

TABLE OF CONTENTS

<u>1.0</u>	BACKGROUND OF SCHEME	10
1.1	General	10
1.2	History	11
1.3	The Lower Manawatu Scheme	11
1.4	The Lower Manawatu Design Standard	12
1.5	Lower Manawatu Scheme Works	12
1.6	Flood Behaviour and History	13
	1.6.1 Flood Behaviour	13
	1.6.2 Flood History	14
1.7	Timeline of Scheme Development	15
1.8	Key Reference Documents	17
2.0	ILLUSTRATION AND EXTENT OF SCHEME	24
2.1	Illustration of Scheme	24
2.2	Map of Key Assets (temporary image)	25
<u>3.0</u>	SEA TO MOUTOA GATES	29
3.1	Level of Service and Design	29
3.2	Illustrations and Maps	31
	3.2.1 Illustration (First draft only)	31
	3.2.2 Map of Significant Assets	32
3.3	Description of Reaches and Significant Features	33
	3.3.1 Summary	33
	3.3.2 Reach 1 - Sea to Upstream end of Whirokino Cut	33
	3.3.3 Reach 2 - Whirokino Cut	34
	3.3.4 Reach 3 - Whirokino Cut to 10 Miles	35
	3.3.5 Reach 4 - 10 Miles to 20 Miles	35
	3.3.6 Reach 5 – 20 Miles to 24 Miles (Moutoa Gates)	35
	3.3.7 Moutoa Gates and Floodway	36
	3.3.8 Tributary - The Tokomaru Stream	38
	3.3.9 Foxton Loop	38
3.4	Critical Assets and Vulnerabilities	39
	3.4.1 Moutoa Floodway Stopbanks	39
	3.4.2 Moutoa Floodway	40
	3.4.3 Moutoa Gates	40
	3.4.4 Moutoa Gates Inlet Channel	42
	3.4.5 Moutoa Floodway Drainage Systems	42
3.5	Flood Event Characteristics	42
3.6	Management Strategy (and Key Performance Measures)	43
3.7	Maintenance and Monitoring Schedule	44
3.8	Surveillance Plan (Before, During and After)	48
3.9	Resource Consents	54
3.10	Third Party Agreements / Responsibilities	54
3.11	Iwi Engagement	54
<u>4.0</u>	MOUTOA GATES TO OPIKI	55
4.1	Level of Service and Design	55
4.2	Illustrations and Maps	57
	4.2.1 Illustration	57
4.0	4.2.2 Map of Significant Assets (temporary image)	58
4.3	Description of Reaches and Significant Features	59
	4.3.1 Summary	59
	4.3.2 Reach 6 – 24 Miles to 31 Miles (Moutoa Gates to Opiki Bends)	59
	4.3.3 Reach 7 – 32 Miles to 41 Miles (Opiki Bends)	59
4.4	Critical Assets and Vulnerabilities	60



4.5 4.6 4.7 4.8 4.9 4.10 4.11	4.4.1 Opiki Road Inundation Flood Event Characteristics Management Strategy Maintenance and Monitoring Schedule Flood Surveillance Plan (Before, During and After) Resource Consents Third Party Agreements / Responsibilities Iwi Engagement	60 62 62 63 64 67 68
<u>5.0</u>	TAONUI BASIN	69
5.1	Level of Service and Design	70
5.2	Illustrations and Maps	72
	5.2.1 Illustration	72
- 0	5.2.2 Map of Significant Assets (temporary image)	73 75
5.3	Description of Reaches and Significant Features	75 75
	5.3.1 Summary 5.3.2 Reach 8 – 41 Miles to 51 Miles (Opiki to Palmerston North)	75 75
	5.3.3 Tributary – The Oroua River	75
	5.3.4 Taonui Basin	76
	5.3.5 Five Spillways	79
5.4	Critical Assets and Vulnerabilities	82
	5.4.1 Five Spillways	82
	5.4.2 Drainage Stopbanks	82
	5.4.3 Burkes Drain Capacity	82 82
	5.4.4 Large Culverts for Gravity Drainage of Ponded Water 5.4.5 Removable/Manually Operated Flood Barriers	83
	5.4.6 Burkes Floodgates	83
	5.4.7 Burkes Pump Station	83
5.5	Flood Event Characteristics	83
5.6	Management Strategy	85
5.7	Maintenance and Monitoring Schedule	86
5.8	Flood Surveillance Plan (Before, During and After)	89
5.9	Resource Consents	93 97
5.10 5.11	Third Party Agreements / Responsibilities Iwi Engagement	97
0.11		
<u>6.0</u>	PALMERSTON NORTH TO ASHHURST (INCL MANGAONE)	98
6.1	Level of Service and Design	98
6.2	Illustrations and Maps	100
	6.2.1 Illustration	100 101
6.3	6.2.2 Map of Significant Assets (temporary image for now) Description of Reaches and Significant Features	101
0.3	6.3.1 Summary	102
	6.3.2 Reach 9 – 50 Miles to 63 Miles (Palmerston North to Ashhurst)	102
	6.3.3 Tributary – Mangaone Stream	102
	6.3.4 Tributary – Turitea Stream	103
6.4	Critical Assets and Vulnerabilities	103
	6.4.1 Palmerston North Stopbanks	103
	6.4.2 Manawatū River Stopbanks from Napier Road to Maxwell's Line landfill, at	
	Road, and at Turitea.	104 105
	6.4.3 Fitzroy Bend Secondary Stopbank (at Ruamahanga Crescent)6.4.4 Mangaone Stream Stopbanks	103
	6.4.5 Mangaone (Flygers) Spillway	106
	6.4.6 Floodgates and Sluice Gates on Stopbank Culverts	106
	6.4.7 Miscellaneous Flood Protection Measures Buick Crescent and Sharon Place	107
	6.4.8 Concrete Flood Walls	107
	6.4.9 Timber Flood Walls	107
	6.4.10 Manawatū River Gravel Management	108
	6.4.11 Vegetation Management	109



	6.4.12 Lateral Erosion – Rock Linings (including Anzac Cliffs) 6.4.13 Rock and Permeable Groynes at Fitzroy Bend 6.4.14 Mangaone Stream Channel Management and Bank Stabilisation	109 110 111
6.5	6.4.15 River Amenity Enhancement ElementsFlood Event Characteristics6.5.1 Mangaone Stream Warnings and Travel Time	112 112 112
6.6	Management Strategy	113
6.7	Maintenance and Monitoring Schedule	114
6.8	Flood Surveillance Plan (Before, During and After)	124
6.9	Resource Consents	132
6.10	Third Party Agreements / Responsibilities	139
6.11	lwi Engagement	139
<u>7.0</u>	FEILDING FLOOD PROTECTION	140
7.1	Level of Service and Design	140
7.2	Illustrations and Maps 7.2.1 Illustration	141
	7.2.1 Map of Significant Assets (temporary image)	141 142
7.3	Description of Reaches and Significant Features	142
7.0	7.3.1 Summary	143
	7.3.2 Feilding Flood Protection	143
	7.3.3 Tributary – Makino Stream	145
	7.3.4 Tributary – Kiwitea Stream	145
7.4	Critical Assets and Vulnerabilities	145
	7.4.1 Critical Stopbanks	145
	7.4.2 Tributary Culverts and Guillotine Gates	146
	7.4.3 Makino Gates (including adjacent rock linings)	147
	7.4.4 Makino Gates – Upstream Debris Fence	147
	7.4.5 Pharazyn Line Gate	148
	7.4.6 Reid Line Floodway Drop Structure	148
	7.4.7 Stream Channel Maintenance	148
7.5	7.4.8 Waterloo and Heatley Ave Pump Stations? Flood Event Characteristics	148
7.6	Management Strategy	149 150
7.7	Maintenance and Monitoring Schedule	150
7.8	Flood Surveillance Plan (Before, During and After)	156
7.9	Resource Consents	160
7.10	Third Party Agreements / Responsibilities	164
7.11	Iwi Engagement	164
8.0	OPERATING PROCEDURES	165
8.1	Introduction	165
8.2	Sea to Moutoa Gates Operating Procedures	166
	8.2.1 Moutoa Gates Operation Procedure	166
	8.2.2 Moutoa Stopbank Inspections	167
	8.2.3 Moutoa Floodway Lease and Cropping Approval Process	167
	8.2.4 Moutoa Gates Concrete Structure Annual Inspection Checklist	168
	8.2.5 Moutoa Gates Steel Components Annual Inspection Checklist	168
	8.2.6 Moutoa Gates Electrical/Control Six Monthly Inspection Checklist8.2.7 Moutoa Gates Electrical/Control Annual Inspection Checklist	168
	8.2.7 Moutoa Gates Electrical/Control Annual Inspection Checklist8.2.8 Moutoa Gates Generator Test Run and Servicing Procedure	168 168
	8.2.9 Moutoa Gates Mechanical Components Six Monthly Inspection Checklist	168
	8.2.10 Moutoa Gates Control Tower Six Monthly Inspection Checklist	168
	8.2.11 Foxton Loop Dry Gates Test Operation and Inspection Procedure	168
	8.2.12 White Elephant Gates Test Operation and Inspection Procedure	168
	8.2.13 Moutoa Floodway Stopbank Grazing Guidelines	168
8.3	Moutoa Gates to Opiki Operating Procedures	169
8.4	Taonui Basin Operating Procedures	170
	8.4.1 Flygers Line Spillway Operation	170



	8.4.2	Flygers Spillway Annual Inspection Checklist	170	
	8.4.3	"Lowered Bank" Spillway Annual Inspection Checklist	170	
	8.4.4	Drain Annual Inspection Checklist (Generic)	170	
	8.4.5	Stopbank Annual Inspection Checklist (Generic)	170	
	8.4.6	Culvert and/or Floodgate Annual Inspection Checklist (Generic)	171	
	8.4.7	Taonui Basin Removable Flood Barriers Annual Inspection and Trial Run Proce	edure171	
8.5	Opiki 1	o Ashhurst (Palmerston North) Operating Procedures	172	
	8.5.1	Palmerston North Removable/Manually Operated Flood Barriers Operation	172	
	8.5.2	Annual and Five Yearly Inspection Procedure for Secondary Stopbank Ruam	ahanga	
	Cresc	ent (private property)	172	
	8.5.3	Comprehensive Surveillance and Operational Regime - Routine	172	
	8.5.4	Comprehensive Surveillance and Operational Regime - Intermediate	172	
	8.5.5	Comprehensive Surveillance and Operational Regime – Special Inspection	173	
	8.5.6	Comprehensive Surveillance and Operational Regime - Comprehensive	Safety	
	Review 174			
	8.5.7	Palmerston North Hot Spot Stopbank Surveillance Plan	174	
8.6	The M	angaone Stream Operating Procedures	175	
	8.6.1	Mangaone Spillway Operation	175	
8.7	Fieldir	ng Flood Protection Operating Procedures	176	
	8.7.1	Makino Gates Operation	176	
8.8	Rural	Operating Procedures	177	
	8.8.1	Annual Stopbank Inspection	177	
	8.8.2	Concrete and Timber Flood Wall Inspections	178	
	8.8.3	Major Flood Gate Structure Inspections	178	
	8.8.4	Major and Minor flood-gated culverts Inspections	178	
	8.8.5	Rock and demolition concrete linings Inspections	179	
	8.8.6	Live tree bank protection	179	
	8.8.7	Edge Protection Planting/Vegetation Management	179	
9.0	STUF	F TO MAYBE FIND A HOME FOR	180	



TABLE OF TABLES

,, (DLE 01 17 (DLE)	
Table 1: LMS and Moutoa Drainage Scheme (MDS) Monitoring and Maintenance Responsibilit	ies 42
Table 2: Maintenance and Monitoring Schedule – Sea to Moutoa Gates	44
Table 3: Surveillance Plan – Sea to Moutoa Gates	48
Table 4: Resource Consents – Sea to Moutoa Gates	54
Table 5: Third Party Agreements / Responsibilities – Sea to Moutoa Gates	54
Table 6: Maintenance and Monitoring Schedule – Moutoa Gates to Opiki	63
Table 7: Surveillance Plan – Moutoa Gates to Opiki	64
Table 8: Resource Consents – Moutoa Gates to Opiki	67
Table 9: Third Party Agreements / Responsibilities – Moutoa Gates to Opiki	68
Table 10: Taonui BasinSpillway Flow Limits from Resource Consent 104965	79
Table 11: Lead times for Road Flooding within Taonui Basin (7.55m at Teacher's College	
AEP) Table 12: Maintenance and Manifesius Calcalula. Taxasi B.	84
Table 12: Maintenance and Monitoring Schedule – Taonui Basin	86
Table 13: Surveillance Plan – Taonui Basin Table 14: Resource Consents – Taonui Basin	89
Table 15: Third Party Agreements / Responsibilities– Taonui Basin	93
Table 16: Maintenance and Monitoring Schedule – Palmerston North to Ashhurst	97 114
Table 17: Surveillance Plan – Palmerston North to Ashhurst	124
Table 18: Resource Consents – Palmerston North to Ashhurst	132
Table 19: Third Party Agreements / Responsibilities – Palmerston North	139
Table 20: Maintenance and Monitoring Schedule – Feilding	151
Table 21: Surveillance Plan – Feilding	156
Table 22: Resource Consents – Feilding	160
Table 23: Third Party Agreements / Responsibilities – Feilding	164
TABLE OF FIGURES Figure 1: Extent of Flooding with no Flood Control Scheme Figure 2: Extent of Flood Control Scheme Assets Figure 3: The Moutoa floodgates, built between 1959 and 1962, in operation in February : Water is being diverted from the Manawatū River's course into the floodway. Courte: www.teara.govt.nz Figure 4: Extent of Flooding in Taonui Basin during 1:100 year flood Figure 5: Flygers Spillway Operation Cross Section	
TABLE OF PHOTOS Photo 1: Creation of Whirokino Cut Photo 2: Location of Opiki Road Inundation Issue Photo 3: 1953 Floodwaters at Fitzherbert Bridge Photo 4: Anzac Cliffs earthworks 2016 to slope the cliffs (courtesy of Stuff) Photo 5: Fitzroy Bend Location (groynes highlighted in yellow)	34 61 108 110
Photo 6: Fitzroy Bend Groyne 3 Armour Layer being Placed	111