

Contents

ABBREVIATIONS	I
GLOSSARY OF TERMS	IV
EXECUTIVE SUMMARY	VII
1 INTRODUCTION	1
1.1 Overview	1
1.2 The proponent	1
1.3 Objective of the project	2
1.4 Key features of the project	2
1.5 The location of the project	4
1.6 Summary of planning approval process	4
1.7 Purpose and structure of the environmental impact statement	7
2 THE ENVIRONMENTAL ASSESSMENT PROCESS	9
2.1 Overview	9
2.2 NSW statutory framework and approval process	9
2.3 ACT statutory framework and approval process	17
2.4 Commonwealth statutory framework and approval process	24
2.5 Summary of approvals required	28
2.6 Methodology for this assessment	29
3 LOCATION AND SETTING	33
3.1 Regional setting	33
3.2 Preferred project location	36
3.3 Land leases/ownership	39
3.4 Local setting – key features of the existing environment	48
4 CONSULTATION DURING PREPARATION OF THE ENVIRONMENTAL ASSESSMENT	53
4.1 Consultation prior to the assessment	53
4.2 Consultation for the project and environmental assessment	53
4.3 Consultation with government agencies	56
4.4 Consultation on the draft EIS/EA	59
4.5 Next steps for consultation	66
5 STRATEGIC CONTEXT AND NEED	67
5.1 Overview	67
5.2 Strategic context for the preferred project	68
5.3 Preferred project need	69
5.4 Preferred project benefits and objectives	75
6 PREFERRED PROJECT DESCRIPTION	77
6.1 Overview	77
6.2 Project changes since notification of the draft EIS/EA	77
6.3 Intake/low lift pump station	78
6.4 High lift pump station	81
6.5 Pipeline	83

6.6	Outlet structure	86
6.7	Mini-hydro power facility	87
6.8	Power supply	87
6.9	Water supply and storage	88
6.10	Sewerage	88
6.11	Construction of the preferred project	88
6.12	Rehabilitation	96
6.13	Operation of the preferred project	96
6.14	Maintenance of the preferred project	99
6.15	Project timing	100
6.16	Incorporating sustainability into the preferred project	100
7	ALTERNATIVES CONSIDERED	107
7.1	Overview	107
7.2	Assessment of alternative options	110
7.3	Pipeline alternatives	125
7.4	Refining the 'Angle Crossing' option	132
8	GENERAL ENVIRONMENTAL RISK ANALYSIS	141
8.1	Overview	141
8.2	NSW Director-Generals requirements	141
8.3	ACT request for scoping documentation	147
8.4	Risk assessment methodology	147
8.5	Residual risks	153
9	HYDROLOGY AND GEOMORPHOLOGY OF THE MURRUMBIDGEE RIVER AND PIPELINE WATERWAY CROSSINGS	155
9.1	Overview	155
9.2	Methodology	155
9.3	Existing environment	157
9.4	Impact assessment	166
9.5	Summary of impacts	176
9.6	Mitigation measures	177
10	HYDROLOGY AND GEOMORPHOLOGY OF BURRA CREEK	179
10.1	Methodology	179
10.2	Existing environment	179
10.3	Impact assessment	190
10.4	Summary of impacts	204
10.5	Mitigation measures	205
11	WATER QUALITY	209
11.1	Methodology	209
11.2	Existing environment	211
11.3	Impact assessment	220
11.4	Summary of results	221
11.5	Mitigation measures	222

12	AQUATIC ECOLOGY	225
12.1	Methodology	225
12.2	Existing environment	225
12.3	Impact assessment	237
12.4	Summary of results	248
12.5	Mitigation measures	249
13	TERRESTRIAL ECOLOGY	253
13.1	Methodology	253
13.2	Existing environment	258
13.3	Impact assessment	284
13.4	Offset Plan	295
13.5	Summary of results	301
13.6	Mitigation measures	302
14	INDIGENOUS HERITAGE	305
14.1	Methodology	305
14.2	Existing environment	308
14.3	Impact assessment	318
14.4	Summary of results	322
14.5	Mitigation measures	323
15	NON-INDIGENOUS HERITAGE	325
15.1	Methodology	325
15.2	Existing environment	325
15.3	Impact assessment	334
15.4	Summary of results	335
15.5	Mitigation measures	335
16	TOPOGRAPHY, SOILS AND GROUNDWATER	337
16.1	Methodology	337
16.2	Existing environment	337
16.3	Impact assessment	346
16.4	Summary of results	350
16.5	Mitigation measures	350
17	LAND USE	353
17.1	Methodology	353
17.2	Existing environment	353
17.3	Impact assessment	356
17.4	Summary of results	360
17.5	Mitigation measures	361
18	LANDSCAPE CHARACTER AND VISUAL AMENITY	363
18.1	Methodology	363
18.2	Existing environment	363
18.3	Key visual features of the preferred project	366
18.4	Impact assessment	369

18.5	Summary of results	372
18.6	Mitigation measures	372
19	SPOIL HANDLING AND WASTE MANAGEMENT	375
19.1	Methodology	375
19.2	Impact assessment	375
19.3	Summary of results	382
19.4	Mitigation measures	382
20	NOISE AND VIBRATION	383
20.1	Methodology	383
20.2	Existing environment	383
20.3	Noise and vibration goals	384
20.4	Impact assessment	387
20.5	Summary of results	397
20.6	Mitigation measures	398
21	AIR QUALITY, CLIMATE AND BUSHFIRE	403
21.1	Air quality	403
21.2	Climate	406
21.3	Bushfire risk	417
22	GREENHOUSE GAS ASSESSMENT	421
22.1	Methodology	421
22.2	Scope 1, 2 and 3 emissions	422
22.3	Summary of results	423
22.4	Mitigation measures	424
23	SOCIO-ECONOMIC IMPACTS	425
23.1	Methodology	425
23.2	Existing environment	425
23.3	Impact assessment	427
23.4	Summary of results	432
23.5	Mitigation measures	433
24	HEALTH AND RISK IMPACTS	435
24.1	Potential hazards and risk	435
24.2	Methodology of the screening level water quality risk assessment	435
24.3	Impact assessment and mitigation measures	435
24.4	Summary of results	441
24.5	Mitigation measures	443
25	TRAFFIC AND TRANSPORT	445
25.1	Methodology	445
25.2	Existing environment	445
25.3	Impact assessment	449
25.4	Summary of results	457
25.5	Mitigation measures	458

26	CUMULATIVE IMPACTS AND COMMONWEALTH REQUIREMENTS	459
26.1	Overview	459
26.2	Cumulative impacts	459
26.3	Cumulative impacts of the ACTEW Major Water Security Projects initiative.	461
26.4	Summary of the application of the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999	462
27	ENVIRONMENTAL MANAGEMENT AND MONITORING	469
27.1	Overview	469
27.2	Residual impact	469
27.3	Management strategies	485
27.4	Monitoring Programs	488
28	STATEMENT OF COMMITMENTS	495
28.1	Overview	495
29	PREFERRED PROJECT JUSTIFICATION AND CONCLUSION	503
29.1	Justification for undertaking the preferred project	503
29.2	Conclusion	504
30	REFERENCES	507
31	CORE STUDY TEAM	515
32	SPECIALIST STUDY TEAM	521

Appendices

Appendix A – NSW Director-General's Requirements and ACT Scoping Document

Appendix B – Cross-references to NSW Director-General's Requirements and ACT Scoping Document

Appendix C – Impact of the M2G on flow in the Murrumbidgee River and Burra Creek

Appendix D – Fluvial geomorphic assessment

Appendix E – Potential implications for the London Bridge natural arch and karst

Appendix F – Water quality summary data

Appendix G – Aquatic impact assessment

Appendix H – Terrestrial flora and fauna impact assessment

Appendix I – Cultural heritage assessment including subsurface testing program

Appendix J – Soils, contamination and groundwater assessment

Appendix K – Landscape and visual impact assessment

Appendix L – Noise and vibration assessment

Appendix M – Climate change risk assessment

Appendix N – Greenhouse gas assessment

Appendix O – Social impact assessment

Appendix P – Quantitative risk assessment for drinking water

Appendix Q – Construction traffic impact assessment

Appendix R – Electrical infrastructure for the Murrumbidgee to Googong Water Transfer

Appendix S – Consultation and submissions report

List of tables

Table 1.1 Key features of the project	3
Table 2.1 Summary of approvals required	28
Table 3.1 Location of structures	39
Table 3.2 Blocks of land affected by the preferred project	39
Table 4.1 Issues raised by agencies	57
Table 6.1 Summary of pump operation for the intake/low lift pump station	81
Table 6.2 Indicative construction plant/equipment	93
Table 6.3 Estimated average monthly supply from Angle Crossing to Burra Creek	98
Table 6.4 Environmental flow at Lobbs Hole	99
Table 6.5 Australian Green Infrastructure Council categories and sub-categories	101
Table 6.6 Opportunities for enhanced outcomes	102
Table 6.7 Principles for sustainable development in the ACT Territory Plan relevant to the preferred project	103
Table 7.1 Options identified in Options for the Next ACT Water Source	107
Table 7.2 Sustainability criteria for evaluation of Future Water Options (ACTEW 2005a).	109
Table 7.3 Murrumbidgee to Googong Water Transfer (Angle Crossing option) – summary of performance	112
Table 7.4 New reservoir in the Cotter catchment – summary of performance	113
Table 7.5 Tennent Reservoir – summary of performance	114
Table 7.6 Tantangara Transfer – summary of performance	116
Table 7.7 Seawater source – summary of performance	117
Table 7.8 Groundwater – summary of performance	117
Table 7.9 Water purification scheme – summary of performance	118
Table 7.10 Stormwater use – summary of performance	119
Table 7.11 Rainwater collection (private tanks) – summary of performance	120
Table 7.12 Grey water use – summary of performance	120
Table 7.13 Other non-potable reuse options (large scale irrigation) – summary of performance	121
Table 7.14 Accelerated demand management – summary of performance	122
Table 7.15 Cloud seeding – summary of performance	123
Table 7.16 Watermining TM – summary of performance	123
Table 7.17 Evaporation control on reservoirs – summary of performance	124
Table 7.18 Study evaluation criteria and qualitative weighting.	128
Table 7.19 Overall ranking and performance of pipeline options.	129
Table 8.1 General environmental risk assessment	143
Table 8.2 Likelihood descriptors	148
Table 8.3 Evaluating consequence	150
Table 8.4 Potentially significant impacts identified in the ACTEW Request for Scoping application as submitted to ACTPLA in 2008.	151

Table 9.1 Issues addressed by the hydrological modelling	155
Table 9.2 Murrumbidgee River flow (ML/day) entering ACT over the period of record 1974 to present (measured at Lobbs Hole gauge)	159
Table 9.3 Estimated Angle Crossing peak flood rates (m ³ /s) for average recurrence interval (ARI)	160
Table 9.4 Flow conditions across Angle Crossing for more frequent floods	162
Table 9.5 Summary of waterway condition along the pipeline route	164
Table 9.6 Murrumbidgee flow at Angle Crossing (ML/month), generated with data from the last ten years	168
Table 9.7 Depth in the Murrumbidgee upstream of Angle Crossing (m) from stochastic data	170
Table 9.8 Depth in the Murrumbidgee downstream of Angle Crossing (m), stochastic data	170
Table 9.9 Velocity in the Murrumbidgee upstream of Angle Crossing (ms ⁻¹) from stochastic data	170
Table 9.10 Velocity in Murrumbidgee downstream of Angle Crossing (ms ⁻¹), stochastic data	170
Table 9.11 Forecast average annual reduction in flows leaving the ACT	171
Table 9.12 Overall impact of preferred project on ACT flows (ML/month), generated with stochastic data	173
Table 9.13 Overall impact of preferred project on ACT flows (ML/month), generated with data from the last ten years	173
Table 9.14 Overall impact of preferred project on ACT flows (ML/month), generated with period of record historical data (1871 – present)	173
Table 10.1 Seasonal flow profile for Burra Creek over the period of record, 1985 to 2008 (ML/day measured at Burra Road)	181
Table 10.2 Summary of Burra Creek geomorphology	187
Table 10.3 Burra Creek flow (ML/day), generated with stochastic data	190
Table 10.4 Velocity (m/s) and shear stress (N/m ²) ranges for pools and riffles for the range of flows modelled	194
Table 10.5 Riffle zone types along Burra Creek	196
Table 10.6 Summary of pool and downstream riffle zone associations	198
Table 10.7 Description of pools with downstream high adjustment riffles and expected impacts	198
Table 10.8 Bank erosion potential categories and descriptions.	202
Table 10.9 Description of banks with high erosion potential.	203
Table 10.10 Guidelines for morphological monitoring and management actions	206
Table 11.1 Summary of water resources and the water users that may be impacted by a change in water quality as a result of the project	213
Table 11.2 Key water quality parameters and default trigger values identified by ANZECC for ecosystem protection and NHMRC for drinking water	214
Table 12.1 Aquatic Plants Occurring in Burra Creek and in the Murrumbidgee River near Angle Crossing. The list is not comprehensive, but is illustrative of the differences between the two.	231
Table 12.2 Fish species previously recorded in the Murrumbidgee River and Googong Reservoir	232
Table 12.3 Threatened aquatic species with the potential to occur in the region	236
Table 12.4 Invasive alien fish species present in the Murrumbidgee and Googong catchments	237
Table 12.5 Assessment of key thresholds	237
Table 13.1 Flora survey methods and effort	254
Table 13.2 Fauna survey effort	257
Table 13.3 Classification of the Box Gum Woodland EEC	266
Table 13.4 Rare and threatened plant species that have known, or potential, habitat within the study area	269

Table 13.5 .Terrestrial fauna listed on the Environment Protection and Biodiversity Conservation Act 1999, Nature Conservation Act 1980 and/or Threatened Species Conservation Act 1995 that are extant or previously recorded in the study area	273
Table 13.6 Key thresholds for threatened species and communities	287
Table 13.7 Impacts to native vegetation in ACT and NSW (ha)	296
Table 13.8 Box-Gum Woodland offset calculations	297
Table 13.9 ACTEW Williamsdale - environmental values	300
Table 14.1 Summary of Aboriginal recordings	309
Table 14.2 Archaeological sub-surface potential	314
Table 14.3 Scientific significance of NSW sites	316
Table 14.4 Scientific significance of ACT sites	318
Table 14.5 Number of sites potentially impacted by the preferred project	319
Table 14.6 Sites with the potential to be directly impacted by the preferred project	319
Table 14.7 Sites located on the edge of the 40 m pipeline easement that are vulnerable to impact during construction	320
Table 15.1 Heritage listed sites	326
Table 15.2 Summary of significance assessment – NSW recordings	333
Table 15.3 Summary of significance assessment – ACT recordings	334
Table 16.1 Summary of expected geology along the proposed pipeline route (Henderson 1987 and Richardson and West 1977)	339
Table 16.2 Summary of soil landscapes located along the proposed pipeline route (DCLM 1994)	344
Table 19.1 Likely spoil material	376
Table 19.2 Estimated quantities of spoil generated	377
Table 19.3 Waste management measures	380
Table 20.1 Summary of the rating background level (RBL) LA90(Period) noise monitoring results, dB(A)	384
Table 20.2 NSW construction noise criteria, dB(A)	384
Table 20.3 NSW road traffic noise criteria	385
Table 20.4 Human comfort vibration goals (mm/s PPV)	385
Table 20.5 Adjustments for duration	387
Table 20.6 Air valve noise criteria	387
Table 20.7 Predicted construction noise at the ACT and NSW potentially impacted receivers for each stage of Angle Crossing works at the low lift pump station and high lift pump station, dB(A)	388
Table 20.8 Predicted pipeline construction noise for different distances, dB(A)	389
Table 20.9 Predicted construction noise at the outlet structure, dB(A)	389
Table 20.10 Predicted construction compound noise, dB(A)	390
Table 20.11 Predicted operation noise from the low lift pump station at the ACT and NSW potentially impacted receivers, dB(A)	393
Table 20.12 Predicted operation noise from the high lift pump station at the ACT and NSW potentially impacted receivers, dB(A)	394
Table 20.13 Air valves locations and nearest sensitive receivers	395
Table 20.14 Predicted operation noise from the outlet structure at the NSW residential receivers, dB(A)	396
Table 21.1 Air quality mitigation measures for the construction period	405
Table 21.2 Annual reference period climate annual statistics (1961-1990, Canberra Airport)	407
Table 21.3 Climate summary and comparison (annual statistics) (Canberra Airport)	408
Table 21.4 Projected climate change outcomes and recent climate for Canberra compared to the reference period	411
Table 21.5 Climate change projections for the ACT	412

Table 21.6 Summary of major climate change risks and actions	414
Table 22.1 Summary of Scope 1, 2 and 3 emissions for the preferred project	422
Table 23.1 Employment impacts, ACT, 2008-09 to 2010-11 (full time equivalents)	431
Table 23.2 Real economic indicators 2008-09 to 2010-11 (deviations)	431
Table 23.3 Average cost and benefit data	432
Table 24.1 Screening level quantitative risk assessment of the safety of drinking water	442
Table 25.1 Existing traffic count data	446
Table 25.2 Level of service for two-lane roads	446
Table 25.3 Construction traffic – haulage requirements	450
Table 25.4 Construction traffic – heavy vehicle movements for main preferred project components	450
Table 25.5 Construction traffic – light vehicle movements	451
Table 25.6 Construction traffic assignment	452
Table 25.7 Construction traffic	452
Table 25.8 Road crossings by the pipeline	453
Table 25.9 Intersection volumes below which capacity analysis is unnecessary	455
Table 25.10 SIDRA intersection analyses	455
Table 26.1 Status of the Major Water Security Projects	461
Table 26.2 Identified matters of national environmental significance	463
Table 26.3 Other matters protected by the Environment Protection and Biodiversity Conservation Act 1999	465
Table 27.1 Residual Risk Assessment	470
Table 27.2 Proposed monitoring for Angle Crossing and Burra Creek	490
Table 28.1 Statement of commitments	495
Table 31.1 Core study team	515
Table 32.1 Qualifications of lead advisors for responsible for assessment of the project (EIS/EA documentation input, management and preparation).	521

List of figures

Figure 1.1 Location of the project	5
Figure 2.1 Zoning for the preferred project	12
Figure 2.2 NSW approval process	13
Figure 2.3 Flow chart for impact track approvals in the ACT	22
Figure 3.1 Regional setting of the preferred project	34
Figure 3.2 Schematic representation of the ACT's water supply and treatment system	35
Figure 3.3 Looking west towards Angle Crossing and the intake/low lift pump station site, from the high lift pump station site	36
Figure 3.4 Looking north across Burra Creek towards Williamsdale Road	38
Figure 3.5 Location of the intake/low lift pump station	40
Figure 3.6 Location of the high lift pump station	41
Figure 3.7 Location of the pipeline (ACT section)	42
Figure 3.8 Location of the pipeline (NSW section)	43
Figure 3.9 Location of air and scour valves	44
Figure 3.10 Location of the mini-hydro power generator/outlet structure	45
Figure 3.11 Location of the power supply	46
Figure 3.12 Land leases and ownership	47

Figure 3.13 Catchment area boundaries	50
Figure 4.1 Submissions received by topic.	11
Figure 4.1 Submissions received by topic.	62
Figure 5.1 Combined Corin, Bendora and Googong inflows (1871-2008)	70
Figure 5.2 Total water storage of Corin, Bendora and Googong reservoirs from 2000-2009	71
Figure 6.1 Intake/low lift pump station structure	78
Figure 6.2 Main components of the intake/low lift pump station structure	79
Figure 6.3 Concept layout of the high lift pump station	82
Figure 6.4 Typical cross-section of the water transfer pipeline	84
Figure 6.5 Pipeline route showing chainage	85
Figure 6.6 Outlet structure	86
Figure 6.7 General layout of site compounds	92
Figure 7.1 Pipeline corridor options	126
Figure 9.1 Seasonal profile of Murrumbidgee River flow entering the ACT	160
Figure 9.2 River cross-section at Angle Crossing with computed water levels	161
Figure 9.3 Bar is unvegetated upstream of proposed intake location	163
Figure 9.4 View upstream of proposed intake location	163
Figure 9.5 Location of the waterway crossings in the vicinity of the pipeline	165
Figure 9.6 Murrumbidgee River flows showing proposed transfer volumes and environmental flows using historical data	167
Figure 9.7 Murrumbidgee at Angle Crossing flow duration curve, generated with stochastic data	168
Figure 9.8 Murrumbidgee at Angle Crossing flow duration curve, generated with data from the last ten years	169
Figure 9.9 Murrumbidgee at Cotter Pump Station plus Queanbeyan River downstream Googong Reservoir combined flow duration curve, generated with stochastic data	174
Figure 9.10 Murrumbidgee at Cotter Pump Station plus Queanbeyan River downstream Googong Dam combined flow duration curve, generated with data from the last ten years	174
Figure 10.1 Historical flows for Burra Creek at the "Burra Road" gauging station (Site 410774)	180
Figure 10.2 Seasonal profile of Burra Creek flow regime measured at the Burra Road site	182
Figure 10.3 Reaches of Burra Creek	183
Figure 10.4 Upstream view of expanded channel section in Reach 1.	184
Figure 10.5 Confined valley- floodplain pockets at upstream limit of reach 2 (downstream view)	184
Figure 10.6 Partly confined bedrock controlled channel in reach 3 (downstream view). Displaying channel bounded by bedrock on one side and alluvial soils on the other side	185
Figure 10.7 Upstream of London Bridge, reach 4	186
Figure 10.8 Downstream from London Bridge, reach 4	186
Figure 10.9 Downstream from London Bridge circa 1976	188
Figure 10.10 Downstream from London Bridge 2008	188
Figure 10.11 Downstream side of London Bridge during a flood in November 1976	189
Figure 10.12 Burra Creek flow duration curve, generated with stochastic data	191
Figure 10.13 Burra Creek showing a 3 month ARI flood and the depth of a 100 ML/day flow	192
Figure 10.14 Computed Water Surface Profiles along Burra Creek through London Bridge (flow is from right to left)	193
Figure 10.15 Computed Water Levels downstream end of London Bridge	193
Figure 10.16 (a) The upstream extent is characterised by long, shallow pools separated by short riffles; and (b) the downstream extent consists of well-vegetated, swampy channel floor.	201
Figure 11.1 Schematic of the current water resources and the water users	212
Figure 11.2 ActewAGL/EcoWise water quality monitoring sites (prior to project).	216

Figure 11.3 Location of ECOWISE monitoring points in Burra Creek	219
Figure 12.1 Burra Creek aquatic habitat survey sites 1 to 7	227
Figure 12.2 Murrumbidgee River aquatic habitat survey sites A to P	228
Figure 12.3 Angle Crossing causeway (looking upstream)	242
Figure 13.1 Vegetation communities	263
Figure 13.2 Location of Endangered Ecological Communities (EECs)	268
Figure 13.3 Environmentally sensitive areas	272
Figure 13.4 Location of threatened flora recorded during this study	290
Figure 13.5 Location of threatened fauna recorded during the study	291
Figure 13.6 Proposed biodiversity offset location	299
Figure 14.1 Location of test pits within the study area	310
Figure 14.2 Location of test pits within the study area	311
Figure 14.3 Location of test pits within the study area	312
Figure 14.4 Location of test pits within the study area	313
Figure 14.5 Number of items in each technological class	315
Figure 15.1 Location of non-Indigenous heritage recordings in the study area	328
Figure 15.2 Location of non-Indigenous heritage recordings in the study area	329
Figure 15.3 Location of non-Indigenous heritage recordings in the study area	330
Figure 15.4 Location of non-Indigenous heritage recordings in the study area	331
Figure 15.5 Location of non-Indigenous heritage recordings in the study area	332
Figure 16.1 Topography of the preferred project area	338
Figure 16.2 Selected groundwater bores	342
Figure 16.3 Yield and salinity in fractured and unconsolidated rocks (Evans, 1987)	343
Figure 17.1 Location of dwellings within 1,400m of the pipeline alignment	358
Figure 17.2 Location of reserves in the vicinity of the preferred project	359
Figure 18.1 Views of the existing environment	365
Figure 18.2 Simulation of the intake/low lift pump station	366
Figure 18.3 Simulation of the high lift pump station	367
Figure 18.4 Simulation of view to the high lift pump station from Angle Crossing	367
Figure 18.5 Simulation of the outlet structure	368
Figure 19.1 The waste hierarchy	379
Figure 21.1 Comparison of recent and historical median monthly rainfall for Canberra	410
Figure 25.1 Road network in the vicinity of the pipeline	447
Figure 27.1 Location of ECOWISE monitoring points in Burra Creek	492

