
High	• *Steep source area with fast response times and high annual rainfall and/or storm intensities and/or source areas subject to high rainfall intensities with sparse vegetation cover.* • *Receiving streams that frequently overtop their banks.* • *Main debris source areas close to streams*	CHANNEL FREQUENTLY OVERTOPS
Medium	• *Source areas generally falling between the High and Low categories.*	
Low	• *Low rainfall intensities and large, flat source areas.* • *Receiving streams that Infrequently overtop their banks.* • *Main source areas well away from streams*	

DEBRIS TRANSPORTABILITY (HML) - *for the selected debris type/size and stream characteristics*

Transportability	Typical Transporting Stream Characteristics	Notes
High	• *Steep bed slopes (> 3%).and/or high stream velocity (V>2.5m/sec)* • *Deep stream relative to vertical debris dimension (D>0.5L_{10})* • *Wide streams relative to horizontal debris dimension. (W>L_{10})* • *Streams relatively straight and free of constrictions/snag points.* • *High temporal variability in maximum stream flows*	
Medium	• *Streams generally falling between High and Low categories*	
Low	• *Flat bed slopes (< 1%).and/or low stream velocity (V<1m/sec)* • *Shallow stream relative to vertical debris dimension (D<0.5L_{10})* • *Narrow streams relative to horizontal debris dimension.(W<L_{10})* • *Streams meander with frequent constrictions/snag points.* • *Low temporal variability in maximum stream flows*	

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BLOCKAGE ASSESMENT FORM

Australian Rainfall & Runoff

SITE BASED DEBRIS POTENTIAL 1%AEP (HML) - *for the selected debris type/size arriving at the site*

Debris Potential	Combinations of the Above (any order)	Notes
DP_{High}	HHH or HHM	
DP_{Medium}	MMM or HML or HMM or HLL	LHM
DP_{Low}	LLL or MML or MLL	Eg. MML, therefore DP_{Low} selected

AEP ADJUSTED SITE DEBRIS POTENTIAL (HML) - *for the selected debris type/size*

Event AEP	At Site 1% AEP Debris Potential			AEP Adjusted At Site Debris potential
	DP_{High}	DP_{Medium}	DP_{Low}	
AEP > 5% *(frequent)*	Medium	Low	Low	Eg. Low LOW
AEP 5% - AEP 0.5%	High	Medium	Low	Eg. Low MEDIUM
AEP < 0.5% *(rare)*	High	High	Medium	Eg. Medium n/a

Debris Blockage

MOST LIKELY DESIGN INLET BLOCKAGE LEVEL (B_{DES}%) *for the selected debris type/size*

Control Dimension Inlet Width W (m)	At-Site Debris Potential (Generally)		
	High	Medium	Low
$W < L_{10}$	100%	50%	25%
$W \geq L_{10} \leq 3*L_{10}$	20%	10%	0%
$W > 3*L_{10}$	10%	0%	0%

Event AEP	Bdes %
AEP > 5% *(frequent)*	Eg. Low – 0% 0%
AEP 5% - AEP 0.5%	Eg. Low – 0% 10%
AEP < 0.5% *(rare)*	Eg. Medium – 10% n/a

Refer Guideline if opening H<0.33W

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BLOCKAGE ASSESMENT FORM

Barrel Blockage

The following tables are only relevant to sites subject to a significant debris load of sediment. Where inlet blockage and barrel blockage are both likely, the blockage producing the greatest impact on flood behaviour should be used in design.

LIKELIHOOD OF SEDIMENT BEING DEPOSITED IN THE BARREL OR WATERWAY (HML)

Peak Velocity Through Structure (m/sec)	Mean Sediment Size Present				
	Clay/Silt 0.001 to 0.04 mm	Sand 0.04 to 2 mm	Gravel 2 to 63 mm	Cobbles 63 to 200 mm	Boulders >200 mm
>= 3	L	L	L	L	M
1.0 to < 3.0	L	L	L	M	M
0.5 to < 1.0	L	L	L	M	H
0.1 to < 0.5	L	L	M	H	H
< 0.1	L	M	H	H	H

Likelihood of Sediment: Eg. Medium ~~Low~~ SEDIMENT POTENTIAL CONSIDERED HIGH (CONSERVATIVE ESTIMATE)

MOST LIKELY DESIGN BARREL BLOCKAGE (Bdes%) *for sediment of a particular mean size is then;*

Likelihood That Deposition Occurs	AEP Adjusted Sediment Potential		
	High	Medium	Low
High	100%	60%	25%
Medium	60%	40%	15%
Low	25%	15%	0%

Event AEP	Bdes %	
AEP > 5% (frequent)	Eg. Low – 15%	15%
AEP 5% - AEP 0.5%	Eg. Low – 15%	25%
AEP < 0.5% *(rare)*	Eg. Medium – 40%	n/a

For modelling blockage mechanism (type, location and timing), refer to Guideline Table 8

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Annex J Sensitivity Test Impact Mapping

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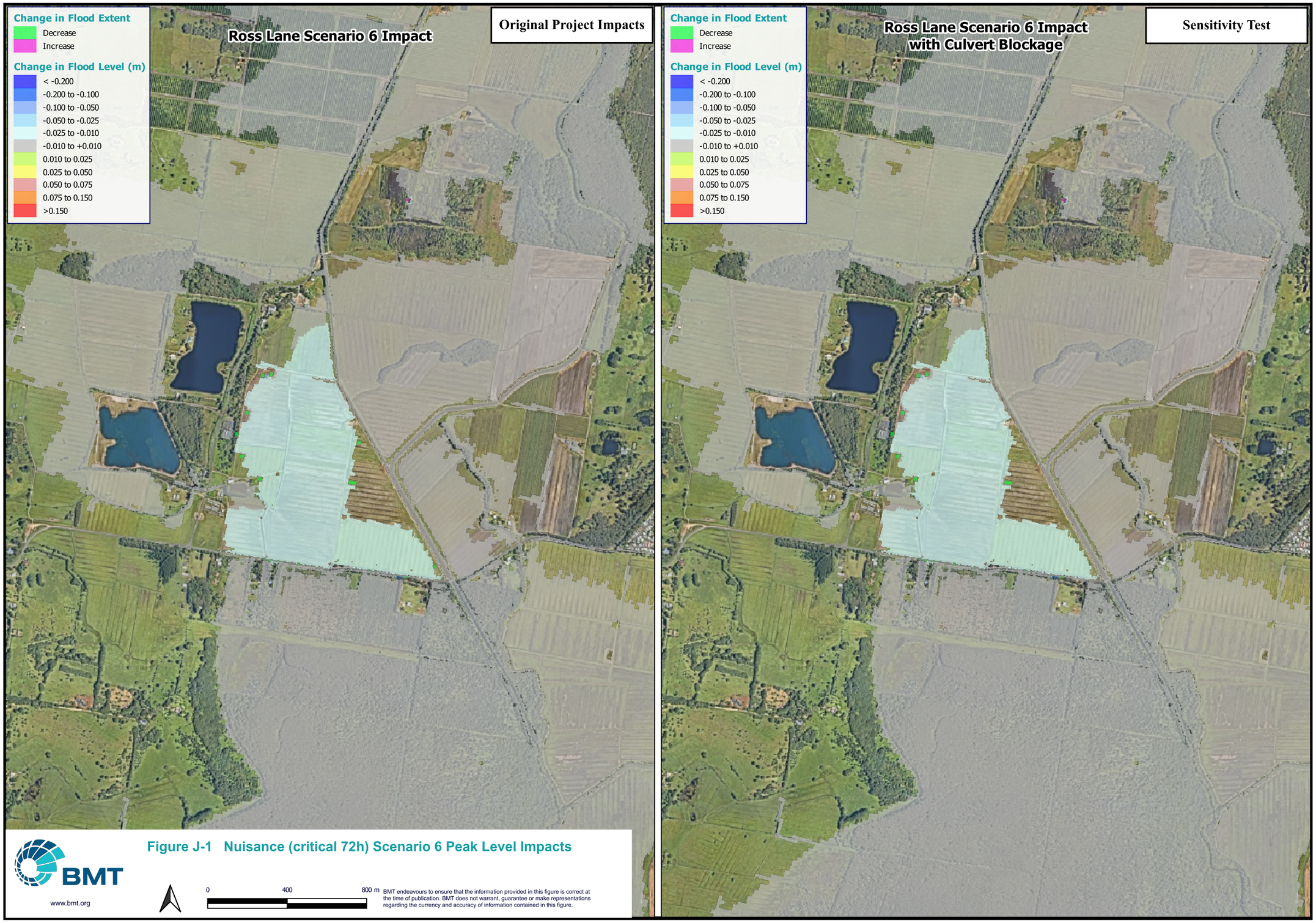


Figure J-1 Nuisance (critical 72h) Scenario 6 Peak Level Impacts

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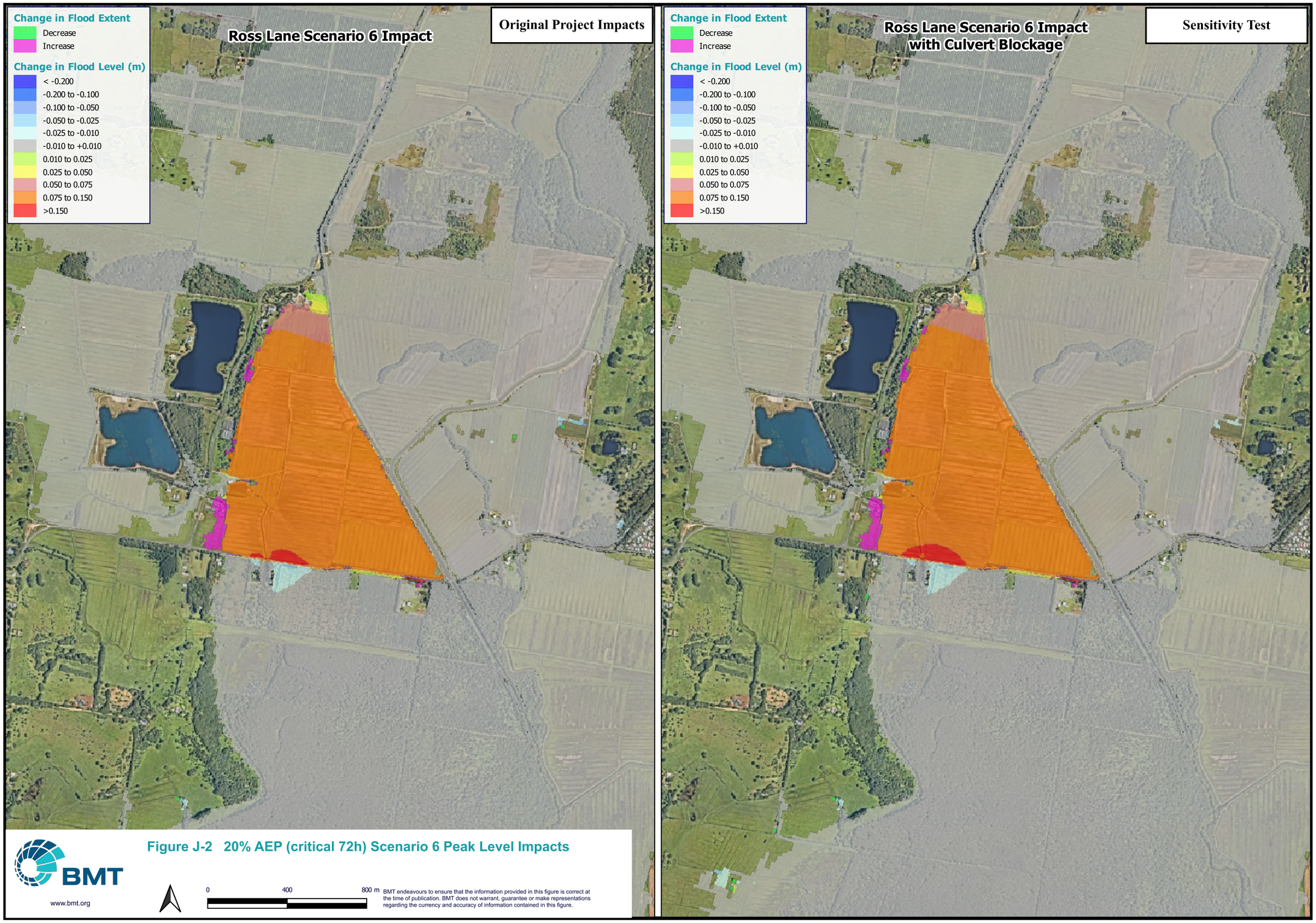


Figure J-2 20% AEP (critical 72h) Scenario 6 Peak Level Impacts

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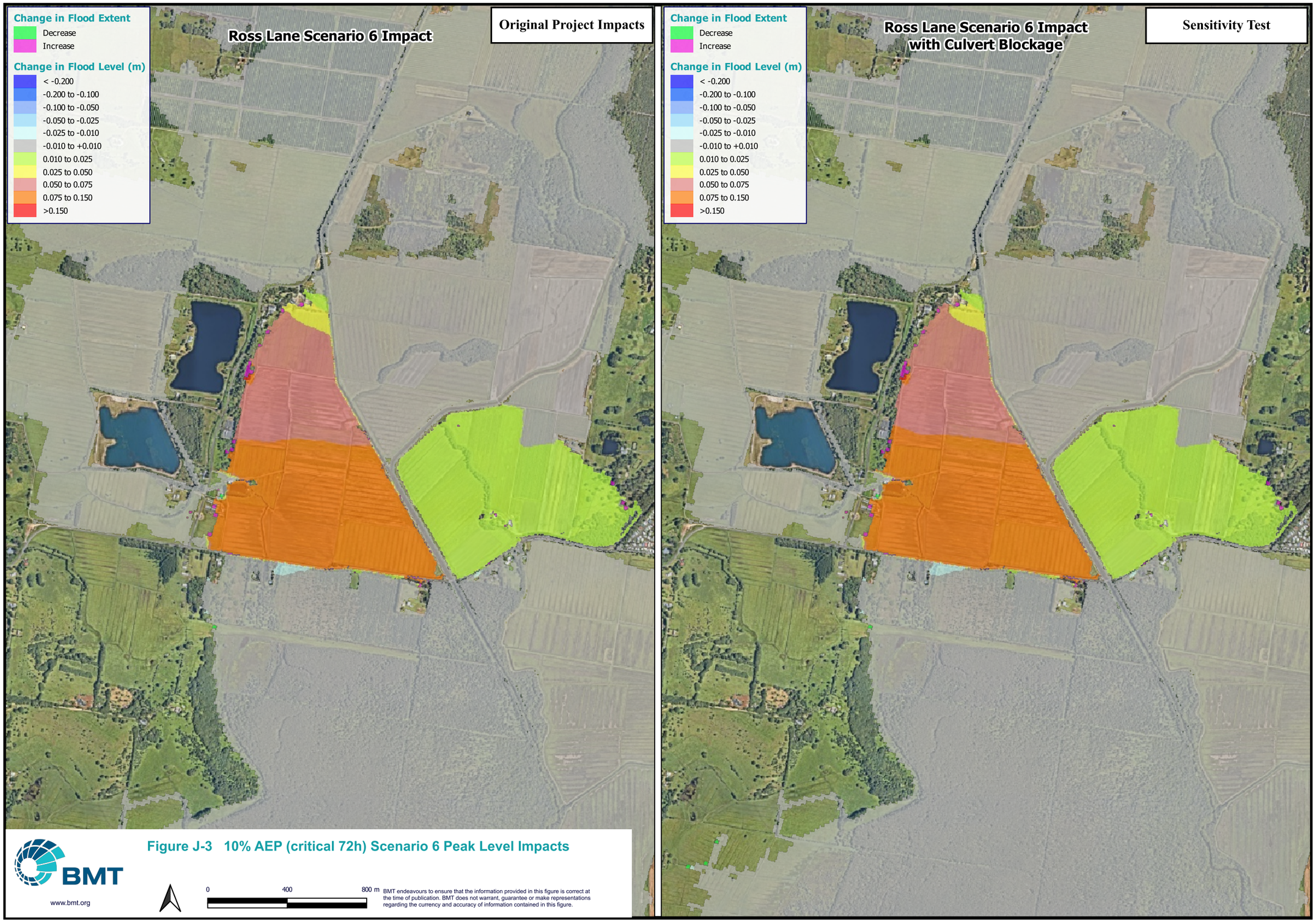


Figure J-3 10% AEP (critical 72h) Scenario 6 Peak Level Impacts

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5.1 Ross Lane Betterment

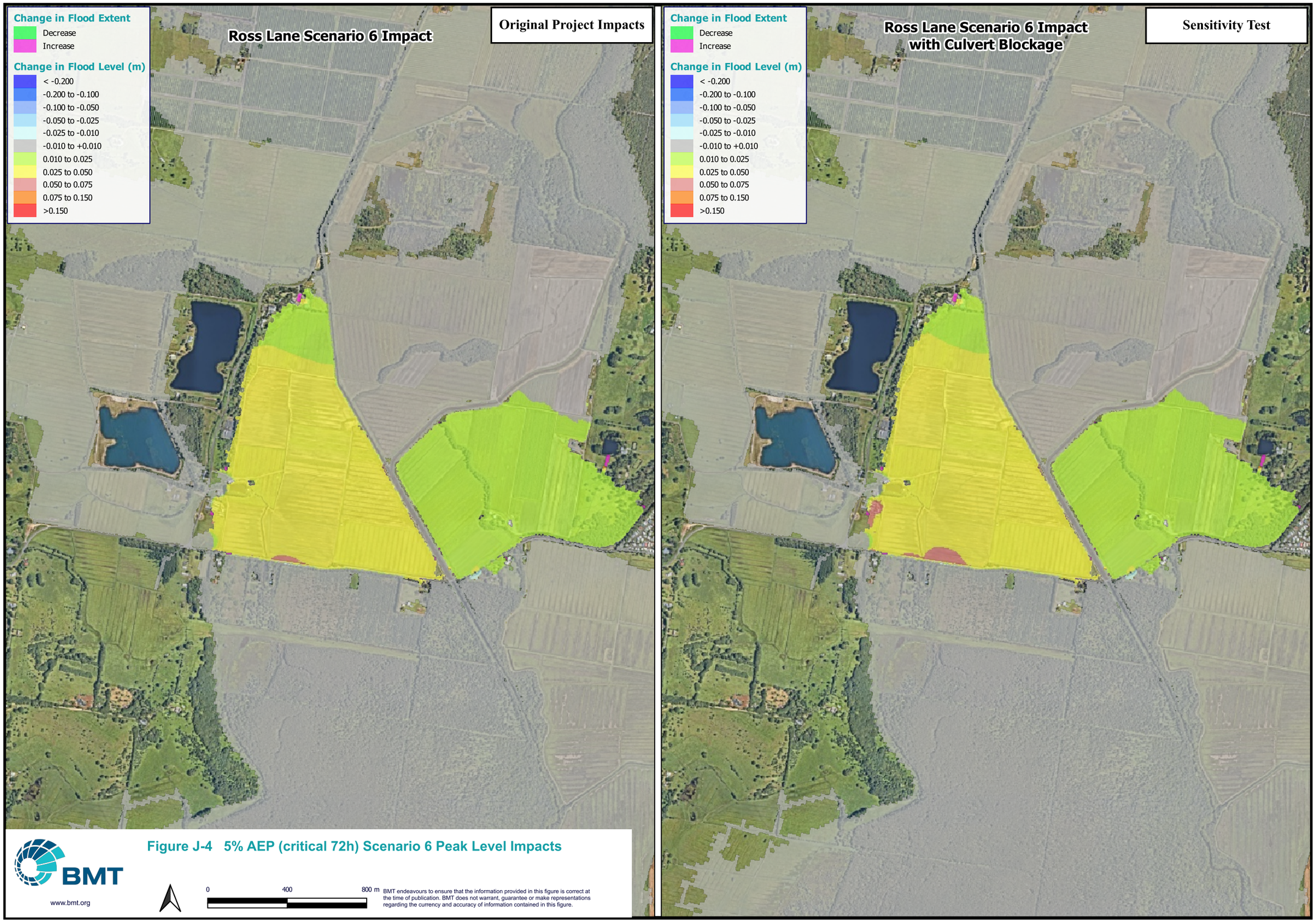


Figure J-4 5% AEP (critical 72h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

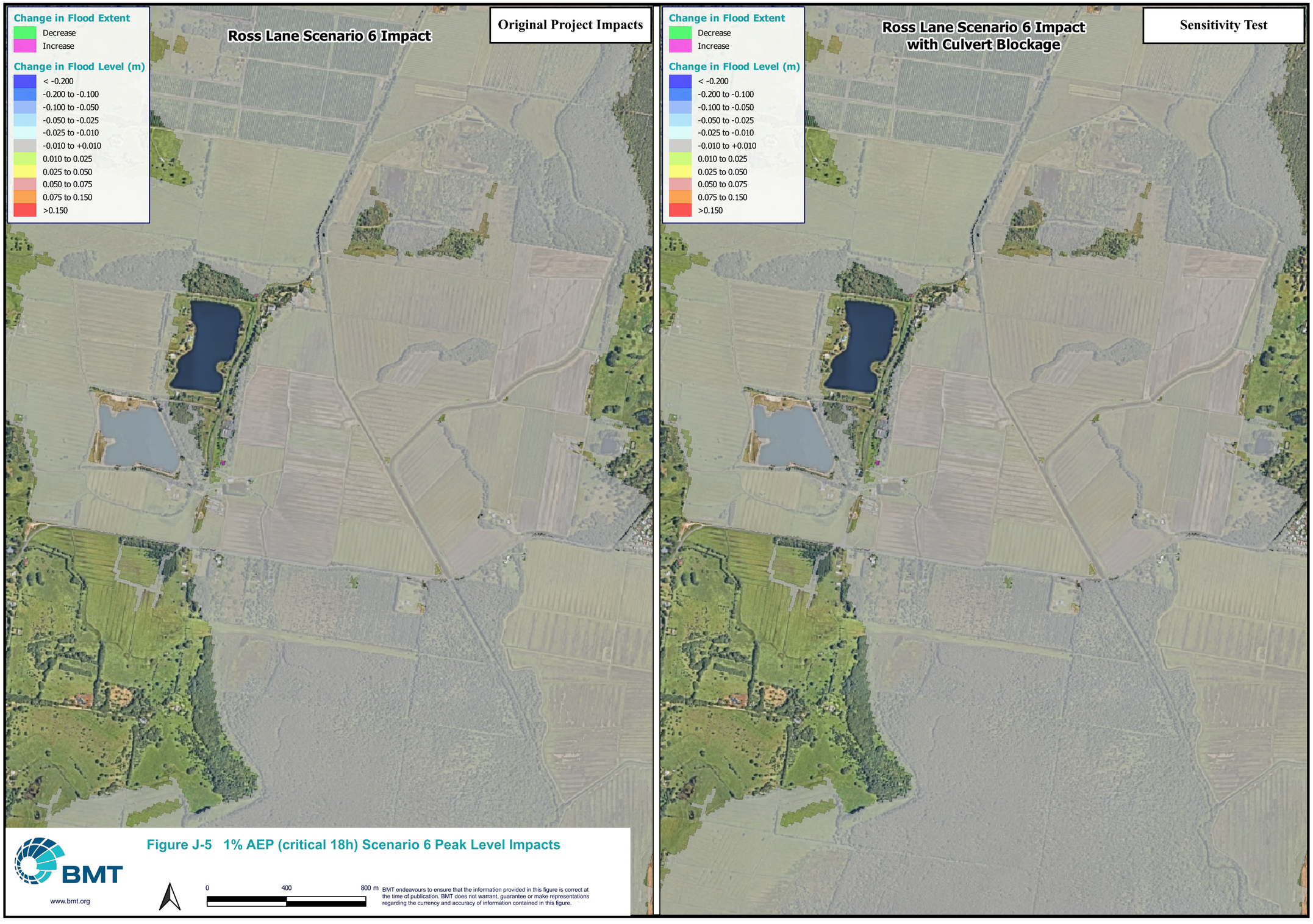


Figure J-5 1% AEP (critical 18h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

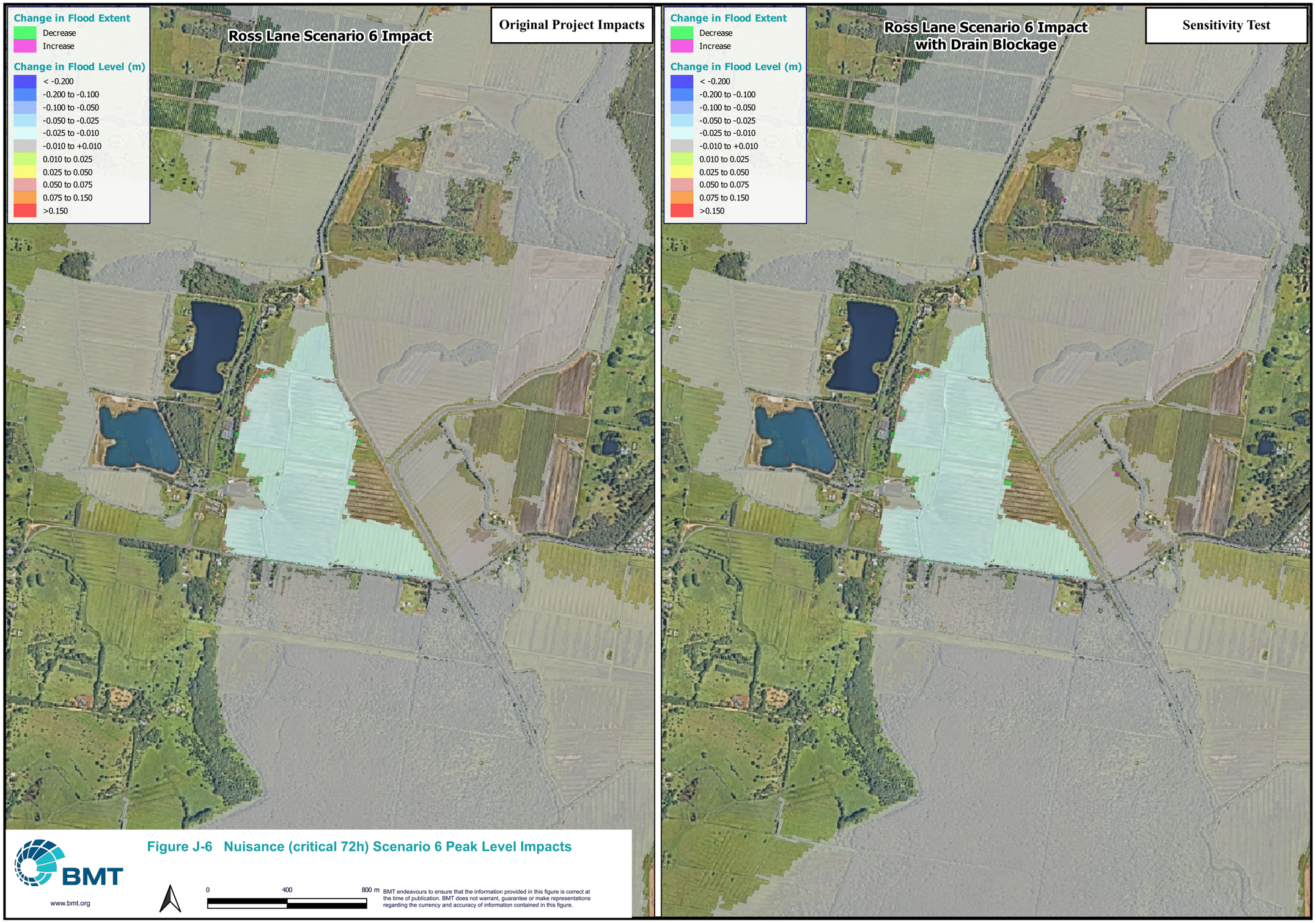


Figure J-6 Nuisance (critical 72h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

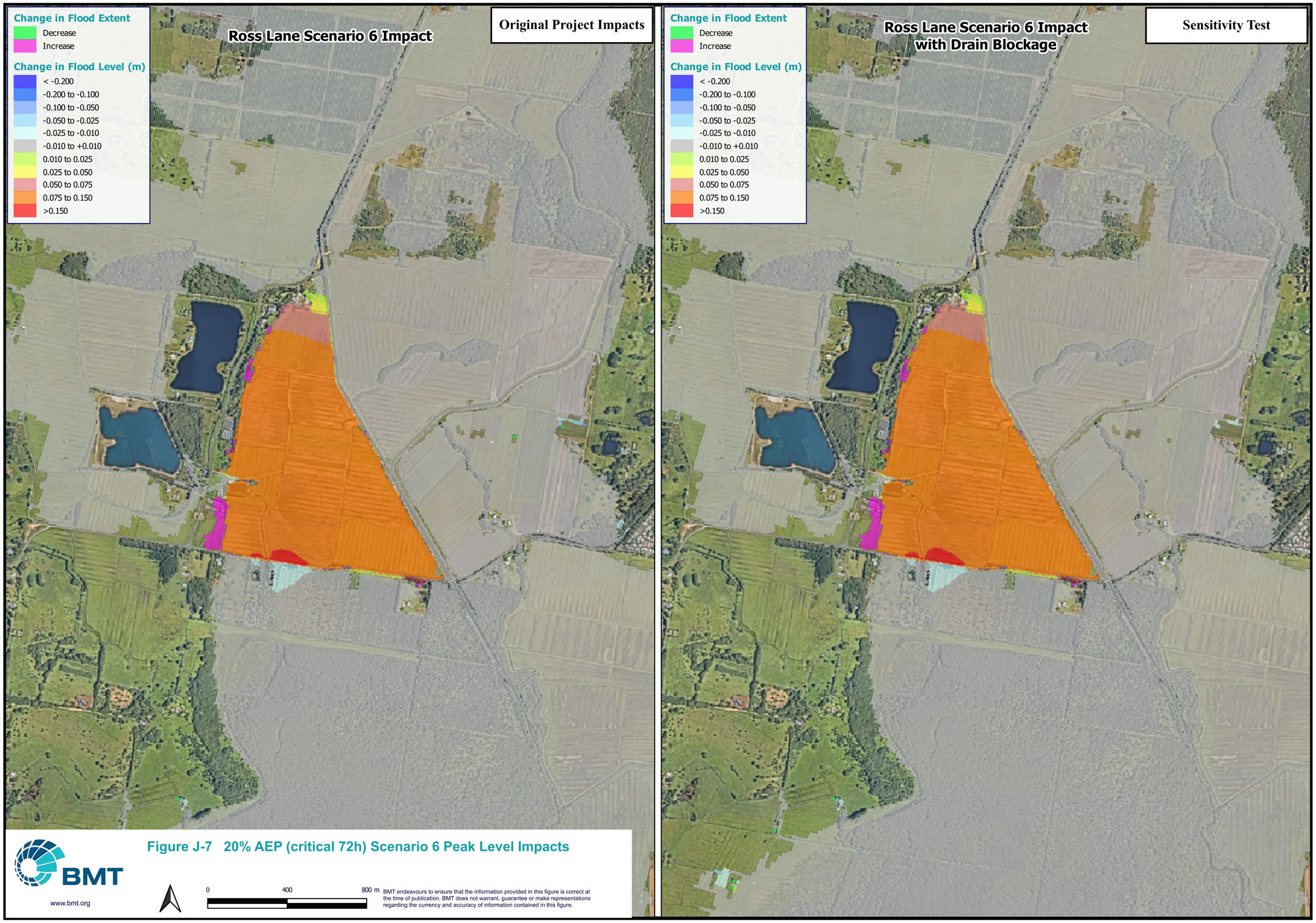


Figure J-7 20% AEP (critical 72h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

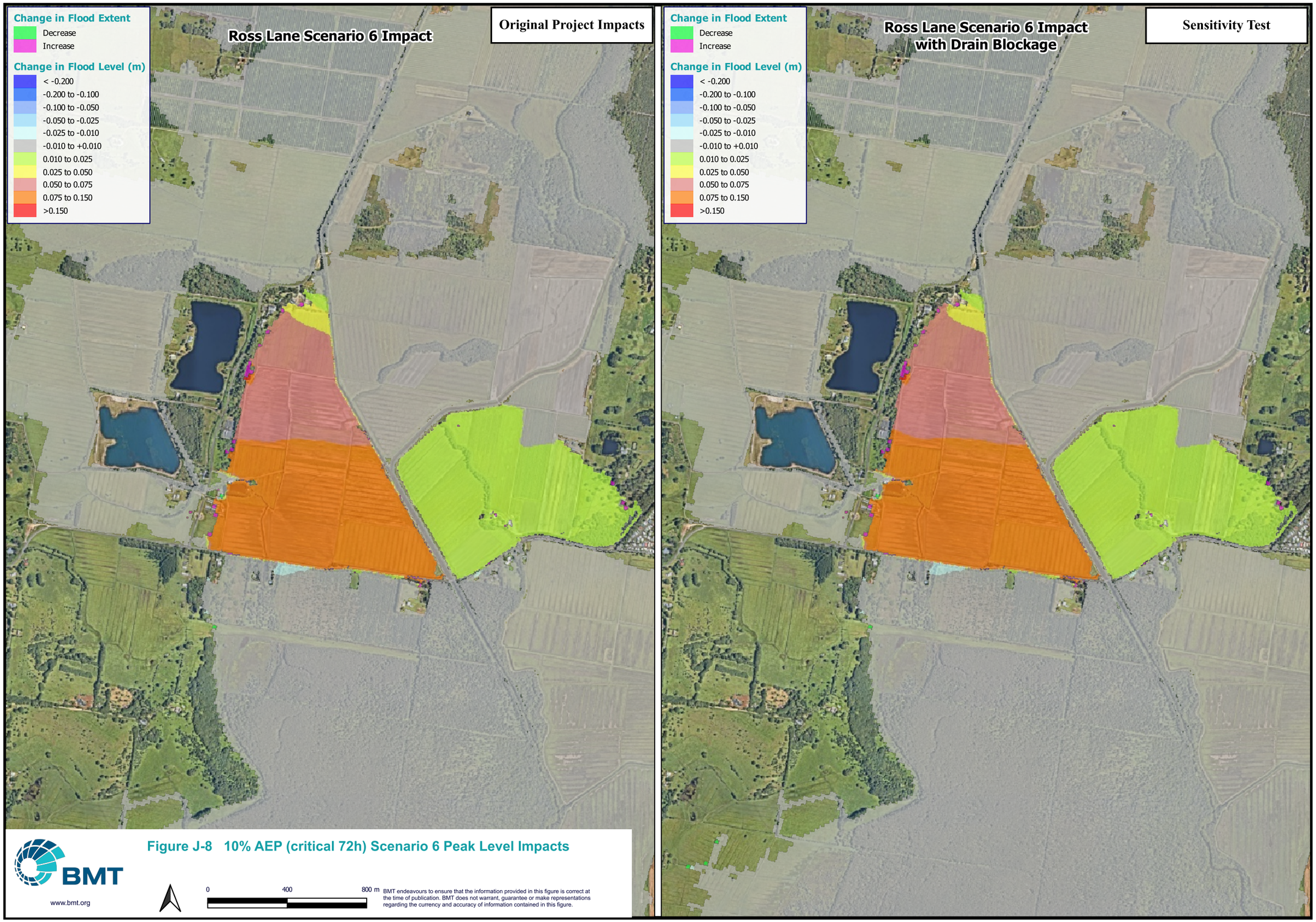


Figure J-8 10% AEP (critical 72h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

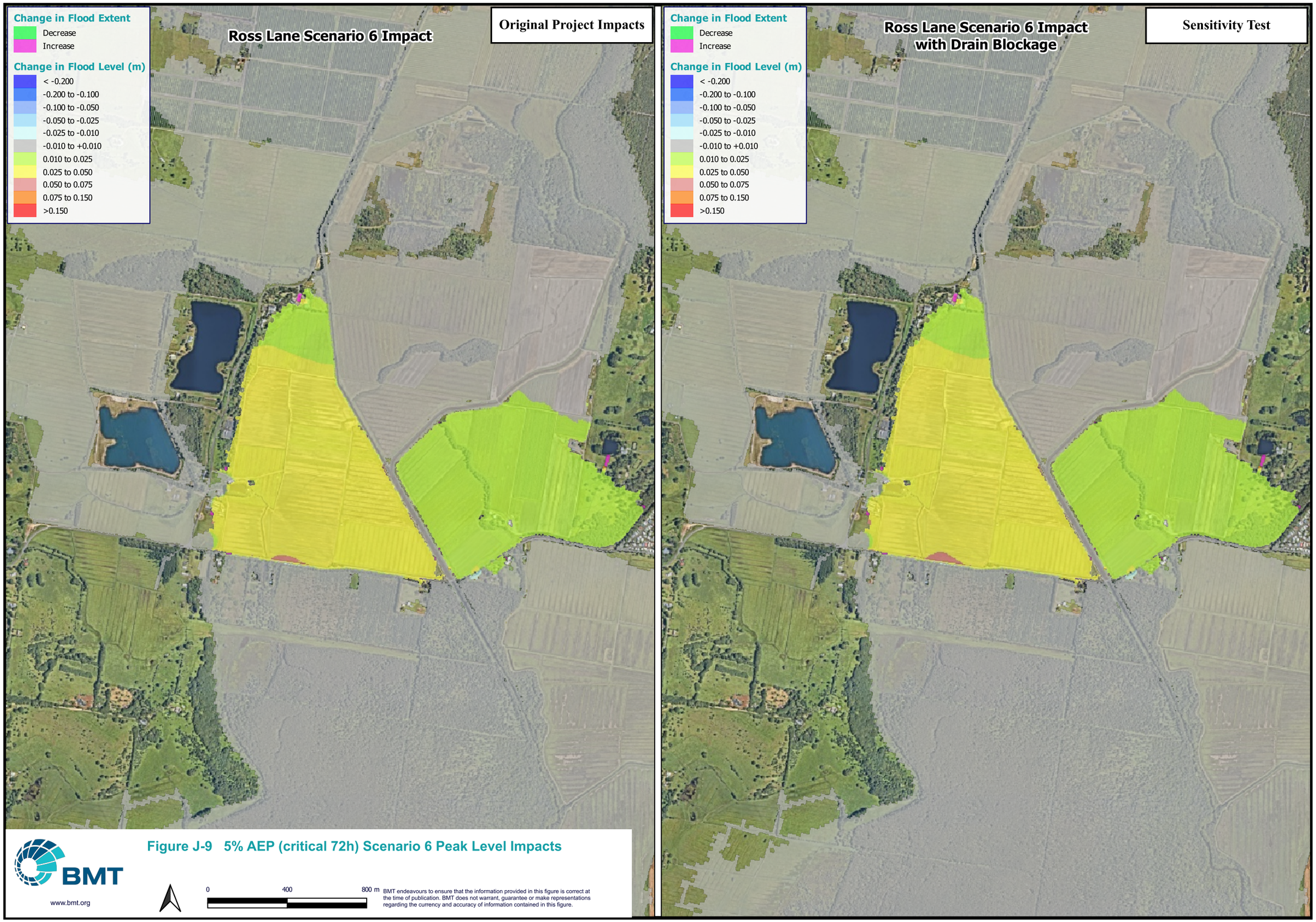


Figure J-9 5% AEP (critical 72h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

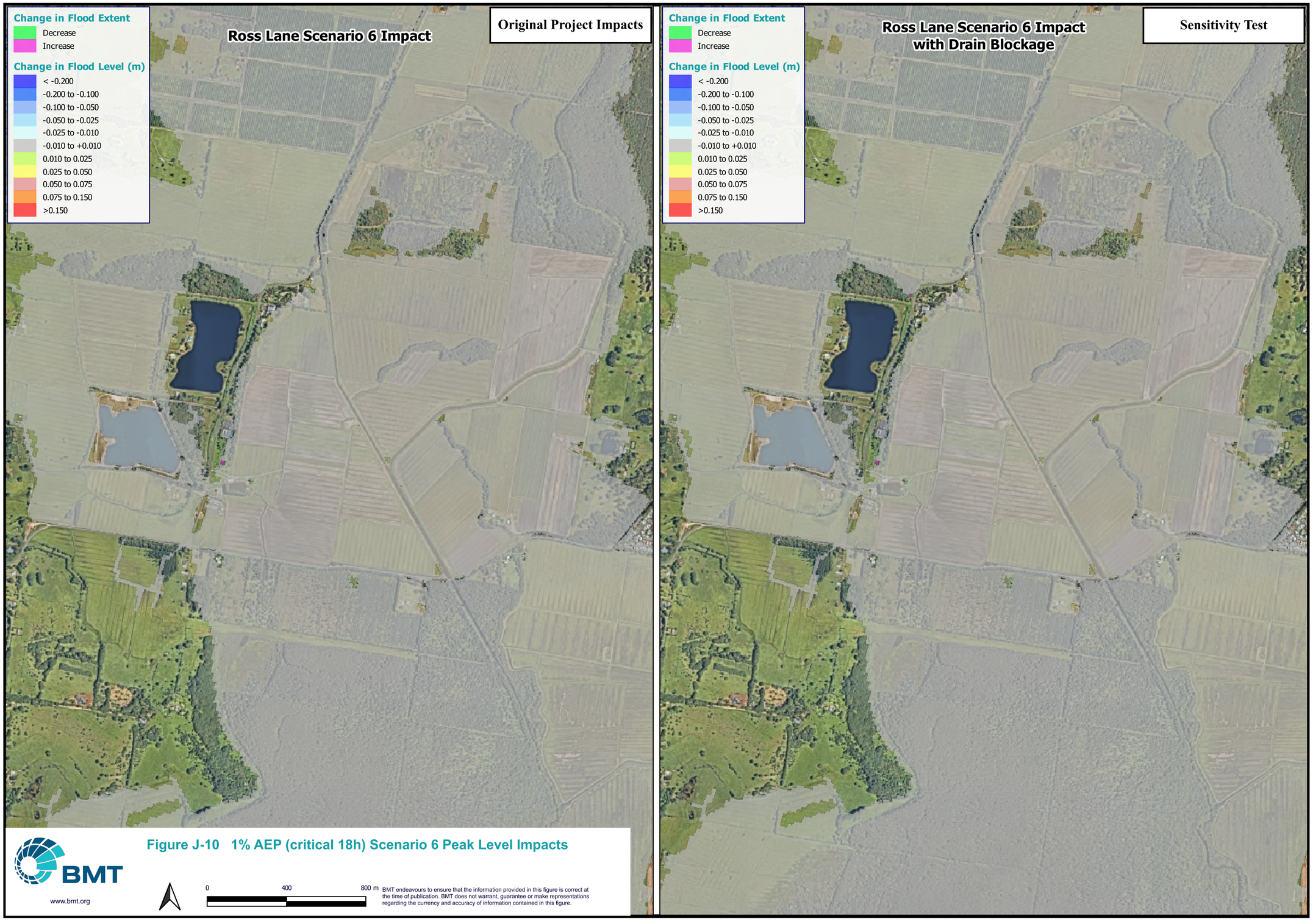


Figure J-10 1% AEP (critical 18h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

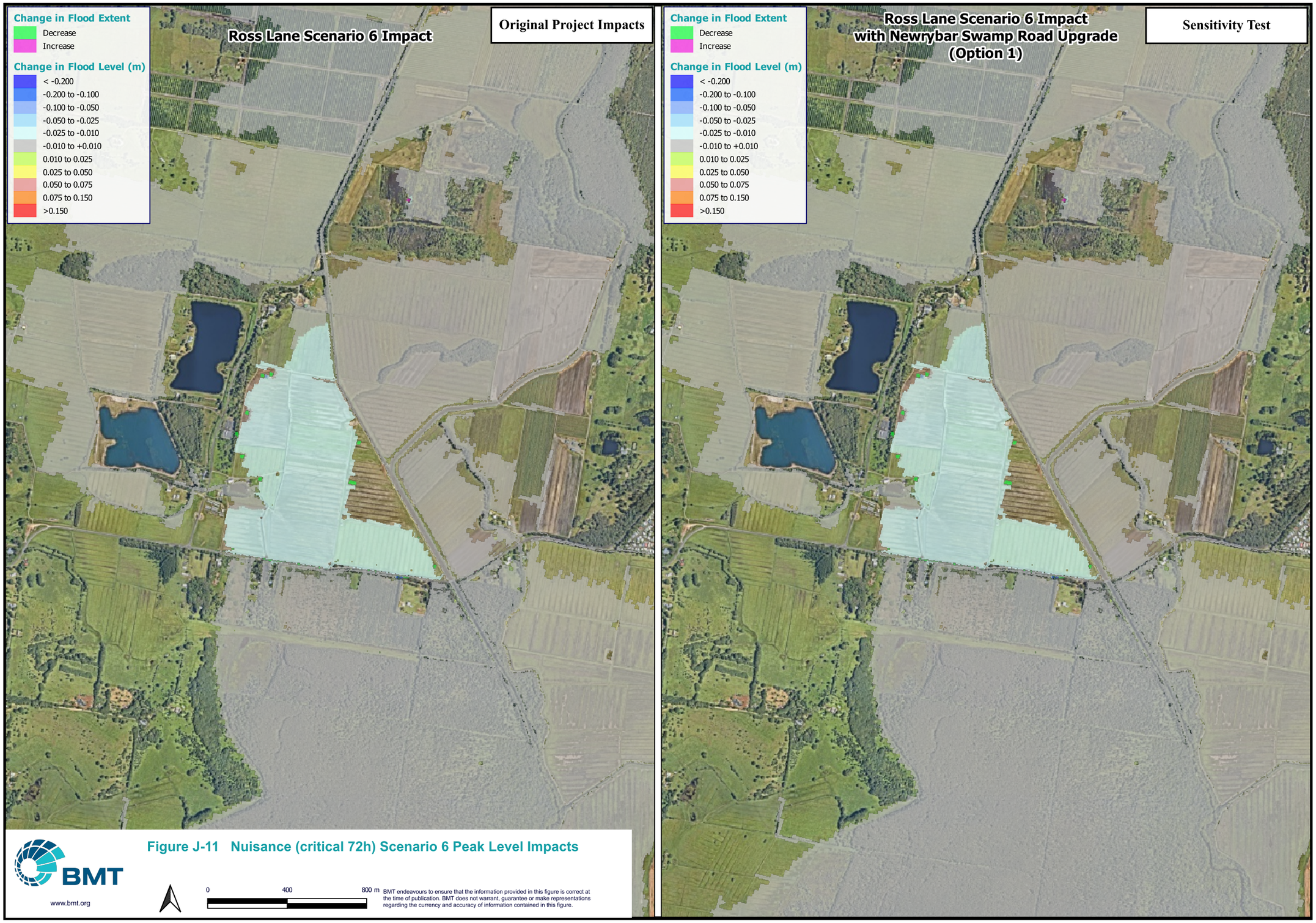


Figure J-11 Nuisance (critical 72h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

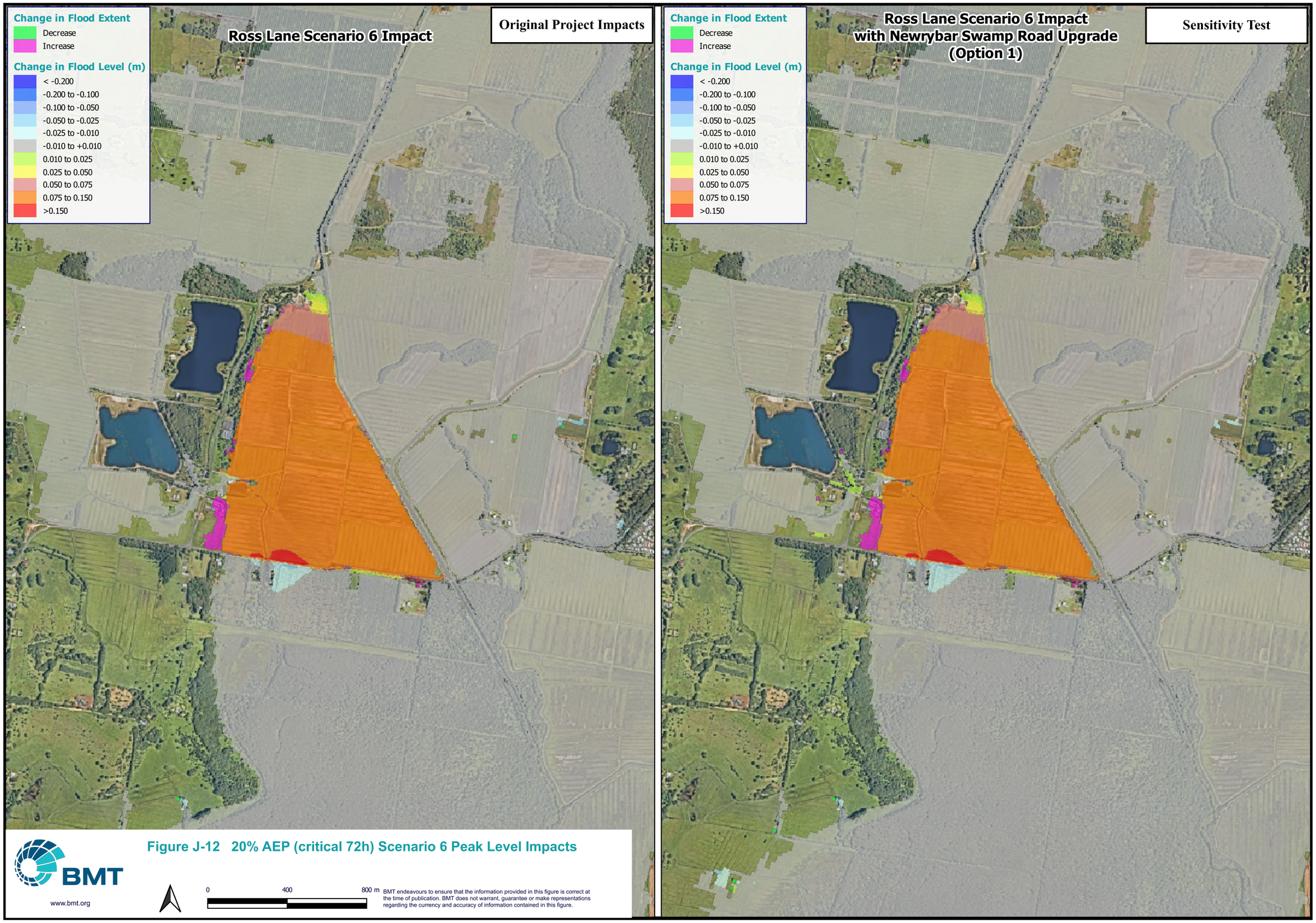


Figure J-12 20% AEP (critical 72h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

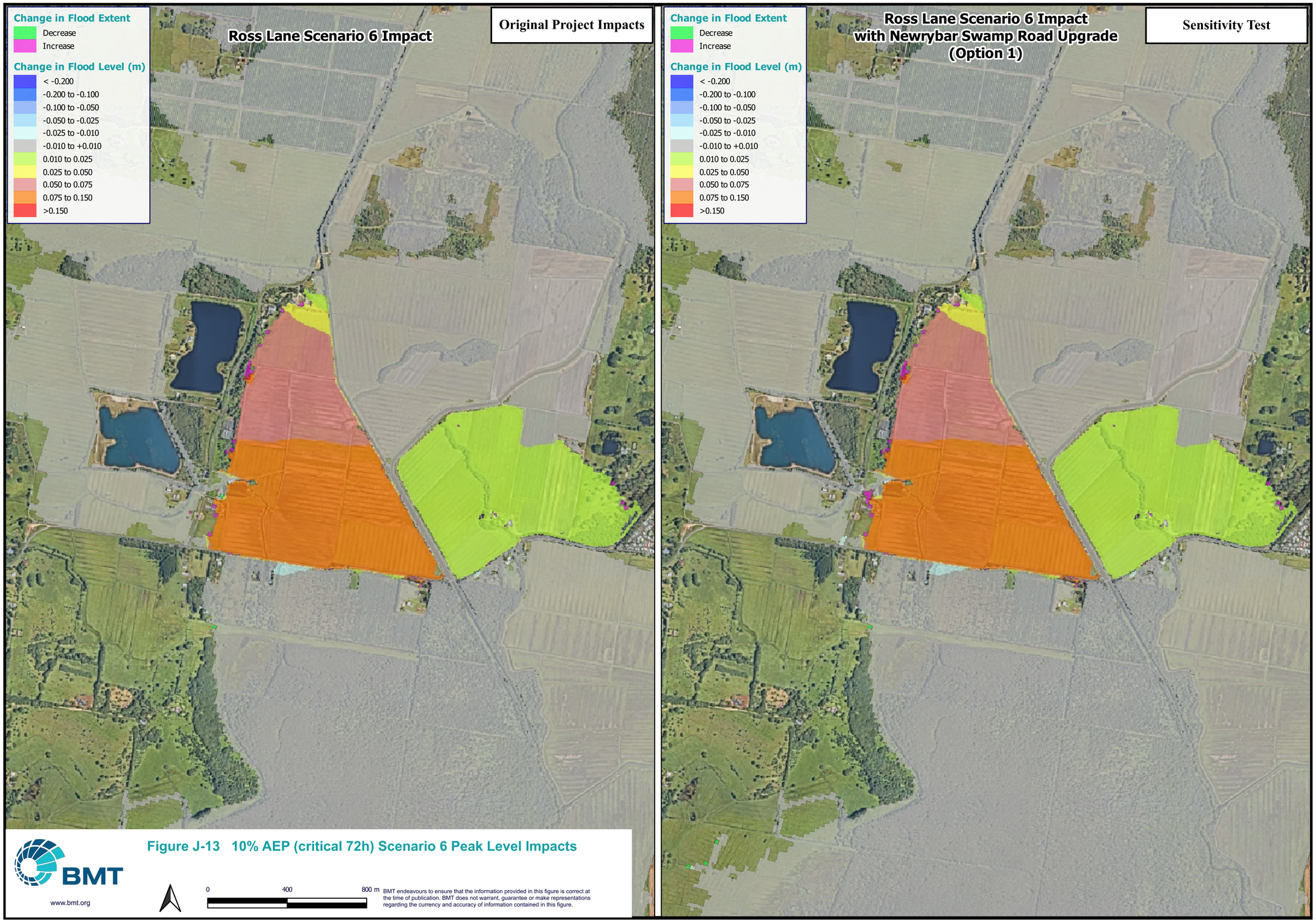


Figure J-13 10% AEP (critical 72h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

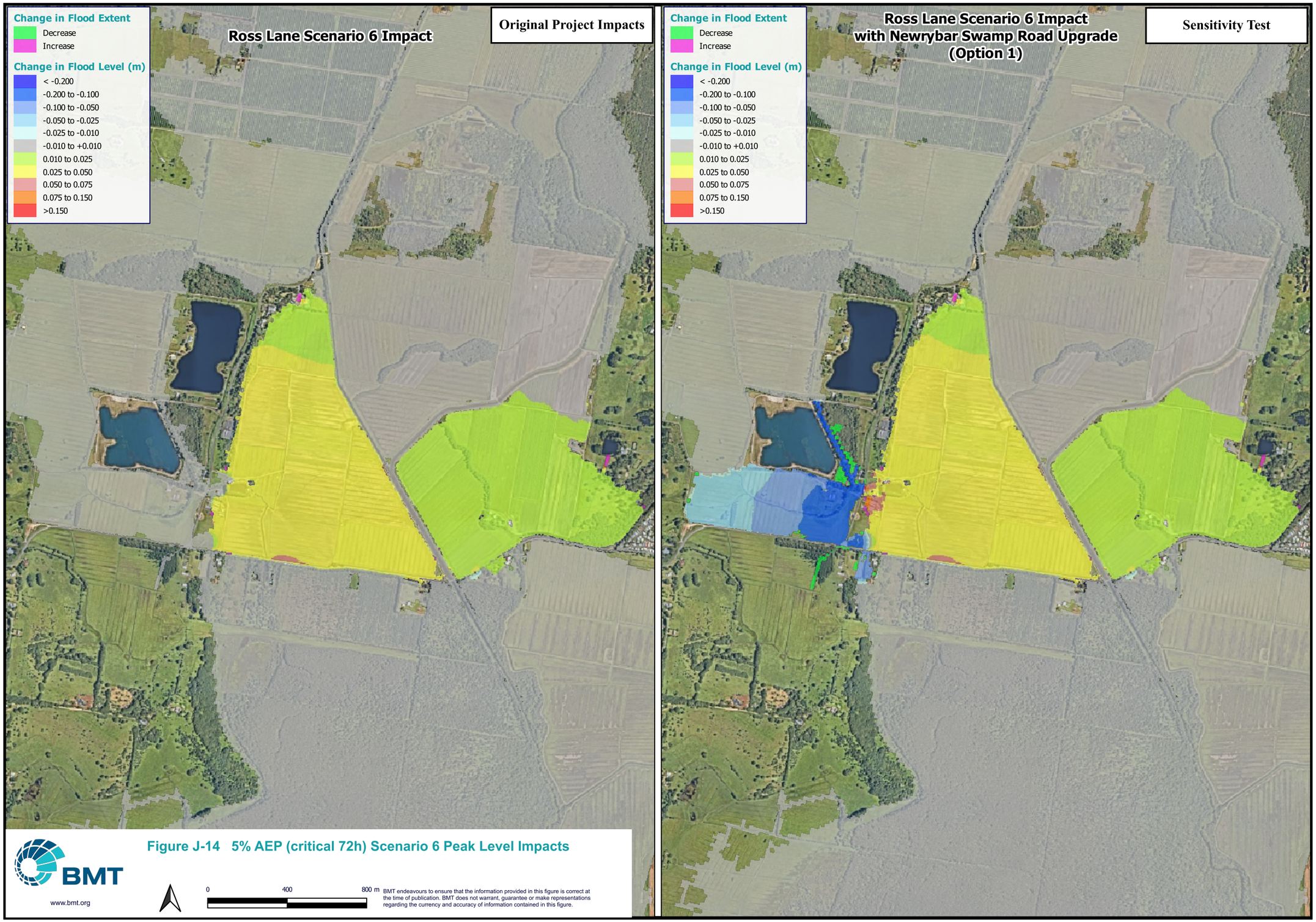


Figure J-14 5% AEP (critical 72h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

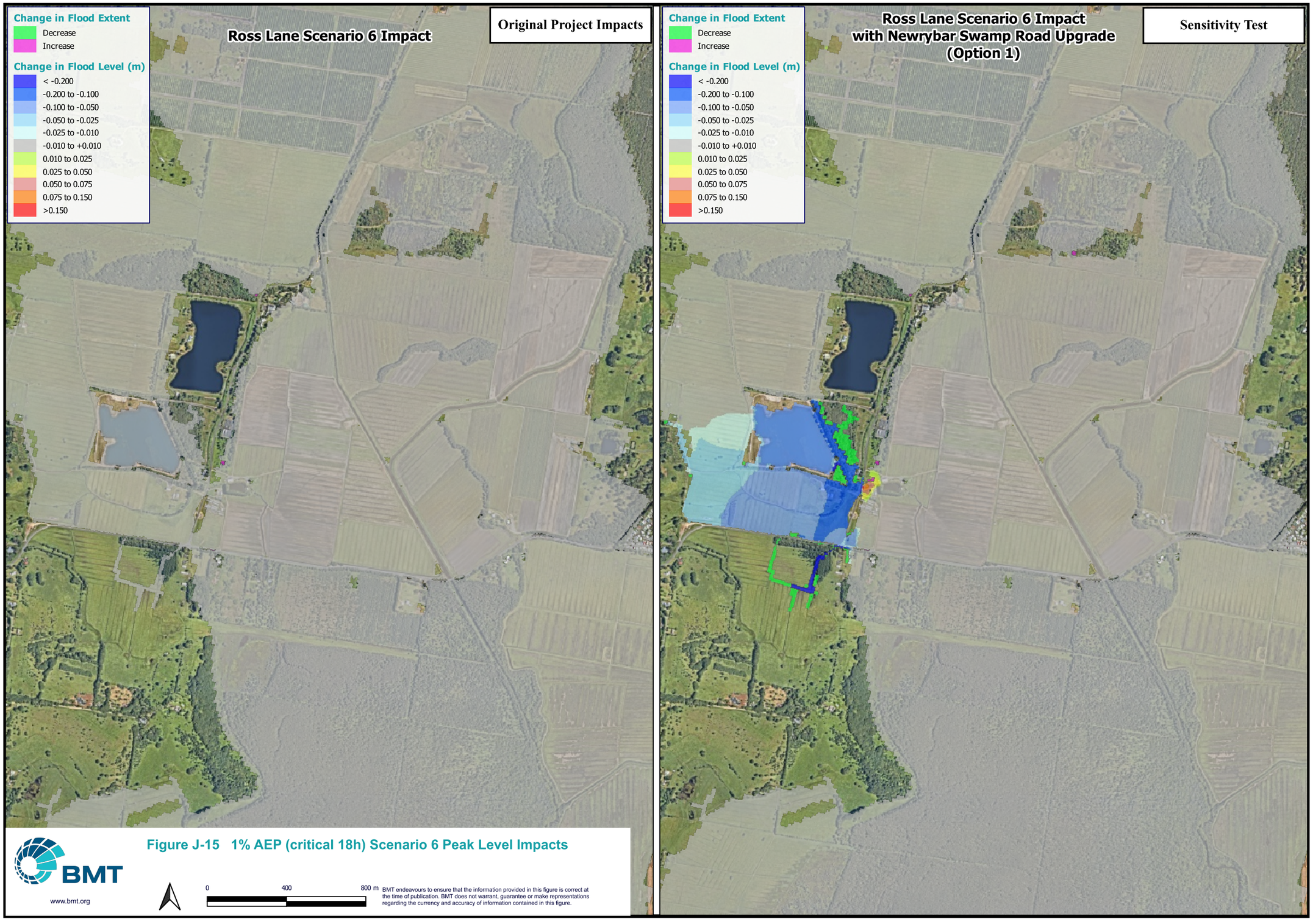


Figure J-15 1% AEP (critical 18h) Scenario 6 Peak Level Impacts

K:\003764.k.BR.Ross_Lane_FIA\GIS\FG_Project\Annex_J\003764_Annex_J.qgz

5.1 Ross Lane Betterment

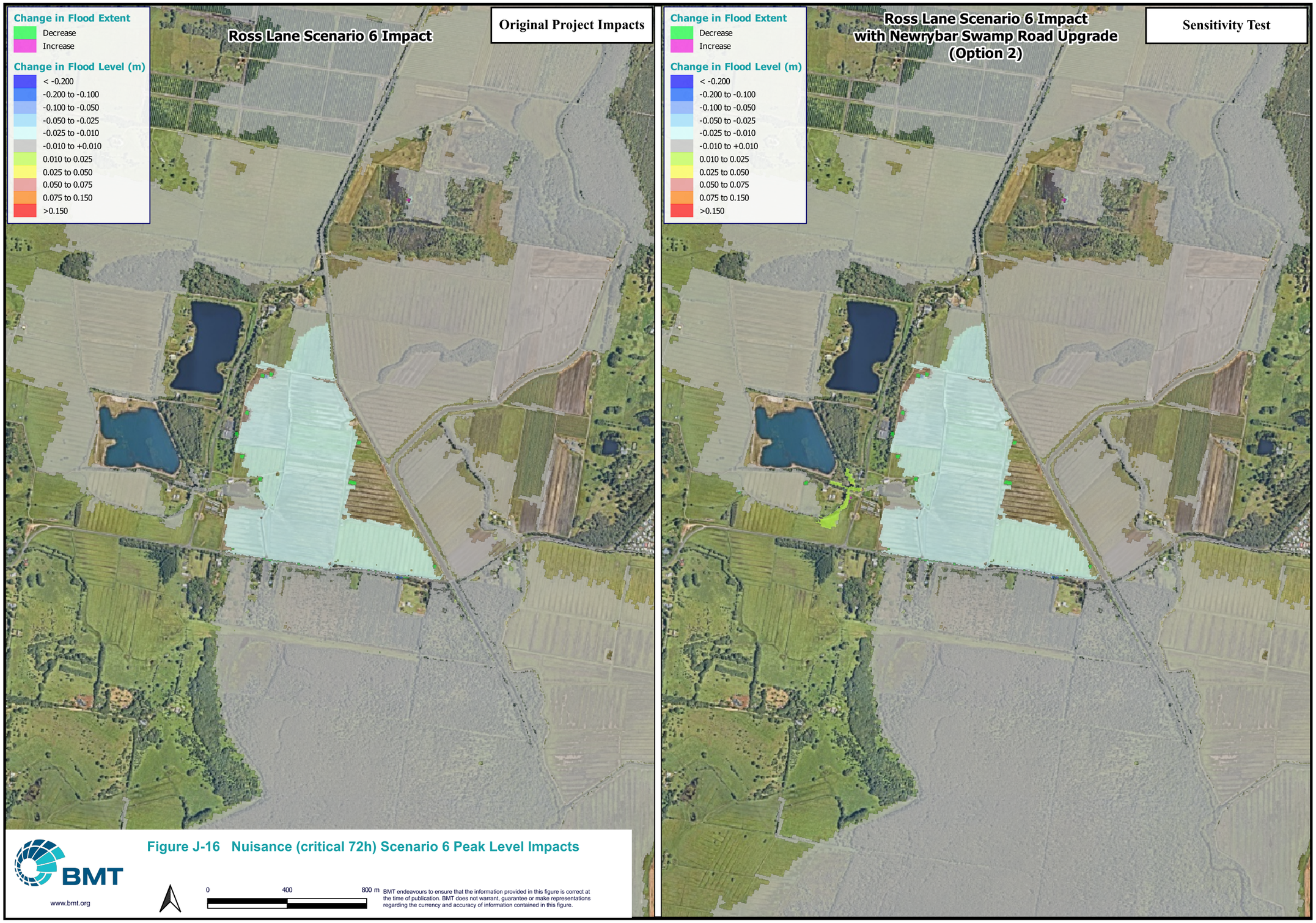


Figure J-16 Nuisance (critical 72h) Scenario 6 Peak Level Impacts

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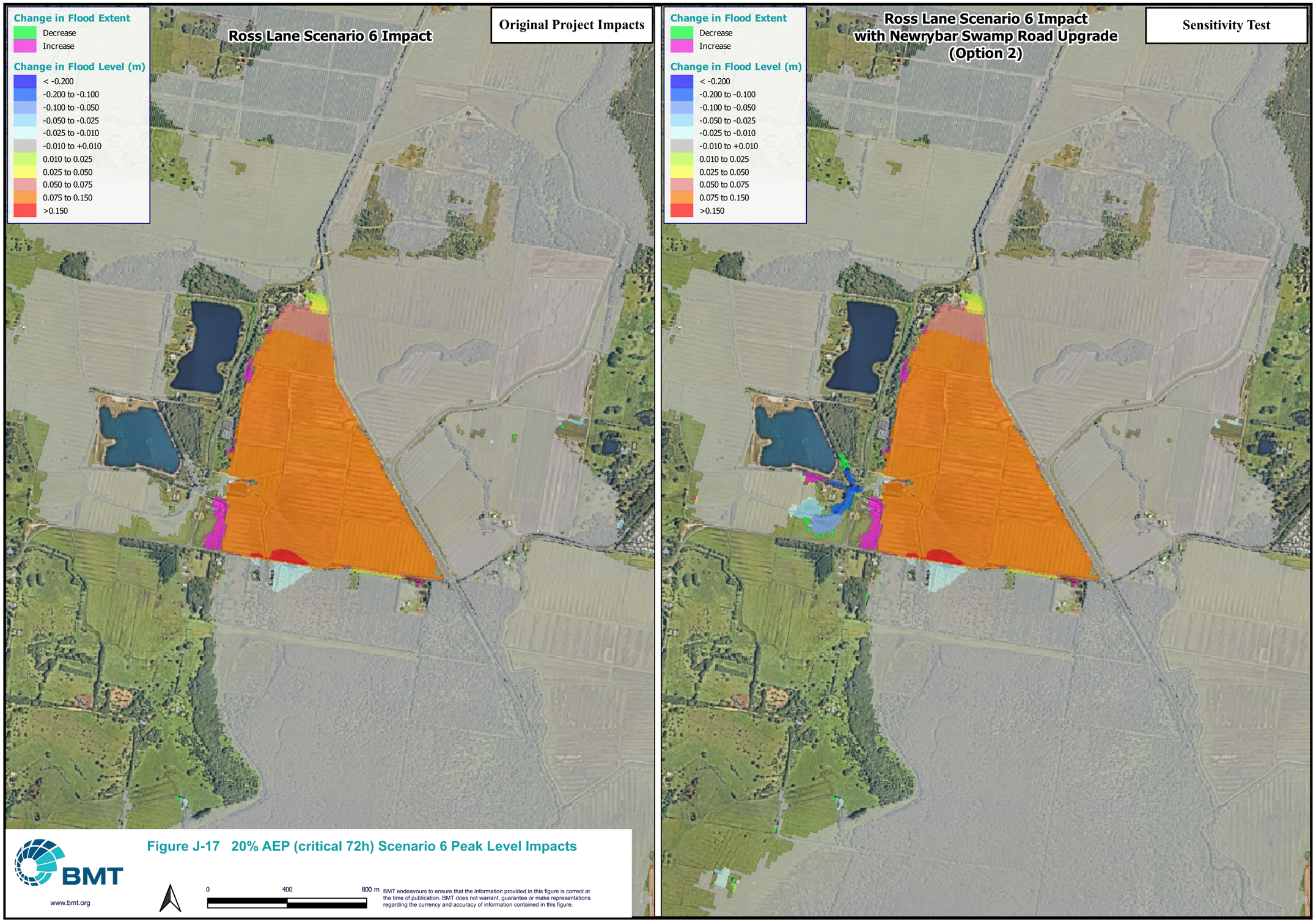


Figure J-17 20% AEP (critical 72h) Scenario 6 Peak Level Impacts

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5.1 Ross Lane Betterment

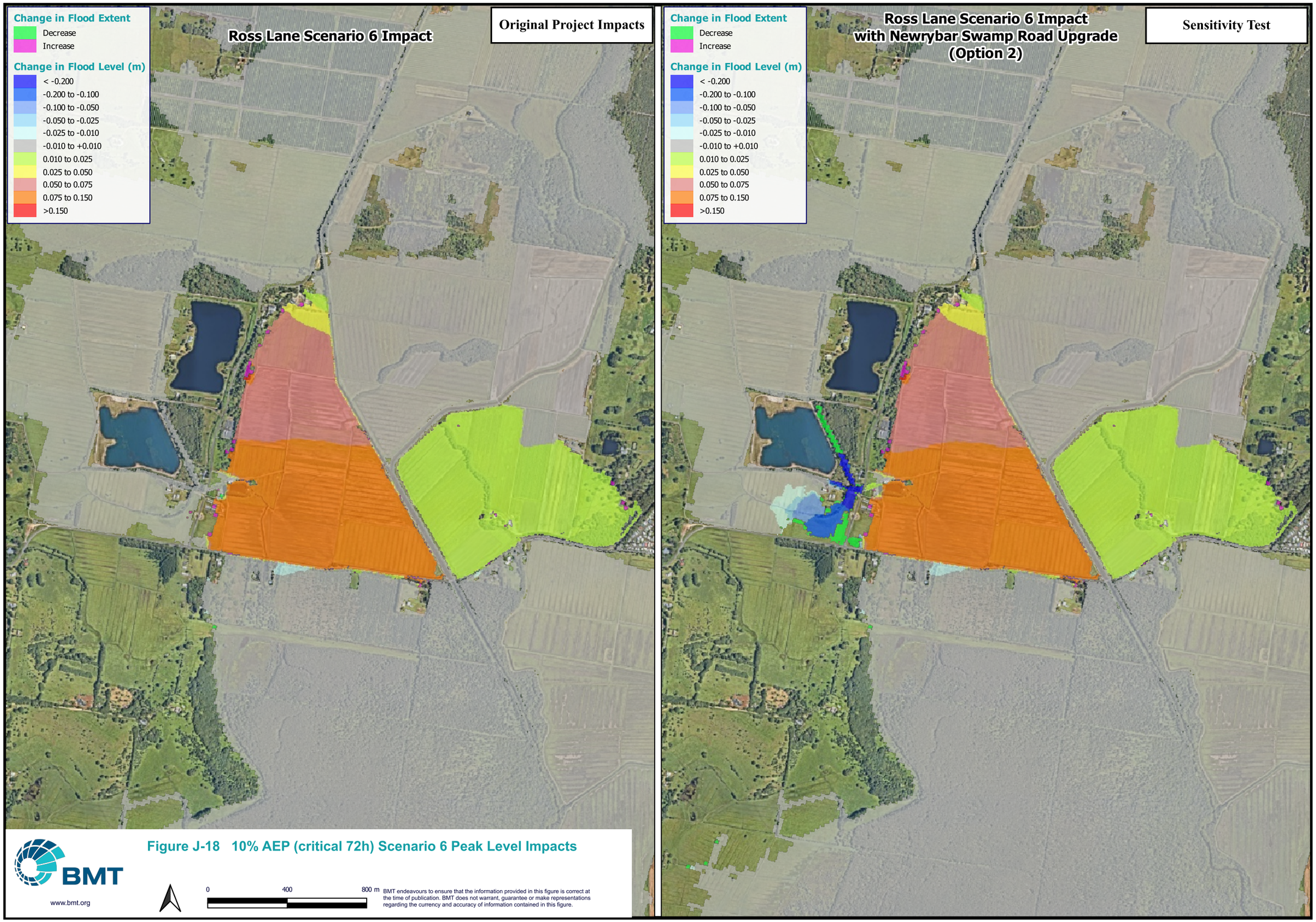


Figure J-18 10% AEP (critical 72h) Scenario 6 Peak Level Impacts

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5.1 Ross Lane Betterment

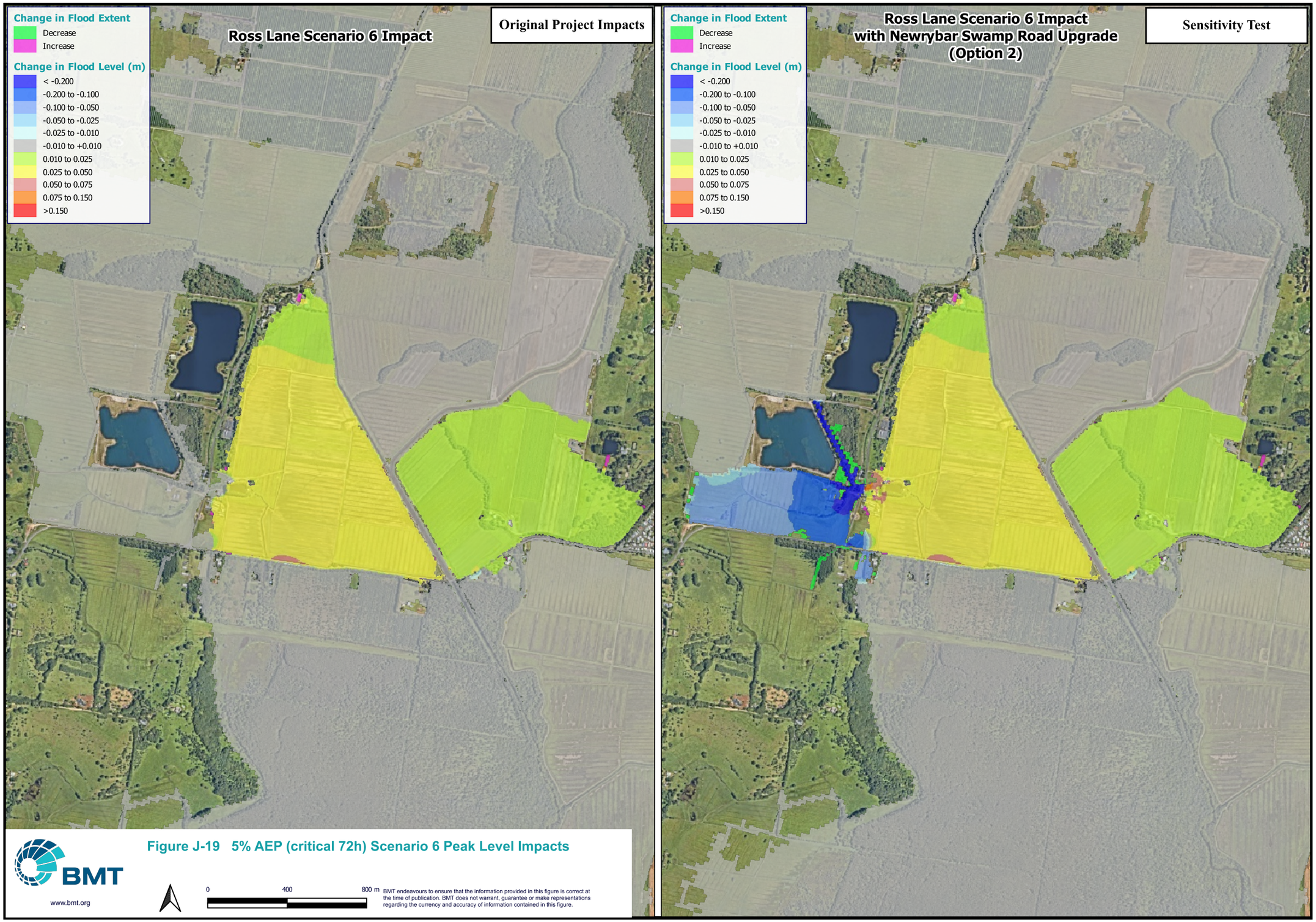


Figure J-19 5% AEP (critical 72h) Scenario 6 Peak Level Impacts

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5.1 Ross Lane Betterment

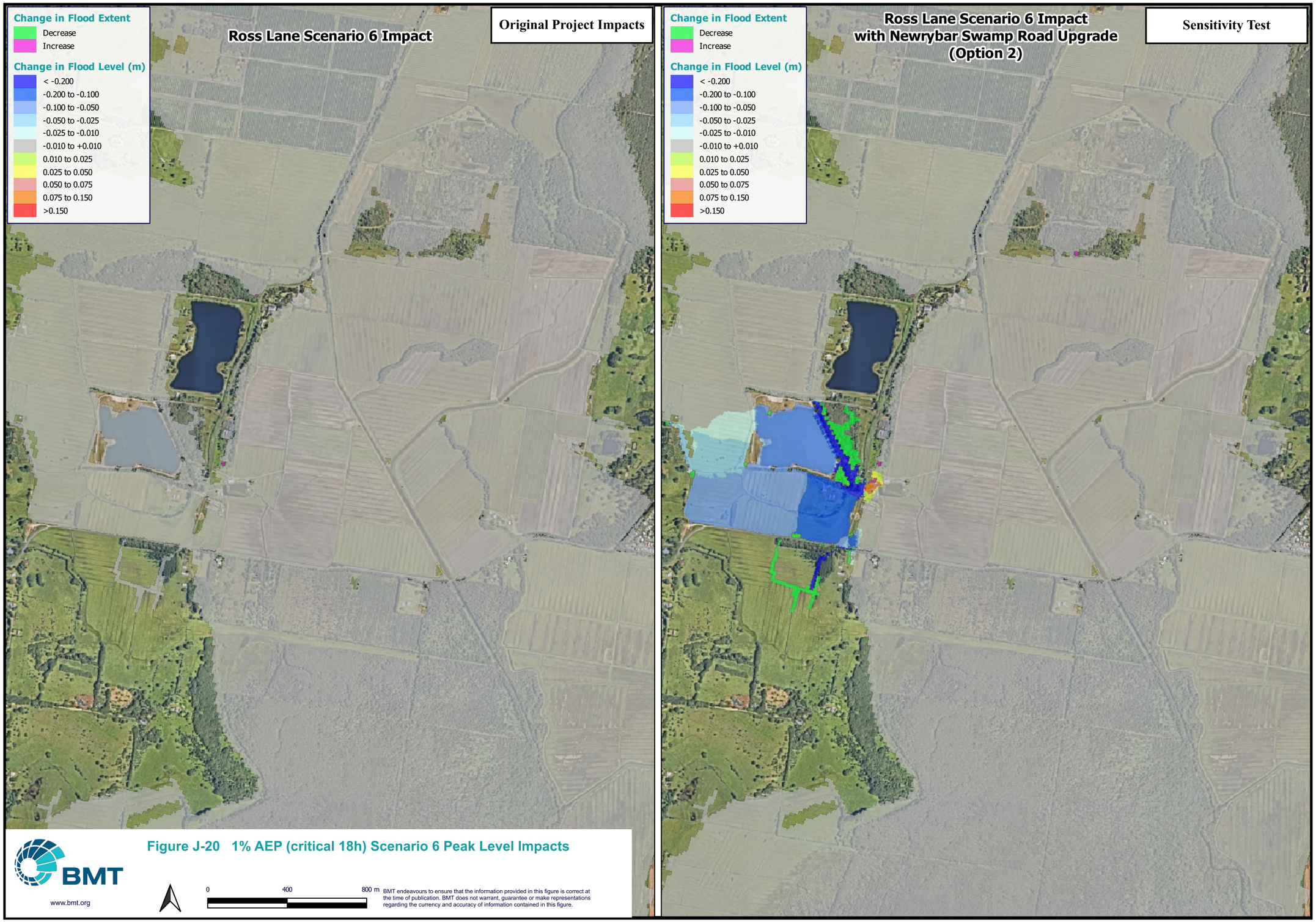
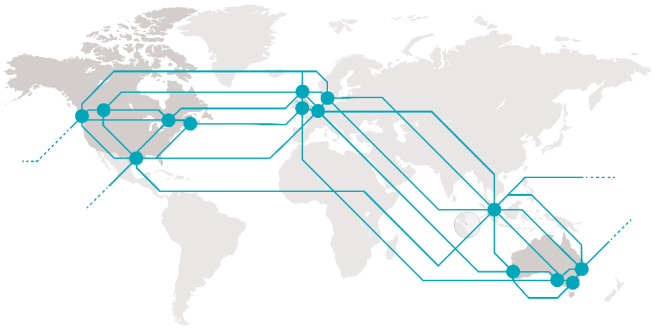


Figure J-20 1% AEP (critical 18h) Scenario 6 Peak Level Impacts

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