

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	
STUDY OBJECTIVE	
CATCHMENT AND STUDY AREA.....	I
DATA SETS	I
HISTORY OF FLOODING	II
COMMUNITY CONSULTATION.....	II
STUDY METHODOLOGY.....	II
MODEL CALIBRATION	III
DESIGN FLOOD MODELLING.....	III
SENSITIVITY TESTING	IV
RECOMMENDATIONS	V
LIST OF FIGURES	X
LIST OF TABLES	XII
LIST OF APPENDICES	XIV
1 FOREWORD	1
2 ACKNOWLEDGEMENT.....	3
3 INTRODUCTION	4
4 OBJECTIVES	6
5 STUDY AREA	7
5.1 CATCHMENT DESCRIPTION	7
5.2 FLOOD MODELLING AREA	9
6 DATA COLLECTION AND REVIEW	11
6.1 TOPOGRAPHIC, GIS AND OTHER RELEVANT DATA SETS.....	11
6.2 RAINFALL AND PLUVIOMETER STATIONS	12
6.3 STREAMFLOW GAUGING STATIONS	13
6.4 SITE INSPECTION	14
6.5 TOPOGRAPHIC AND SURVEY DATA	14
6.5.1 General Catchment and Modelling Area Topography.....	14
6.5.2 Additional Survey	15
6.6 DATA FOR HYDROLOGIC MODELLING OF DAMS	18
6.6.1 Brogo Dam	18
6.6.2 Cochrane Dam	18
6.7 MOGAREEKA INLET HISTORIC AERIAL PHOTOS	19
7 PREVIOUS REPORTS.....	23
8 HISTORY OF FLOODING	29
9 FLOOD PHOTOS	32
9.1 FEBRUARY 1971 EVENT	32
9.2 MARCH 2011 EVENT.....	33
9.3 FEBRUARY 2010 EVENT	36
10 COMMUNITY CONSULTATION	37
10.1 FLOOD QUESTIONNAIRE.....	37
10.2 SUMMARY OF RESPONSES TO FLOOD QUESTIONNAIRE.....	37
10.3 PUBLIC EXHIBITION	38
11 FLOOD FREQUENCY ANALYSIS	43

12 HYDROLOGICAL MODELLING	51
12.1 HYDROLOGIC MODELLING SOFTWARE	51
12.2 CATCHMENT DELINEATION	51
12.3 XP-RAFTS MODEL SETUP	53
12.3.1 <i>Rainfall Losses</i>	53
12.3.2 <i>Storage Factors</i>	54
12.3.3 <i>Land Types and Surface Roughness</i>	55
12.3.4 <i>Land Zoning and Percentage Imperviousness</i>	56
13 HYDRAULIC MODELLING.....	58
13.1 HYDRAULIC MODELLING SOFTWARE.....	58
13.2 XP-SWMM2D MODEL SETUP	58
13.2.1 <i>Model Configuration</i>	58
13.2.2 <i>Classes of Entrances and their Modelling</i>	59
13.2.3 <i>Boundary Conditions</i>	60
13.2.4 <i>Site Specific Analysis of Ocean Levels</i>	60
13.2.5 <i>Surface Roughness</i>	61
13.2.6 <i>Modelling of Hydraulic Structures / Bridges</i>	62
13.2.7 <i>Princes Highway Upgrade</i>	62
13.3 CANDELO CREEK MODEL	62
14 CALIBRATION AND VALIDATION.....	63
14.1 INTRODUCTION	63
14.2 SELECTION OF EVENTS FOR CALIBRATION	63
14.3 HYDROLOGIC MODEL CALIBRATION	63
14.3.1 <i>Spatial Distribution of Rainfall / Isohyetal Maps</i>	63
14.3.2 <i>Temporal Distribution of Rainfall / Pluviographic Data</i>	66
14.3.3 <i>Flow and Water Level Gauging Data</i>	71
14.3.4 <i>Reliability of Gauged Rating Curves</i>	72
14.3.5 <i>Separation of Baseflow</i>	73
14.3.6 <i>Modelling of Brogo Dam</i>	73
14.3.7 <i>Modelling of Cochrane Dam</i>	73
14.4 HYDROLOGIC MODEL CALIBRATION SUMMARY	75
14.5 ADOPTION OF HYDROLOGIC MODEL PARAMETERS FOR DESIGN EVENTS.....	79
14.5.1 <i>Rainfall Loss Parameters</i>	79
14.5.2 <i>Adopted Basic Model Parameters</i>	83
14.5.3 <i>Adopted Hydrologic Roughness Coefficients</i>	83
14.6 HYDRAULIC MODEL CALIBRATION AND VALIDATION.....	84
14.6.1 <i>Model Establishment</i>	84
14.6.2 <i>Approach</i>	84
14.6.3 <i>Results</i>	86
14.7 HYDRAULIC MODEL CALIBRATION SUMMARY.....	99
14.8 ADOPTION OF HYDRAULIC MODELLING PARAMETERS FOR DESIGN EVENTS	101
14.8.1 <i>Modelling Surface Roughness Coefficients</i>	101
14.8.2 <i>Modelling Bridge Entry/Exit Losses</i>	101
14.8.3 <i>Sandbar/ Berm Geometry</i>	102
15 DESIGN EVENTS MODELLING	104
15.1 DESIGN RAINFALL	104
15.2 RAINFALL FOR PROBABLE MAXIMUM FLOOD (PMF).....	105
15.3 OCEAN WATER LEVELS FROM SITE SPECIFIC ANALYSIS	106
15.4 CLIMATE CHANGE IMPACTS	107
15.4.1 <i>Sea Level Rise</i>	108
15.4.2 <i>Increase of Rainfall Intensities</i>	109
15.4.3 <i>Management Options for Climate Change Impacts</i>	109
15.5 COINCIDENTAL FLOODING FROM THE RIVER AND OCEAN.....	109
15.6 ASSESSMENT OF BLOCKAGE	111

15.6.1	<i>Basis for Assessment</i>	111
15.6.2	<i>Adopted Approach</i>	112
15.7	DESIGN EVENT RUNS	117
15.7.1	<i>Scenarios for Design Modelling Runs</i>	117
15.7.2	<i>Flood Behaviour</i>	117
15.7.3	<i>Capacity of Hydraulics Structures</i>	120
15.7.4	<i>Other Considerations</i>	122
16	SENSITIVITY ANALYSIS	123
16.1	VARYING MODEL PARAMETERS.....	123
16.2	VARIATIONS IN RESULTS FROM SENSITIVITY ANALYSIS.....	125
16.2.1	<i>Rainfall Intensities /Climate Change Scenario</i>	125
16.2.2	<i>Sea Level Rise /Climate Change Scenario</i>	126
16.2.3	<i>Rainfall Loss</i>	126
16.2.4	<i>Catchment Roughness</i>	127
16.2.5	<i>Surface Roughness in Hydraulic Model</i>	127
16.2.6	<i>Blockage at Bridges</i>	128
16.2.7	<i>Sedimentation</i>	129
16.2.8	<i>Downstream Tailwater Condition</i>	130
17	MAPPING	133
17.1	MAPPING OF MODELLING RESULTS.....	133
17.2	HYDRAULIC CATEGORIES	133
17.3	FLOW HAZARD.....	134
17.4	PRELIMINARY FLOOD PLANNING LEVELS.....	135
18	FLOOD EMERGENCY RESPONSE PLANNING	136
18.1	DESCRIPTION OF FLOOD BEHAVIOUR	136
18.2	THE BEGA VALLEY SHIRE FLOOD EMERGENCY SUB PLAN	137
18.3	FLOOD EMERGENCY RESPONSE PLANNING CLASSIFICATION OF COMMUNITIES.....	139
19	CONCLUSION AND RECOMMENDATIONS	154
20	GLOSSARY	158
21	REFERENCES	161
	APPENDICES	162