

DETAILED BUSINESS CASE

NULLINGA DAM AND MAREEBA DIMBULAH WATER SUPPLY SCHEME IMPROVEMENTS PROJECT

June 2019



ABOUT THIS DOCUMENT

Building Queensland finalised the Nullinga Dam and Mareeba Dimbulah Water Supply Scheme Improvements Detailed Business Case in June 2019. The core elements of the detailed business case are presented in this document.

This document has been publicly released to ensure that stakeholders and community members are aware of the outcomes of the detailed business case and have access to information that supports these outcomes. However, in making this detailed business case publicly available, commercially sensitive information has been removed.

This detailed business case has been prepared with the support of funding from the Australian Government National Water Infrastructure Development Fund (NWIDF), an initiative of the Northern Australia and Agricultural Competitiveness White Papers.

A glossary is provided following the table of contents.



CONTENTS

About this document.....	1
Contents.....	2
Glossary.....	14
1 Executive Summary.....	18
1.1 Background.....	18
1.2 Service need	20
1.2.1 Current situation	21
1.2.2 Future demand	21
1.2.3 Market influencers and constraints	22
1.2.4 Total demand	23
1.3 Options considered	26
1.3.1 Non-infrastructure options	26
1.3.2 Modernisation options	26
1.3.3 Nullinga Dam options	27
1.3.4 Alternative options	27
1.4 Base case	28
1.5 Reference Project.....	28
1.6 Analysis.....	33
1.7 Funding gap.....	36
1.8 Findings and conclusions.....	36
1.9 Stakeholder implications	38
1.10 Recommendations	39
1.11 Risks.....	39
PART A – BACKGROUND AND OVERVIEW	40
2 Proposal Background.....	41
2.1 Purpose	42
2.2 Study area	42
2.2.1 Overview	42
2.2.2 Mareeba Dimbulah Water Supply Scheme	43
2.3 Development of the proposal.....	46
2.3.1 Overview	46
2.3.2 Preliminary business case	46
2.3.3 Detailed business case drivers	47
2.4 Related infrastructure or services	47
3 Methodology.....	49
3.1 Purpose	49
3.2 Development process.....	49
3.3 Methodologies	50
3.4 Ongoing management strategies	52
3.4.1 Risk framework and approach	53
3.4.2 Summary of key risks	56
4 Governance.....	57
4.1 Purpose	57



4.2	Overview of Sunwater and Building Queensland	57
4.3	Governance Structure	58
4.4	Roles and responsibilities	58
PART B – STRATEGIC REQUIREMENTS.....		61
5	Service Need	62
5.1	Purpose	65
5.2	Current situation	66
5.2.1	Cairns	66
5.2.2	Mareeba	73
5.2.3	Atherton	73
5.2.4	Mareeba Dimbulah Water Supply Scheme	74
5.3	Future demand.....	85
5.3.1	Urban water demand	85
5.3.2	Agricultural Water Demand	89
5.4	Influencers and constraints	94
5.5	Service Need.....	102
5.5.1	Demand Profiles	103
5.5.2	Total Demand	104
5.6	Benefits	106
5.7	Stakeholders.....	107
6	Strategic Considerations.....	111
6.1	Queensland Government	111
6.1.1	Water Policy	111
6.1.2	Agriculture	113
6.1.3	Planning	114
6.1.4	Infrastructure	114
6.2	Commonwealth Government.....	115
6.2.1	Infrastructure	115
6.2.2	Water	116
6.3	Local Government	117
6.3.1	Cairns Water Security Strategy	117
6.3.2	Cairns 2050	117
6.4	Proponent policies and plans	118
6.5	Conclusion	119
PART C – OPTIONS.....		121
7	Options Considered.....	122
7.1	Purpose	124
7.2	PBC Options.....	124
7.3	DBC Options	137
7.4	Alternative options	137
8	Base Case	140
8.1	Purpose	140
8.2	Proposed Nullinga Dam	141
8.3	Overarching assumptions.....	141
8.4	Urban water	141



8.4.1	Cairns	141
8.4.2	Tablelands Regional Council	144
8.4.3	Mareeba Shire Council	144
8.5	Industrial water use.....	145
8.6	Agricultural water use	145
8.6.1	Higher value crops are expanding in the region	147
8.6.2	MDWSS Efficiency Improvement Project	148
8.6.3	Agricultural production forecast	149
8.7	Summary of the Base Case	151
9	Reference Project.....	153
9.1	Purpose	155
9.2	Project objectives and outcomes	156
9.3	Implications of not proceeding.....	156
9.4	Cost development	157
9.5	Reference Project 1 – Nullinga Dam (58,000ML)	159
9.5.1	Overview and location	159
9.5.2	Scope of Reference Project 1A and 1B	160
9.5.3	Timing	169
9.5.4	Costs	170
9.6	Reference Project 2 – Nullinga Dam (73,000ML)	171
9.6.1	Scope of Reference Project 2A, 2B and 2C	171
9.6.2	Timing	176
9.6.3	Costs	178
10	Legal Considerations	180
10.1	Purpose	180
10.2	Water planning.....	181
10.2.1	Water Act and other instruments	181
10.2.2	The Dam	181
10.3	Water pricing.....	182
10.3.1	Sale of new water allocations	182
10.3.2	NWI Pricing Principles	182
10.3.3	QCA price paths	183
10.4	Local management arrangements.....	183
10.5	Third party supply arrangements	183
10.6	Service provider registration	184
10.6.1	Transfer to irrigation entity	184
10.7	Other infrastructure and assets – Utilities.....	184
10.8	Environment Protection and Biodiversity Conservation Act	185
10.9	Planning and Environment	185
10.10	Land Acquisition	189
10.10.1	Revocation of any protected areas	189
10.10.2	Land acquisition legislation	189
10.10.3	Land access agreements and roads	189
10.11	Local Heritage.....	190
10.12	Native Title	190
10.12.1	Native Title considerations	190
10.12.2	Native title process	190



10.12.3 Native title process – Compulsory Acquisition	191
10.13 Aboriginal cultural heritage	191
10.13.1 Relevant legislation	191
10.14 Other Legal Matters	192
10.14.1 Contract Delivery Model	192
10.14.2 General Liabilities – Negligence, Breach of Statutory Duty, Nuisance and Trespass	192
10.14.3 Legal and Policy Changes	194
10.14.4 Work Health and Safety	195
11 Market Considerations	196
11.1 Purpose	196
11.2 Market Sounding Objectives	196
11.3 Market Sounding Approach.....	197
11.4 Conclusions	197
12 Public Interest Considerations.....	198
12.1 Purpose	198
12.2 Stakeholder and Community Engagement.....	198
12.2.1 Engagement objectives	199
12.2.2 Approach to engagement	199
12.2.3 Engagement outcomes	203
12.2.4 Social Licence to Operate	211
12.2.5 Engagement recommendations	212
12.3 Impact on stakeholders	213
12.3.1 Property impacts	213
12.3.2 Environment impacts	214
12.4 Public access and equity.....	215
12.4.1 Public access	215
12.4.2 Equity	215
12.5 Consumer rights	216
12.6 Safety and security	216
12.7 Privacy	216
PART D – ANALYSIS.....	217
13 Delivery Model Analysis	218
13.1 Purpose	218
13.2 Approach for the delivery model analysis	219
13.2.1 Methodology for the delivery model analysis	219
13.3 Project context	220
13.3.1 Sunwater capability assumptions	221
13.3.2 Market capability assumptions	221
13.3.3 Precedent projects	221
13.3.4 Indicative Reference Project timeframes	222
13.3.5 Objectives for the Delivery Strategy	222
13.4 Packaging options.....	223
13.4.1 Packaging	224
13.5 Available delivery models	224
13.5.1 VfM Assessment of the PPP delivery model option	229
13.5.2 Shortlisting of delivery models to be assessed	231



13.6	Assessment of delivery model options	233
13.6.1	Assessment criteria and weightings	233
13.6.2	Delivery model rating process	234
13.6.3	Delivery model assessment	234
13.6.4	Collaboration during procurement phase	239
13.7	Recommended delivery model.....	240
14	Sustainability Assessment.....	241
14.1	Purpose	242
14.2	Approach	242
14.3	Sustainability Assessment Criteria.....	243
14.4	Sustainability Assessment Response	243
15	Economic Analysis	255
15.1	Purpose	256
15.2	Approach and assumptions	256
15.2.1	Identification of costs and benefits	256
15.2.2	Quantification of central case costs and benefits	258
15.3	Summary of central case results	268
15.4	Central case cost results.....	269
15.5	Central case benefit results.....	270
15.5.1	Agricultural benefits	270
15.5.2	Urban benefits	271
15.5.3	Recreational benefits	272
15.6	Uncertainty.....	272
15.6.1	Monte Carlo analysis	273
15.6.2	Sensitivity analysis	278
15.6.3	Scenario analysis	280
16	Social Impact Evaluation.....	281
16.1	Purpose	282
16.2	Approach	282
16.2.1	Stakeholder Engagement	285
16.2.2	Data Sources	286
16.2.3	Assumptions	287
16.3	Stakeholder impact analysis	287
16.4	Social Context.....	289
16.4.1	Local study area baseline	289
16.4.2	Regional study area baseline	292
16.5	Identified Social Impacts	301
16.5.1	Social Impact Baseline	307
16.6	Social Impact Evaluation.....	308
17	Environmental Assessment	313
17.1	Purpose	315
17.2	Legislation and permit requirements	315
17.3	Identification of Environmental Impacts	318
17.3.1	Planning and land use	318
17.3.2	Property impacts	319
17.3.3	Topography, geology, soils and contaminated land	320



17.3.4	Water quality	322
17.3.5	Hydrology	323
17.3.6	Climatic influences and climate change	329
17.3.7	Terrestrial flora and fauna	329
17.3.8	Aquatic flora and fauna	331
17.3.9	Environmental Offsets	333
17.3.10	Air quality, noise and vibration	333
17.3.11	Landscape and visual	334
17.3.12	Cultural heritage	334
17.3.13	Waste management	334
18	Financial and Commercial Analysis	336
18.1	Purpose	337
18.2	Financial model input and assumptions	337
18.2.1	Reference Project assumptions	337
18.2.2	Timing assumptions	337
18.2.3	Raw capital cost estimates	338
18.2.4	Operations and maintenance cost estimates	338
18.2.5	Implementation cost estimates	339
18.2.6	P90 Cost Contingency Estimates for Project Risk	339
18.2.7	Price escalation - Costs	341
18.2.8	Water demand estimates	342
18.2.9	Water pricing	342
18.2.10	Project Revenues	344
18.2.11	Discount rates – financial analysis and regulatory pricing	344
18.3	Whole of Life Financial Analysis	346
18.3.1	Real and Nominal Cashflows	346
18.3.2	FNPV Results	347
18.4	Sensitivity Analysis	349
18.5	Scenario Analysis	350
19	Affordability Analysis	352
19.1	Purpose	352
19.2	Background	352
19.3	Funding gap	353
19.4	Sources of funding	353
19.1.1	Customers	354
19.1.2	Value uplift	354
19.1.3	Government	354
PART E – RECOMMENDATIONS		357
20	Conclusions	358
20.1	Purpose	358
20.2	The Analysis	359
20.3	Key findings	361
20.4	Summary of Conclusions	362
21	Recommendations	363



TABLES

Table 1-1	Demand influencers and/or constraints	22
Table 1-2	Demand for new water allocations (upon availability), at stated price	24
Table 1-3	Summary of Reference Projects and key metrics	29
Table 1-4	Summary of economic analysis findings, discounted at 7% real	33
Table 1-5	Estimated upfront water charges under full cost recovery approaches	34
Table 1-6	Reference Projects, Whole of Life Costs, FNPV P90	35
Table 1-7	Project cashflows and net funding gap (Nominal \$M)	36
Table 1-8	Findings from the DBC	37
Table 2-1	Local Government Areas (LGAs) impacted by initiative	43
Table 2-2	MDWSS availability and entitlements, 2017-18	44
Table 2-3	Key findings and recommendations of the PBC (2017).	47
Table 3-1	Methodologies utilised throughout the DBC	51
Table 3-2	Likelihood rating	54
Table 3-3	Consequence categories	55
Table 4-1	Roles, responsibilities and composition	58
Table 5-1	Cairns' Water Supply Sources	67
Table 5-2	CRC Level of Service criteria and targets	70
Table 5-3	Hydrological analysis for Copperlode Falls Dam and Behana Creek	70
Table 5-4	Cairns Water Security Strategy Initiatives	72
Table 5-5	Water entitlements for TRC	74
Table 5-6	FSL, minimum operating level and dead storage volumes for existing water storage across MDWSS	76
Table 5-7	Crop mix and metrics across MDWSS	80
Table 5-8	Area and value by citrus type	81
Table 5-9	Entitlement and availability by customer segment, 2017-18	81
Table 5-10	Population data for Cairns urban supply area	85
Table 5-11	Water demand data for Cairns urban supply area	86
Table 5-12	Categories and criteria for RFI response/s	91
Table 5-13	Number of years to reach full production by crop type	93
Table 5-14	Demand influencers and/or constraints	95
Table 5-15	Market trends and outlook	97
Table 5-16	Comparison of preparedness to pay and capacity to pay	99
Table 5-17	Demand for new water allocations (upon availability), at stated price	104
Table 5-18	Anticipated benefits from addressing the service need (for review / revision and update)	106
Table 5-19	Stakeholders and project interest (For Review / Revision and update)	107
Table 6-1	Requirements under QBWOS	112
Table 6-2	Alignment with key objectives of SIP	114
Table 6-3	Alignment with key objectives of Sunwater	118
Table 6-4	Service need and shortlisted options alignment with government policies and programs	119
Table 7-1	MDWSS rule / operational improvement opportunities, strategic assessment summary	125
Table 7-2	Improvement Initiatives, funded and unfunded	128
Table 7-3	Unfunded Channel Upgrades	128
Table 7-4	East Barron System Flow Summary (ML/a)	130
Table 7-5	Summary of findings for additional modernisation works	131
Table 7-6	Concept Engineering Summary	132
Table 7-7	Assumptions for the comparative CBA	133
Table 7-8	Results from comparative CBA (excl. residual values)	134
Table 7-9	Preliminary Engineering Summary	135



Table 7-10	Operations under the different distribution arrangements	136
Table 7-11	MDWSS use of distribution loss allocations	137
Table 8-1	Preferred Water Security Strategy for Cairns	142
Table 8-2	Water use in the MDWSS, 2016–17	146
Table 8-3	Permanent market summary	148
Table 8-4	Temporary market summary	148
Table 8-5	Summary of the Base Case	151
Table 9-1	Anticipated outcomes and benefits from meeting the primary objective	156
Table 9-2	Reference Project 1A: Nullinga Dam Characteristics	161
Table 9-3	Design considerations for irrigation outlets	164
Table 9-4	Design criteria (functionality)	164
Table 9-5	Distribution infrastructure for Reference Project 1A	165
Table 9-6	Constructability issues	166
Table 9-7	Reference Project 1A and 1B, delivery schedule	169
Table 9-8	Real and Nominal Cost Estimate for Reference Project 1A (50 years)	170
Table 9-9	Real and Nominal Cost Estimate for Reference Project 1B (50 years)	170
Table 9-10	Reference Project 2A: Nullinga Dam Characteristics	173
Table 9-11	Outlet works for Reference Project 2A, 2B and 2C	175
Table 9-12	New distribution pipelines under Reference Project 2	175
Table 9-13	Reference Project 2A, 2B and 2C delivery schedule	176
Table 9-14	Real and Nominal Cost Estimate for Reference Project 2A (30 years)	178
Table 9-15	Real and Nominal Cost Estimate for Reference Project 2B (30 years)	178
Table 9-16	Real and Nominal Cost Estimate for Reference Project 2C (50 years)	179
Table 10-1	Key risks	193
Table 12-1	Stakeholder list	199
Table 12-2	Engagement tools and activities	201
Table 12-3	Stakeholder Reference Group members	203
Table 12-4	Meeting outcomes	204
Table 12-5	Traditional Media	205
Table 12-6	Digital media	206
Table 12-7	Impacted landowners - dam	206
Table 12-8	Landowner engagement	207
Table 12-9	Information stall themes	210
Table 13-1	Summary of Reference Projects' key characteristics shared with participants	218
Table 13-2	Constraints and opportunities	220
Table 13-3	Precedent greenfield and brownfield dam projects	221
Table 13-4	Delivery models and approach to risk transfer to the private sector	225
Table 13-5	Delivery model options	225
Table 13-6	Key VfM drivers for PPP delivery (sourced from National PPP Guideline)	229
Table 13-7	Scoring scheme for the qualitative assessment of VfM Drivers	230
Table 13-8	Qualitative assessment of VfM Drivers	231
Table 13-9	Shortlisting of delivery models by reference project	232
Table 13-10	Assessment criteria including description and weighting	233
Table 13-11	Assessment criteria and rating scheme	234
Table 13-12	Construct Only Delivery Model Assessment	234
Table 13-13	D&C Delivery Model Assessment	235
Table 13-14	Construction Management Delivery Model Assessment	236
Table 13-15	Managing Contractor Delivery Model Assessment	237
Table 13-16	Alliance Delivery Model Assessment	238



Table 13-17	Outcomes of the Delivery Model Assessment	239
Table 13-18	Summary of delivery model components	240
Table 14-1	Sustainability Assessment Rating	243
Table 14-2	Sustainability Assessment Template	243
Table 15-1	Social and environmental impacts shortlist	257
Table 15-2	Parameter assumptions	258
Table 15-3	Activities included in the cost estimates	259
Table 15-4	Agricultural water supply assumptions	260
Table 15-5	Urban water demand assumptions	263
Table 15-6	Supply augmentation yield assumptions	265
Table 15-7	Supply augmentation cost assumptions	265
Table 15-8	Project water treatment costs assumptions	266
Table 15-9	Recreational benefit assumptions	267
Table 15-10	Summary CBA results (\$2019)	268
Table 15-11	Recap of economic costs under the central case	269
Table 15-12	Undiscounted capital and operating costs	270
Table 15-13	Recap of economic benefits under the central case	270
Table 15-14	Undiscounted agricultural benefits	271
Table 15-15	Uniform probability distribution parameters	273
Table 15-16	Discrete probability distribution parameters	274
Table 15-17	Additional probability distribution parameters	274
Table 15-18	Results of Monte Carlo analysis – NPV	275
Table 15-19	Reference Projects Sensitivities	278
Table 15-20	Sensitivity analysis results	279
Table 15-21	Summary CBA results, central case v scenarios	280
Table 16-1	Risk assessment likelihood categories	283
Table 16-2	Risk assessment consequence categories	284
Table 16-3	Risk and value assessment criteria	285
Table 16-4	Data sources utilised for the SIE	286
Table 16-5	Stakeholder impacts	287
Table 16-6	Land tenure of properties impacted by a proposed Nullinga Dam	290
Table 16-7	Population by age (2016)	294
Table 16-8	Level of highest educational attainment (people aged 15 years and over)	295
Table 16-9	Employment by Industry (2016)	296
Table 16-10	Employment by occupation – 2016	298
Table 16-11	Number of emergency services and hospitals	299
Table 16-12	Identified social impacts	302
Table 16-13	Summary of social impacts of the project	307
Table 16-14	Impact risk assessment	308
Table 17-1	Potential approvals for the Reference Projects	315
Table 17-2	Land tenure for Nullinga Dam solutions	319
Table 18-1	Project Timings	338
Table 18-2	Raw capital costs, excluding contingency (Real \$M)	338
Table 18-3	Annual Average O&M Costs (Real \$M)	339
Table 18-4	Refurbishment and upgrade costs (Real \$M)	339
Table 18-5	Implementation Cost Estimates (Real \$M)	339
Table 18-6	Price Escalation (Costs) – Nominal and Real Rates	341
Table 18-7	Estimated upfront water charges, HP and MP users under full cost recovery	343
Table 18-8	Estimated Upfront Capital Charges, 100% MP users	343



Table 18-9	Reference Project revenues (Real \$M)	344
Table 18-10	Key Parameters – Financial Evaluation WACC	344
Table 18-11	Key Parameters – Regulatory Evaluation WACC	345
Table 18-12	Reference Projects, Whole of Life Costs, Real P90	346
Table 18-13	Reference Projects, Whole of Life Costs, Nominal P90	347
Table 18-14	Reference Projects, Whole of Life Costs, FNPV P90	348
Table 18-15	Reference Projects, P90 FNPVs with and without terminal values	348
Table 18-16	Reference Projects Sensitivities	349
Table 18-17	Reference Projects FNPVs, central case v scenarios	351
Table 19-1	Net funding gap for the Reference Projects (Nominal \$M)	353
Table 19-2	Sources of Government Funding	355
Table 20-1	Project cashflows and net funding gap (Nominal \$M)	361
Table 20-2	Summary of DBC findings	361

FIGURES

Figure 1-1	Study Area (<i>existing Barron Water Plan Area</i>)	18
Figure 1-2	Past reports relevant for a potential Nullinga Dam	19
Figure 1-3	Assessing the need and/or opportunity	21
Figure 1-4	Proportion of crop types underpinning agricultural benefits for the central demand case	25
Figure 1-5	Central case demand scenario ‘most likely to occur’	25
Figure 1-6	Reference Project’s scope of works—snapshot	32
Figure 1-7	FNPV summary of P90 financial analysis of the Reference Projects	35
Figure 2-1	Study Area (<i>existing Barron Water Plan Area</i>)	42
Figure 2-2	Tinaroo Falls Dam	44
Figure 2-3	MDWSS map	45
Figure 2-4	Relevant past studies to consider Nullinga Dam	46
Figure 3-1	DBC development process	50
Figure 3-2	Risk management process	53
Figure 3-3	Business Case Risk Matrix	53
Figure 4-1	Governance structure for the DBC	58
Figure 5-1	Assessing the need and/or opportunity	66
Figure 5-2	Recorded storage behaviour of Copperlode Falls Dam between 1994 and 2019	67
Figure 5-3	Total water production from Freshwater Creek WTP and Behana Creek vs total annual rainfall	68
Figure 5-4	Frequency of water restrictions and supply shortfalls against total annual demand	69
Figure 5-5	Historic Storage of Copperlode Falls Dam and restriction triggers	71
Figure 5-6	Water demand and allocation for Mareeba Shire	73
Figure 5-7	Current land use	75
Figure 5-8	MDWSS Map	77
Figure 5-9	Operational systems in the MDWSS	78
Figure 5-10	Water use by operational system/s in the MDWSS	79
Figure 5-11	Tinaroo Falls Dam accessible volume	82
Figure 5-12	Water use and availability in the MDWSS	82
Figure 5-13	Rainfall and trading patterns	83
Figure 5-14	Allocation and value (\$/ML)	84
Figure 5-15	CRC’s Population Growth Projections	86
Figure 5-16	Annual demand / supply	87
Figure 5-17	HP and MP volumes by crop type	89



Figure 5-18	Willingness to pay (for given HP and MP volumes)	90
Figure 5-19	Willingness to pay (for given HP and MP volumes), by given crop types	91
Figure 5-20	Willingness to pay (for given HP and MP volumes), by given crop types	92
Figure 5-21	Water use (ML) from 2002-03 to 2015-16	94
Figure 5-22	Identified Service Need (Need and Opportunity)	103
Figure 5-23	Demand profile for Scenario A	103
Figure 5-24	Demand profile for Scenario B	104
Figure 7-1	MDWSS improvement initiatives	127
Figure 7-2	Arriga Main Channel	129
Figure 7-3	Arriga MC Proposed Arrangements	129
Figure 7-4	Location of Malone and Kay Road Pipeline	130
Figure 7-5	Nullinga Dam Options, yield and cost per ML	133
Figure 8-1	Supply augmentation for Cairns – Medium Population Growth	143
Figure 8-2	Cairns Population Growth	144
Figure 8-3	Mareeba Shire supply and demand	145
Figure 8-4	Land suitability mapping for irrigated agriculture in the MDIA	146
Figure 8-5	Water use and availability in the MDWSS	147
Figure 8-6	MDWSS Efficiency Improvement Project	149
Figure 8-7	Base Case, irrigated agricultural production outlook (ML)	150
Figure 8-8	Base Case, irrigated agricultural production outlook (Ha)	150
Figure 9-1	Cost estimation development process	157
Figure 9-2	Location of Nullinga Dam site	159
Figure 9-3	Scope of works for Reference Project 1	160
Figure 9-4	Main Dam Spillway and Dissipator	161
Figure 9-5	Saddle dam location	162
Figure 9-6	Saddle dam configuration	162
Figure 9-7	Proposed outlet works for Reference Project 1A	163
Figure 9-8	Arriga Main Channel Upgrade Concept for Reference Project 1B	166
Figure 9-9	Scope of works for Reference Project 2	172
Figure 9-10	Main Dam Spillway and Dissipator	173
Figure 9-11	Saddle dam configuration for Reference Project 2	174
Figure 13-1	Indicative construction schedule	222
Figure 13-2	Relationship between contract model options, project uncertainty, and design maturity	222
Figure 15-1	Impacts and quantified costs and benefits	256
Figure 15-2	Spectrum of benefits from three agricultural models	260
Figure 15-3	Likely Ag demand for MP allocations	261
Figure 15-4	Likely Ag demand for HP allocations	261
Figure 15-5	Illustrative example, agricultural benefits to irrigators (Reference Project 1, MP only)	262
Figure 15-6	Projected annual Cairns water demand over time	263
Figure 15-7	Illustrative supply augmentation schedule for Cairns	264
Figure 15-8	Supply augmentation schedule for Cairns – Base Case	271
Figure 15-9	Supply augmentation schedule for Cairns, with Nullinga Dam	272
Figure 15-10	Histogram of BCR results – Reference Project 1A	276
Figure 15-11	Histogram of BCR results – Reference Project 1B	277
Figure 15-12	Histogram of BCR results – Reference Project 2A	277
Figure 15-13	Histogram of BCR results – Reference Project 2B	278
Figure 15-14	Histogram of BCR results – Reference Project 2C	278
Figure 16-1	Building Queensland SIE methodology	282
Figure 17-1	Active and abandoned mines	321



Figure 17-2	Barron Water Plan Catchments and sub-catchments	324
Figure 17-3	Base case median monthly flow	325
Figure 17-4	Base case flow duration curve	326
Figure 17-5	Length of watercourse impacted by stream order	326
Figure 17-6	Walsh River mean monthly flows	327
Figure 17-7	Barron Water Plan Catchments and sub-catchments	328
Figure 17-8	Essential habitat Nullinga	331
Figure 18-1	P90 Cost Contingency Estimates	340
Figure 18-2	P90 Monte Carlo Output, Construction Costs	340
Figure 18-3	Central Case – Demand Estimates	342
Figure 18-4	FNPV Summary of P90 Financial Analysis of the Reference Projects	347
Figure 18-5	Sensitivity analysis for Reference Project 1A and 1B	350
Figure 18-6	Sensitivity analysis for Reference Project 2A, 2B and 2C	350
Figure 20-1	BCRs of the Reference Projects	359
Figure 20-2	FNPV Summary of P90 Financial Analysis of the Reference Projects	360



GLOSSARY

Abbreviation	Description
A	
ACH Act	Aboriginal Cultural Heritage Act 2003
AHD	Australian Height Datum
AMTD	Adopted Middle Thread Distance
ANCOLD	Australian National Committee on Large Dams
B	
	Business Case Development Framework
BCDF	Building Queensland's guidance framework for development of business cases and supporting analysis
BCR	Benefit Cost Ratio Ratio equal to the discounted benefits over the life of the project divided by the total of the discounted capital costs plus discounted operating and maintenance costs
C	
CBA	Cost Benefit Analysis A decision support tool that considers quantified benefits to costs.
CHMP	Cultural Heritage Management Plan
CRC	Cairns Regional Council
CSIRO	Commonwealth Scientific and Industrial Research Organisation
D	
DAF	Department of Agriculture and Fisheries (Queensland)
DBC	Detailed Business Case
	Department of Environment, Resources and Management
DERM	Department formerly in charge of state-wide water supply and distribution planning and regulation. This function (along with others performed by DERM) was transferred to DEWS and subsequently to DNRME as of 2018.
DES	Department of Environment and Science
	Department of Energy and Water Supply
DEWS	Department formerly in charge of state-wide water supply and distribution planning and regulation. This function (along with others performed by DEWS) is undertaken by DNRME as of 2018
DNRME	Department of Natural Resources, Mines and Energy
DPC	Department of Premier and Cabinet
DSDMIP	Department of State Development, Manufacturing, Infrastructure and Planning
E	
EFO	Environmental Flow Objective
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP Act	Environmental Protection Act 1994



Abbreviation	Description
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)
ERA	Environmentally Relevant Activity
F	
FNPV	Financial Net Present Value Discounted financial cashflows at a given rate over a prescribed length of time
FNQRWSS	Far North Queensland Regional Water Supply Strategy
FSL	Full Supply Level
G	
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRWHA	Great Barrier Reef World Heritage Area
GOC	Government Owned Corporation
GOC Act	Government Owned Corporations Act 1993
GRP	Gross Regional Product
H	
ha	Hectares
HP	High Priority
I	
ILUA	Indigenous Land Use Agreement
L	
LG Act	Local Government Act 2009 (Qld)
LOS	Level of Service
M	
MDIA	Mareeba Dimbulah Irrigation Area
MDWSS	Mareeba Dimbulah Water Supply Scheme
ML	Megalitre
MNES	Matter of National Environmental Significance
MoU	Memorandum of Understanding
MP	Medium Priority
MSC	Mareeba Shire Council
MSES	Matters of State Environmental Significance
N	
NC Act	Nature Conservation Act 1994 (Qld)
NDMIP	Nullinga Dam and Mareeba Dimbulah Water Supply Scheme Improvements Project
NPV	Net Present Value Discounted economic cashflows at a given rate over a prescribed length of time
NWI	National Water Initiative
NWIDF	National Water Infrastructure Development Fund
NWILF	National Water Infrastructure Loan Facility



Abbreviation	Description
O	
O&M	Operations and Maintenance
P	
PAF	Project Assessment Framework
PBC	Preliminary Business Case
Proponent	Sunwater Limited
PSC	Project Steering Committee
PWG	Project Working Group
Q	
QBWOS	Queensland Bulk Water Opportunity Statement
QCA	Queensland Competition Authority
QGSO	Queensland Government Statistician's Office
R	
RAB	Regulated Asset Base
RCC	Roller Compacted Concrete
RFI	Request for Information
RWSSA	Regional Water Supply Security Assessment
S	
SDPWO Act	State Development and Public Works Organisation Act 1971 (Qld)
SIE	Social Impact Evaluation
SIP	The State Infrastructure Plan
SRG	Stakeholder Reference Group
SRO	Senior Responsible Officer
T	
TEC	Threatened ecological community
TI Act	Transport Infrastructure Act 1994 (Qld)
TMR	Transport and Main Roads
ToR	Terms of Reference
TRC	Tablelands Regional Council
U	
USL	Unallocated State Land
UXO	Unexploded Ordnance
V	
VM Act	Vegetation Management Act 1999 (Qld)
W	
WASO	Water Allocation Security Objective
Water Act	Water Act 2000 (Qld)
Water Supply Act	Water Supply (Safety and Reliability) Act 2008
WDV	Written Down Value



Abbreviation	Description
	Depreciated value of an asset
WHA	World Heritage Area
WHS	Work Health and Safety
WSS	Water Supply Scheme
WTP	Water Treatment Plant