

CHAPTER 24 – MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE PART 2 – WATER RESOURCES

STANMORE ID EXTENSION PTY LTD

ISAAC DOWNS EXTENSION PROJECT

TABLE OF CONTENTS

24.1 Introduction 24-1
24.2 Regulatory Framework 24-2
24.2.1 Environment Protection and Biodiversity Conservation Act 1999 24-2
24.2.2 Mineral Resource Act 1989 24-2
24.2.3 Environmental Protection Act 1994 24-2
24.2.4 Environmental Authority and Progressive Rehabilitation and Closure Plan Schedule under the EP Act 24-2
24.2.5 Environmental Protection Regulation 2019 24-3
24.2.6 Environmental Protection (Water and Wetland Biodiversity) Policy 2019 24-4
24.2.7 Isaac River Sub-basin Environmental Values and Water Quality Objectives 24-4
24.2.8 Manual for Assessing Consequence Categories and Hydraulic Performance of Structures 24-4
24.2.9 Model Mining Conditions 24-4
24.2.10 Water Act 2000 24-5
24.2.11 Water Plan (Fitzroy Basin) 2011 24-6
24.2.12 Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017 24-6
24.2.13 Fisheries Act 1994 24-6
24.2.14 IESC Cross Reference 24-7
24.3 Environmental Values – Surface Water 24-30
24.3.1 Environmental Values under EPP Water 24-30
24.3.2 Water Quality Objectives 24-30
24.3.3 Regional Drainage Network 24-32
24.3.4 Local Drainage Network 24-33
24.3.4.1 Isaac River 24-33
24.3.4.2 Cherwell Creek and JB Gully 24-38
24.3.4.3 Conrock Gully 24-38
24.3.5 Streamflow 24-39
24.3.5.1 Isaac River at Deverill Stream Flow Gauge 24-39
24.3.5.2 Isaac River at Stanmore Stream Flow Gauge 24-40
24.3.5.3 Conrock Gully Stream Flows 24-40
24.3.6 Water Quality 24-41
24.3.6.1 Monitoring Locations 24-41
24.3.6.2 Regional Water Quality 24-43
24.3.6.3 Local Water Quality 24-43
24.3.7 Existing Water Use Entitlements 24-46
24.3.8 Wetlands 24-46
24.3.9 Existing Surface Water Infrastructure 24-46
24.3.9.1 Overview 24-46
24.4 Methodology and Fieldwork – Groundwater 24-48
24.4.1 Groundwater 24-48
24.4.1.1 Desktop Data 24-48
24.4.1.2 Overview of Fieldwork Programs 24-49
24.4.1.3 Groundwater Bore Census 24-49
24.4.1.4 Bore Drilling and Installation 24-49
24.4.1.5 Fault Exploration Drilling and Down-hole Geophysics Survey 24-49
24.4.1.6 Hydraulic Testing 24-50
24.4.1.7 Electrical Resistivity Imaging Survey 24-50
24.4.1.8 Routine Groundwater Level and Quality Monitoring 24-51

24.4.2 Groundwater Dependent Ecosystems 24-51
24.4.2.1 GDE Survey Timing 24-51
24.4.2.2 GDE Survey Methods 24-51
24.4.2.3 GDE Data Interpretation 24-52
24.4.3 Stygofauna 24-55
24.4.4 Resource Operations and Projects 24-55
24.4.5 Geology 24-57
24.4.5.1 Overview 24-57
24.4.5.2 Cenozoic Sediments 24-60
24.4.5.3 Quaternary Alluvium 24-60
24.4.5.4 Regolith 24-63
24.4.5.5 Triassic Rewan Group 24-63
24.4.5.6 Permian Coal Measures (Blackwater Group) 24-63
24.4.5.7 Structural Geology 24-64
24.5 Environmental Values – Groundwater 24-64
24.5.1 Overview 24-64
24.5.2 Groundwater Monitoring 24-65
24.5.2.1 Project Monitoring Network 24-65
24.5.2.2 Other Monitoring Networks 24-67
24.5.3 Hydraulic Properties 24-67
24.5.3.1 Site Specific Hydraulic Conductivity Data 24-67
24.5.3.2 Regional Hydraulic Conductivity Ranges 24-68
24.5.3.3 Faulting 24-68
24.5.4 Groundwater Recharge 24-69
24.5.4.1 Overview 24-69
24.5.4.2 Deep Drainage 24-69
24.5.4.3 Chloride Mass Balance 24-70
24.5.5 Groundwater Distribution, Flow, Recharge and Discharge 24-70
24.5.5.1 Alluvium 24-70
24.5.5.2 Regolith 24-72
24.5.5.3 Permian Coal Measures 24-72
24.5.5.4 Vertical Connectivity and Hydraulic Gradient Between Aquifers 24-73
24.5.6 Groundwater Quality 24-73
24.5.6.1 Groundwater Types 24-73
24.5.6.2 Salinity 24-74
24.5.6.3 Water Quality Objectives 24-75
24.6 Environmental Values – Groundwater Receptors 24-77
24.6.1 Overview 24-77
24.6.2 Landholder Bores 24-78
24.6.3 Groundwater Dependent Ecosystems 24-80
24.6.3.1 Ecological Characteristics of GDE Species and Communities 24-80
24.6.3.2 Hydrogeological Setting 24-80
24.6.3.3 GDE Assessment Findings - Leaf Water Potential 24-81
24.6.3.4 GDE Assessment Findings - Soil Auger Sampling 24-81
24.6.3.5 GDE Assessment Findings - Stable Isotopes 24-82
24.6.3.6 GDE Assessment Findings - Radon Analysis 24-82
24.6.3.7 Summary of Results 24-82
24.6.3.8 Ecohydrological Conceptual Site Models 24-83
24.6.3.9 Mapped Extent of GDEs 24-84
24.6.4 Stygofauna 24-90
24.6.4.1 Desktop Data 24-90

24.6.4.2 Stygofauna Field Data....24-90
24.6.4.3 Status under Commonwealth and State legislation....24-91
24.7 Surface Water and Water Management System....24-91
24.7.1 Water Management System....24-91
24.7.1.1 Overview and Objectives....24-91
24.7.1.2 Integration of the Water Management System into IPC....24-92
24.7.1.3 Proposed Water Management Infrastructure....24-93
24.7.2 Preliminary Consequence Category Assessment....24-95
24.7.3 Water Balance Model....24-96
24.7.3.1 Methodology....24-96
24.7.3.2 Climate and Climate Change....24-97
24.7.3.3 Catchment Yield Parameters and Catchment Areas....24-97
24.7.3.4 Water Management System Configuration....24-103
24.7.3.5 Water Demands....24-103
24.7.3.6 Groundwater Inflows....24-103
24.7.3.7 Controlled Releases....24-105
24.7.3.8 Isaac River Streamflows....24-107
24.7.3.9 Salinity Parameters....24-107
24.7.4 Water Management System Assessment....24-107
24.7.4.1 Overview....24-107
24.7.4.2 Interpretation of Results....24-108
24.7.4.3 Overall Water Balance....24-108
24.7.4.4 Mine-affected Water Inventory....24-108
24.7.4.5 Pit Inundation Characteristics....24-109
24.7.4.6 Controlled Mine-affected Water Releases....24-109
24.7.4.7 Uncontrolled Releases - Mine-affected Water Dams....24-110
24.7.4.8 Sediment Dam Overflows....24-110
24.7.4.9 Mine-affected Water Transfers to IPC....24-111
24.7.4.10 Imported Mine-affected Water from IPC....24-111
24.7.4.11 IPC Mine-affected Water Inventory....24-112
24.7.4.12 IPC Raw Water Take....24-113
24.7.4.13 Overall Salt Balance....24-114
24.7.4.14 Climate Change Assessment....24-114
24.7.4.15 Adaptative Management of the WMS....24-115
24.8 Flood Modelling Assessment....24-115
24.8.1 Proposed Surface Water Infrastructure....24-115
24.8.2 Preliminary Consequence Category Assessment....24-117
24.8.2.1 Overview....24-117
24.8.2.2 Assessable Infrastructure....24-117
24.8.2.3 Assessment Outcomes....24-117
24.8.3 Overview....24-117
24.8.4 Existing Conditions....24-120
24.8.5 Developed Conditions....24-121
24.8.6 Developed Conditions – Levee Water Levels and Velocities Impact Assessment....24-127
24.8.7 Developed Conditions – Flood Level Change Assessment....24-130
24.8.8 Developed Conditions – Flood Duration Impact Assessment....24-134
24.8.9 Developed Conditions – Velocity Change Assessment....24-138
24.8.10 Final Landform Conditions....24-142
24.8.11 Final Landform – Flood Level and Velocity Change Assessment....24-142
24.8.12 Climate Change Assessment....24-149

24.8.12.1 Overview 24-149
24.8.12.2 Developed Conditions – Climate Change Flood Assessment 24-149
24.8.12.3 Final Landform Conditions – Climate Change Flood Assessment 24-150
24.9 Isaac River Geomorphic Impact Assessment 24-154
24.9.1 Overview 24-154
24.9.2 Hydraulic Criteria 24-154
24.9.3 Impacts on Channel Morphology 24-155
24.9.3.1 Existing Conditions – Hydraulic Characteristics 24-155
24.9.3.2 Developed Conditions – Channel Impact Assessment 24-156
24.9.3.3 Final Landform Conditions – Channel Impact Assessment 24-161
24.9.4 Impacts on Floodplain Morphology 24-165
24.9.4.1 Existing Conditions – Hydraulic Characteristics 24-165
24.9.4.2 Developed Conditions – Floodplain Impact Assessment 24-165
24.9.4.3 Final Landform Conditions – Floodplain Impact Assessment 24-171
24.9.4.4 Geomorphic Impact Assessment Summary 24-176
24.10 Conrock Gully Assessment 24-177
24.10.1 Functional Design Report 24-177
24.10.2 Design Approach 24-177
24.10.3 Hydraulic Assessment Methodology 24-178
24.10.4 Diversion Depths and Velocities 24-178
24.10.4.1 Summary – Depths and Velocities 24-178
24.10.4.2 Outlet Velocities 24-178
24.10.5 Comparison to DNRME Guideline Hydraulic Criteria 24-179
24.10.6 Project Site Access Road Assessment 24-183
24.10.7 Monitoring 24-183
24.10.8 Assessment Summary 24-183
24.11 Groundwater Modelling 24-186
24.11.1 Conceptual Hydrogeological Model 24-186
24.11.2 Numerical Groundwater Model 24-189
24.11.2.1 Overview 24-189
24.11.2.2 Central Bowen Basin Regional Numerical Groundwater Model 24-189
24.11.2.3 Project's Numerical Groundwater Model 24-189
24.11.2.4 Model Objectives 24-192
24.11.2.5 Model Design 24-192
24.11.2.6 Model Calibration 24-192
24.11.2.7 Model Performance and Limitations 24-192
24.11.3 Peer Review 24-193
24.11.3.1 Overview 24-193
24.11.3.2 Peer Review Findings 24-193
24.11.3.3 Conclusion 24-195
24.11.4 Model Predictions – Drawdown 24-195
24.11.4.1 Overview 24-195
24.11.4.2 Maximum Incremental Drawdown 24-195
24.11.4.3 Maximum Cumulative Drawdown 24-200
24.11.4.4 Residual Incremental Drawdown 24-204
24.11.4.5 Residual Cumulative Drawdown 24-206
24.11.5 Model Predictions – Groundwater Interception 24-208
24.11.5.1 Operations 24-208
24.11.5.2 Closure – Residual Void 24-208
24.11.6 Model Predictions - Incidental Water Impacts 24-209
24.11.6.1 Influence on Alluvial Aquifer - Operations 24-209

24.11.6.2 Influence on Alluvial Aquifer – Post Mining 24-211
24.11.6.3 Loss of Flow in Stream - Operations 24-213
24.11.6.4 Loss of Flow in Stream – Post Mining 24-213
24.11.7 Model Predictions – Landholder Bores 24-214
24.11.8 Model Predictions - Flow Path Simulation 24-214
24.11.9 Sensitivity Analysis 24-217
24.11.10 Uncertainty Analysis 24-217
24.11.10.1 Overview 24-217
24.11.10.2 Uncertainty of Drawdown 24-217
24.11.10.3 Uncertainty of Mine Groundwater Inflows 24-218
24.11.10.4 Uncertainty in Alluvium Water Take 24-218
24.11.10.5 Uncertainty in River Baseflow Loss 24-218
24.11.11 Climate Change 24-218
24.12 Assessment of Impacts and Management Measures – Surface Water 24-219
24.12.1 Overview of Potential Impacts 24-219
24.12.2 Changes to Water Quality 24-219
24.12.2.1 Mine-affected Water Management – Uncontrolled Releases 24-219
24.12.2.2 Mine-affected Water Management – Controlled Releases 24-219
24.12.2.3 Sediment Water Management 24-221
24.12.2.4 Management Measures 24-222
24.12.3 Streamflow Changes 24-222
24.12.3.1 Operations 24-222
24.12.3.2 Final Landform 24-223
24.12.4 Regional Water Availability 24-224
24.12.5 Release of Contaminants 24-224
24.12.6 Cumulative Impacts 24-224
24.12.6.1 Overview and Projects Assessed 24-224
24.12.6.2 Water Quality 24-224
24.12.6.3 Loss of Catchment and Stream Flows in the Isaac River 24-225
24.12.7 Downstream Water Users 24-226
24.12.8 Water Management System Monitoring and Maintenance 24-226
24.12.9 Erosion and Sediment Control Plan 24-226
24.12.9.1 Overview 24-226
24.12.9.2 Erosion and Sediment Control 24-227
24.12.9.3 Erosion Control Measures 24-227
24.12.9.4 Drainage Control Measures 24-228
24.12.9.5 Sediment Control Measures 24-228
24.12.9.6 Erosion and Sediment Control - Construction 24-229
24.12.9.7 Erosion and Sediment Control Planning 24-229
24.12.9.8 Monitoring and Maintenance 24-230
24.12.10 Surface Water Monitoring 24-230
24.12.10.1 Overview 24-230
24.12.10.2 Water Quality Monitoring Locations 24-230
24.12.10.3 Mine-affected Water Quality Monitoring 24-233
24.12.10.4 Receiving Water Contaminant Trigger Levels 24-234
24.12.10.5 Water Storage Monitoring 24-234
24.12.11 Fitzroy Regional Receiving Environment Monitoring Program 24-234
24.13 Assessment of Impacts and Management Measures – Hydrology and Geomorphology 24-234
24.13.1 Potential Impacts 24-234
24.13.2 Flood Impacts 24-235

24.13.2.1 Mining Operations – Flood Regime Summary 24-235
24.13.2.2 Final Landform – Flood Regime Summary 24-238
24.13.3 Final Void – Flood Ingress Summary 24-238
24.13.4 Geomorphic Impacts 24-239
24.13.4.1 Isaac River Channel Geomorphology 24-239
24.13.4.2 Isaac River Floodplain Geomorphology 24-239
24.13.4.3 Chewrell Creek and JB Gully Geomorphology 24-239
24.13.4.4 Conrock Gully Diversion Geomorphology 24-239
24.13.5 Cumulative Impact Assessment 24-240
24.13.6 Proposed Mitigation and Management Measures - Operations 24-240
24.13.6.1 Levee and Levee Plugs 24-240
24.13.6.2 Conrock Gully Diversion 24-241
24.13.6.3 Isaac River Bridge and Cherwell Creek Bridge 24-241
24.13.6.4 Temporary Isaac River Dragline Crossing 24-242
24.13.6.5 JB Gully Bed-level Crossing and Conrock Gully Diversion Crossing 24-242
24.13.7 Proposed Mitigation and Management Measures – Final Landform 24-243
24.13.7.1 Levee and Levee Plugs 24-243
24.13.7.2 Conrock Gully Diversion 24-243
24.13.7.3 Isaac River Bridge and Cherwell Creek Bridge 24-243
24.13.7.4 Temporary Isaac River Dragline Crossing 24-243
24.13.7.5 JB Gully Bed-level Crossing and Conrock Gully Diversion Crossing 24-244
24.14 Assessment of Impacts – Groundwater 24-244
24.14.1 Landholder Bores 24-244
24.14.2 Surface Drainage 24-246
24.14.3 Groundwater Quality 24-246
24.14.3.1 Spoil 24-246
24.14.3.2 Final Void 24-246
24.14.3.3 Workshops and Storage – Leaks or Spills 24-247
24.14.3.4 Blasting 24-247
24.14.4 Aquifer Physical Integrity and Hydraulic Properties 24-247
24.14.5 Groundwater Dependent Ecosystems 24-247
24.14.5.1 Overview of Potential Impacts 24-247
24.14.5.2 Clearing of GDEs 24-249
24.14.5.3 Aquifer Depressurisation 24-250
24.14.5.4 Surface Flow Changes 24-250
24.14.5.5 Water Quality Changes or Sedimentation 24-250
24.14.5.6 Cumulative Impacts 24-251
24.14.6 Stygofauna 24-252
24.14.6.1 Overview of Potential Impacts 24-252
24.14.6.2 Leaks or Spills 24-252
24.14.6.3 Seepage – Spoil and Void 24-252
24.14.6.4 Changes in Groundwater Levels 24-252
24.15 Management and Mitigation Measures - Groundwater 24-253
24.15.1 Landholder Bores 24-253
24.15.2 Management of Leaks or Spills 24-253
24.15.3 Groundwater Monitoring and Management Plan 24-254
24.15.3.1 Overview 24-254
24.15.3.2 Groundwater Monitoring Network 24-254
24.15.3.3 Monitoring Regime – Baseline and During Mining 24-254
24.15.3.4 Groundwater Level Triggers 24-259
24.15.3.5 Groundwater Quality Limits 24-260

24.15.3.6 Exceedance Investigations 24-264
24.15.3.7 Monitoring Regime – Post-Mining 24-264
24.15.3.8 Quality Assurance / Quality Control 24-264
24.15.3.9 Reporting, Review and Improvement Process 24-264
24.15.4 Groundwater Dependent Ecosystems 24-265
24.15.4.1 Disturbance Area Management 24-265
24.15.4.2 Water Management 24-265
24.15.4.3 Groundwater Monitoring and Management 24-266
24.15.4.4 Groundwater Dependent Ecosystem Monitoring and Management 24-266
24.15.4.5 Potential Corrective Actions and Adaptative Management Measures 24-273
24.15.4.6 Groundwater Dependent Ecosystem Habitat Quality Monitoring Program 24-273
24.15.4.7 Assessment of Residual Risk to GDEs 24-276
24.16 Assessment of Significance of Impacts 24-276
24.16.1 Methodology 24-276
24.16.2 Sensitivity 24-277
24.16.3 Impact Assessment Ranking 24-278
24.16.4 Sensitivity of the Receiving Environment 24-280
24.16.5 Residual Significant Impact Assessment 24-283
24.17 Conclusion 24-294
24.18 References 24-300

Tables

Table 24-1 IESC Cross Reference Table 24-8
Table 24-2 Water Quality Objectives, Isaac River Sub-basin 24-30
Table 24-3 Combined Isaac River Water Quality Data 24-45
Table 24-4 Existing and Proposed Resource Operations and Projects in Project Region 24-55
Table 24-5 Summary of Mean Hydraulic Conductivity per Hydrogeologic Unit - Site Testing 24-68
Table 24-6 Water Quality Objectives for Isaac River Sub-basin Environmental Values 24-76
Table 24-7 Isaac River Sub-basin Zone 34 WQOs for Groundwater Resources (Aquatic Ecosystem Protection) 24-76
Table 24-8 Mine-affected Water Release Limits 24-105
Table 24-9 Mine-affected Water Release Conditions 24-106
Table 24-10 Proposed Receiving Water Contaminant Trigger Levels 24-107
Table 24-11 Floodplain Inundation Time Impact Assessment 24-135
Table 24-12 ACARP Design Criteria for Bowen Basin Stream Diversions 24-154
Table 24-13 Conrock Gully Diversion – Channel Geomorphic Characteristics Comparison 24-184
Table 24-14 Conrock Gully Diversion – Modelled Guideline Hydraulic Conditions Comparison 24-184
Table 24-15 Catchment Area Captured During Operations by the Project 24-222
Table 24-16 Catchment Area Captured Within the Project's Final Landform 24-223
Table 24-17 Proposed Surface Water Monitoring Program 24-231
Table 24-18 Release Contaminant Trigger Investigations Levels 24-233
Table 24-19 Summary of Modelled Potential Water Level Impacts – Project's Mining Operations 24-236
Table 24-20 Summary of Modelled Potential Velocity Impacts – Project's Mining Operations 24-237
Table 24-21 Drawdown Impact on Landholder Bores 24-245
Table 24-22 Project GMMP Monitoring Network 24-256

Table 24-23 Groundwater Level Trigger Thresholds 24-259
Table 24-24 Proposed Parameters for Groundwater Quality Limits 24-261
Table 24-25 Interim Groundwater Quality Limits for Compliance Bores 24-263
Table 24-26 GDEs, REs and Associated MNES and MSES 24-274
Table 24-27 Criteria for Sensitivity 24-277
Table 24-28 Consequence Definitions 24-278
Table 24-29 Frequency Categories for Likelihood 24-280
Table 24-30 Risk Analysis Matrix 24-280
Table 24-31 Sensitivity of Surface Water Resource Values 24-281
Table 24-32 Assessment of Significance of Residual Impacts to Surface Water Resources 24-284
Table 24-33 Assessment of Significance of Residual Impacts to Groundwater 24-289

Figures

Figure 24-1 Regional Catchments and Watercourses 24-35
Figure 24-2 Upper Isaac River Drainage 24-36
Figure 24-3 Local Catchments and Watercourses 24-37
Figure 24-4 Stream Flow Duration Curves – Isaac River's Deverill Gauge 24-40
Figure 24-5 Local Water Quality Monitoring Locations 24-42
Figure 24-6 Layout of Existing and Approved Surface Water Infrastructure 24-47
Figure 24-7 GDE Assessment Sites 24-54
Figure 24-8 Project Surface Geology 24-58
Figure 24-9 Conceptual Geological Cross Section across the Project Area and Pit 24-59
Figure 24-10 Cross Section of the Alluvium along the Isaac River 24-61
Figure 24-11 Cross Section of the Alluvium along Cherwell Creek 24-61
Figure 24-12 Interpreted Extent and Thickness of Alluvium 24-62
Figure 24-13 Project Groundwater Monitoring Network 24-66
Figure 24-14 Salinity Ranking by Groundwater Unit 24-75
Figure 24-15 Registered and Landholder Bores 24-79
Figure 24-16 LWP for GDE Assessment Sites – Ranges and Averages 24-81
Figure 24-17 Conceptual Ecohydrological Model – Dry Season 24-86
Figure 24-18 Conceptual Ecohydrological Model – Wet Season 24-87
Figure 24-19 Conceptual Ecohydrological Model – Post Wet Season 24-88
Figure 24-20 GDE Areas 24-89
Figure 24-21 Catchment and Land Use Plan - Phase 1 and 2 24-98
Figure 24-22 Catchment and Land Use Plan - Phase 3 24-99
Figure 24-23 Catchment and Land Use Plan - Phase 4 24-100
Figure 24-24 Catchment and Land Use Plan - Phase 5 24-101
Figure 24-25 Catchment and Land Use Plan - Phase 6 24-102
Figure 24-26 Water Management System Schematic 24-104
Figure 24-27 Forecast Mine-Affected Water Inventory 24-109
Figure 24-28 Forecast Annual Mine Water Controlled Release Volumes 24-110
Figure 24-29 Forecast Annual Sediment Dam Overflow Volumes 24-111
Figure 24-30 Annual Mine-affected Water Demand from IPC 24-112
Figure 24-31 Forecast Total IPC Mine-affected Water Inventory 24-113
Figure 24-32 External Raw Water Demand for IPC (Including Project Demands) 24-114
Figure 24-33 Proposed Surface Water Infrastructure Layout 24-116
Figure 24-34 Key Reporting Locations – Flood Modelling Assessment 24-119
Figure 24-35 Developed Conditions – 1% AEP Flood Depths and Heights 24-123
Figure 24-36 Developed Conditions – 0.1% AEP Flood Depths and Heights 24-124

Figure 24-37 Developed Conditions – 1% AEP Flood Velocity 24-125
Figure 24-38 Developed Conditions – 0.1% AEP Flood Velocity 24-126
Figure 24-39 Isaac River Levee - Long Section - 0.1% AEP Water Levels and Velocities 24-128
Figure 24-40 Cherwell Creek Levee Plug - Long Section - 0.1% AEP Water Levels and Velocities 24-129
Figure 24-41 Conrock Gully Levee Plug - Long Section - 0.1% AEP Water Levels and Velocities 24-130
Figure 24-42 1% AEP Flood Level Impacts 24-132
Figure 24-43 0.1% AEP Flood Level Impacts 24-133
Figure 24-44 Assessment Point Cross-sections in the Isaac River, US1 24-135
Figure 24-45 Assessment Point Cross-sections in the Isaac River, US2 24-136
Figure 24-46 Assessment Point Cross-sections in the Isaac River, DS1 24-136
Figure 24-47 Assessment Point Cross-sections in the Isaac River, DS2 24-137
Figure 24-48 Assessment Point Cross-sections in the Isaac River, DS3 24-137
Figure 24-49 1% AEP Flood Velocity Impacts 24-140
Figure 24-50 0.1% AEP Flood Velocity Impacts 24-141
Figure 24-51 Final Landform – 0.1% AEP Flood Depths and Heights 24-144
Figure 24-52 Final Landform – 0.1% AEP Flood Velocities 24-145
Figure 24-53 Final landform – PMF Flood Depths and Heights 24-146
Figure 24-54 Final Landform – 0.1% AEP Flood Level Impacts 24-147
Figure 24-55 Final Landform – 0.1% AEP Flood Velocity Impacts 24-148
Figure 24-56 Isaac River Levee – Long Section – 0.1% AEP Water Levels plus Year 2050 Climatic Conditions 24-149
Figure 24-57 Cherwell Creek Levee Plug – Long Section – 0.1% AEP Water Levels plus Year 2050 Climatic Conditions 24-150
Figure 24-58 Conrock Gully Levee Plug – Long Section – 0.1% AEP Water Levels plus Year 2050 Climatic Conditions 24-150
Figure 24-59 Final Landform Conditions – 0.1% AEP Climate Change Flood Event – Flood Depths 24-152
Figure 24-60 Final Landform Conditions – 0.1% AEP Climate Change Flood Event – Flood Velocities 24-153
Figure 24-61 50% AEP Flood Event – Developed Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel) 24-158
Figure 24-62 2% AEP Flood Event – Developed Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel) 24-159
Figure 24-63 0.1% AEP Flood Event – Developed Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel) 24-160
Figure 24-64 50% AEP Flood Event – Final Landform Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel) 24-162
Figure 24-65 2% AEP Flood Event – Final Landform Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel) 24-163
Figure 24-66 0.1% AEP Flood Event – Final Landform Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel) 24-164
Figure 24-67 2% AEP Flood Event – Bed Shear Stress Impacts (Developed minus Existing Conditions) 24-167

Figure 24-68 0.1% AEP Flood Event – Bed Shear Stress Impacts (Developed minus Existing Conditions) 24-168
Figure 24-69 2% AEP Flood Event – Stream Power Impacts (Developed minus Existing Conditions) 24-169
Figure 24-70 0.1% AEP Flood Event – Stream Power Impacts (Developed minus Existing Conditions) 24-170
Figure 24-71 Final Landform – 2% AEP Flood (Minus Existing Conditions) – Bed Shear Stress Impacts 24-172
Figure 24-72 Final Landform – 0.1% AEP Flood (Minus Existing Conditions) – Bed Shear Stress Impacts 24-173
Figure 24-73 Final Landform – 2% AEP Flood (Minus Existing Conditions) – Stream Power Impacts 24-174
Figure 24-74 Final Landform – 0.1% AEP Flood (Minus Existing Conditions) – Stream Power Impacts 24-175
Figure 24-75 Longitudinal Profiles: 50% AEP Section-averaged Velocity, Stream Power and Bed Shear Stress 24-181
Figure 24-76 Longitudinal Profiles: 2% AEP Section-averaged Velocity, Stream Power and Bed Shear Stress 24-182
Figure 24-77 Conceptual Hydrogeological Model of the Project Groundwater System 24-188
Figure 24-78 Model Mesh, Boundary Conditions and Approved Operations 24-191
Figure 24-79 Predicted Maximum Drawdown (Incremental) – Alluvium 24-197
Figure 24-80 Predicted Maximum Drawdown (Incremental) – Regolith 24-198
Figure 24-81 Predicted Maximum Drawdown (Incremental) – Leichardt Seam 24-199
Figure 24-82 Predicted Maximum Drawdown (Cumulative) – Alluvium 24-201
Figure 24-83 Predicted Maximum Drawdown (Cumulative) – Regolith 24-202
Figure 24-84 Predicted Maximum Drawdown (Cumulative) – Leichardt Seam 24-203
Figure 24-85 Residual Incremental Drawdown – Alluvium 24-205
Figure 24-86 Residual Cumulative Drawdown – Alluvium 24-207
Figure 24-87 Mine Groundwater Inflows – Active Mining 24-208
Figure 24-88 Predicted Residual Void Groundwater Inflows – Project Void 24-209
Figure 24-89 Incremental (Project) Predicted Alluvium Net Flux (top) and Change in Alluvium Net Flux (bottom) 24-210
Figure 24-90 Predicted Alluvium Net Flux (top) and Change in Alluvium Net Flux (bottom) – Post Mining 24-212
Figure 24-91 Predicted Reduction in River Baseflow (Incremental and Cumulative) 24-213
Figure 24-92 Predicted Reduction in River Baseflow (Incremental and Cumulative) – Post Mining 24-214
Figure 24-93 Predicted Movement of Particles 24-216
Figure 24-94 Electrical Conductivity in the Isaac River - Controlled Release of Mine-affected Water 24-220
Figure 24-95 Electrical Conductivity in the Isaac River - Sediment Dam Releases 24-221
Figure 24-96 Surface Water Monitoring Locations 24-232
Figure 24-97 Pre-Mining Groundwater Regime 24-248
Figure 24-98 Mining Operations – Maximum Cumulative Drawdown 24-249
Figure 24-99 Project GMMP Monitoring Network 24-258
Figure 24-100 GDEMMP Assessment Sites 24-269
Figure 24-101 GDE Monitoring, Assessment and Decision Process 24-272

24. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE PART 2 – WATER RESOURCES

24.1 Introduction

The Isaac Downs Extension (IDE) Project (the Project) will be integrated into Isaac Plains Complex (IPC), comprising Isaac Downs Mine (IDM) and Isaac Plains Mine (IPM). The proponent for the Project, Stanmore ID Extension Pty Ltd (ID Extension) is a wholly owned subsidiary of Stanmore Resources Ltd (Stanmore). The Project's water management systems will be integrated into IPC.

This chapter provides an assessment of surface water and groundwater resources of the Project area and surrounds, collectively referred to as water resources, including whether the Project is likely to have a significant impact on water resources as a matter of national environment significance (MNES).

This chapter describes the surface water environmental values for the Project, establishes water quality objectives, describes the proposed water management strategy, system and infrastructure for management of all types of water in the Project area, provides a site water balance, assesses the performance of the water management system, and assesses the management measures and mitigation strategies designed to protect surface water environmental values.

This chapter describes the hydrology of the Project area and its surrounding environment, the potential for flooding under different rainfall events in the Project area, and assesses changes to hydrology and geomorphology because of Project infrastructure and landform changes during and post mining. The potential changes to the geomorphic characteristics of the Isaac River, Cherwell Creek and Conrock Gully were assessed for the mining and closure phases of the Project.

This chapter describes the groundwater environmental values of the Project area and surrounds, groundwater fieldwork investigations, development of conceptual groundwater and ecohydrological models, the assessment of impacts on groundwater environmental values through the development of a numerical groundwater model, and the management measures and mitigation strategies designed to protect groundwater environmental values. The assessment of groundwater environmental values includes groundwater dependent ecosystems (GDEs) and stygofauna. The groundwater impact assessment, including conceptual and numerical modelling was subject to an independent peer review.

The information in this chapter is primarily based on the:

- Surface Water and Water Management Assessment provided in **Appendix I**
- Flooding, Hydrology and Geomorphology Assessment provided in **Appendix J**, including functional design report for the construction and operation of the Conrock Gully diversion (Appendix D of **Appendix J**)
- Groundwater Assessment provided in **Appendix K**
- Groundwater Assessment Peer Review provided in **Appendix L**
- Groundwater Dependent Ecosystem Assessment provided in **Appendix N**
- Stygofauna Assessment provided in **Appendix O**
- Erosion and Sediment Control Plan in **Appendix AD**
- Groundwater Monitoring and Management Plan provided in **Appendix AE**
- Groundwater Dependent Ecosystem Monitoring and Management Plan provided in **Appendix AF**
- Groundwater Dependent Ecosystem Habitat Quality Monitoring Program provided in **Appendix AG**.

24.2 Regulatory Framework

24.2.1 Environment Protection and Biodiversity Conservation Act 1999

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) determined the Project to be a controlled action (EPBC 2025/10183) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The controlling provisions include 'a water resource, in relation to coal seam gas development and large coal mining development (sections 24D & 24E)'. This controlling provision is relevant to the surface water assessment.

The Independent Expert Scientific Committee (IESC) on Coal Seam Gas and Large Coal Mining Developments provides scientific advice to decision makers on the impact that coal seam gas and large coal mining development may have on Australia's water resources. The IESC assesses the proposals against the Information Guidelines for Independent Expert Scientific Committee advice (IESC, 2024)[1] (IESC Guidelines) on coal seam gas and large coal mining development proposals where there is a significant impact on water resources. The core purpose of the guideline is to determine whether a coal seam gas (CSG) or large coal mining development has or is likely to have a significant impact on a water resource.

The IESC Guidelines specify information required for groundwater studies including the Australian Groundwater Modelling Guidelines (Barnett et al., 2012) as well as a methodology to assess uncertainty associated with groundwater modelling (Peeters and Middlemis, 2023). The groundwater assessment was specifically designed to provide the information required by these guidelines, including utilising proposed concepts for assessing model confidence that are expected in future updates to the Australian Groundwater Modelling Guidelines.

This chapter provides an assessment of the significance of impacts to water resources (Section 24.16), and provides a cross reference table identifying where the requirements of the IESC Guidelines have been addressed (Section 24.2.14).

24.2.2 Mineral Resource Act 1989

The *Mineral Resources Act 1989* (MR Act) entitles the holder of a mining lease to take or interfere with underground water (i.e. groundwater) as part of approved mining operations. This entitlement is termed the mining lease holder's 'underground water rights'. Groundwater that is taken or interfered with while exercising the underground water rights is termed 'associated water'. The holder of the mining lease is entitled to use associated water for any purpose.

24.2.3 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) provides for environmental protection policies that establish the environmental values (EVs) which are to be protected, that include quality standards that are relevant to the water environment. The EVs of waterways in Queensland are protected under the EP Act and the subordinate *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water).

24.2.4 Environmental Authority and Progressive Rehabilitation and Closure Plan Schedule under the EP Act

The Project requires an environmental authority (EA) and progressive rehabilitation and closure plan (PRCP) schedule under the EP Act for the Project's mining leases. All Project-related activities will be conditioned by the EA and PRCP schedule, including water releases, management of water systems,

[1] https://www.iesc.gov.au/sites/default/files/2024-02/info-guidelines-proponents-preparing-coal-seam-gas-large-coal-mining-development-proposals.pdf

groundwater impacts and rehabilitation of water management infrastructure. EAs and PRCP schedules are administered by the Department of the Environment, Tourism, Science and Innovation (DETSI).

Appendix AA provides a draft EA, with proposed conditions related to surface water management. DETSI is responsible for granting the EA conditions for the Project. In relation to surface water and groundwater, the proposed draft EA conditions cover:

- the release of mine affected water to the receiving environment, including by specifying authorised release points
- required water quality of mine affected water
- the frequency, locations, and quality characteristics of water monitoring
- that releases must only take place during periods of natural flow events in accordance with the receiving water flow criteria
- that releases must comply with the water management plan
- surface water monitoring
- groundwater monitoring and management
- groundwater quality limits and level trigger thresholds
- requirements for investigations should there be exceedances of limits or trigger levels.

The water management plan must be developed and implemented by an appropriately qualified person, in accordance with relevant government guidelines, and must be reviewed and reported on annually by an appropriately qualified person. **Appendix I** provides the content requirements and basis for a water management plan.

Release criteria have been established in accordance with Model Mining Conditions which use variable flow rates in the receiving environment to determine the release volumes and water quality of mine affected water releases, so that downstream EVs and water quality objectives (WQOs) are protected.

The EA will authorise the construction and operation of the Project's levees, Conrock Gully diversion and other infrastructure potentially interacting with waters. The PRCP schedule will specify the progressive rehabilitation and closure requirements for the Project's levees, Conrock Gully diversion and other water-related infrastructure.

Water quality monitoring at specified locations and frequencies is proposed for water storages associated with the release points, and for the receiving environment at upstream background sites and downstream of release points. The draft EA outlines actions that must be taken if quality characteristics of the mine affected water release or downstream monitoring sites exceed any of the trigger levels. For all water monitoring, information including the date, time, flow rate, and details of any exceedances of the conditions must be submitted annually to the administering authority, being DETSI.

A receiving environment monitoring program (REMP) and erosion and sediment control plan (ESCP) are required to be developed and implemented by an appropriately qualified person. As described in **Chapter 25**, the proponent proposes to join the Fitzroy Regional Receiving Environment Monitoring Program (FRREMP) (Fitzroy Basin Association, 2025). The FRREMP is supported by DETSI, which has prepared the Fitzroy Basin regional receiving environment monitoring program guideline (ESR/2023/6463) (DETSI, 2025). An ESCP for the Project is provided as **Appendix AD**.

Appendix AC provides a draft PRCP schedule, including the rehabilitation milestones and completion criteria for water management infrastructure.

24.2.5 Environmental Protection Regulation 2019

The *Environmental Protection Regulation 2019* (EP Regulation) elaborates how the principles and objectives of the EP Act are to be implemented and enforced. The EP Regulation also defines the environmental objective and performance outcomes for Queensland's water environment, which are applicable to the Project's assessment and management of potential surface water impacts.

24.2.6 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The EPP Water is the primary instrument for surface water management under the EP Act. The EPP Water governs discharge to land, surface water and groundwater, aims to protect EVs and sets water quality guidelines and objectives.

The processes to identify EVs and to determine WQOs in Queensland waters is based on the Australian and New Zealand Guidelines (ANZG) for Fresh and Marine Water Quality (ANZG, 2018), hereafter referred to as the 'Australian Water Quality Guidelines'. The EPP Water is supported by the Queensland Water Quality Guidelines 2009 (QWQG) (DEHP, 2013).

EVs and WQOs have been established for many waterways in Queensland under Schedule 1 of the EPP Water.

24.2.7 Isaac River Sub-basin Environmental Values and Water Quality Objectives

The relevant document, pursuant to the EPP Water, for the Project is the *Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Isaac River Sub-basin (including Connors River), September 2011* (DEHP, 2011), hereafter referred to as the 'Isaac River Sub-basin EVs and WQOs'. The document is made pursuant to the provisions of the EPP Water. It contains EVs and WQOs for waters in the Isaac River Sub-basin, and they are listed under Schedule 1 of EPP Water.

The environmental values of Isaac groundwaters, as listed in the 'Isaac River Sub-basin EVs and WQOs' is for aquatic ecosystems, irrigation, farm supply/use, stock water, drinking water, industrial use, primary recreation and cultural and spiritual values.

24.2.8 Manual for Assessing Consequence Categories and Hydraulic Performance of Structures

The Manual for Assessing Consequence Categories and Hydraulic Performance of Structures[2] (the Manual) defines the methodology and assessment criteria to determine if a structure associated with an environmentally relevant activity should be regulated under the EP Act. The Manual details the hydraulic design requirements for regulated structures (e.g. dams and levees) and this document has been used as a reference in the preliminary design of the water management system and preliminary sizing of dams associated with the Project. It has also been used to inform the design of Project levees.

In relation to water systems, the draft EA conditions the design, construction and operation of regulated structures, including that they are designed, constructed and operated in accordance with the Manual.

24.2.9 Model Mining Conditions

The Model Mining Conditions[3] are a set of model conditions to form general environmental protection commitments given for mining activities, and EA conditions for resource activities imposed by the administering authority under the EP Act. These model conditions have been used as a guide for developing environmental protection commitments relating to water management and for appropriate conditions for the draft EA (**Appendix AA**) for the Project.

The Model water conditions for coal mines in the Fitzroy basin[4] provide a set of model conditions to form the basis of water related environmental protection commitments in an EA for coal mines located within the Fitzroy Basin.

[2] https://www.detsi.qld.gov.au/_global/policy-register/policy-register-pdf?getdoc=1933&name=era-mn-assessing-consequence-hydraulic-performance.pdf

[3] https://www.detsi.qld.gov.au/_global/policy-register/policy-register-pdf?getdoc=1936&name=rs-gl-model-mining-conditions.pdf

[4] https://www.detsi.qld.gov.au/_global/policy-register/policy-register-pdf?getdoc=1561&name=rs-gl-water-conditions-mines-fitzroy.pdf

24.2.10 Water Act 2000

In Queensland, the *Water Act 2000* (Water Act) is the primary statutory document that establishes a framework for the planning, allocation and use of non-tidal water. The Water Act is primarily administered by the Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (DNRMMRRD) and the Department of Local Government, Water and Volunteers.

The main purposes of the Water Act, as relevant to the Project, include for the following:

- The sustainable management of Queensland's water resources by establishing a system for the planning, allocation and use of water; and riverine protection.
- The sustainable and secure water supply for designated regions.
- The management of impacts on underground water caused by the exercise of underground water rights by the resource sector.

The Project does not require a licence or permit under the Water Act to take surface waters for water supply to the Project, as all water required for the Project is from the Project's water managements systems or existing external water supplies.

The right to take associated water comes with monitoring and reporting obligations under the MR Act and the Water Act. The MR Act requires that the volume of associated water taken is measured and reported. Obligations under Chapter 3 of the Water Act include undertaking baseline assessments of the groundwater regime and water supply bores, providing ongoing assessment and reporting of groundwater take, preparing underground water impact reports (UWIRs) and, where necessary, entering into make good agreements with owners of affected water supply bores.

The taking of or interfering with groundwater is regulated under the water licensing provisions of the Water Act. The Water Act specifies that a water licence is required to take or interfere with sub-artesian groundwater within areas declared as management areas or declared areas under subordinate Queensland legislation. The Project will not result in the take or interference with groundwater, other than associated water while exercising its underground water rights.

A watercourse is defined by the Water Act as a river, creek or stream in which water flows permanently or intermittently and includes the bed and banks and any other element of a river, creek or stream confining or containing water. DNRMMRRD have published a watercourse identification map of the State that shows: watercourses (other than their lateral limits), the downstream limit of watercourses, drainage features, lakes and springs.

Under the Water Act, the defined watercourses in the vicinity of the Project are:

- Isaac River
- Cherwell Creek
- the downstream reach of Conrock Gully (the upstream reach is a defined drainage feature).

A diversion of Conrock Gully is proposed for the Project. Under Section 97 and 98 of the Water Act, diversions associated with an EA (Section 97), or resource activity (Section 98) are approved through the EA process, and therefore, a separate water licence is not required.

Placing fill or excavating in a watercourse will require a riverine protection permit (RPP) if the activity does not comply with guidelines for Riverine protection permit exemption requirements[5]. The proponent will obtain a RPP if the exemption requirements cannot be met.

A Quarry Material Allocation Notice will not be required for the Project as riverine materials will not be taken with the intent to be sold or used for productive purposes.

[5] https://www.rdmw.qld.gov.au/_shared-content/policy-register/policy-register-pdf?getdoc=726&name=riverine-protection-permit-exemption-requirements.pdf

24.2.11 Water Plan (Fitzroy Basin) 2011

The *Water Plan (Fitzroy Basin) 2011* (Fitzroy Basin WP) was developed under the Water Act to define the availability of water in the Fitzroy Basin and:

- provide a framework for sustainably managing water and the taking of water
- identify priorities and mechanisms for dealing with future water requirements
- provide a framework for establishing water allocations
- provide a framework for reversing, where practicable, degradation in natural ecosystems
- regulate the taking of overland flow water
- regulate the taking of groundwater.

The Project falls within the Isaac River sub-basin area of the Fitzroy Basin Resources Operations Plan 2014 (DNRM, 2015).

The Project is located within the Fitzroy River catchment which is managed under the Fitzroy Basin WP, which is subordinate legislation under the Water Act. The plan covers surface water (zone WQ1301) associated with Isaac River, and groundwaters (zone WQ1310 – Fitzroy Basin groundwaters). The Project is located within the Isaac Connors Groundwater Management Area (GMA) as described in the Fitzroy Basin WP. The Isaac Connors GMA is subdivided into the following groundwater units:

- Isaac Connors Groundwater Unit 1, also known as the Isaac Connors Alluvium groundwater sub-area, containing aquifers of the Quaternary alluvium; and
- Isaac Connors Groundwater Unit 2, containing all sub-artesian aquifers within the Isaac Connors GMA other than the aquifers included in Isaac Connors Groundwater Unit 1.

In the Project area and surrounds the Isaac Connors Groundwater Unit 1 is limited to the alluvium of the Isaac River channel, floodplain and associated historical Isaac River channel meanders (paleochannels). The western and southern areas of the Project occur within the Isaac Connors Groundwater Unit 1, with the northern and eastern areas outside the Isaac River floodplain being situated within the Isaac Connors Groundwater Unit 2.

The Project occurs within zone 34 within the Fitzroy Basin on plan WQ1310 of the 'Isaac River Sub-basin EVs and WQOs'. WQOs are long-term goals for water quality management that protect environmental values. WQOs are provided, as statistical percentiles, for two depths (shallow < 30 m, and deep > 30 m). In addition, the 'Isaac River Sub-basin EVs and WQOs' provide WQOs for stock drinking water and short term irrigation, against which the water quality data from the Project monitoring bores has been compared.

24.2.12 Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017

The Project is located over 160 km east of the boundary of the Great Artesian Basin (GAB). No approvals or groundwater allocations associated with the Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017 are applicable within the Project area.

24.2.13 Fisheries Act 1994

Approval under the *Fisheries Act 1994* for waterway barrier works within waterways is not required as mining activities on a mining lease are exempt from the Act. There are no declared fish habitat areas in the area of the Project's activities. Refer to **Chapter 25** for additional information on waterway barriers. Where relevant, the Project's activities in waterways will be conducted in accordance with the Accepted development requirements for operational work that is constructing or raising waterway barrier works (DPI, 2025) (Waterway Barrier Works guideline).

24.2.14 IESC Cross Reference

Table 24-1 provides a cross reference table identifying where the requirements of the IESC Guidelines have been addressed in this **Chapter 23**, **Chapter 24**, **Chapter 25**, **Appendix I**, **Appendix J** and **Appendix K**. Blank cells in Table 24-1 indicate that a particular appendix to the EIS does not address the IESC information requirement.

Table 24-1 IESC Cross Reference Table

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Description of the proposed project - General				
Provide a regional overview of the proposed project area, including a description of the geological basin, coal resource, surface water catchments, groundwater systems, water-dependent assets (including terrestrial and aquatic GDEs), and past, present and reasonably foreseeable coal mining and CSG developments.	23.5, 24.3, 24.4, 24.4.5, 24.4.4, 24.5, 24.6	Sections 1, 2, 3, 9.9	Sections 1, 2, 3	Sections 1, 3, 4, 5, 6
Describe the proposal's location, purpose, scale, duration and disturbance area, and the means by which it is likely to have a significant impact on water resources and water-dependent assets.	23.2, 23.5, 23.7, 24.12, 24.13, 24.14, 24.16		Section 4	Sections 1, 10
Assess the frequency (and time lags, if any), location, volume and direction of interactions between water resources, including surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.	24.5, 24.11.1, 24.11.2, 24.11.6, 24.14.2			Section 5.4
Description of the proposed project – Regulatory context				
Describe the statutory context, including information on the proposal's status within the regulatory assessment process and any applicable water management policies or regulations.	24.2	Section 1	Section 1	Section 2
Describe how potentially impacted water resources are currently being regulated under state or Commonwealth law, including whether there are any applicable standard conditions.	24.2, 24.2.3, 24.2.4			Section 2
Describe existing water quality guidelines, environmental flow objectives and other requirements (e.g., water planning rules) for the surface water catchments and groundwater basins within which the development proposal is based.	24.2, 24.2.5, 24.2.6, 24.2.7, 24.3, 24.3.1, 24.3.2, 24.5, 24.5.6, 24.5.6.3	Sections 1, 2	Sections 1, 2	Section 2
Describe public health, recreation, amenity, Indigenous, tourism and/or agricultural values for each water resource, and the plans relevant to their management and protection.	24.3, 24.3.1, 24.3.2, 24.3.7, 24.5, 24.5.6, 24.6, 24.6.2	Sections 2, 3		Sections 2, 5.6
Description of the proposed project – Groundwater context				

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Describe and map the geology at an appropriate level of horizontal and vertical resolution, including:	24.4, 24.4.5, 24.5			Section 4
• definition of the geological sequence(s) in the area, with names and descriptions of the formations and accompanying surface geology, cross-sections and any relevant field data	24.4, 24.4.5, 24.5			Sections 4, 5
• identification of hydrogeological sequences and characteristics.	24.4, 24.4.5, 24.5			Sections 4, 5
Define and describe or characterise significant geological structures (e.g., faults, folds, intrusives) and associated fracturing in the area and their influence on groundwater – particularly groundwater flow, discharge or recharge.	24.4, 24.4.1, 24.4.5, 24.4.5.7			Sections 1.4, 4.2, 5
• Provide geological maps appropriately annotated with symbols that denote fault type, throw and the parts of sequences the faults intersect or displace (e.g., Murray and Power 2021).	24.4, 24.4.1, 24.4.5, 24.4.5.7			Sections 1.4, 4.2, 5
• Include discussion of how the faults potentially influence regional-scale groundwater conditions.	24.4.1.5, 24.4.5.7			Sections 1.4, 4.2, 5
Describe the likely recharge, discharge and flow pathways for all hydrogeological units likely to be impacted by the proposed development.	24.5, 24.5.3, 24.5.4, 24.5.5			Sections 3, 5.5, 7, 10
• Identify current stressors, including impacts from any currently approved projects.	24.5, 24.5.3, 24.5.4, 24.5.5			Sections 3, 5.5, 7, 10
Describe the existing water quality of all aquifers in the project area.	24.5, 24.5.6			Sections 5.6
• Where groundwater is to be used for a given purpose such as irrigation, compare the data with relevant guideline values (ANZG 2018) and regional and local water quality objectives.	24.5, 24.5.6			Sections 5.6
Description of the proposed project – Surface water context				
Describe the watercourses, standing waters and springs across the site, including:	24.3.3, 24.3.4, 24.3.5, 24.3.8, 24.3.9	Section 3	Section 2	Sections 3.2, 8

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
• drainage patterns and key surface water and floodplain features	24.3.3, 24.3.4, 24.3.5, 24.3.8, 24.3.9	Section 3	Section 2	Section 3.2
• hydrological regimes (especially ecologically relevant components such as durations, timing and frequency of periods when no surface water is present)	24.3.3, 24.3.4, 24.3.5, 24.3.8, 24.3.9	Section 3	Section 2	Sections 3.2, 8
• current stressors, including impacts from any currently approved projects.	24.3.3, 24.3.4, 24.3.5, 24.3.8, 24.3.9	Section 3	Section 2	Sections 3.2, 8
Describe the existing water quality of surface waters potentially impacted by the proposed development.	24.3, 24.3.6	Section 2 Section 3.7 Section 9.10		Sections 5, 8
• Include comparison to relevant default guideline values (ANZG 2018) and regional and local (or site-specific) water quality objectives.	24.3, 24.3.6, 24.12.10	Section 2 Section 3.7 Section 9.10		Sections 5, 8
Description of the proposed project – Ecological context				
Describe the ecological water-dependent assets in and near the proposed development area, including:	24.4, 24.4.2, 24.4.3, 24.6, 24.6.3, 24.6.4, 25.5, 25.6			Section 5.6, 5.7, 10.1
• water-dependent fauna and flora and their habitats, including GDEs (see Doody et al. 2019)	24.4, 24.4.2, 24.4.3, 24.6, 24.6.3, 24.6.4, 25.5, 25.6			Section 5.7
• their current condition and environmental values	24.4, 24.4.2, 24.4.3, 24.6, 24.6.3, 24.6.4, 25.5, 25.6			Section 5.6, 5.7
• stressors that currently affect each ecological water-dependent asset, including stressors that alter the quantity and/or quality of water required by each asset in and near the proposed development area.	24.4, 24.4.2, 24.4.3, 24.6, 24.6.3, 24.6.4, 25.5, 25.6			Sections 5.7, 10.1
Environmental impact assessment - General				

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Describe the intensity, duration, magnitude, timing and geographic extent of each potential impact, specifying the impact's significance and consequences, especially on the environmental condition and human values of each water resource.	23.2, 23.5, 23.7, 24.12, 24.13, 24.14, 24.16			Sections 8, 10
For proposed expansions or modifications, distinguish potential impacts from those of the existing project, and include the likely contribution of the proposed expansion to potential cumulative impacts.	23.5, 23.5.2, 24.3.9, 24.4.4, 24.7, 24.7.1, 24.7.1.2, 24.7.4, 24.11, 24.11.2, 24.11.4, 24.11.5, 24.11.6, 24.12.6, 24.13.5, 24.14.5, 24.14.5.6			Section 8, 10
Assess the significance of each impact with reference to the range of system behaviour found under pre-development conditions and natural environmental and climatic variability.	24.12, 24.13, 24.14, 24.16			Sections 8, 10
Environmental impact assessment – Risk-based assessment				
Identify and assess all potential environmental risks to water resources and water-related assets, and their possible impacts. In selecting a risk-assessment approach, consideration should be given to the complexity of the project and the probability and potential consequences of the project's impacts.	23.9. 23.9.5, 23.9.7, 23.9.8 24.12, 24.13, 24.14, 24.15 24.16			Section 10
Describe the consultation with relevant stakeholders and regulators about the likely risks to water resources and water-related assets. This initial engagement should include agreement about the nature of the action, which assets (including water resources) may be impacted, and the likely sources of impacts and the receptors that may be affected.	23.8			Section 10
The risk assessment should include a systematic and evidence-based assessment of:	23.9. 23.9.5, 23.9.7, 23.9.8 24.12, 24.13, 24.14, 24.15 24.16			Section 10
• the sources of environmental impacts in the project area	23.9. 23.9.5, 23.9.7, 23.9.8 24.12, 24.13, 24.14, 24.15 24.16			Section 10

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
• the exposure pathways by which impacts may be transferred from these sources to water resources (receptors), presented as one or more impact pathway diagrams (IPDs) based on ecohydrological conceptualisation	23.9. 23.9.5, 23.9.7, 23.9.8 24.12, 24.13, 24.14, 24.15 24.16			Section 10
• the likely response of each receptor, especially when the impact(s) may be severe and likely to cause irreversible damage (posing a high risk)	23.9. 23.9.5, 23.9.7, 23.9.8 24.12, 24.13, 24.14, 24.15 24.16			Section 10
• 'hot spots', or areas in the project area (e.g., where vulnerable receptors occur close to impact sources) where risks are especially high	23.9. 23.9.5, 23.9.7, 23.9.8 24.12, 24.13, 24.14, 24.15 24.16			Section 10
• 'hot moments', or periods during and after the project (e.g., when activities are likely to generate major impact) when risks are especially high.	23.9. 23.9.5, 23.9.7, 23.9.8 24.12, 24.13, 24.14, 24.15 24.16			Section 10
Specify where and how each risk can be avoided or mitigated (or, as a last resort, requires appropriate offsets and/or a conservation payment), and:	23.9. 23.9.5, 23.9.7, 23.9.8 24.12, 24.13, 24.14, 24.15 24.16			Section 11
• provide evidence (preferably from equivalent activities and regions) for the feasibility and effectiveness of mitigation or offset methods	23.9. 23.9.5, 23.9.7, 23.9.8 24.12, 24.13, 24.14, 24.15 24.16			Section 11
• describe how monitoring will be able to demonstrate the effectiveness of the mitigation measures.	24.12, 24.12.10, 24.12.11, 24.13, 24.14, 24.15, 24.15.3, 24.15.4.4, 24.15.4.6, 24.16			Section 11

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Describe the risks of potential cumulative impacts of all past, present and reasonably foreseeable actions and activities that are likely to impact on water resources, including from multiple stressors arising from the proposed action.	23.5, 23.5.2, 24.3.9, 24.4.4, 24.7, 24.7.1, 24.7.1.2, 24.7.4, 24.11, 24.11.2, 24.11.4, 24.11.5, 24.11.6, 24.12.6, 24.13.5, 24.14.5, 24.14.5.6, 24.16			Sections 8, 10
Specify all sources of uncertainty in the assessments of each risk and describe how information has been and will be collected to reduce this uncertainty.	23.2.5, 24.7, 24.7.3, 24.7.4, 24.8, 24.9, 24.11, 24.11.2, 24.11.9, 24.11.10			Sections 8, 9
Investigate relevant context for the risk assessment, such as bioregional assessments, Commonwealth and state water resource plans (e.g., Murray–Darling Basin Plan, Hunter River Salinity Trading Scheme) and state processes such as those that apply in the Surat Cumulative Management Area and the Commonwealth's Joint Industry Framework on Coal Seam Gas.	24.16, 24.16.1, 24.16.2, 24.16.3, 24.16.4			Section 2
Assess residual risks remaining after the implementation of the proposed mitigation and management options, to determine whether these effectively reduce risks to an acceptable level based on the identified environmental objectives.	24.12, 24.13, 24.14, 24.15 24.16			Section 10, 11
Environmental impact assessment – Modelling of water storage and movement				
Incorporate causal mechanisms and pathways identified in the risk assessment (e.g., IPDs) in conceptual and numerical modelling. Use the results of these models to update the risk assessment.	23.9. 23.9.5, 23.9.7, 23.9.8 24.6, 24.6.3, 24.6.3.8, 24.7, 24.7.3, 24.7.4, 24.8, 24.9, 24.10, 24.11, 24.11.1, 24.11.2, 24.11.4, 24.11.5, 24.11.6, 24.11.8, 24.16			Sections 8, 10

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Provide a detailed description of all analytical, numerical and conceptual models used, and any methods and evidence (e.g., expert opinion, analogue sites) employed in addition to modelling.	23.9. 23.9.5, 23.9.7, 23.9.8 24.6, 24.6.3, 24.6.3.8, 24.7, 24.7.3, 24.7.4, 24.8, 24.9, 24.10, 24.11, 24.11.1, 24.11.2	Section 6 Section 8	Section 5, Appendix A, Appendix B	Section 7
Explain the conceptualisation of the system(s), including multiple conceptual models if appropriate. Describe the data and information, including field data, on which the models are based; all key assumptions; and model limitations and their consequences.	23.9. 23.9.5, 23.9.7, 23.9.8 24.6, 24.6.3, 24.6.3.8, 24.11, 24.11.1	Section 4 Section 6 Section 8	Appendix A, Appendix B	Section 6,7
Calibrated models require adequate monitoring data from either the project area or sites representative of local conditions, ideally with calibration targets related to model predictions. Summarise the extent to which parameterisation is consistent with expectations based on literature values, outcomes of field or laboratory investigations, or with values obtained by calibration in similar nearby applications.	23.9. 23.9.5, 23.9.7, 23.9.8 24.7, 24.7.3, 24.8, 24.8.3, 24.11, 24.11.2	Section 6	Appendix A, Appendix B	Section 7
Where possible, verify models by using past and/or existing site monitoring data that were not used for calibration.	23.9. 23.9.5, 23.9.7, 23.9.8 24.8, 24.8.3, 24.11, 24.11.2		Appendix A	Section 7
Assess the quality of, and risks and uncertainty inherent in, the data used to establish baseline conditions and in modelling, particularly with respect to predicted potential impact scenarios. Identify key gaps in data and knowledge and describe how they can be addressed.	23.9. 23.9.5, 23.9.7, 23.9.8 24.7, 24.7.3, 24.8, 24.8.3, 24.11, 24.11.2	Section 6 Section 7.5	Appendix A, Appendix B	Sections 7, 8, 9
Describe the various stages of the proposed project (construction, operation and rehabilitation) and their incorporation into the model. Provide predictions of changes and recovery in each water resource for the life of the project and beyond, including an assessment of the impacts of climate change where applicable, and cumulative impacts.	23.5, 23.9. 23.9.5, 23.9.7, 23.9.8 24.7, 24.7.3, 24.8, 24.8.3, 24.11, 24.11.2, 24.7.4.14, 24.8.12, 24.11.11	Section 4.4 Section 6 Section 7.4 Section 8.4	Section 4, Section 5.6, Section 7.5	Sections 7, 8
Provide a program for reviewing and updating models as more data and information become available, including reporting requirements.	24.7.4.15, 24.15.3, 24.15.3.9	Section 7.5		Section 7

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Environmental impact assessment – Groundwater				
Undertake groundwater modelling in accordance with the Australian groundwater modelling guidelines (Barnett et al. 2012), including independent peer review.	24.2.1, 24.11.2, 24.11.3			Section 7
Describe each hydrogeological unit as incorporated in the groundwater model, including the thickness, storage and hydraulic characteristics, and hydraulic linkages between units, if any.	24.5			Section 7
Describe the existing recharge/discharge pathways of the units and the changes that are predicted to occur upon commencement, throughout, and after completion of the proposed project.	24.5, 24.11.4, 24.11.5, 24.11.6, 24.11.7, 24.11.8			Section 5.5
Select and justify appropriate boundary conditions across the model domain to enable a comparison of groundwater model outputs to seasonal field observations.	24.11.2, 24.11.3			Section 7, Appendix H and Appendix I
Where possible, calibration should incorporate measurements of both potentiometric head (or pressure) and flux, such as measured mine inflows or measured discharges to streams or springs.	24.11.2, 24.11.3			Section 7, 8
Undertake sensitivity analysis of boundary conditions and hydraulic and storage parameters, and justify the conditions applied in the final groundwater model. Where the interaction between surface water and groundwater is important, parameters describing their connectivity, such as riverbed conductance, should be assessed.	24.11.2, 24.11.9, 24.11.10			Section 9
Assess the potential impacts of the proposal, including how impacts are predicted to change over time and any residual long-term impacts. Consider and describe:	24.11, 24.11.2, 24.11.4, 24.11.5, 24.11.6, 24.11.7, 24.11.8, 24.14			Section 8, 10
• any hydrogeological units that will be directly or indirectly dewatered or depressurised (including lateral effects), interactions between water resources (inter-aquifer connectivity), and connectivity with sea water	24.11, 24.11.2, 24.11.4, 24.11.5, 24.11.6, 24.11.7, 24.11.8, 24.14			Section 8, 10

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
• the magnitude, extent and change over time of drawdown/mounding, including the time for post-development equilibrium to be reached	24.11, 24.11.2, 24.11.4, 24.11.5, 24.11.6, 24.11.7, 24.11.8, 24.14			Section 8, 10
• the extent of impacts on surface water/groundwater connectivity, water-dependent assets, flow direction and surface topography, including resultant impacts on the groundwater balance	24.11, 24.11.2, 24.11.4, 24.11.5, 24.11.6, 24.11.7, 24.11.8, 24.14, 24.14.2			Section 8, 10
• the potential range of drawdown at each affected bore, and clearly articulate the spatial and temporal scales of impacts on other water users	24.11, 24.11.2, 24.11.4, 24.11.7, 24.14, 24.14.1			Section 8, 10
• the potential impacts on hydraulic and storage properties of hydrogeological units, including changes in storage, potential for physical transmission of water within and between units, and estimates of likelihood of leakage of contaminants through hydrogeological units	24.11, 24.11.2, 24.11.4, 24.11.5, 24.11.6, 24.11.7, 24.11.8, 24.14, 24.14.2, 24.14.3, 24.14.4			Section 10
• the possible fracturing of and other damage to confining layers.	24.11, 24.11.2			Section 10
Undertake an uncertainty analysis of key predictive outputs (i.e., quantities of interest as per Peeters and Middlemis 2023).	24.2.1, 24.11.2, 24.11.3			Section 9
For each relevant hydrogeological unit, describe the proportional increase in groundwater use and impacts as a consequence of the proposed project, including an assessment of any consequential increase in demand for groundwater from towns or other industries resulting from associated population or economic growth due to the proposal.	24.11.2, 24.11.5, 24.12.4			Section 10
Environmental impact assessment – Surface water				

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
For flood estimation, use methods in accordance with the most recent publication of *Australian rainfall and runoff* (Ball et al. 2019); for rainfall-runoff modelling, use methods as outlined by Vaze et al. (2012); and for the modelling of water and salt balances related to mine water management, refer to the water accounting framework (Minerals Council of Australia 2022). Consider the relevance of regional information (see Nathan and McMahon 2017). It is expected that flood risks are assessed for annual exceedance probabilities of at least 1% (i.e., 1 in 100); however, in many instances it may be necessary to estimate floods with rarer annual exceedance probabilities, such as 0.1% (i.e., 1 in 1,000), or events which have a negligible chance of being exceeded (the probable maximum flood).	24.8, 24.8.3		Section 5, Appendix A	
Describe all potential impacts of the proposed project on surface waters. Include a clear description of the impact on the resource and the likelihood and consequences of the impact. Consider:	24.7.4, 24.8, 24.9, 24.10, 24.12, 24.13, 24.16	Section 7 Section 8 Section 9	Section 5, Section 7	
• impacts on streamflow under the full range of flow conditions, focusing on metrics that are most relevant to ecologically important flow components (e.g., the timing, frequency and variability of zero- and low-flow days, low flows exceeded 90% of the time, flow pulses related to ecological processes such as spawning and migration) as well as those relevant to water supply reliability	24.8, 24.9, 24.10, 24.12, 24.12.3, 24.13, 24.16	Section 7 Section 8 Section 9	Section 5, Section 7	
• impacts associated with surface water diversions	24.8, 24.9, 24.10, 24.13.4, 24.13.4.4	Section 7 Section 8 Section 9	Section 5, Section 7	
• impacts on water quality, including consideration of mixing zones (i.e., areas downstream of discharges where water quality objectives do not apply) if applicable	24.7.4, 24.7.4.6, 24.7.4.7, 24.7.4.8, 24.12, 24.12.2, 24.12.5	Section 7 Section 8 Section 9	Section 5, Section 7	

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
• the quality, quantity and ecotoxicological effects of operational and emergency discharges of water (including saline water) at different flows, and the likely impacts on water resources and water-dependent assets	24.7.4, 24.7.4.6, 24.7.4.7, 24.7.4.8, 24.12, 24.12.2, 24.12.5, 24.14.5, 24.14.5.4, 24.14.5.5	Section 7 Section 8 Section 9	Section 5, Section 7	
• landscape modifications such as subsidence, voids, post-rehabilitation landform collapses and on-site earthworks (including disturbance of acid-forming or sodic soils, roadway and pipeline networks), and describe how these could affect surface water flow, surface water quality, erosion and sedimentation within and downstream of the project area.	23.9. 23.9.5, 23.9.7, 23.9.8 23.6.4, 23.7, 24.8, 24.8.10, 24.8.11, 24.9, 24.9.3, 24.9.3.3, 24.9.4, 24.9.4.3, 24.12, 24.12.3	Section 7 Section 8 Section 9	Section 5, Section 7	
Identify processes to determine surface water quality guidelines and quantity thresholds which incorporate seasonal variation but provide early indication of potential impacts on assets.	24.3, 24.3.2, 24.3.6, 24.7.3, 24.7.4, 24.12, 24.12.2, 24.12.10	Section 2 Section 9.10		
Assess the risks of flooding (including channel form and stability, water level, depth, extent, velocity, shear stress and stream power) and the impacts of flooding on water-dependent assets, project infrastructure and the final project landform.	24.8, 24.9, 24.10, 24.13		Section 5, Section 7	
Identify and evaluate the quality (including uncertainty) and other aspects of streamflow and other hydrological data, such as proximity to rainfall stations and stream gauges, duration of data records, and whether missing data have been patched.	24.3, 24.3.5, 24.8, 24.8.3	Section 3.4 Section 3.7	Section 2, Section 5	
Develop and describe a plan for ongoing ecotoxicological monitoring, including direct toxicity assessment of discharges to surface waters where appropriate.	24.12.10, 24.12.11			
Environmental impact assessment – Ecology				
Assess direct and indirect impacts of the proposed project (e.g., landscape modifications such as voids, on-site earthworks, roads, pipelines and stream-channel diversions, mine dewatering, operational releases of water affected by mining or CSG activities) on water-dependent ecological assets such as flora and fauna dependent on surface water and groundwater, including springs and other GDEs.	24.14, 24.14.5, 24.14.6, 25.7.3, 25.10			

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Using suitable IPDs based on an initial ecohydrological conceptualisation, describe the likely cause–effect mechanism(s) from impact sources to each receptor. Consider:	24.6.3, 24.6.3.8, 24.11.1, 25.7.3, 25.10			Sections 6, 10.1
• direct and indirect impacts on aquatic and water-dependent terrestrial populations, species and communities, including those whose water dependence may not yet be demonstrated (e.g., terrestrial GDEs)	24.14, 24.14.5, 24.14.6, 25.7.3, 25.10			Sections 6, 10.1
• how predicted alterations of the hydrological regime (especially ecologically relevant components such as durations, timing and frequency of periods when no surface water is present; and timing and duration of overbank flooding) in standing and flowing waters might affect each water-dependent ecological asset in and near the project area at a range of temporal scales (e.g., seasonal, annual, decadal)	24.14, 24.14.5, 24.14.6, 25.7.3, 25.10			Sections 6, 10.1
• how predicted alterations of water quality (including water temperature and salinity) might affect each water-dependent ecological asset in and near the project area at a range of temporal scales (e.g., seasonal, annual, decadal)	24.14, 24.14.5, 24.14.6, 25.7.3, 25.10			Sections 6, 10.1
• how interactions of predicted alterations of quantities and quality of surface water and/or groundwater might affect each water-dependent ecological asset in and near the project area at a range of temporal scales (e.g., seasonal, annual, decadal)	24.14, 24.14.5, 24.14.6, 25.7.3, 25.10			Sections 6, 10.1
• the likely cumulative impacts of the proposed development with those of pre-existing water-intensive activities and other drivers such as climate change.	24.14, 24.14.5, 24.14.6, 25.7.3, 25.10			Sections 6, 10.1
For ecological risk-based assessment, evaluate the likelihood and consequences of the impacts and their pathways based on the impact assessment and IPDs (outlined above), particularly for highly valued receptors and in 'hot spots' where impacts are especially likely. Consider that some impacts may be especially likely during particular phases of the proposed development, and describe these 'hot moments' and their associated risks to water-dependent ecological assets.	24.14, 24.14.5, 24.14.6, 24.16			Sections 6, 10.1

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Environmental impact assessment – Water and salt balances				
Describe the proposed development's water requirements and on-site water management infrastructure, including modelling to demonstrate the infrastructure's adequacy under a range of potential climatic conditions, including extremes associated with predicted climate change.	24.7, 24.7.3, 24.7.4	Section 4 Section 6 Section 7	Section 4, Section 5	
Provide salt balance modelling that includes stores and the movement of salt between stores, and takes into account seasonal and long-term variation.	24.7, 24.7.3, 24.7.4, 24.12.2	Section 7.3.10 Section 8 Section 9.6		
Indicate the vulnerability to contamination (e.g., from salt production and salinity) of, and the likely impacts of contamination on, the identified water-dependent ecological assets.	24.7, 24.7.3, 24.7.4, 24.12.2, 24.12.5, 24.14.5, 24.14.6, 25.10, 25.10.5, 25.10.8	Section 9.6		
Identify how produced water, brine and waste from water treatment plants that are stored on site during operations will be managed and disposed of after operations cease, where applicable.	23.9, 23.9.4, 23.9.11	Section 4.11		
Provide a quantitative site-level water balance model describing the total water supply and demand under a range of rainfall conditions and allocations of water for mining activities (e.g., dust suppression, coal washing), including all sources and uses.	24.7, 24.7.3, 24.7.4	Section 6, Section 7		
Provide estimates of the quality and quantities of operational discharges under dry, median and wet conditions, potential emergency discharges due to unusual events, and the likely impacts on water-dependent ecological assets.	24.7, 24.7.3, 24.7.4, 24.12.2, 24.12.5, 24.14.5, 24.14.6	Section 7.3.4, Section 7.3.5, Section 9.6		
Environmental impact assessment – Geochemistry (e.g., acid-sulfate soils)				
Identify the presence and potential exposure of acid-sulfate soils (including from oxidation arising during groundwater drawdown) and other geochemical sources of contaminants and extreme pH.	23.8.4, 23.8.5, 23.9.7			

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Identify the presence and volume of potentially acid-forming waste rock and fine-grained amorphous sulfide minerals and describe coal reject/tailings material and potential exposure pathways.	23.8.4, 23.8.5, 23.9.7			
Identify other sources of contaminants, such as high metal concentrations in groundwater, leachate generation potential and seepage paths. Where identified, quantify potential contaminants in coal rejects and leachate with appropriate testing methods.	23.8.4, 23.8.5, 23.9.7, 24.14.3			
Assess the potential impacts on and risks to water-dependent ecological assets, taking into account dilution factors and including solute transport modelling where relevant; representative and statistically valid sampling; and appropriate analytical techniques.	23.8.4, 23.8.5, 23.9.7, 24.14.3			
Describe proposed measures to avoid or mitigate risks of impacts on water resources, water users and water-dependent ecosystems and species, and provide evidence for the likely feasibility and effectiveness of these measures. Specify handling and storage plans for acid-forming materials (e.g., co-disposal, tailings dam, encapsulation) to reduce their risks to water-dependent ecological assets.	23.5.2, 23.7.6, 23.8.4, 23.8.5, 23.9.7, 24.14.3			
Environmental impact assessment – Subsidence. Not applicable, the Project is not an underground mine and does not involve activities that result in subsidence, see Section 23.5.16.				
Environmental impact assessment – Chemicals (CSG). Not applicable, the Project is not a CSG activity, see Section 23.5.16.				
Environmental impact assessment – Drilling and hydraulic stimulation. Not applicable, the Project is not a CSG activity, see Section 23.5.16.				
Environmental impact assessment – Closure, rehabilitation and post-development final landforms and voids				
Describe the timing and processes planned for cessation of operations and the closure of the development, particularly any risks of impacts on water-dependent assets that may arise during this phase (e.g., when dismantling and removing infrastructure). Explain how such risks will be avoided or mitigated.	23.9, 24.14.5			

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
If appropriate, qualitatively describe the various final landform options that were considered and their likely legacy impacts on water resources. This context will be useful for justifying the choice of the proposed final landform and how it avoids or mitigates risks of legacy impacts on water resources.	23.9, 23.9.2, 23.9.3, 23.9.5, 23.9.6, 23.9.7, 23.9.8	Section 8	Section 5	Section 8
Ideally, describe how land disturbed by mining activities will be progressively rehabilitated to a safe and stable landform that does not cause environmental harm to water resources and is able to sustain one or more approved post-mining land uses (PMLUs). Give details of the consultation with regulators and the community about the intended PMLUs, the targets associated with their achievement, and how achievement of these targets may be hampered by, for example, site geology and climatic extremes.	23.9, 23.9.9, 23.9.10, 23.9.11			
If requested by regulators, specify and justify the methods and techniques that will be used to achieve particular rehabilitation targets and milestones. Explain how these methods may be constrained by project-specific features (e.g., topography, climate, geology and hydrology).	23.9, 23.9.11			
If appropriate, describe how the effectiveness of the proposed rehabilitation methods and techniques for protecting or restoring water resources will be monitored, and present details (e.g., parameters, sampling frequency) of a monitoring program for demonstrating successful achievement of the targeted PMLUs across the project area after mining or CSG extraction has finished. These monitoring programs should be linked to explicit milestones for completion of progressive stages of rehabilitation, and should include appropriate baseline data against which to judge the effectiveness of the rehabilitation.	23.9, 23.9.11			
Describe the final landform and any voids that may remain after closure, and specify the predicted legacy impacts that may persist, such as ongoing effects on surface water and groundwater movements and water quality, erosion and sedimentation, and habitat fragmentation of water-dependent species and communities. Evaluate the adequacy of the modelling underlying these predictions, especially all sources of uncertainty.	23.9, 23.9.2, 23.9.5, 23.9.7, 23.9.8 24.11.2, 24.11.4, 24.11.5 24.11.6, 24.11.8, 24.12.3, 24.13.2, 24.13.3, 24.13.4, 24.13.7, 24.14.3	Sections 8, 10	Sections 5, 7	Sections 7, 8, 10

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Assess qualitatively the likely long-term risks of impacts on water resources and water-dependent assets posed by various options for the final landform design, including complete or partial backfilling of mining voids. Assessment of the final landform for which approval is being sought should consider:	23.9, 23.9.2, 23.9.5			
• stability (e.g., resistance to erosion and slumping), soil geochemistry and quality (relevant for post-closure establishment of vegetation) and the likely effects of the final landform on long-term surface water and groundwater behaviour (e.g., fluxes and runoff) and on water quality, including salinity, pH, toxicity and concentrations of contaminants	23.8.4, 23.8.5, 23.9, 23.9.6, 23.9.7, 23.9.11, 24.12, 24.12.3, 24.13, 24.13.3, 24.13.7, 24.14, 24.14.3,, 24.11.2, 24.11.4, 24.11.5, 24.11.6, 24.11.8	Sections 8, 10	Sections 5, 7	Sections 7, 8, 10
• geochemistry and its potential effects on seepage through waste rock (e.g., fully or partially refilled voids, remnant rock dumps) and on the quality of water exiting from mine adits and other post-closure sources	23.8.5, 23.9, 23.9.7			
• groundwater behaviour and rate and depths of water table recovery, including timeframe and final levels of stabilisation	24.11.2, 24.11.4, 24.11.5 24.11.6, 24.11.8			Sections 7, 8, 10
• available measures (and their likely effectiveness and feasibility) to avoid or mitigate legacy impacts from the final landform and any voids on water resources and water-dependent assets.	24.12.10, 24.12.11, 24.13.7, 24.15, 24.15.3, 24.15.4			
Baseline data				
For groundwaters, surface waters and ecological water-dependent assets that have been identified in the risk-based assessment, present data that are sufficient to establish pre-development (baseline) conditions and that have been collected at an appropriate sampling frequency and spatial coverage of monitoring sites, ideally over a period sufficiently long to characterise the impacts of climatic variability.	24.3, 24.4, 24.5, 24.6	Section 3.4, Section 3.7	Section 2	Section 5, 11
Baseline data - Groundwater				

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Provide data from surveyed boreholes to demonstrate the varying depths of the hydrogeological units and associated standing water levels or potentiometric heads, including directions of groundwater flow, contour maps and hydrographs.	24.5			Section 5.2
Present information from site-specific studies (e.g., geophysical, coring/wireline logging) to characterise the local stress regime and fault structure (e.g., damage zone size, open/closed along fault plane, presence of clay/shale smear, fault jogs or splays).	24.4.1, 24.4.1.5, 24.5, 24.5.3			Section 1.4 Section 4
Provide site-specific values for hydraulic parameters (e.g., vertical and horizontal hydraulic conductivity and specific yield or specific storage characteristics, including the data from which these parameters were derived) for each relevant hydrogeological unit. In situ observations of these parameters should be sufficient to characterise the heterogeneity of these properties for modelling.	24.4.1, 24.5, 24.5.3, 24.11.2			Section 5.3
Provide hydrochemical characterisation (e.g., acidity/alkalinity, electrical conductivity, metals and major ions) and a suitable suite of environmental tracers (e.g., heat; stable isotopes of water; tritium, helium, strontium isotopes) (e.g., Kurukulasuriya et al. 2022; OWS 2020) commensurate with the risks of the proposed development to water resources and water-dependent assets.	24.4, 24.4.1, 24.4.2, 24.5, 24.5.6, 24.6.3			Section 5.6
Provide sufficient data on physical aquifer parameters and hydrogeochemistry to establish pre-development conditions, including fluctuations in groundwater levels at time intervals relevant to aquifer processes. This should include time-series data for water levels and water quality that represent seasonal and climatic cycles.	24.5			Section 5.6
Provide long-term groundwater monitoring data, including a comprehensive assessment of all relevant chemical parameters to inform changes in groundwater quality and detect potential contamination events.	24.4.1, 24.5			Section 5
Baseline data – Surface water				
Provide data for the hydrological regime of all watercourses, standing waters and springs across the site, including:	24.3	Section 3.4, Section 3.7	Section 2	

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
• spatial, temporal and seasonal trends in streamflow and/or standing water levels	24.3	Section 3.4, Section 3.7	Section 2	
• spatial, temporal and seasonal trends in water quality data (such as turbidity, acidity, salinity, relevant organic chemicals, metals, metalloids and radionuclides).	24.3	Section 3.4, Section 3.7	Section 2	
Baseline data – Ecology				
Provide clear statements of the goals of the baseline data, specifying how the information will address knowledge gaps (e.g., current ecological condition of water-dependent assets in the project area, potential impact pathways) and justifying the choice of parameters and measures.	24.4, 24.4.2, 24.4.3, 24.6, 24.6.3, 24.6.4, 25.5, 25.6			Section 5.7
Describe and justify the sampling program (e.g., sampling frequency, locations of impact and control sites) and collection methods for gathering appropriate baseline data on all ecological water-dependent assets that have been identified in the risk-based assessment. The data and methods used may also help address information gaps in the IPDs and be used to monitor responses to predicted impacts of the development and the effectiveness of mitigation measures.	24.4, 24.4.2, 24.4.3, 24.6, 24.6.3, 24.6.4, 25.5, 25.6			Section 5.7
Ensure ecological sampling methods reflect best practice, are quantitative if needed, and comply with relevant state or national monitoring guidelines (e.g., Queensland Government (2015) for sampling stygofauna). Identify plants and animals (including stygofauna and aquatic invertebrates) to the lowest feasible taxonomic resolution to optimise the value of the baseline data. Where possible, make baseline data publicly available.	24.4, 24.4.2, 24.4.3, 24.6, 24.6.3, 24.6.4, 25.5, 25.6			Section 5.7
Identify potential aquatic and terrestrial GDEs, using the method outlined by Eamus et al. (2006) and information from the GDE Toolbox (Richardson et al. 2011), the GDE Atlas (CoA 2023) and the GDE Explanatory Note (Doody et al. 2019).	24.4, 24.4.2, 24.4.3, 24.6, 24.6.3, 24.6.4			Section 5.7
Present information on the distribution of potential aquatic and terrestrial GDEs within and near the project area, and explain how their groundwater dependence has been ground-truthed and on which hydrogeological units they are likely to depend (see Doody et al. 2019).	24.4, 24.4.2, 24.4.3, 24.6, 24.6.3, 24.6.4			Section 5.7

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Monitoring and management				
Describe the rationale for selected monitoring parameters and their sampling duration, frequency and methods, including the use of satellite or aerial imagery to identify and monitor large-scale impacts. Target monitoring programs to address key areas of uncertainty, especially for valued assets and water resources that are at greater risk of impacts from the proposed development.	24.12.8, 24.12.10, 24.12.11, 24.15.3, 24.15.4, 24.15.4.4, 24.15.4.6	Section 9.10		Section 11
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy guidelines (ANZG 2018) and relevant legislated state protocols (e.g., Queensland Government 2018).	24.12.10, 24.12.11, 24.15.3	Section 9.10		Section 5.6 and 11
Identify and justify monitoring sites representative of the diversity of potentially affected water-dependent assets and the nature and scale of potential impacts. Match suitably replicated control and reference sites (BACI design, Downes et al. 2002) to enable detection and monitoring of potential impacts.	24.15.3, 24.15.4, 24.15.4.4, 24.15.4.6	Section 9.10		Section 11
Describe the processes employed to determine impact thresholds for water-dependent assets (e.g., threshold at which a significant impact on an asset may occur).	24.15.4, 24.15.4.4, 24.15.4.6	Section 9.10		Section 11
Describe proposed mitigation and management actions, and their adequacy, for each significant impact identified, including any proposed mitigation or offset measures for long-term impacts post mining.	24.15.4, 24.15.4.4, 24.15.4.6	Section 4 Section 5 Section 9		Section 11
Identify modifications or alternatives to avoid, minimise or mitigate potential cumulative impacts, and provide evidence of the likely success of these measures (e.g., case studies).	24.12.6, 24.13.5, 24.14.5.6	Section 9 Section 9.9		Section 11
Propose adaptive management measures and management responses, giving details of trigger action response plans (TARPs) for valued assets and water resources that are at greater risk of impacts from the proposed development.	24.15.4, 24.15.4.4, 24.15.4.6	Section 4.1		Section 11
Monitoring and management - Groundwater				

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Describe a robust groundwater monitoring program using dedicated groundwater monitoring bores – including nested arrays where there may be connectivity between hydrogeological units – and targeting specific aquifers, providing information on the groundwater regime and on recharge and discharge processes and identifying changes in quantities and quality of groundwater over time.	24.15.3			Section 11
Where reinjection schemes are proposed to manage wastewater (e.g., managed aquifer recharge), the monitoring program should include components specifically targeted at identifying any potential impacts from this management action.	Not applicable			
Monitoring and management – Surface water				
Identify and justify dedicated sites to monitor hydrology, water quality, and channel and floodplain geomorphology before, during and for a suitable period after the proposed development.	24.10.7, 24.12.9, 24.12.10, 24.12.11	Section 9.10		
Describe a surface water monitoring program that will collect sufficient data to detect and identify the cause of any changes from established baseline conditions, and assess the effectiveness of mitigation and management measures. The program should:	24.12.10, 24.12.11	Section 9.10		
• include baseline monitoring data for physico-chemical parameters, as well as contaminants (e.g., metals)	24.12.10, 24.12.11	Section 9.10		
• compare physico-chemical data to national/regional guidelines or to site-specific guidelines derived from reference condition monitoring if available	24.12.10, 24.12.11	Section 9.10		
• identify baseline contaminant concentrations and compare these to national guidelines, allowing for local background correction (e.g., bioavailability) if required.	24.12.10, 24.12.11	Section 9.10		
Monitoring and management – Ecology				

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Provide clear statements of the goals of the monitoring program, specifying how the information will address knowledge gaps about, for example, changes in abundance, composition and condition of ecological water-dependent assets in and near the project area. Ensure that the monitoring program is powerful enough to detect relevant changes that indicate significant impacts or where management and mitigation measures are not working as predicted.	24.15.4, 24.15.4.4, 24.15.4.6, 25.10.6			
Describe and justify the monitoring program (e.g., sampling frequency, locations of impact and control sites) and collection methods for gathering appropriate monitoring data on all ecological water-dependent assets that have been identified in the risk-based assessment. Where possible, match the methods to those used in the baseline surveys so that the data are directly comparable and can be used to monitor responses to predicted impacts of the development and the effectiveness of mitigation measures.	24.15.4, 24.15.4.4, 24.15.4.6, 25.10.6			
Ensure that all proposed ecological monitoring uses standard sampling methods that reflect best practice and are quantitative if needed. Identify plants and animals (including stygofauna and aquatic invertebrates) to the lowest feasible taxonomic resolution to optimise the value of the monitoring data, and strive to make these data publicly available.	24.15.4, 24.15.4.4, 24.15.4.6, 25.10.6			
Describe how the monitoring data will be analysed and reported, specifying how the information will feed back into regular assessment of whether (and where) impacts are occurring and whether mitigation measures are being effective. Ensure that this information is explicitly linked to TARPs that guide adaptive management of impacts of the proposed development on ecological water-dependent assets in and near the project area during and for a suitable period after the proposed development.	24.15.4, 24.15.4.4, 24.15.4.6, 25.10.6			
Specify and justify all proposed management and mitigation measures to protect ecological water-dependent assets that were identified in the risk-based assessment. Present relevant evidence to demonstrate the likely effectiveness of these measures. Specify how the data to be collected in the monitoring program will illustrate the effectiveness of these management and mitigation measures, and present relevant TARPs describing this adaptive management.	24.15.4, 24.15.4.4, 24.15.4.6, 25.10.6			

IESC Requirement	EIS Section Reference	Appendix I (Surface Water)	Appendix J (Flooding)	Appendix K (Groundwater)
Cumulative impacts				
Assess the condition and likely responses of all water-dependent assets and water resources likely to be cumulatively impacted by the proposed development combined with all developments (past, present and/or reasonably foreseeable) and other water-intensive activities.	24.14.5, 24.14.5.6, 24.14.6	Section 9.9	Section 7.5	Section 10
Assess the cumulative impacts on potentially affected water-dependent assets and water resources, considering:	24.14.5, 24.14.5.6, 24.14.6	Section 9.9	Section 7.5	Section 10
• the full extent of potential impacts from the proposed project (including whether there are alternative options for infrastructure and mine configurations which could reduce impacts)	24.14.5, 24.14.5.6, 24.14.6	Section 9.9	Section 7.5	Section 10
• all stages of the development, including exploration, operations and post-closure/rehabilitation	24.14.5, 24.14.5.6, 24.14.6	Section 9.9	Section 7.5	Section 10
• the likely spatial magnitude and timeframe over which cumulative impacts will occur (ensuring that the analysis has sufficiently broad geographic and temporal boundaries to include all potentially significant impacts)	24.14.5, 24.14.5.6, 24.14.6	Section 9.9	Section 7.5	Section 10
• opportunities to work with other water users to avoid or mitigate potential cumulative impacts to meet specified environmental objectives.	24.14.5, 24.14.5.6, 24.14.6	Section 9.9	Section 7.5	Section 10

24.3 Environmental Values – Surface Water

24.3.1 Environmental Values under EPP Water

The watercourses and drainage features within and surrounding the Project area are the Isaac River, Cherwell Creek, Conrock Gully and JB Gully. Only the downstream portion of Conrock Gully is a defined watercourse under the Water Act.

The Isaac River and Conrock Gully are located within the Isaac and lower Connors River main channel region of the Isaac River Sub-Basin (WQ1301). Cherwell Creek and JB Gully are located within the Isaac western upland tributaries region of the Isaac River Sub-Basin.

The EVs under the EPP Water that are potentially relevant for watercourses and drainage features within and surrounding the Project area are:

- aquatic ecosystem protection (slightly to moderately disturbed ecosystems, QWQG 2009)
- visual recreation
- cultural and spiritual values.

It is unlikely that the following EVs under the EPP Water are relevant for watercourses and drainage features within and surrounding the Project area, due to the identified downstream uses of water, water quality or ephemeral nature of flows:

- irrigation, farm use and stock watering
- human consumption
- primary and secondary recreation
- drinking water
- industrial use.

The Project will not impact the marine environment, including seagrass beds and corals.

24.3.2 Water Quality Objectives

The indicators and water quality guidelines relevant to the EPP Water environmental values are listed in the QWQG and Australian Water Quality Guidelines. The conditions of waterways located in the vicinity of the Project are classified as slightly to moderately disturbed ecosystems under the QWQG.

The WQOs relevant to the identified EVs are provided in Table 24-2 and are generally based on the trigger values or default guideline values (DGVs) nominated in the QWQG and Australian Water Quality Guidelines. Where different EVs have different WQOs/DGVs, the lowest value has been adopted. WQOs/DGVs are displayed for physio-chemical parameters only.

A comparison of the WQOs against local streamflow water quality monitoring in the Isaac River has been undertaken to assess whether local site-specific trigger values (SSTVs) can be assigned to any water quality parameters. The outcomes of this assessment are presented in Section 3.7.2.4 of **Appendix I**.

Table 24-2 Water Quality Objectives, Isaac River Sub-basin

Parameter	WQO/DGV	Relevant EV
Ammonia N	< 720 µg/L	Aquatic ecosystem[a]
Oxidised N	< 60 µg/L	Aquatic ecosystem[b]
Organic N	< 420 µg/L	Aquatic ecosystem[b]
Total nitrogen	< 500 µg/L	Aquatic ecosystem[b]

Parameter	WQO/DGV	Relevant EV
Filterable Reactive Phosphorus (FRP)	< 20 µg/L	Aquatic ecosystem[b]
Total phosphorus	< 50 µg/L	Aquatic ecosystem[b]
Chlorophyll a	< 5 µg/L	Aquatic ecosystem[b]
Dissolved oxygen	85-110% saturation > 4 mg/L at surface	Aquatic ecosystem[b] Drinking water[c]
Turbidity	< 50 NTU	Aquatic ecosystem[b]
Suspended solids	< 55 mg/L	Aquatic ecosystem[b]
pH	pH 6.5-8.5	Aquatic ecosystem[b]
Conductivity (EC) baseflow	720 µS/cm	Aquatic ecosystem[b]
Conductivity (EC) high flow	250 µS/cm	Aquatic ecosystem[b]
Sulphate	250 mg/L 25 mg/L	Drinking water[c] Aquatic ecosystem[b]
Total Dissolved Solids	< 2000 mg/L	Stock watering[d]
Colour	50 Hazen Units	Drinking water[c]
Total Hardness	150 mg/L as CaCO3	Drinking water[c]
Sodium	< 188 mg/L	Based on 80th percentile for Isaac River at Goonyella gauge
Aluminium	< 5 mg/L < 55 µg/L	Stock watering[d] Aquatic ecosystem[a]
Antimony	< 9 µg/L	Aquatic ecosystem[h]
Arsenic	2.0 mg/L 0.5 mg/L up to 5 mg/L < 13 µg/L	Irrigation[g,e] Stock watering[f] Aquatic ecosystem[a]
Beryllium	< 0.5 mg/L	Irrigation[g]
Boron	< 5 mg/L < 940 µg/L	Stock watering[f,e] Aquatic ecosystem[a]
Cadmium	< 0.01 mg/L < 0.2 µg/L	Stock watering[f,e] Aquatic ecosystem[a]
Chromium	< 1 mg/L < 1 µg/L	Stock watering[f,e] Aquatic ecosystem[a]
Cobalt	< 0.1 mg/L < 1.4 µg/L	Irrigation[g] Aquatic ecosystem[h]
Copper	< 1 mg/L < 1.4 µg/L	Stock watering (cattle)[f,e] Aquatic ecosystem[i]
Fluoride	< 2 mg/L < 320 µg/L	Irrigation[g] Based on 80th percentile for Isaac River at Goonyella gauge
Iron	< 10 mg/L < 280 µg/L	Irrigation[g] Aquatic ecosystem[a]
Lead	< 0.1 mg/L < 3.4µg/L	Stock watering[f,e] Aquatic ecosystem[i]

Parameter	WQO/DGV	Relevant EV
Lithium	< 2.5 mg/L	Irrigation[g]
Manganese	< 10 mg/L < 1,900 µg/L	Irrigation[g] Aquatic ecosystem[a]
Mercury	< 0.002 mg/L < 0.2 µg/L	Irrigation[g] Aquatic ecosystem[i]
Molybdenum	< 0.05 mg/L < 34 µg/L	Irrigation[g] Aquatic ecosystem[h]
Nickel	< 1 mg/L < 11 µg/L	Stock watering[f,e] Aquatic ecosystem[a]
Selenium	< 0.02 mg/L < 5 µg/L	Stock watering[f,e] Aquatic ecosystem[i]
Silver	< 1 µg/L	Aquatic ecosystem[i]
Uranium	< 0.1 mg/L < 1 µg/L	Irrigation[g] Aquatic ecosystem[i]
Vanadium	< 0.5 mg/L < 10 µg/L	Irrigation[g] Aquatic ecosystem[i]
Zinc	< 5 mg/L < 8 µg/L	Irrigation[g] Aquatic ecosystem[a]
Nitrate	< 1.1 mg/L	Aquatic ecosystem[a], for soft water

a - Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018): trigger values for slightly-moderately disturbed systems (95% level of protection)
b - Table 2 of Isaac River Sub-Basin Environmental Values and Water Quality Objectives: Aquatic ecosystem – moderately disturbed
c - Table 4 of Isaac River Sub-Basin Environmental Values and Water Quality Objectives: Drinking water EV
d - Table 10 of Isaac River Sub-Basin Environmental Values and Water Quality Objectives: Stock watering EV: salinity
e - short-term trigger value
f - Table 11 of Isaac River Sub-Basin Environmental Values and Water Quality Objectives: Stock watering EV: heavy metals and metalloids
g - Table 9 of Isaac River Sub-Basin Environmental Values and Water Quality Objectives: Irrigation EV: heavy metals and metalloids
h - Section 8.3.7 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000): low reliability guideline
i - Based on Limit of Reporting (LOR) for ICPMS/CV FIMS analytical methods

24.3.3 Regional Drainage Network

The Project is located within the headwaters of the Isaac sub-catchment of the greater Fitzroy Basin. The Isaac River is the main watercourse in the vicinity of the Project area (the Project's mining lease application (MLA) areas), and flows in a north-west to south-east direction to the east of the Project.

The catchment commences at the Denham Range located about 98 km to the north of the Project. The Isaac River flows in a southwesterly direction through the Carborough and Kerlong Ranges before turning in a southeasterly direction near the Goonyella Riverside Mine. The Connors River, which has a catchment area similar to the upstream Isaac River, flows into the Isaac River approximately 120 km downstream of the Project. The Isaac River finally converges with the Mackenzie River a further 53 km downstream.

Ultimately, the Mackenzie River joins the Fitzroy River, which flows initially north and then east towards the east coast of Queensland and discharges into the Coral Sea southeast of Rockhampton near Port Alma. Port Alma is located approximately 450 km downstream of the Project. Figure 24-1 presents the regional

location of the Project in the Fitzroy Basin and Isaac-Connors sub-catchment. Figure 24-2 shows the upper Isaac River drainage including the Cherwell Creek and Conrock Gully catchments.

The catchment area of the Isaac River to downstream of the Cherwell Creek confluence and including the Project area is around 3,528 km^2. This represents around 2.5% of the overall Fitzroy River catchment and 15.8% of the Isaac-Connors sub-catchment.

The Project area is approximately 27 km^2, which represents 0.02% and 0.12% of the overall Fitzroy River and Isaac-Connors catchment areas, respectively.

The Isaac River is a seasonally flowing watercourse, typically with surface flows in the wetter months from November to April, reducing to shallow subsurface flows from about May to October. All other waterways in the vicinity of the Project are ephemeral and experience flow only after sustained or intense rainfall in the catchment. Stream flows are highly variable, with most channels drying out during winter to early spring when rainfall and runoff is historically low.

24.3.4 Local Drainage Network

The following ephemeral drainage systems (Figure 24-3) are located in the vicinity of the Project and are designated as watercourses under the Water Act:

- Isaac River – 2,759 km^2 catchment to the Project (upstream of the confluence with Conrock Gully).
- Cherwell Creek – 698 km^2 catchment to its confluence with the Isaac River.
- JB Gully – 26 km^2 catchment to its confluence with Cherwell Creek.
- Conrock Gully – 71 km^2 catchment to its confluence with the Isaac River.

The majority of Conrock Gully upstream and including the beginning of the proposed diversion is defined as a drainage feature under the Water Act. The 3.2 km downstream reach of Conrock Gully to its confluence with Isaac River is defined as a watercourse. There are several minor drainage lines in the vicinity of the Project that are designated as either drainage features or unmapped (Figure 24-3).

24.3.4.1 Isaac River

The Isaac River channel in the vicinity of the Project has an average bed width of 45 metres (m) varying between 33 m and 60 m (90% confidence limits) and is approximately 10 m deep. The bed slope and hydraulic gradient from Moranbah township to the Cherwell Creek confluence is very uniform at 0.08%. Under the Strahler ordering system, the Isaac River is a fifth order stream upstream of the Grosvenor Creek confluence, which is located 7.3 km upstream of the Project, and a sixth order stream downstream of the Grosvenor Creek confluence, including the reach that drains past the Project.

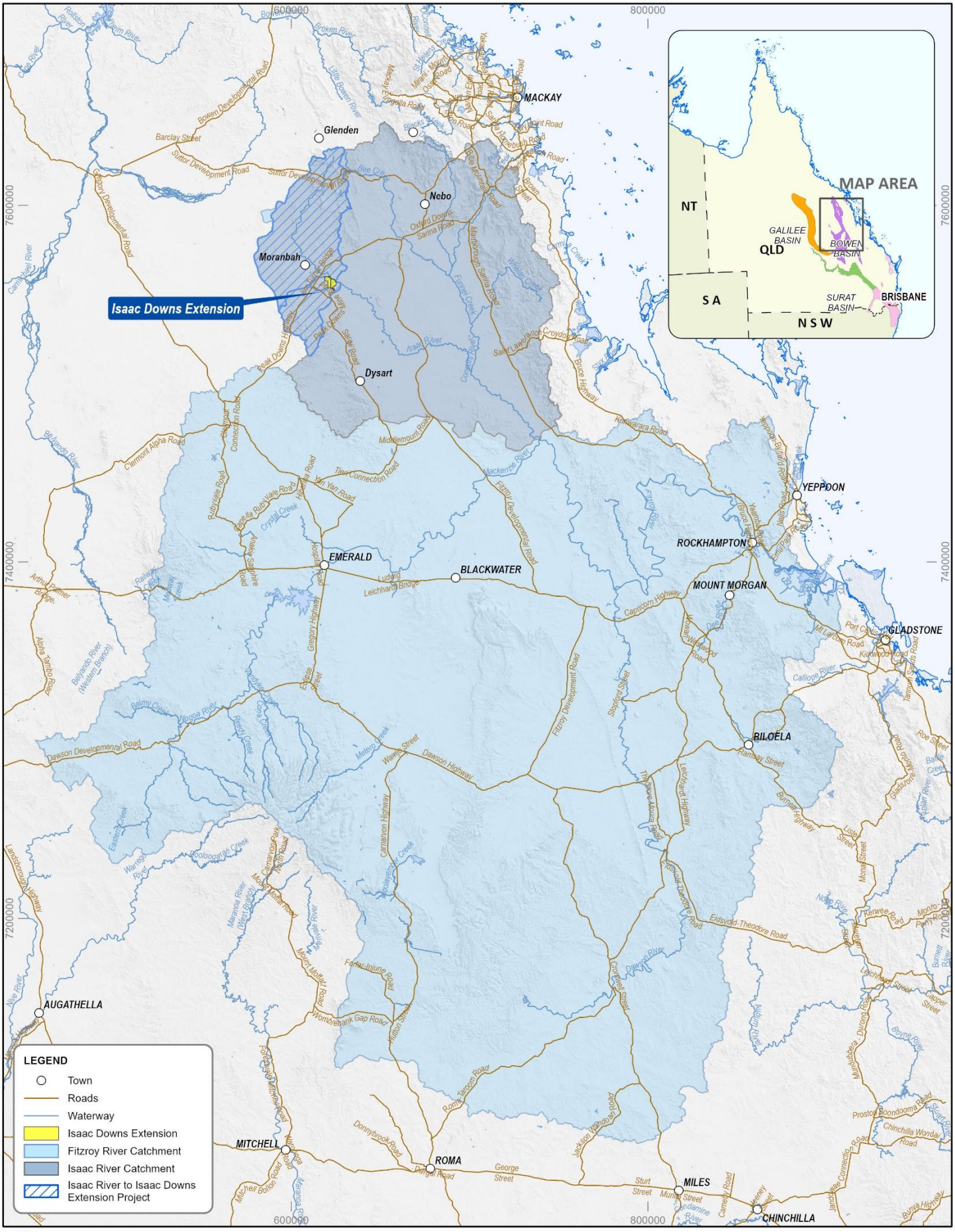
The bed of the river channel is characterised by extensive sand sheet deposits indicating it is sediment choked. Sand point bars are evident on the inside of bends and vegetated benches are located on one or both sides of the river along the straight sections. A number of well vegetated sand islands are located in the river channel indicating that some of the old benches have eroded forming channels either side of the old riverbank. SedNet modelling of the catchment undertaken by Dougall et al. (2006) indicated hillslope erosion to be a dominant input over gully and riverbank erosion. Total predicted sediment inputs range from 0.31 to 1.25 t/ha/annum.

The banks of the river consist of a sandy loam and have eroded to near vertical for a depth of 1 m to 2 m along much of its length and 1V:4H[6] to 1V:5H batters above this depth. The bank batters are well vegetated with established and mature trees, mostly eucalypts and casuarinas, and buffel grass understorey. The active benches consist of scattered trees and buffel grass with the overbank areas cleared for grazing.

[6] V = vertical, H = horizontal

As part of the Project works, a bridge will be constructed across the Isaac River, connecting the Project with the neighbouring IDM, as part of the integration of the Project into IPC. A temporary dragline crossing will also be constructed across the Isaac River. No diversion of the Isaac River is proposed.

Section 3.2.1.1 and Figure 3.2 of **Appendix I** provide a review of other geomorphic investigations of the Isaac River, and include photographs of the Isaac River channel, upstream, downstream and adjacent to the Project area, respectively.



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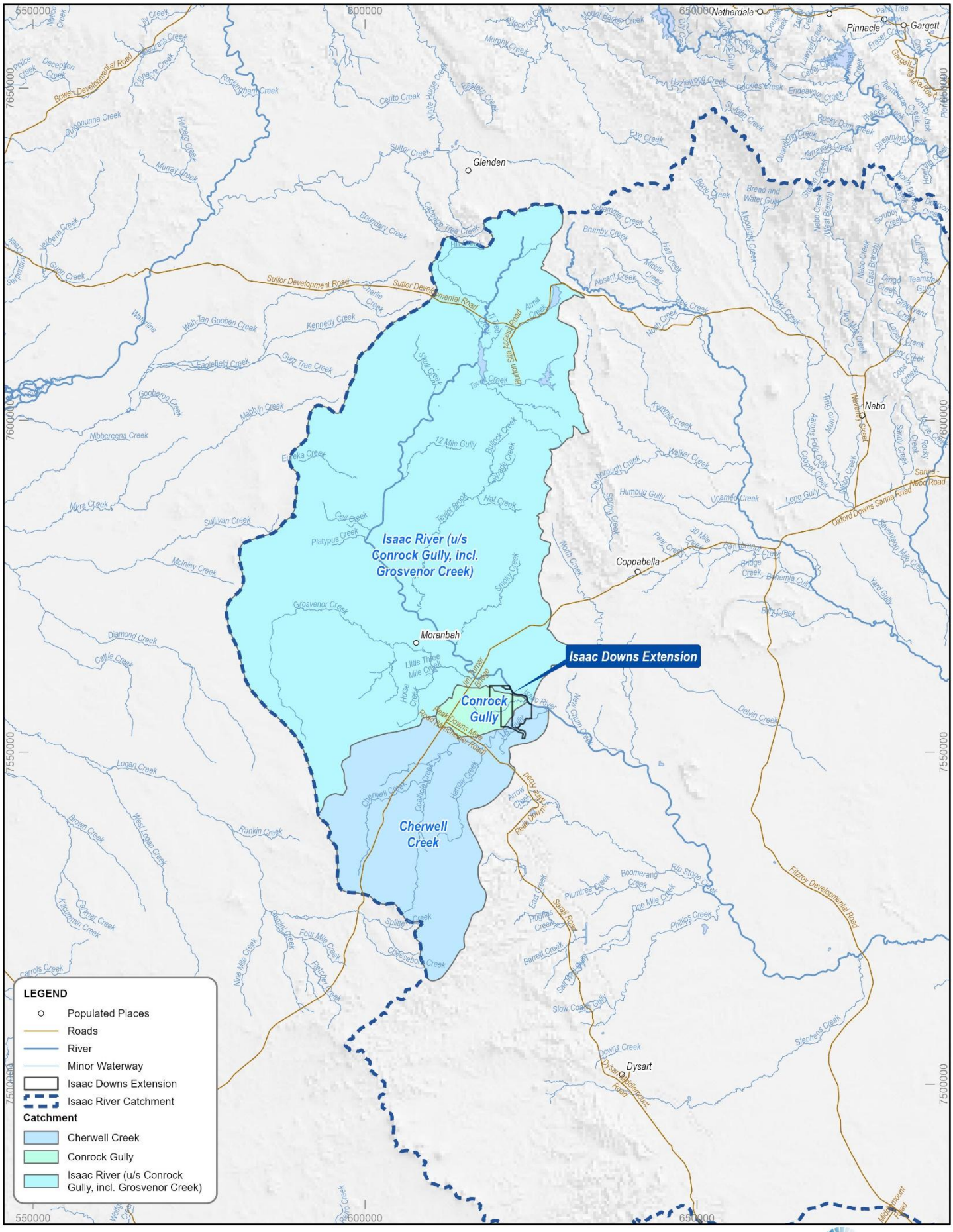
DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.

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ISAAC DOWNS EXTENSION

Regional Catchments and Watercourse

Figure | **24-1**



Datum:	GDA2020 Zone 55
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Source:	Hydrobalance
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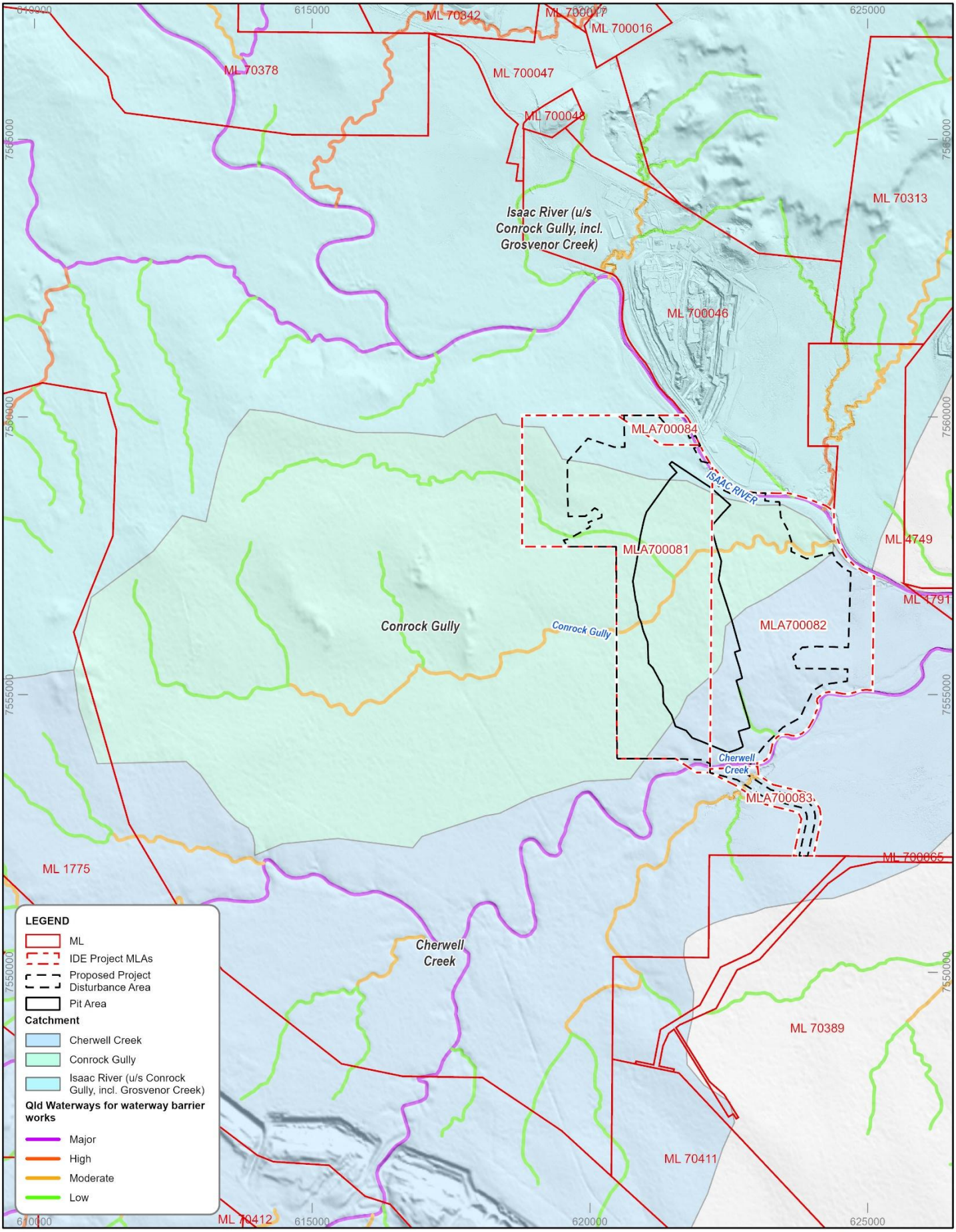
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ISAAC DOWNS EXTENSION

Upper Isaac River Drainage

Figure | **24-2**



Datum:	GDA2020 Zone 55
Scale:	See Scale Bar
Date:	14/04/2026 7:25 AM
Drawn:	Minserve
Source:	Minserve/Stanmore
File:	20260223 Local Catchments.aprx

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ISAAC DOWNS EXTENSION

Local Catchments and Watercourses

Figure | **24-3**

24.3.4.2 Cherwell Creek and JB Gully

Cherwell Creek, a tributary of the Isaac River, runs west to east to the south of the Project area. The Cherwell Creek catchment begins in the Cherwell Range and Denham Ranges at an elevation of 380 m, west of the Project area, and flows downstream to join the Isaac River at an elevation of 200 m, east of the Project area. Cherwell Creek is approximately 65 km long to the Isaac River junction with a catchment area of approximately 698 km^2. Cherwell Creek and its tributaries have clearly defined channels.

The dominant land use within the Cherwell Creek catchment is beef cattle grazing, with substantial clearing of vegetation having occurred over time to improve pastures and increase grazing area. The Peak Downs Mine is located in the middle reaches of Cherwell Creek, about 13 km upstream of the Project, and has approval for controlled releases to Cherwell Creek. The catchment is not in pristine condition and is susceptible to the impacts of these land use activities, such as increase runoff, scouring, erosion and unstable creek banks.

Cherwell Creek was diverted in 1991 and 1995 as part of the progression of Peak Downs Mine. Both diversions replaced meandering sections of creek floodplain, terraces, benches, low flow channel, active channel, and high flow channel features with a relatively straight alignment and trapezoidal channel. The designs were developed in accordance with best practice at the time, which preceded DNRME (2019) as the current best practice design guideline. Erosion of the Cherwell Creek diversions in the form of channel widening and deepening, and reduced functioning of stream stabilisation structures, have been observed in previous years.

Within and adjacent the Project area, the natural low flow channel width varies between 15 m to 25 m wide and the high flow channel top width varies between approximately 100 m to 200 m. The channels are generally deeply incised to a depth of 6 m to 10 m. The channel banks slopes are typically 1(V) in 2(H) and vegetated with native long grass and scattered trees. A number of minor anabranches form along the length of Cherwell Creek, particularly within the Isaac River floodplain. The riverbed comprises mainly silty sands.

Cherwell Creek also includes a second order tributary, JB Gully, that runs west to east to the south of the Project area. JB Gully is significantly smaller than Cherwell Creek, with a typical main channel bed width of 1 m to 2 m and a depth of 2 m. The high flow channel near the confluence with Cherwell Creek is relatively wide, around 200 m to 300 m, likely due to natural head cut from Cherwell Creek backwater flows.

The Project's planned secondary access route will cross Cherwell Creek, via a bridge, and JB Gully, via a bed-level crossing.

24.3.4.3 Conrock Gully

Conrock Gully has a catchment area of approximately 38 km^2 upstream of the proposed stream diversion, and approximately 71 km^2 to its confluence with the Isaac River.

The catchment extends west approximately 10 km from the western Project MLA boundary and east to the Isaac River confluence, at the east of the Project MLA boundary.

The Conrock Gully channel banks appear well vegetated and relatively stable. Digital elevation models acquired from 2012 to 2018 show no evidence of significant channel movement when compared to photographs taken in 2011.

A long section of the Conrock Gully channel bed in the vicinity of the Project area, approximately 6 km upstream from the confluence with the Isaac River, including the section that intersects the Project area, is shown in Figure 3.3 of **Appendix I**. The channel bed slope in this area is a uniform 0.14% (1 in 690), aside from a steeper downstream section at 0.48% (1 in 210) as Conrock Gully joins the Isaac River.

The Conrock Gully channel cross-section geometry can be typified by the generalised cross-section provided in Figure 3.4 of **Appendix I**, which was created from a statistical analysis of cross-section data collected from the topography within and surrounding the Project area. The median channel can be described as having a:

- base width of approximately 4 m
- side slope of 1V in 6H for the channel
- side slope of 1V in 30H on the channel overbank.

The channel is typically approximately 1.5 m to 3.5 m deep. At a depth of 2 m, the channel top width is typically approximately 50 m.

24.3.5 Streamflow

24.3.5.1 Isaac River at Deverill Stream Flow Gauge

The Isaac River at Deverill stream flow gauge (Deverill) is located 25 km downstream of Conrock Gully, and is operated by DNRMMRRD.

Figure 24-4 provides a ranked plot of the daily stream flows in the Isaac River recorded at Deverill. The following salient points are noted with respect to the recorded stream flows:

- The Isaac River is ephemeral with flows recorded only on 27% of days at Deverill. Flows above 100 megalitres per day (ML/d) occur for less than 10% of days at Deverill. A flow of 100 ML/d would not fully inundate the bed of the Isaac River at Deverill.
- The mean daily flow for all days is 430 ML/d at Deverill.
- The highest recorded flow, 2,638 cubic metres per second (m^3/s), at Deverill occurred in March 1988 where the river reached a gauge height of 11.4 m.

The downstream reach of Conrock Gully, including the proposed diversion, will be impacted by Isaac River flood flows. Hydraulic modelling presented in Section 24.8 and Section 24.9 indicates Isaac River flood flows will back up into Conrock Gully during a 50% annual exceedance probability (AEP) (1 in 2 year) regional flood event, which is equivalent to a 375 m^3/s (32 ML/d) peak discharge in the Isaac River at Deverill. Isaac River floodwaters are expected to back up into Conrock Gully for approximately 15% of total days or around 55% of Isaac River flow days.

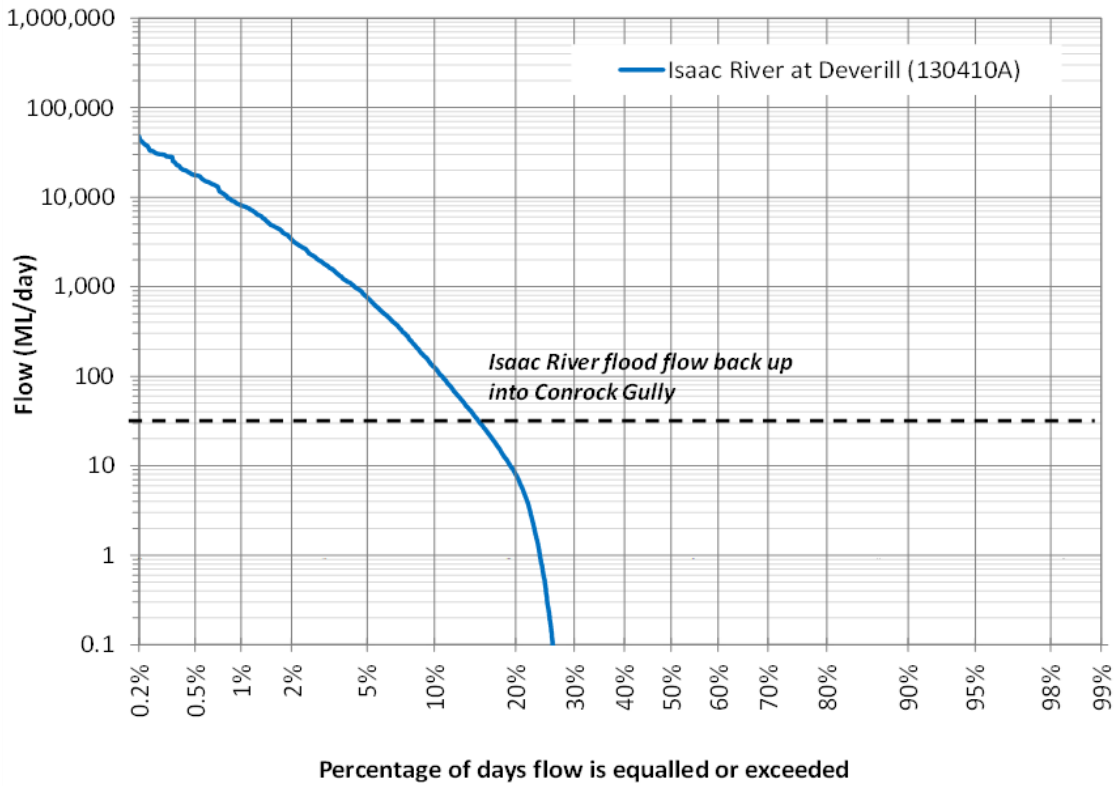


Figure 24-4 Stream Flow Duration Curves – Isaac River's Deverill Gauge

24.3.5.2 Isaac River at Stanmore Stream Flow Gauge

Stanmore has operated a stream flow gauge on the Isaac River in the vicinity of IDM since August 2021. The IDM stream flow gauge (gauge no. 333925) is located approximately 4.5 km upstream of the Conrock Gully confluence.

The recorded stream flows in the Isaac River at the IDM stream flow gauge are shown as water levels in Figure 3.8 of **Appendix I**. At the IDM stream flow gauge, Isaac River flows were recorded on approximately 6.6% of days over the four-year period of operation. Flows of greater than 100 ML/d occurred for less than 1.2% of days at this location over the four-year period of operation.

During April 2025, a maximum water level of around 6.292 m was recorded for the Isaac River at the IDM stream flow gauge, which corresponded to a flow of 1,028 m^3/s (approximately 88,819 ML/d).

24.3.5.3 Conrock Gully Stream Flows

There are no streamflow gauges on Conrock Gully, and as a result, there is no current or historical streamflow data for Conrock Gully.

Stanmore has operated a stream gauge on Billy's Gully at the nearby IDM since 2013 (gauge no. 332402). Billy's Gully has a similar catchment area (68 km^2) and general characteristics to Conrock Gully. Therefore, an analysis of the Billy's Gully streamflows was undertaken to represent the potential flows in Conrock Gully.

The recorded streamflows in Billy's Gully, along with recorded rainfall, is displayed in Figure 3.9 of **Appendix I**. At Billy's Gully streamflow gauge, flows were recorded on approximately 0.1% of days. During February 2016, a maximum water level was recorded at Billy's Gully of around 2.6 m at the gauge.

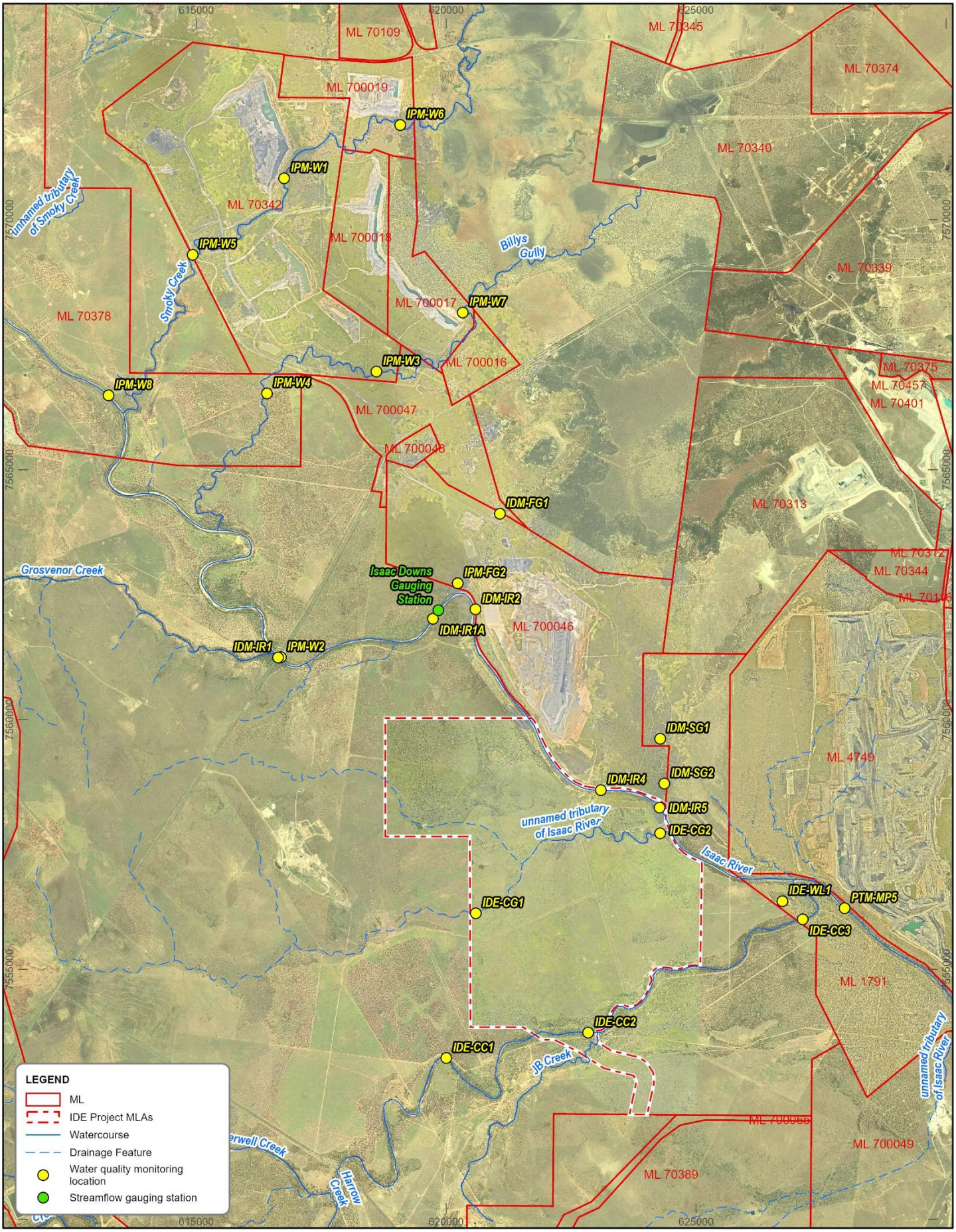
24.3.6 Water Quality

24.3.6.1 Monitoring Locations

Water quality monitoring results for the area surrounding the Project area are available from a number of gauging stations, in addition to the baseline monitoring that has been undertaken by Stanmore at the Project area and nearby IPC operations. Details on the water quality monitoring locations are summarised in Table 3.1 of **Appendix I** (including number of sampling events), and their locations are shown in Figure 24-5. These locations are associated with IPC (comprising IDM and IPM) and Poitrel Mine.

As IDM adjoins the Project, with the Isaac River located between IDM and the Project, monitoring sites along the Isaac River, associated with IDM, have also been used as the Project monitoring sites upstream, adjacent and downstream of the Project, to avoid unnecessary duplication of monitoring sites. Monitoring sites along Cherwell Creek (3 sites), Conrock Gully (2 sites) and a wetland (1 site) were established for the Project as there were no historical monitoring sites within and adjacent the Project area.

In combination these monitoring locations are representative of the surface water environment within and surrounding the Project area.



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Metres

Datum:	GDA2020 Zone 55
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File:	20260414 Water Quality Monitoring.aprx

DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.

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Local Water Quality Monitoring Locations

Figure | **24-5**

24.3.6.2 Regional Water Quality

Publicly available regional water quality data for the Isaac River at the Burton Gorge, Goonyella and Deverill gauging stations have been analysed and a comparison of 20th percentile, median and 80th percentile water quality at these sites to the WQOs/DGVs are displayed in Table 3.2 of **Appendix I**. These sites were selected because complete datasets (i.e. individual sample analysis results) are publicly available as opposed to only summary data being publicly available.

The Isaac River (Burton Gorge) and Isaac River (Goonyella) stations are no longer operating, having ceased operation in 1988 and 2021, respectively.

The Isaac River (Goonyella) and Isaac River (Deverill) stations are located downstream of several operating mines, and therefore, may potentially include releases from these mines. The Isaac River (Burton Gorge) and Isaac River (Goonyella) stations are about 78 km and 42 km upstream of the Project, respectively. The Isaac River (Deverill) station is located about 24 km downstream of the Project. These stations provide an indication of water quality and in particular metal toxicants in the Isaac River upstream and downstream of the Project.

The water quality data show that some readings at these monitoring locations are at or above the relevant WQO/DGV, including the following:

- dissolved aluminium at Goonyella and Deverill (80th percentile);
- dissolved copper at Goonyella and Deverill (median and 20th/80th percentile);
- EC at Goonyella (80th percentile) exceeds the high flow DGV;
- dissolved iron at Burton Gorge (median and 80th percentile) and Deverill (80th percentile);
- nitrate at Burton Gorge (median and 80th percentile) and Goonyella (median and 80th percentile) and Deverill (80th percentile);
- total sodium at Burton Gorge/Goonyella (median and 80th percentile) and Deverill (90th percentile);
- total suspended solids at all three sites (median and 80th percentile values);
- turbidity at Burton Gorge (median and 20th/80th percentile) and Goonyella (median and 80th percentile) and Deverill (80th percentile); and
- dissolved zinc at Goonyella/Deverill (median and 20th/80th percentile).

These results indicate that the current WQOs/DGVs may not necessarily reflect the typical background water quality within the upper Isaac River. It is acknowledged that some exceedances at the Goonyella and Deverill stations may potentially be associated with coincident water releases from upstream mining operations.

24.3.6.3 Local Water Quality

Taken as a whole, the water quality data from IPM, IDM and Project specific monitoring provides a comprehensive dataset of local water quality. Water quality sampling has been done in accordance with the Monitoring and Sampling Manual (DES, 2018).

Water quality data from IPM is shown in Table 3.3 to Table 3.5 of **Appendix I**. This includes 26 and 44 samples at each of the two Isaac River monitoring sites associated with IPM, which are upstream of the Project.

Water quality data from IDM is shown in Table 3.6 to Table 3.8 of **Appendix I** This dataset includes sites which form part of the Project's baseline water quality monitoring as they are shared with IDM. There are between 12 and 20 samples per monitoring site (5 sites) along the Isaac River. For the upstream and downstream sites for IDM (sites IR1 and IR4 with data from 2020 to 2025), the data shows:

- median EC values of 209 µS/cm and 307 µS/cm
- pH is slightly alkaline;

- median TSS values of 315 mg/L and 111 mg/L
- aluminium, copper, iron and sodium exceed the ANZG (2018) WQOs for multiple samples.

Project water quality data (where it is not already included in an IDM dataset) is shown in Table 3.9 and Table 3.10 of **Appendix I**. As flows in these local watercourses are ephemeral and access can be constrained for health and safety reasons, the number of samples over the study period for the Project is limited with around 3 – 5 samples per location. Certain baseline water quality values surrounding the Project do not meet the WQOs for the region, these include:

- electrical conductivity and sulphate
- turbidity and TSS
- sodium
- aluminium, copper, zinc and iron (dissolved)

In addition, water quality data from a monitoring site utilised for monitoring water quality upstream of Poitrel Mine, and which is downstream of the Project, had 10 sampling events.

A review of the Isaac River WQOs have been undertaken with reference to the Information Guidelines Explanatory Note - Deriving site-specific guideline values for physico-chemical parameters and toxicants (Huynh & Hobbs, 2019).

To establish local WQOs, the QWQG require that with 3 or more reference sites, 12 samples are collected over at least 12, but preferably 24 months. Stanmore has established 8 reference sites along the Isaac River between the IPM, IDM and Poitrel operations. These reference sites have been used to collect a large database of water quality sampling information along the local reach of the Isaac River, with up to 150 samples across the 8 sites, over the period 2016 to 2026. The majority of the samples (around 85%) have been collected in the last 5 years (since 2021).

Statistical analysis of this water quality data from these 8 sites is presented in Table 24-3 with a comparison to WQOs/DGVs, which shows the following:

- The 80th percentile value for dissolved aluminium (0.212 mg/L) is almost four time the WQO trigger value (0.055 mg/L).
- The 80th percentile value for dissolved copper (0.003 mg/L) is more than double the WQO trigger value (0.0014 mg/L).
- The 80th percentile value for turbidity (1,930 NTU) is significantly higher than the WQO trigger value (50 NTU).
- The 80th percentile value for total suspended solids (1,050 mg/L NTU) is significantly higher than the WQO trigger value (55 mg/L).

Based on this water quality data, the following site-specific trigger values are proposed based on the 80th percentile for Isaac River water quality where site specific values exceed the WQOs/DGVs:

- Dissolved aluminium – 0.212 mg/L
- Dissolved copper – 0.003 mg/L
- Total suspended solids (TSS) – 1,050 mg/L

There are no proposed changes for turbidity, as it is not typically included as a WQO in contemporary EAs, with TSS usually used in its place.

Site specific trigger values cannot be derived for Cherwell Creek and Conrock Gully as there is insufficient data to establish local WQOs in accordance with the QWQG. This is typical for the ephemeral watercourses and creeks in the region where many years of data may be required to capture sufficient information.

Table 24-3 Combined Isaac River Water Quality Data

Parameter	Units	Limit of Reporting	Combined Isaac River Sites				*WQO*
			No. Samples	20%ile value	Median	80%ile value	
pH (Lab)	-	0.01	158	7.36	7.57	7.80	*6.5-8.5*
Electrical Conductivity (Lab)	µS/cm	1	158	148	227	377	*250-720*
Sulfate as SO4 - Turbidimetric (filtered)	mg/L	1	152	3	7	14	*25*
TSS	mg/L	5	148	85	225	1,050	*55*
Turbidity	NTU	0.1	158	242	479	1,930	*50*
Aluminium (filtered)	mg/L	0.01	152	0.010	0.030	0.212	*0.055*
Arsenic (filtered)	mg/L	0.001	152	0.001	0.001	0.001	*0.013*
Boron (filtered)	mg/L	0.05	143	0.05	0.06	0.08	*0.94*
Cadmium (filtered)	mg/L	0.0001	152	0.0001	0.0001	0.0001	*0.0002*
Chromium (III+VI) (filtered)	mg/L	0.001	152	0.001	0.001	0.001	*0.001*
Cobalt (filtered)	mg/L	0.001	152	0.001	0.001	0.001	*0.0014*
Copper (filtered)	mg/L	0.001	151	0.001	0.002	0.003	*0.0014*
Iron (filtered)	mg/L	0.05	143	0.005	0.08	0.206	*0.28*
Lead (filtered)	mg/L	0.001	152	0.001	0.001	0.001	*0.0034*
Manganese (filtered)	mg/L	0.001	143	0.001	0.001	0.0026	*1.9*
Mercury (filtered)	mg/L	0.0001	143	0.0001	0.0001	0.0001	*0.0002*
Molybdenum (filtered)	mg/L	0.001	142	0.001	0.001	0.001	*0.034*
Nickel (filtered)	mg/L	0.001	151	0.002	0.002	0.003	*0.011*
Selenium (filtered)*	mg/L	0.01	142	0.01	0.01	0.01	*0.005*
Silver (filtered)	mg/L	0.001	143	0.001	0.001	0.001	*0.001*
Sodium (filtered)	mg/L	1	138	15	26	45	*188*
Uranium (filtered)	µg/L	1	143	1	1	1	*1*
Vanadium (filtered)	mg/L	0.01	142	0.01	0.01	0.01	*0.01*
Zinc (filtered)	mg/L	0.005	152	0.005	0.005	0.005	*0.008*
Fluoride	mg/L	0.1	152	0.1	0.1	0.2	*0.32*
TRH C6-C9	mg/L	79	40	20	20	20	*20*
TRH C10-C36	mg/L	78	40	100	100	100	*100*
*The exceedance for filtered Selenium is due to the limit of reporting being above the WQO trigger value							

24.3.7 Existing Water Use Entitlements

There are 10 licences to take water from the Isaac River downstream of the Project which have been issued for irrigation, stock watering, domestic supply and water harvesting, as shown in Figure 3-14 of **Appendix I**. The nearest of these licences is 25 km downstream. Detailed information regarding individual licences for Isaac River surface water users was obtained through analysis of water licences data provided by DNRMMRRD. Some limitations in the dataset include the absence of names of water users, and in some cases, allocated volumes for water licenses due to privacy restrictions. Details regarding the volume, source and purpose of the licences is included in Table 3.11 of **Appendix I**.

There are also several historical riparian water access notifications along the Isaac River which authorise stock and domestic supplies only. Section 20 of the Water Act provides that an owner of land adjoining a watercourse may take water for domestic and stock purposes without the need for a permit or licence.

The above information indicates that there is currently minimal use of surface water from the Isaac River downstream of the Project, and water use is limited to irrigation and stock watering.

24.3.8 Wetlands

Wetlands in the vicinity of the Project are described in **Chapter 25**, which also provides an assessment of the potential impacts to wetlands, and the proposed management measures to mitigate impacts to wetlands.

24.3.9 Existing Surface Water Infrastructure

24.3.9.1 Overview

The reach of the Isaac River in the vicinity of the Project contains a number of existing and approved mining and transport infrastructure projects. Many of the major infrastructure projects in this reach of the Isaac River maintain surface water infrastructure to manage flows from Isaac River and local creeks. Key major infrastructure projects in the vicinity of the Project, and relevant to the existing or approved surface water drainage network include the following:

- Isaac Downs Mine (IDM) landform and levee
- Poitrel Mine levees
- Winchester South Project levees
- Peak Downs Highway bridge
- Goonyella Railway bridge.

The locality of the relevant surface water infrastructure features in the vicinity of the Project is shown in Figure 24-6.

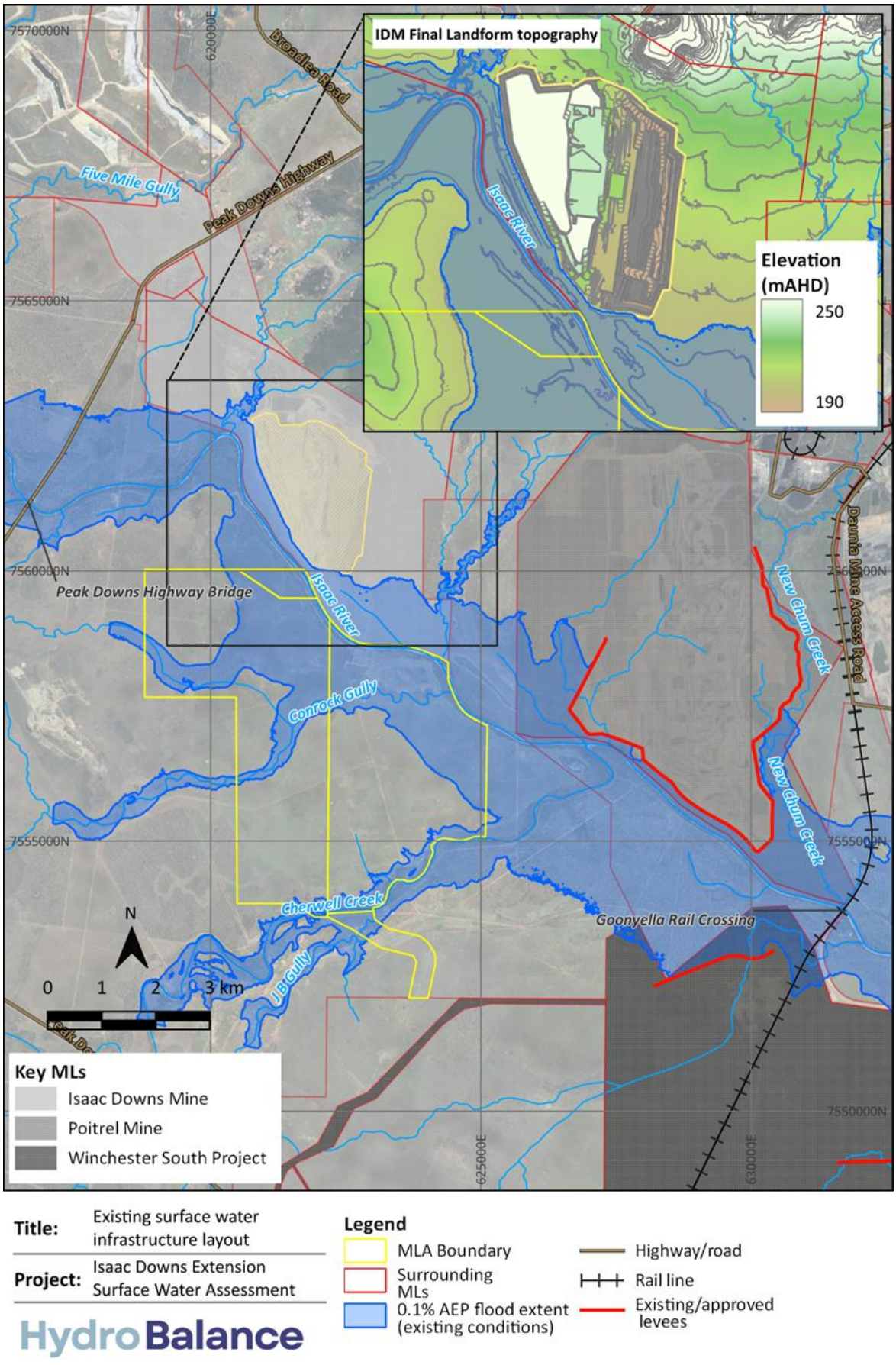


Figure 24-6 Layout of Existing and Approved Surface Water Infrastructure

24.4 Methodology and Fieldwork – Groundwater

24.4.1 Groundwater

24.4.1.1 Desktop Data

Groundwater studies have been undertaken for resource projects in the vicinity of the Project area (the Project's four MLA areas), and were used to inform the Project's groundwater investigation studies and to supplement the extensive program of Project-specific groundwater data collection including the field programs described below. Relevant groundwater information was sourced from:

- Stanmore related projects:
  - the Integrated Isaac Plains project (IIPP) (Matrix+ Consultants, 2008), a discontinued project that targeted the same resource as the Project
  - IDM Groundwater Impact Assessment (AGE, 2020), which is directly relevant to the Project as the IDM area lies along the same geological strike and abuts the northern extent of the Project
  - Poitrel Mine (PTM) assessments, with PTM located immediately to the east of the Project
  - IPM East Extension Project, located to the north of IDM
  - groundwater monitoring data from the Eagle Downs project, located to the south of the Project.
- Stanmore data:
  - detailed topographic data
  - Stanmore's resource structure geological model
  - groundwater monitoring data (bore logs, drilling information, water level and quality data) for Stanmore operated bores in the vicinity of the Project.
- Public data:
  - Queensland Government registered bore database
  - Queensland Government geological mapping.
- Third party data for other nearby mines or mining projects, either publicly available or subject to data sharing agreements with Stanmore[7], for:
  - Peak Downs Mine
  - Moorvale South project
  - Caval Ridge Mine
  - Millennium Mine
  - Millennium Mine
  - Daunia Mine
  - Saraji Mine
  - Saraji East Mining Lease project
  - Winchester South project
  - Caval Ridge Mine Horse Pit Extension project
  - Moorvale South project
  - Olive Downs project
  - Moranbah South project.

Data from these sources has been incorporated into the regional, numerical groundwater model that supports the groundwater assessment for the Project.

[7] References to the sources of these studies and data is provided in Section 1.3 of **Appendix K**.

24.4.1.2 Overview of Fieldwork Programs

Numerous groundwater field programs have been undertaken for the Project to inform the groundwater impact assessment. Each field program sought to build upon the previous programs and address residual gaps identified in the available information and dataset. The Project field programs have included:

- a groundwater bore census (Appendix E to **Appendix K**)
- hydrogeological drilling and bore installation campaigns (Appendix F to **Appendix K**)
- site specific hydraulic testing (Appendix F to **Appendix K**)
- geophysical testing (electrical resistivity surveys (Appendix G to **Appendix K**)
- GDE field studies (See Section 24.4.2)
- Routine and ongoing groundwater level monitoring and groundwater quality sampling.

24.4.1.3 Groundwater Bore Census

The primary objective of the bore census undertaken in November 2024 (Appendix E to **Appendix K**) was to identify and confirm existing bores (specifically bores installed from previous IIPP which were within or surrounding the Project area) that could be incorporated into the baseline groundwater monitoring network. It also served to identify landholder bores that required consideration in the groundwater assessment. The census involved a desktop review and field investigation, including groundwater level measurements and water quality sampling.

In total, 43 bores were assessed, comprising 32 monitoring bores and 11 landholder supply bores. Of the 32 monitoring bores, 16 were found to be functional, while the remaining 16 were either damaged, lost, or destroyed, often due to broken or buried PVC casings. Among the landholder bores, six were active and sampled, while five were inactive at the time of the survey.

The census informed the scope of work for the 2025 groundwater field investigation program (Appendix F to **Appendix K**). An initial groundwater level and quality monitoring event was undertaken during the groundwater bore census and data was included in the baseline groundwater dataset for the 2025 groundwater field investigation program.

24.4.1.4 Bore Drilling and Installation

A baseline groundwater monitoring program for the Project was recommended by AGE (2022), and together with the gap analysis prepared specifically for the Project, formed the foundation for the scope of work for the 2025 groundwater field investigation program. The recommendations included the installation of 19 new monitoring bores. Of these, seven were successfully installed in 2022 but remained undeveloped, requiring contractor services to airlift develop the bores in the 2025 groundwater field investigation program before being deemed suitable for baseline monitoring.

In addition, seven damaged legacy bores identified during the site bore census were recommended for rehabilitation to re-establish the integrity of the bores and widen spatial coverage of the groundwater monitoring network. Two of these legacy bores, considered key components of the monitoring network, were damaged beyond rehabilitation, and therefore, were scheduled for redrilling. Consequently, the installation of a total of 14 additional bores was completed in the 2025 groundwater field investigation program (Appendix F to **Appendix K**).

24.4.1.5 Fault Exploration Drilling and Down-hole Geophysics Survey

A component of the 2025 groundwater field investigation program was exploration drilling to delineate and characterise the Isaac Thrust Fault east of the Project area. Five exploration holes were used to identify the fault core and inform the design and installation of a subsequent groundwater monitoring bore targeting the fault (Appendix F to **Appendix K**).

Exploration drilling was conducted 1.5 km east of the Project area, where State regional geological mapping indicated the likely position of the fault. Five exploratory air-rotary chip holes were drilled

southwest to northeast across geological strike of the mapped fault trace. These chip holes provided key geological information, enabling the identification of the fault's location and depth on the basis of observed structural offsets with respect to the expected stratigraphy as is present within the Project area and surrounds.

The results of this exploratory drilling combined with downhole geophysical logging informed the final design and siting of a monitoring bore targeting the Isaac Thrust Fault itself. The most hydraulically conductive zone of the fault was targeted for the monitoring bore installation, as discussed below.

Epiroc undertook downhole geophysics at all five exploration holes drilled as part of the Fault Investigation. The objective of the downhole geophysics was to support the siting and final design of the monitoring bore targeting the Isaac Thrust Fault.

Wireline geophysical techniques were employed on all drill holes, and nuclear magnetic resonance (NMR) testing was employed on three drillholes. These three drillholes were selected as they were determined to show the most significant faulting present out of the five exploration drillholes. NMR is a widely utilised method employed in the petroleum industry. Resulting data processing provides measurements of:

- porosity: total volume of rock pore space.
- permeability estimates: based on pore size distribution and fluid mobility.
- bound vs. free fluid: helps identify producible fluids vs. those bound to rock surfaces.

The NMR method provides a faster, and higher resolution method of assessing downhole hydrogeological properties than more traditional methods such as packer testing. The aim of the NMR testing was to:

- provide characterisation of Isaac Thrust Fault permeability across the vertical drillhole profile
- contrast the inferred permeabilities between the fault zone and the overlying/underlying undisturbed Rangal Coal Measures interburden
- identify any higher permeability zones for installation of a groundwater monitoring bore.

24.4.1.6 Hydraulic Testing

Groundwater hydraulic slug testing was conducted across the Project's baseline groundwater monitoring network, which comprised 33 bores (Appendix F to **Appendix K**). The testing included both rising and falling head slug tests. Prior to this campaign, slug testing was carried out in 2008 at selected existing bores as part of the IIPP.

Hydraulic testing had previously been carried out on the adjacent IDM, located north of the Project area. This earlier work was conducted by AGE (AGE, 2020), providing useful comparative data for regional hydrogeological interpretation and is included in Section 5.3 of **Appendix K**.

24.4.1.7 Electrical Resistivity Imaging Survey

Between 14 May and 26 June 2025, Marine & Earth Science conducted electrical resistivity imaging (ERI) surveys to test the resistivity of the ground cover up to 80 m below ground level (Appendix G to **Appendix K**). The primary objective of these surveys was to characterise the thickness and lateral extent of alluvial sediments along the Isaac River and Cherwell Creek, the Isaac River alluvium near the northern highwall of the Project mining area as well as the sediments underlying potential wetlands. The survey also assisted to assess the potential connectivity between shallow groundwater and alluvium, possible presence of paleochannels and occurrence and thickness of clay layer between the alluvium and underlying Permian rock. The transects were aligned with existing drilling data as best as possible in order to tie in the geophysical data with the drill hole data.

A total of six ERI transects were completed during the survey period. Two lines were positioned along the riverbeds of Isaac River and Cherwell Creek, while the remaining four were strategically located to investigate subsurface conditions adjacent to the Project's proposed mine pit (see Section 24.4.5.3 for a discussion of results).

24.4.1.8 Routine Groundwater Level and Quality Monitoring

Routine groundwater level and quality monitoring has been conducted monthly at all Project monitoring bores since March 2025 or since bore installation, following an initial monitoring event in late 2024 associated with the groundwater bore census. As new bores have been installed in ongoing drilling campaigns, these have been incorporated into the routine monitoring program, with logger installation completed.

It should be noted that some historical monitoring at bores within the Project area, including initial groundwater levels collected in 2006 as part of the IIPP, as well as routine IDM monitoring bores starting around 2021, have been incorporated into the baseline groundwater database. The bore monitoring network and data is described in Section 24.5.

24.4.2 Groundwater Dependent Ecosystems

24.4.2.1 GDE Survey Timing

GDE field surveys were completed in dry seasons, namely November 2024, with supplementary field data collected in August, September and November 2025. The timing of dry season surveys for GDEs is considered optimal for sampling of groundwater dependent vegetation as it can limit the influence of variables, such as recent rainfall recharge of soil moisture. Due to the intensive nature of the data collection process, representative areas were chosen for GDE sampling which were used as a basis for extrapolation over broader areas considered to present similar ecohydrological function. The data collection process allowed for the conceptualisation of the ecohydrological characteristics of any GDEs confirmed to be present in the Project area and their general distribution. Additional information on survey timing is provided in Section 2 of **Appendix N**.

24.4.2.2 GDE Survey Methods

The field survey included an assessment of 20 'GDE assessment areas (or sites)', all considered to represent potential GDEs from the Bureau of Meteorology GDE Atlas (BOM, 2024), as shown on Figure 24-7. At each assessment site, sampling of two to five trees for leaf water potential (LWP) was completed, with twig samples collected to analyse xylem stable isotope composition. Seven locations were subject to soil auger profiling to facilitate the collection of soil moisture potential (SMP) and stable isotope data from the soil profile. Sampling of groundwater was completed from soil auger holes when groundwater was intersected, and from monitoring bores as part of the groundwater sampling program. All methods are consistent with GDE assessment protocols detailed by Doody et al. (2019) and Richardson et al. (2011).

Four sampling events contributed to the data analyses in the assessment, as follows:

- A primary phase of biophysical and hydrochemical sampling (leaf, soil and water) occurred in November 2024.
- Additional isotopic sampling occurred in two supplementary stages, which occurred in August and September 2025.
- A subsequent phase of isotopic and biophysical sampling occurred in November 2025.

Section 4 of **Appendix N** provides a detailed description of each of the sampling methods, with summary information below.

LWP defines the work required per unit quantity of water to transport it from the moisture held in the soil to leaf stomata. In total, 70 trees were assessed for LWP across the twenty assessment sites, and ranked from extremely low to extremely high[8]. The 'extremely high' category would indicate the potential for interaction with a highly fresh groundwater source, with the degree of groundwater interaction

[8] LWP values are 'negative with smaller negative number (i.e. closer to zero) being the high to extremely high category) and a larger negative number (i.e. approaching or less than minus 2) being the low to extremely low category.

decreasing to the 'moderate' category, which may indicate either utilisation of soil moisture from the vadose zone (the unsaturated zone, above the water table in unconfined aquifers) or interaction with saline groundwater. Categories of 'low' to 'extremely low' are considered unlikely to utilise groundwater to any degree, regardless of salinity.

SMP, which includes the matric (water availability) and osmotic (saltiness) potential, measures the energy required to extract moisture from the soil. Where measured LWP is below the standard wilting point (the maximum suction roots for crops can apply to soil/rock before a plant wilts due to a negative water supply), it indicates plant water deficit, and the tree is unlikely to be supported by a saturated water source regardless of groundwater salinity. Soil sampling was undertaken at regular intervals down the soil profile for analysis of stable isotopes of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$), and duplicate samples were retained for analysis of SMP.

Trees may utilise water from various sources including the phreatic zone (saturated zone), the vadose zone (unsaturated zone) and surface water. The stable isotopes of water, oxygen ($\delta^{18}O$), and hydrogen ($\delta^{2}H$) are valuable tools to help define terrestrial vegetation's predominant water source. The method relies on a comparison between the stable isotope ratios of water contained in plant xylem (from a twig or xylem core) with stable isotope ratios found in the various sources of water, including a shallow groundwater table, potential sub-artesian aquifer water sources, rainfall or shallow soil moisture.

Radon (^{222}Radon) is a by-product of uranium decay that has a much higher concentration in groundwater than surface water. It can therefore provide an accurate indication of how much groundwater has entered surface water bodies. As radon has a half-life of 3.8 days, its concentration will decrease downstream along a river from a source of groundwater discharge. Radon sampling targeted the detection of groundwater discharge into surface waters (if any), and hence sampling included residual surface water bodies on the Isaac River, water in a State mapped high ecological significance (HES) wetland (near the confluence of Isaac River and Cherwell Creek), and groundwater in alluvial monitoring bores, a coal seam bore, a soil auger hole and river sands in the Isaac River.

24.4.2.3 GDE Data Interpretation

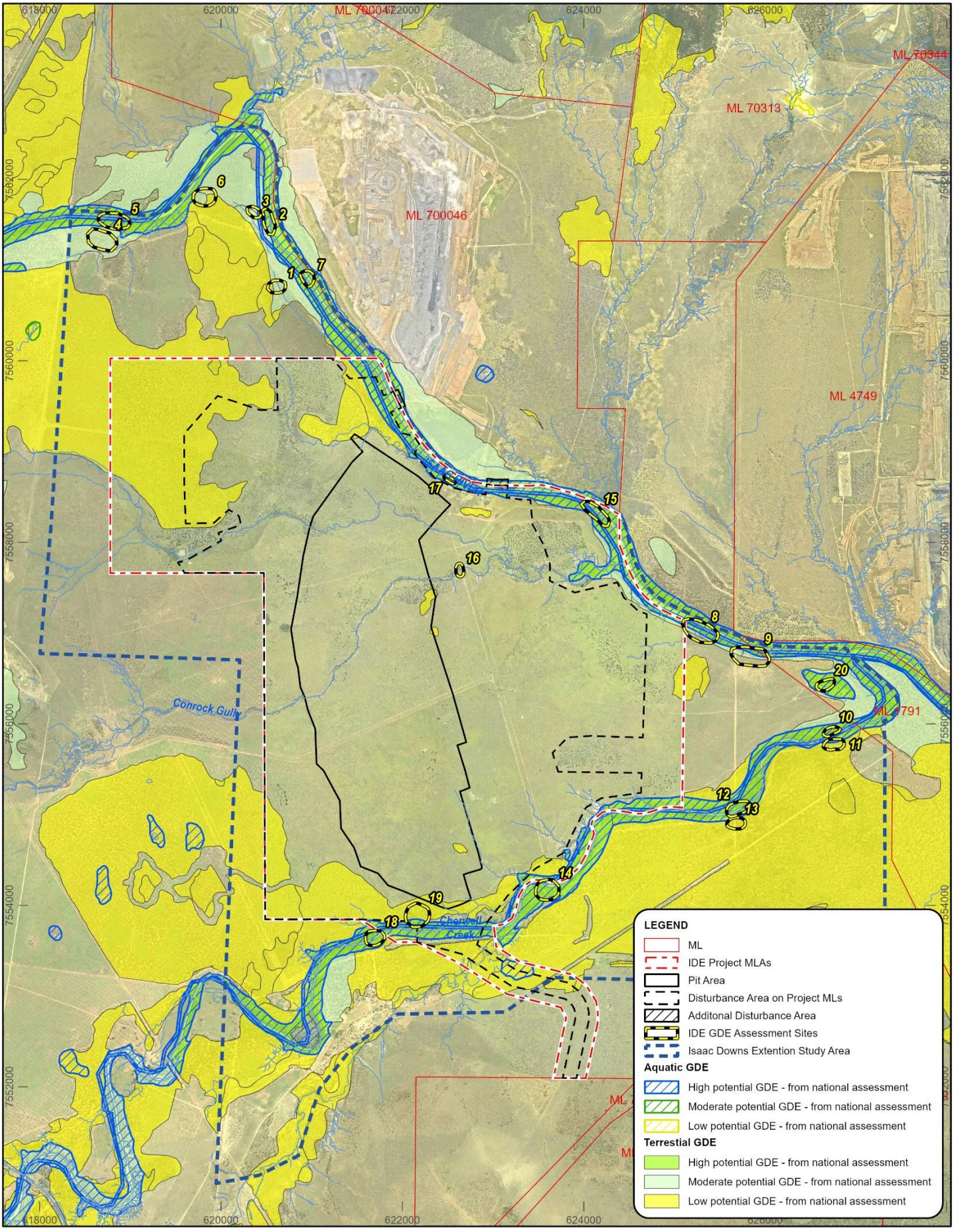
GDE field data interpretation followed a structured approach by filtering multiple lines of evidence to assess groundwater dependence. The biophysical measurement of LWP formed the primary assessment, followed by the adjunct comparison with SMP, with stable isotope data used to provide supplementary evidence where ambiguity remained. In addition, an overview of the depth of the groundwater table and groundwater salinity was completed as a final filter to determine the accessibility of groundwater and suitability as a source of moisture to support transpiration at each assessment locality.

Trees that demonstrate LWP values that are considerably more negative than expected ranges for the local groundwater salinity regimes are assumed not to exhibit any significant degree of groundwater dependence.

For trees where LWP was within the expected range of values for GDEs under specific local salinity regimes, soil augering allowed the direct observation of the physical features of the soil profile, as well as facilitated measurement of SMP to identify the likelihood that moisture for transpiration was being supplied from the upper soil profile, or whether deeper sources of moisture may exist. SMP analysis identifies potential sources of moisture to give context to evaluating stable isotopes.

For trees that demonstrate potential groundwater dependence from LWP measurements, stable isotope signatures from the xylem samples were compared to signatures from groundwater, surface water from residual and permanent pools, and soil moisture to provide a fingerprint for the source of moisture being utilised. Where three lines of evidence indicated utilisation of a groundwater source, the tree was generally accepted as being groundwater dependent. Where ambiguity remained in the assessment, additional features were considered, including site-specific geology, geomorphology, soil physical properties, groundwater salinity, and depth to the water table at the location to inform the final

assessment of groundwater dependence for any tree or site. Radon sampling was useful for conceptualisation of groundwater and surface water interactions, and was used specifically for this purpose.



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Metres

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GDE Assessment Sites

Figure | **24-7**

24.4.3 Stygofauna

A review was undertaken to search for available data and reports on stygofauna within and adjacent to the Project area, including State government data bases and studies for nearby resource projects.

Based on the desktop review, it was determined that the most appropriate approach to stygofauna sampling was to undertake a pilot survey, which typically consists of sampling a minimum of 10 bores with bore locations satisfying specific criteria for conducting stygofauna surveys.

A total of 12 groundwater bores were selected for stygofauna sampling across a study area, comprising the Project area and surrounds, two of which were found to be dry. The locations of the groundwater bores sampled within the proposed study area are shown in Figure 2 of **Appendix O**. Of the 12 bores, two were in the alluvium (alluvial aquifer), three in the regolith (two dry) and seven in the coal seams. All bores were used primarily for groundwater monitoring purposes. Bore construction dates for two bores is at least 15 years old, 2020 for two bores, 2022 for seven bores and 2025 for the one remaining bore. The bore constructed in 2025 (MBIS03) was constructed two months prior to sampling. The bores ranged from 13.5 to 180 metres deep.

Bore inspections and sampling was conducted from 20 to 22 July 2025. The bores were sampled for stygofauna in accordance with the methods defined in Queensland Environment Protection (Water) Policy 2009 – Monitoring and Sampling Manual for Biological Assessment (DES, 2018b) and following established sampling techniques defined elsewhere in Australia and overseas (i.e. the Guideline for the environmental assessment of Subterranean aquatic fauna - Sampling methods and survey considerations, DSITI (2015)). The field sampling program met all the requirements for conducting a stygofauna pilot survey.

The sampling method aimed to collect between four and six replicate hauls off the bottom of each bore in order to be classified as a good sample. Overall, high quality stygofauna samples were collected from the 10 bores which held water.

Stygofauna samples were analysed in a laboratory by specialists in the field. All aquatic animals present were removed (stygofauna and non-stygofauna) and identified to Order/Family level (or lower taxonomic rank if visually possible) in accordance with DSITI (2015).

Further details on desktop and field studies for stygofauna are described in Sections 3 and 4 of **Appendix O**.

24.4.4 Resource Operations and Projects

Table 24-4 provides a summary of the various resource operations and proposed projects located within the Project's region. These operations and projects form the basis for the regional numerical groundwater model which has been used to assess the Project's impacts and cumulative impacts. Additional information on these resource operations and proposed projects is provided in Section 3.3 of **Appendix K**.

Table 24-4 Existing and Proposed Resource Operations and Projects in Project Region

Operation	Status	Type	Planned Start	Planned End	Distance from Project[1]	Target Coal Resource
IDM	Operating	Open-cut	2021	2028	1 km north	Rangal Coal Measures
IPM	Operating	Open-cut	2006	2026	10 km north	Rangal Coal Measures
Moranbah South	Proposed (on hold)	Underground – Longwall and Bord and Pillar	2045	2088	Adjacent west	Moranbah Coal Measures

Operation	Status	Type	Planned Start	Planned End	Distance from Project[1]	Target Coal Resource
Moranbah North	Operating	Underground - Longwall	1998	2033	35 km northwest	Rangal Coal Measures
Winchester South	Proposed (approved)	Open-cut	2026	2051	10 km southeast	Rangal Coal Measures, Fort Cooper Coal Measures
PTM	Operating	Open-cut	2006	2032	7 km northeast	Rangal Coal Measures
Eagle Downs	Care and Maintenance	Underground - Longwall	2029	2064	3 km south	Moranbah Coal Measures
Millennium	Operating	Open-cut	2005	2027	11 km northeast	Rangal Coal Measures
Daunia	Operating	Open-cut	2011	2034	13 km east	Rangal Coal Measures
Moorvale South	Operating	Open-cut	2021	2031	18 km southeast	Rangal Coal Measures, Fort Cooper Coal Measures
Moorvale	Operating	Open-cut	2023	2033	23 km northeast	Rangal Coal Measures
Olive Downs	Operating	Open-cut	2023	2099	21 km southeast	Rangal Coal Measures
Caval Ridge	Operating	Open-cut	2014	2037	13 km west	Moranbah Coal Measures
Peak Downs	Operating	Open-cut and underground	1972	2119	17 km southwest	Moranbah Coal Measures
Lake Vermont	Operating	Open-cut (with approved underground extension)	2008	2045	47 km SW	Rangal Coal Measures
Meadowbrook	Approved / Proposed	Open-cut and underground	2026	2050-2055	35 km SW	Rangal Coal Measures
Moranbah Gas Project	Petroleum lease (PL) 196	Coal Seam Gas	NA	NA	11 km northwest	Rangal Coal Measures, Moranbah Coal Measures
	PL 191		NA	NA	23 km northwest	
	PL 223		NA	NA	17 km northeast	

Operation	Status	Type	Planned Start	Planned End	Distance from Project[1]	Target Coal Resource
	PL 224		NA	NA	16 km northwest	
Bowen Gas Project	Exploration & Appraisal (ATP 1103)	Coal Seam Gas	2030	2060	Large exploration area with small overlap with Project Area	Rangal Coal Measures, Moranbah Coal Measures
	Production (PL 486)		NA	NA	45 km northwest	
1 Distances measured from approximate centre of mining lease or petroleum lease						

24.4.5 Geology

24.4.5.1 Overview

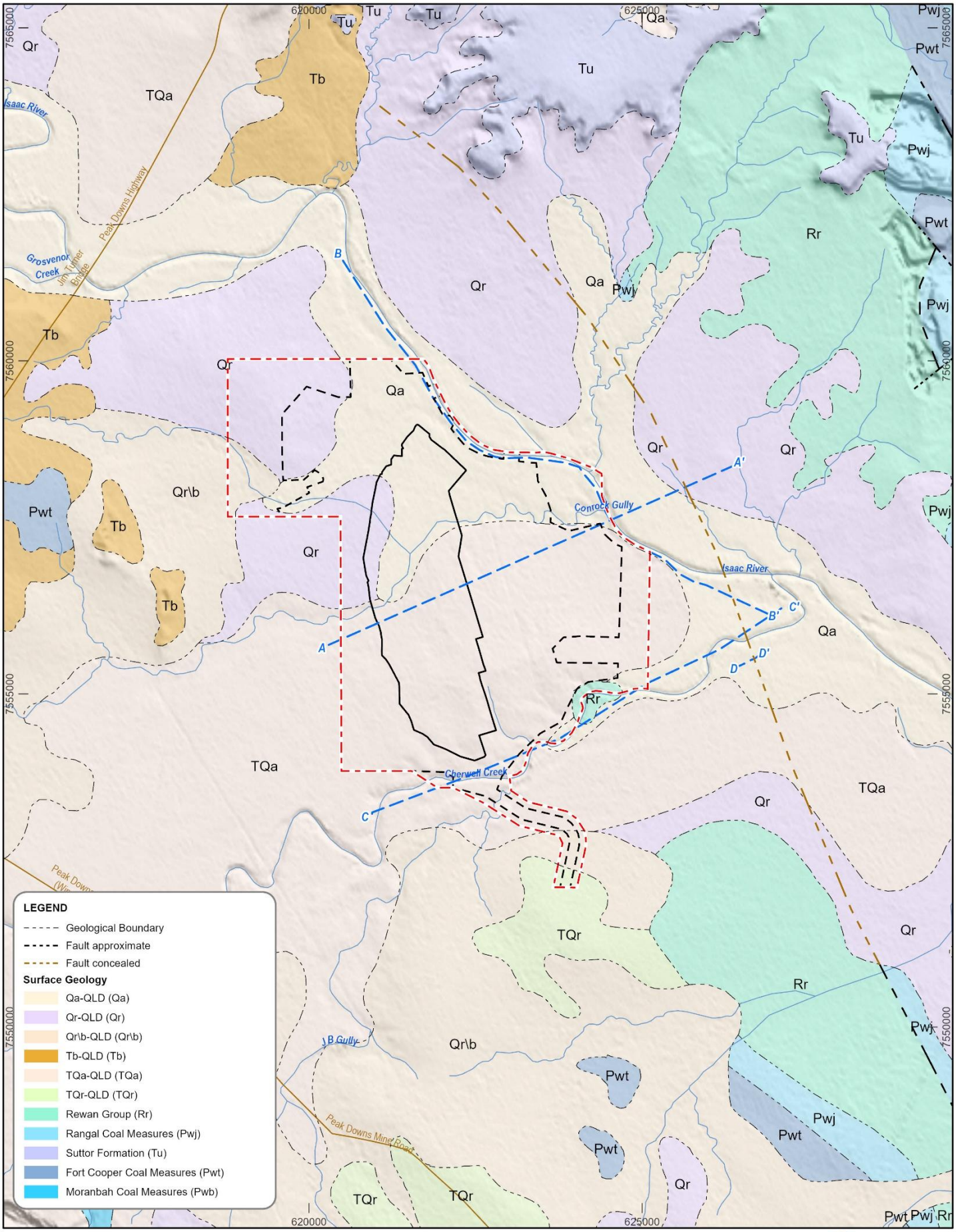
The regional and local geology of the Project area and surrounds is described in Section 7.3.11 of **Chapter 7**. This is supplemented by information in Section 4 of **Appendix K**, summarised below, used to inform the understanding of the hydrogeology of the Project area and surrounds.

Local surface geology in the vicinity of the Project, with cover sequence extents, is shown in Figure 24-8. The local geology of the Project area is well defined through both resource exploration and groundwater drilling, with over 500 individual drillholes at and near to the Project area. Furthermore, Stanmore's extensive resource exploration and groundwater drilling at the adjoining IDM enhances the understanding of the local geology. Additional methods, including downhole geophysical surveys and ERI, have further refined the geological model of the region.

The stratigraphic profile within the Project area and surrounds comprises three distinct units:

- Cenozoic sediments:
  - Quaternary alluvium and colluvium.
  - Tertiary Alluvium, colluvium, and Regolith that includes weathered Permian strata, and weathered Tertiary basalt in places.
- Triassic Rewan Group Strata.
- Permian Strata:
  - Rangal Coal Measures.
  - Fort Coper Coal Measures (at depth).
  - Moranbah Coal Measures (at depth).

A geological cross-section is provided in Figure 24-9 (section A-A' on Figure 24-8). This illustrates the overall stratigraphy and structural geology framework of the Project area and surrounds, depicting the spatial relationships between the main geological units.



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LEGEND

- Waterway
- Roads
- IDE Project MLAs
- Proposed Project Disturbance Area
- Project Pit Extent
- Hydrogeological/Geological Cross Section Line

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Project Surface Geology

Figure | **24-8**

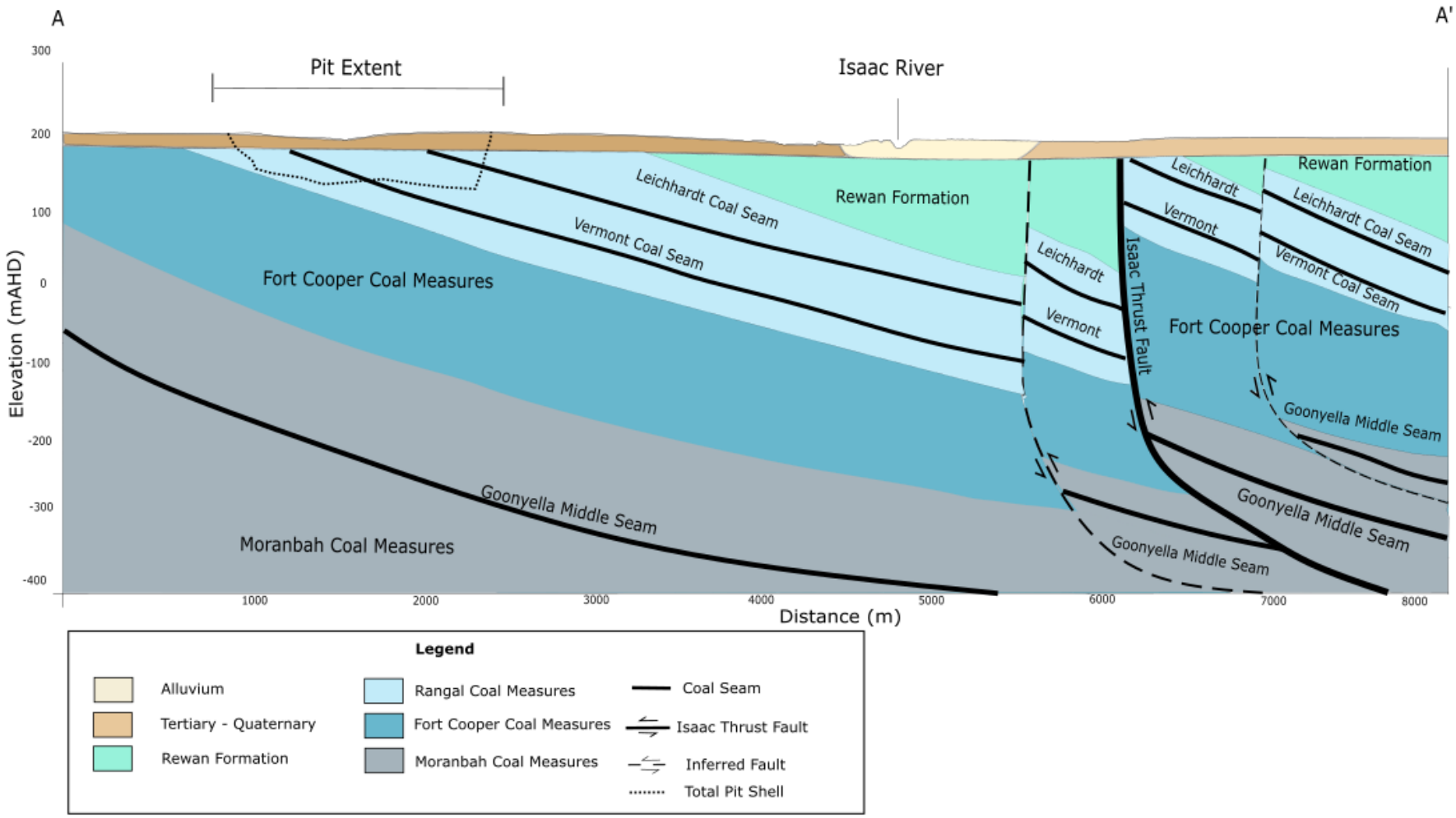


Figure 24-9 Conceptual Geological Cross Section across the Project Area and Pit

24.4.5.2 Cenozoic Sediments

Cenozoic aged (Tertiary to Quaternary) sediments within and surrounding the Project area include recent alluvium associated with the Isaac River, Cherwell Creek and other tributaries, overlying weathering derived colluvium and undifferentiated Tertiary sediments which are collectively termed Regolith in many recent studies and this groundwater assessment.

24.4.5.3 Quaternary Alluvium

Surface geology mapping (Figure 24-8) identifies Quaternary alluvium (Qa) primarily along the Isaac River, which intersects the eastern portion of the Project area. Tributaries such as Cherwell Creek, Conrock Gully, and other smaller unnamed creeks also contain mapped alluvium.

Quaternary alluvium, hereafter referred to as alluvium, in the region is generally described as a geological unit of unconsolidated sequences of clay, silt, sand, and gravel, typically less than 20 m thick (AGE, 2020). Previous studies (e.g. AGE, 2020) report that the thickest accumulations occur adjacent to the Isaac River, with locally deeper sections associated with paleochannel systems incised into bedrock (i.e. former river channels). Away from the main channel, the deposits are dominated by clay and silt derived from floodplain environments.

A series of recent geological and hydrogeological investigations at and near to the Project area have improved the characterisation and determination of the thickness of the alluvium local to the Project area. This includes data from exploration drilling, groundwater bore drilling, geophysical surveys (ERI) and groundwater investigations.

Data from these sources has been used to develop conceptual cross sections, demonstrating the shallow geological conditions along the Isaac River (Figure 24-10) and Cherwell Creek (Figure 24-11) in the vicinity of the Project (cross section locations shown on Figure 24-8).

Drill logs across the Project Area reveal that the alluvial sequences are composed of interbedded layers of clay, silt, sand, and gravel, reflecting fluvial depositional processes. Coarse sands and gravels are present near active surface drainage channels, particularly adjacent to the Isaac River, where alluvium thicknesses of 15 to 20 m have been recorded. These deposits thin progressively toward floodplain margins, where finer grained sediments such as clay and silt become more prevalent. This compositional variability is consistent with regional investigations.

Interpretation of ERI geophysical survey data, in conjunction with drillhole data, has refined the mapped extent of alluvium within and adjacent the Project area, as shown in Figure 24-12, noting that this is similar to the alluvium mapped in Figure 24-8. Alluvium extent along Cherwell Creek is more closely associated with the modern channel compared to the broader Isaac River floodplain. Near the confluence with the Isaac River, saturated alluvial sediments up to 14 m thick have been recorded. Alluvial deposits also extend along Conrock Gully within the Project area, although they are thinner (generally <10 m) than those along the Isaac River.

Several paleochannels filled with gravel and coarse sediments have been identified, up to 15 m thick. Paleochannels were identified from drillhole data and explain localised variations in alluvium thickness. ERI data confirms their presence and distribution.

The investigations and data supported a re-assessment of alluvium extent and thickness local to the Project, as shown in Figure 24-12. Where field specific data on alluvium thickness is not available (e.g. areas outside the Project area, upstream of Isaac River and Cherwell Creek), alluvium thickness is based on publicly available mapped geology and data from surrounding mines and has been iteratively interpolated for model layering using data from these mines.

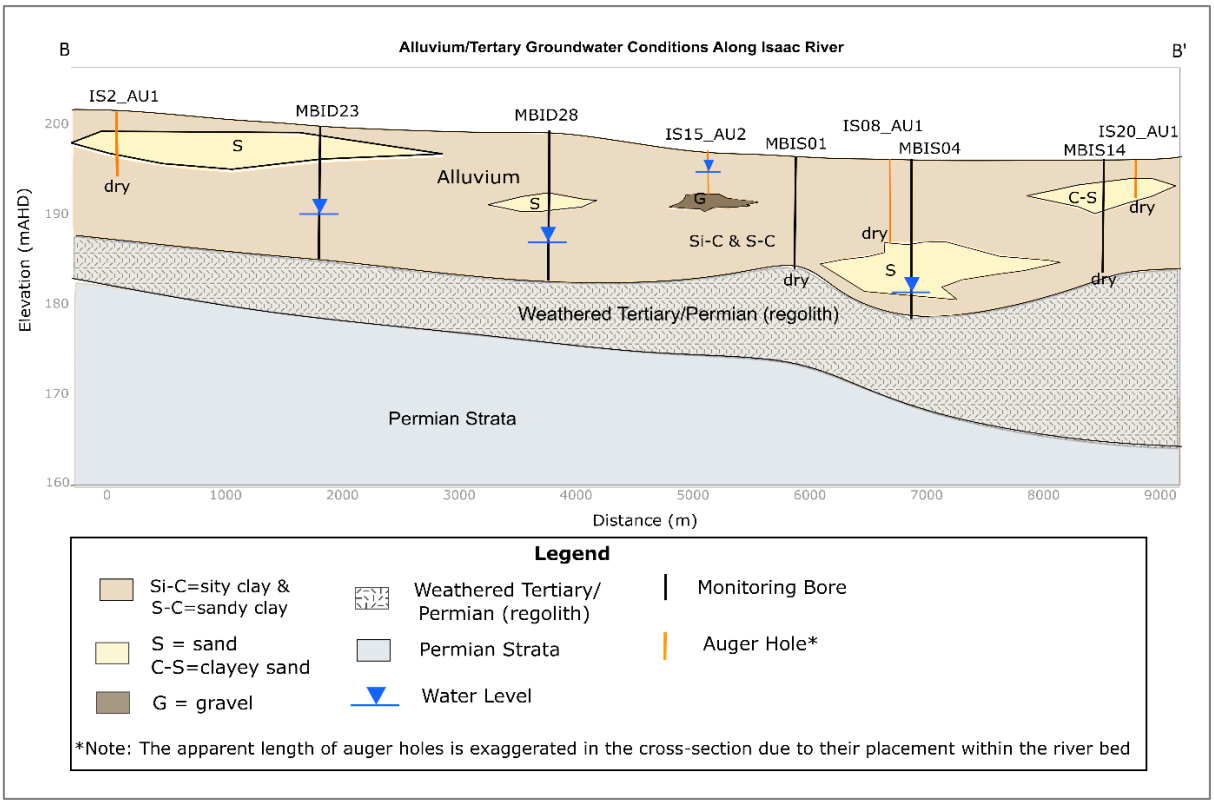


Figure 24-10 Cross Section of the Alluvium along the Isaac River

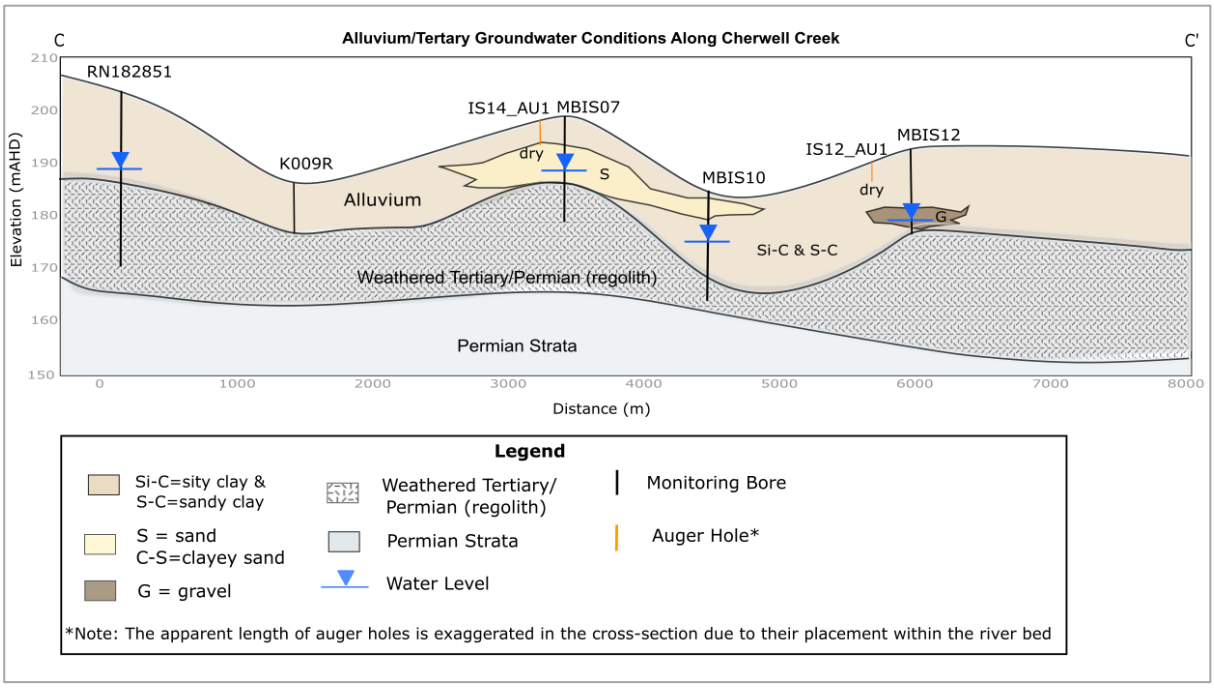


Figure 24-11 Cross Section of the Alluvium along Cherwell Creek

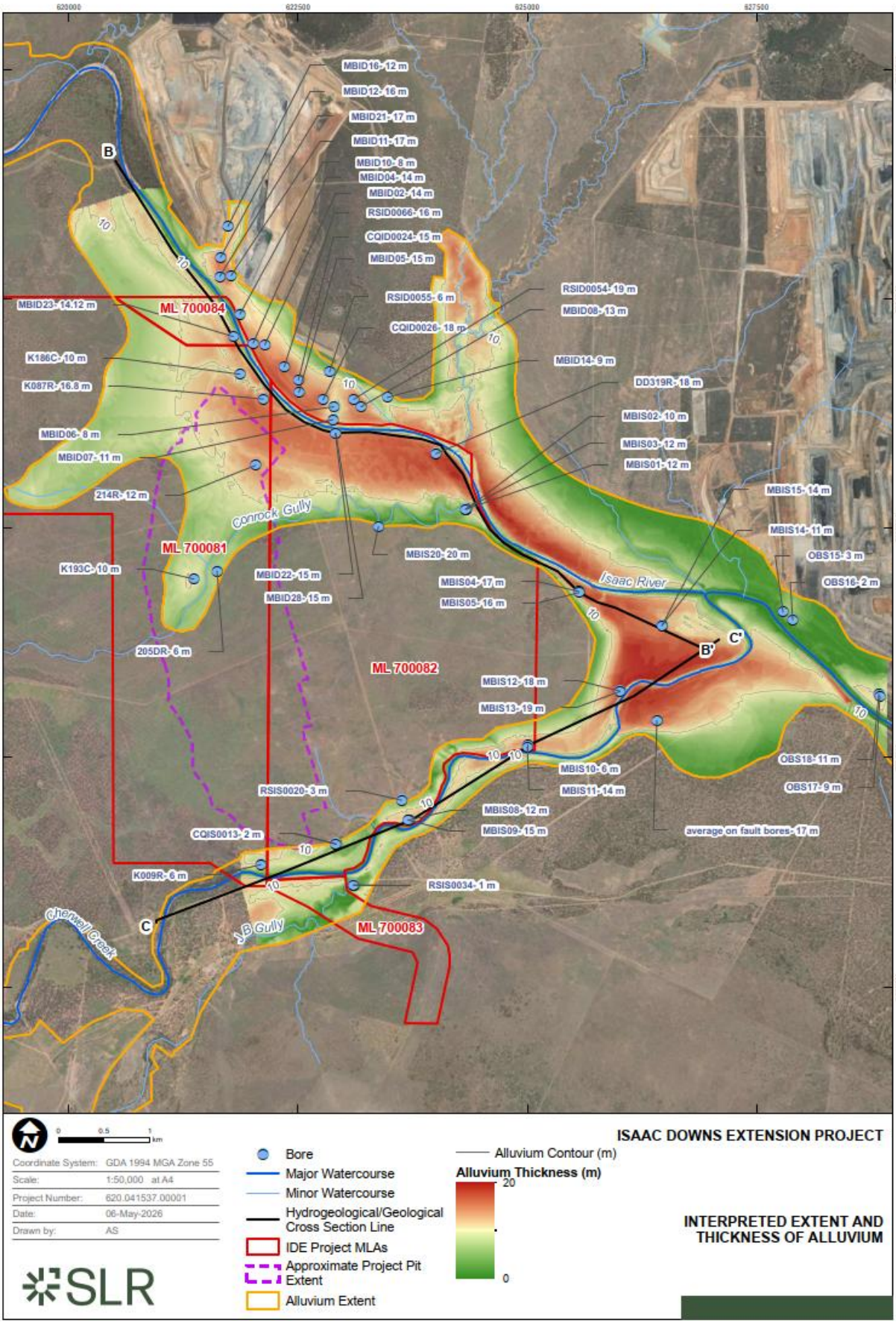


Figure 24-12 Interpreted Extent and Thickness of Alluvium

24.4.5.4 Regolith

The surface geology across the broader study area (approximately 15 km surrounding the Project area), outside of the extent of Quaternary alluvium, is dominated by Cenozoic-aged sediments (Quaternary to Tertiary) comprising a mix of colluvium and semi-consolidated, undifferentiated materials. These materials have been collectively referred to as 'regolith' in the Project's groundwater assessment and other previous investigations, given they function in a hydrogeological sense as one interconnected unit. The regolith also includes older alluvial deposits (mapped as TQa in Figure 24-8), which are widespread throughout the study area.

The regolith is lithologically heterogeneous, consisting of varying proportions of fine- to coarse-grained sand, clay, claystone and highly weathered siltstone and sandstone.

Drilling data from groundwater monitoring and exploration boreholes at and adjacent the Project area indicate that unconsolidated to semi-consolidated Tertiary sediments underlie the Quaternary alluvium to depths of approximately 20 m. These Tertiary units are predominantly composed of low strength, weathered siltstone and fine-grained sandstone. In areas dominated by colluvial processes away from drainage lines, such as at bore MBIS17 to the southeast of Cherwell Creek, the regolith includes clay, clayey sand, and mudstone.

Regionally, Tertiary basalt is also known to occur within paleovalleys incised into the underlying Permian–Triassic bedrock. However, basalt is absent from the Project area. The nearest confirmed occurrence is approximately 4 km to the west of the Project area, where it was intercepted during drilling of Moranbah South project groundwater monitoring bores MB06, MB07, and MB09C.

24.4.5.5 Triassic Rewan Group

The consolidated Triassic sedimentary strata include the Rewan Group, which dips to the east and unconformably overlies the Permian coal measures, outcropping in the east of the Project area. The Rewan Group regionally comprises Late Permian to Early Triassic strata with pebbly lithic sandstone, green to reddish brown mudstone and minor volcano lithic pebble conglomerates.

The Rewan Group is extensive over the eastern and northern parts of the Project area, outcropping and sub-cropping in a number of places. Where intersected within the Project area, the unit is generally comprised of a well consolidated pink-brown sandstone.

24.4.5.6 Permian Coal Measures (Blackwater Group)

Permian coal-bearing sedimentary rocks of the Blackwater Group form the main economic resource of the numerous mines in the study area. In increasing depth order, the major coal measures within the study area include the:

- Rangal Coal Measures (RCM).
- Fort Cooper Coal Measures (FCCM).
- Moranbah Coal Measures (MCM).

The RCM are approximately 100 m thick and dip 2 to 6 degrees to the east-northeast in the Project area. It marks the youngest of the Blackwater Group coal measures, and overlies the FCCM. The transition between the RCM and FCCM is marked by the Yarrabee Tuff, which lies between the Vermont Upper Seam and Vermont Lower Seam.

The RCM comprise light grey, cross-bedded, fine to medium grained labile and well cemented sandstones, grey siltstones, mudstones, shale and coal seams. The Leichhardt and Vermont Seams occur within the RCM and are the target for mining at the Project. The RCM are mined at nearby mines to the east and south.

The FCCM conformably underlie the RCM regionally and at the Project. Regionally, the formation has a maximum thickness of approximately 350 m and drill logs indicate the FCCM comprise lithic sandstone, conglomerate, mudstone, carbonaceous shale, coal, tuff and tuffaceous (cherty) mudstone.

The MCM conformably underlie the FCCM. The MCM underlies the Project area, at significant depth. The unit has little direct relevance to the Project's groundwater assessment. The Goonyella Middle Seam of the MCM is the target for mining at the Moranbah South project, and the MCM is also mined at Caval Ridge, Peak Downs and Saraji mines to the west and southwest.

24.4.5.7 Structural Geology

The main regional scale fault in the vicinity of the Project is the north-northwest trending reverse Isaac Thrust Fault, which forms a wide zone of heavily fractured 'fault complex' and associated secondary northwest trending fault splays, with throws of up to 100 m. The Isaac Thrust Fault is mapped to the east of the Project area, as shown on Figure 24-8 and Figure 24-9.

Field programs to delineate to delineate and characterise the Isaac Thrust Fault (including to improve the understanding of its hydrogeological properties) are described in Section 24.4.1.5 and Section 4.2.5 of **Appendix K**. The field program provided key subsurface geological data, enabling identification of the fault's location, depth, and structural characteristics.

Faulting was evident across all five exploratory drillholes, likely due to the presence of a shallow dip angle to the fault structure (typical of reverse thrust faults) combined with a broad zone of deformation and secondary faulting associated with the main fault structure. Detailed analysis of lithology and geophysical data identified significant faulted zones/structures in three drillholes RFIS0060, RFIS0062, and RFIS0064. NMR logging at these holes provided high-resolution vertical profiles of inferred porosity and hydraulic conductivity, enabling identification of permeability contrasts across the fault zone and the relatively undisturbed RCM strata above and below the fault zone. As a result, monitoring bore MBIS19 was installed at this location, with the screen interval designed to target the most permeable zone within the fault structure as identified in the NMR data. Section 24.5.3 provides discussions of the resulting groundwater information from this bore.

Analysis of lithological data and downhole geophysical logging informed delineation of the fault core and supported a localised characterisation of the Isaac Thrust Fault. Based on the vertical displacement of coal seams and the horizontal distance between drillholes, a dip angle of approximately 5 degrees was calculated. This is consistent with regional fault geometry and confirms a southwest-directed fault throw of approximately 100 m.

24.5 Environmental Values – Groundwater

24.5.1 Overview

Based on the understanding of the geological setting, the hydrogeological regime of the Project area comprises the following key hydrogeological units:

- Cenozoic sediments:
    - Quaternary alluvium (i.e. alluvium) – forms the unconfined alluvial aquifer (sporadically water-bearing strata of permeable unconsolidated sand or gravel with interlayered clays and silts) localised to major ephemeral drainage lines (Isaac River and Cherwell Creek) in the Project area and in the study area.
    - Perched groundwater systems are likely to occur within the alluvium. These are discrete groundwater units sitting above the alluvial aquifer / water table, and are separated by an unsaturated zone. Downward percolation of groundwater in these perched systems is restricted by a material of localised low permeability such as a clay lens.

  - Quaternary to Tertiary non-alluvial sediments and weathered units (collectively termed 'regolith') – unconfined unit with variable but limited saturation and generally present at the surface within the Project area.
- Triassic Rewan Group – considered a regional scale aquitard. However, some saturated, more hydraulically conductive horizons exist within, particularly within the upper weathered zone. The Rewan Group subcrops on the eastern side of the Project area.
- Permian coal measures with:
  - low permeability interburden and overburden units with aquitard properties.
  - coal seams that exhibit water bearing properties associated with secondary porosity through cracks and fissures.

The following terminology is used in this chapter and the groundwater assessment (**Appendix K**) to distinguish between the alluvial aquifer in the alluvium and the perched groundwater systems in the alluvium:

- Bore data and numerical modelling relate to groundwater conditions within the alluvial aquifer.
- 'Perched groundwater systems' are referenced in the context of GDEs.
- None of the groundwater monitoring bores intersect perched systems. Therefore, all monitoring and modelling results relate solely to the alluvial aquifer.
- Perched groundwater systems associated with GDEs are described in Section 24.6.3.
- When referring to water in the alluvium, this relates to water in the alluvial aquifer, unless specifically describing the perched groundwater systems.

The coal seams within the Permian RCM are the main aquifer units in the Project area. The coal seams can be characterised as confined aquifers, with the Leichhardt and Vermont coal seams forming the main aquifer units locally. The RCM overburden and interburden act as aquitards and are typically dry, or very low yielding.

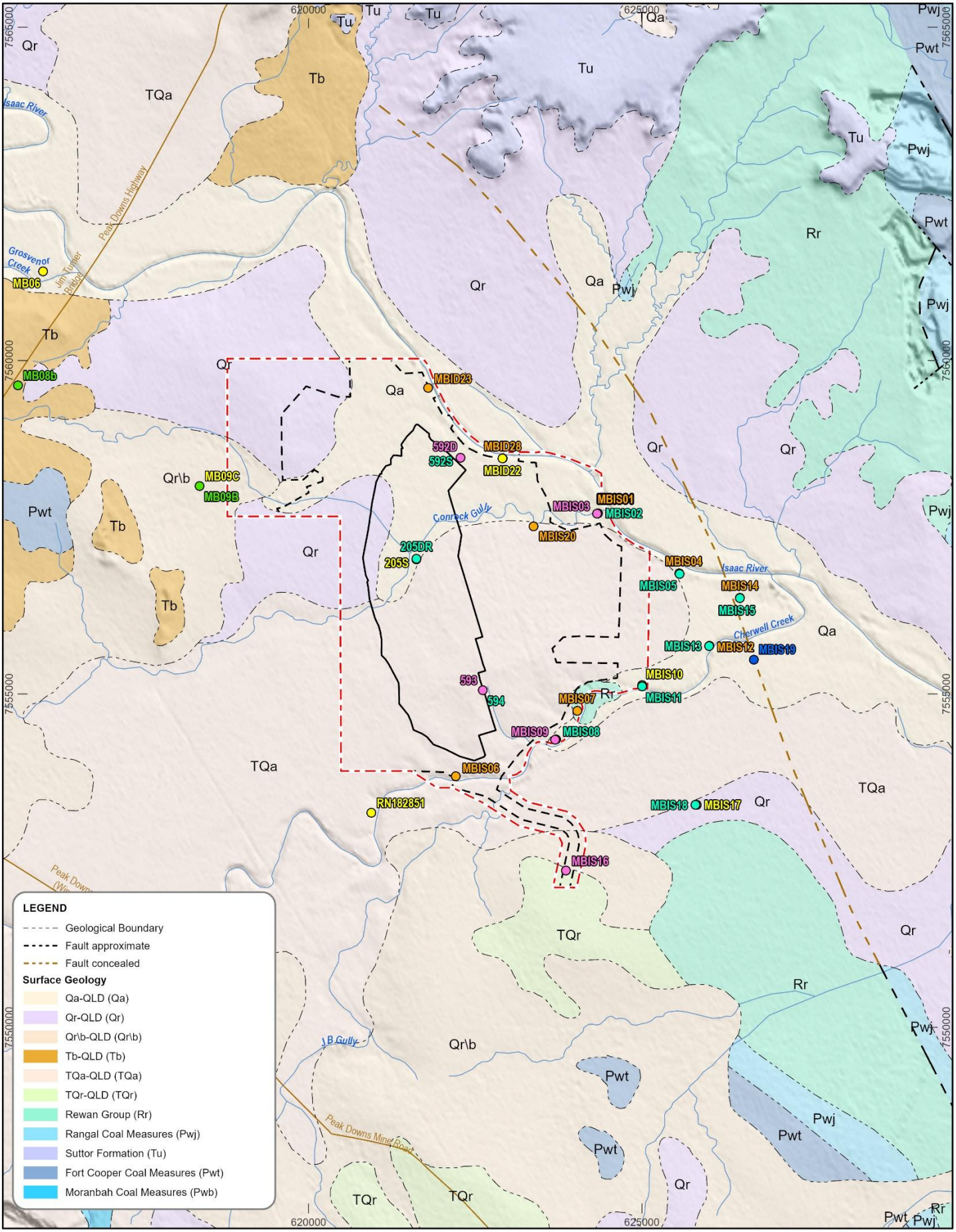
As the Project is located immediately south of IDM, along geological strike, the hydrogeology is very similar between IDM and the Project. AGE (2020) discussed the hydrogeology of IDM, and information presented therein has informed the understanding of the Project's hydrogeology.

24.5.2 Groundwater Monitoring

24.5.2.1 Project Monitoring Network

The Project's groundwater bore monitoring network, developed from the field programs described in Section 24.4.1 is shown in Figure 24-13. This is a comprehensive monitoring network representative of all potential aquifers. Information on each monitoring bore including depth, groundwater unit being monitored and periods over which monitoring of water quality and levels has occurred, is presented in Table 5-1 of **Appendix K**. There are 34 bores in the Project's groundwater monitoring network:

- Nine bores targeting Quaternary alluvium (associated with either Isaac River, Cherwell Creek or Conrock Gully).
- Seven bores targeting the Regolith (colluvium, Tertiary basalts, Tertiary sediments, weathered Rewan Group and shallow highly weathered RCM overburden).
- 10 bores targeting the Leichhardt coal seam of the RCM.
- Five bores targeting the Vermont coal seam of the RCM.
- One bore targeting the core of the Isaac Thrust Fault within the RCM.
- Two bores targeting the FCCM.



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LEGEND

- Waterway
- Roads
- IDE Project MLAs
- Proposed Project Disturbance Area
- Project Pit Extent

Groundwater Monitoring Network

- Alluvium
- Regolith
- Leichhardt coal seam
- Vermont coal seam
- Fort Cooper Coal Measures
- Isaac Thrust Fault core (RCM)

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ISAAC DOWNS EXTENSION

Project Groundwater Monitoring Network

Figure | **24-13**

24.5.2.2 Other Monitoring Networks

IDM is located immediately adjacent (northwest) and along geological strike from the Project. As a result, 18 groundwater monitoring bores from IDM have been incorporated into the groundwater assessment as relevant to characterisation of the baseline setting at the Project, particularly for bores around the southern and southeastern boundary of IDM, adjoining the Project area:

- 11 bores targeting the Alluvium associated with the Isaac River.
- Three bores targeting weathered Rewan Group.
- Two bores targeting the Leichhardt Seam of the RCM.
- One bore targeting the Vermont Seam of the RCM.
- One bore screened across both the Leichhardt and Vermont seams of the RCM.

PTM is also located to the east of to the Project (northeast). Groundwater monitoring bores from PTM have been incorporated into the groundwater assessment as relevant to characterisation of the baseline setting at the Project, particularly for the eight bores around the east and southeastern boundary of PTM:

- One bore targeting the Alluvium associated with the Isaac River.
- One bore targeting both the Alluvium associated with the Isaac River and weathered Tertiary sediments (Regolith).
- Two bores targeting weathered Tertiary sediments (Regolith).
- Two bores targeting the Leichhardt Seam of the RCM.
- One bore targeting the Vermont Seam of the RCM
- One bore screened in the interburden of the RCM.

Stanmore has also entered into groundwater data sharing agreements with the owners of several neighbouring projects and mines. These agreements facilitate the exchange of groundwater data, models, and supporting documentation. Where applicable, relevant data from each participating project or mine's groundwater assessment has been integrated into the groundwater assessment.

These bores are shown in Figure 5-2 of **Appendix K**, with bore details provided in Table 5-2 of **Appendix K**.

The combination of Project monitoring bores and other monitoring bores provides a comprehensive network of over 60 bores from which information has been obtained to inform the groundwater assessment.

24.5.3 Hydraulic Properties

Section 5.3 of **Appendix K** provides detailed information on the hydraulic properties of the hydrogeological units in the Project area, which is summarised below.

24.5.3.1 Site Specific Hydraulic Conductivity Data

Groundwater hydraulic testing results are available from slug (rising and falling head) tests conducted on the Project's monitoring network bores (see Appendix F of **Appendix K**). A summary of the results are provided in Table 24-5.

Hydraulic conductivity values for the alluvium range from 0.33 to 9.68 m/day, with an average of 1.19 m/day, indicating significant variability between bores. This variability is attributed to the heterogeneous nature of floodplain deposits along the Isaac River, where differing grain sizes influence permeability.

Hydraulic conductivity values for the regolith hydrogeological unit range between 0.15 and 2.51 m/day. These bores, with screen depths less than 30 m, target highly weathered material. The mean hydraulic conductivity recorded was 0.71 m/day. This weathered transition zone in the Permian strata is expected to exhibit greater permeability and storage capacity than the underlying fresh Permian rock (RCM) due to the opening of joints and bedding planes through weathering.

The coal seams within the RCM generally exhibit higher hydraulic conductivities than the surrounding non-coal strata and are considered the primary groundwater-bearing zones within the RCM.

Bore MBIS19, installed into the Isaac Thrust Fault zone, yielded hydraulic conductivity estimates generally two orders of magnitude lower than the RCM coal seams (10^{-3} m/day). Noting that MBIS19 was installed in to the most permeable part of the fault zone inferred from NRM data, which indicates that the fault structure does not provide for a preferential groundwater flow pathway with respect to groundwater flow in the RCM.

Table 24-5 Summary of Mean Hydraulic Conductivity per Hydrogeologic Unit - Site Testing

Target Formation	Number of Bores	Number Slug tests Analysed	Minimum Hydraulic Conductivity (m/day)	Maximum Hydraulic Conductivity (m/day)	Median Hydraulic Conductivity (m/day)	Geometric Mean Hydraulic Conductivity (m/day)
Alluvium	5	48	0.33	9.68	1.33	1.19
Regolith	4	49	0.15	2.51	1.00	0.71
Leichhardt Coal Seam	10	74	0.001	30.31	0.25	0.33
Vermont Coal Seam	5	32	0.03	5.90	0.45	0.37
FCCM	2	16	0.04	0.11	0.07	0.07
Isaac Thrust Fault	1	12	0.002	0.006	0.003	0.003

24.5.3.2 Regional Hydraulic Conductivity Ranges

A significant record of aquifer hydraulic testing information is available from adjacent and nearby mines and project sites for the same hydrogeologic units that are found at the Project. Given the similar geologies, these data are considered representative of the hydraulic properties of the units at the Project.

A histogram of the spread of horizontal hydraulic conductivity from the field testing at the nearby mines and projects is presented in Figure 5-4 of **Appendix K**. The results are compared to the range of documented values for the various units in literature. The comparison shows that the field results for the hydrogeologic units within the Project area and immediate surrounds fall within the range of field data collected through other studies across the Bowen Basin. The results of the site specific testing generally fall within the range of regional and literature values for each unit, indicating the site specific dataset aligns with the regional dataset.

24.5.3.3 Faulting

A number of studies, as described in Section 5.3 of **Appendix K**, have been undertaken in the Bowen Basin to understand faulting. Faulting has been inactive within the Bowen Basin for over 140 million years, indicating that the fault zones are less likely to act as conduits to flow. Fault cores typically exhibit hydraulic conductivities one to three orders of magnitude lower than the surrounding host rock. Drill core logs from the study area and surrounding mines indicate that many fractures and faults are 'healed' with calcite and siderite, reducing the effective permeability compared to open fracture networks. Faults act

as a horizontal permeability barrier to water and gas flow, with compartmentalisation evident due to the structural geology (faulting) in the Bowen Basin.

In the Project area, vertical displacement of coal seams (typically thin <4 m) often results in juxtaposition against lower permeability interburden or Rewan Group strata, creating local scale compartmentalisation. The Isaac Thrust Fault, which throws eastward by up to 100 m, contributes significantly to this compartmentalisation in a regional sense. Fault displacement and remineralisation together create hydraulic barriers that disrupt lateral groundwater flow along lithological bedding planes.

This conceptual understanding is supported by the site-specific hydraulic testing at the Project where slug test data from monitoring bore MBIS19 (which targets the Isaac Thrust Fault) recorded hydraulic conductivity values of 10^{-3} m/day, two orders of magnitude lower than the average values observed in the Leichhardt and Vermont coal seams at the Project. These results reinforce the interpretation that fault structures in the Bowen Basin, particularly the Isaac Thrust Fault, act as hydraulic barriers consistent with regional literature and observed field data.

24.5.4 Groundwater Recharge

24.5.4.1 Overview

The dominant mechanism for recharge to the groundwater system in the vicinity of the Project is via diffuse infiltration of rainfall through the soil profile and subsequent deep drainage to the underlying groundwater table. Short term sporadic recharge events to the underlying alluvium may also result from seepage of streamflow in the Isaac River and Cherwell Creek.

Section 5.4 of **Appendix K** provides detailed information on groundwater recharge, which is summarised below.

24.5.4.2 Deep Drainage

Deep drainage is defined as the downward movement of water from the soil profile beyond the root zone into the saturated groundwater system. This process occurs when infiltrated rainfall exceeds the soil water-holding capacity and is not removed through evapotranspiration or root uptake.

The Australian Water Resources Assessment Landscape model (AWRA-L), developed by the Frost, A. J., and Shokri, A. (2021) simulates the historical and projected landscape water balance for Australia and outputs estimates of surface runoff, soil moisture, evapotranspiration and deep drainage.

For the Project's groundwater assessment, monthly AWRA-L deep drainage outputs from 1985 to the end of 2025 were obtained from the Bureau of Meteorology and used as a proxy for groundwater recharge for the Project area. The AWRA-L data is not specific to a particular hydrogeologic unit. These outputs were compared against observed monthly rainfall data from the SILO database[9] for the same location.

To assess the temporal relationship between rainfall and modelled recharge from AWRA-L, a lag analysis was performed. The analysis showed that the strongest correlation between rainfall variability and deep drainage occurred when a four-month lag was applied to the deep drainage data. This pattern indicates a notable time delay between rainfall events and the eventual movement of infiltrated water to the groundwater table, which ultimately contributes to groundwater recharge.

Annual deep drainage shows a link relative to annual rainfall, with deep drainage as a percentage of rainfall ranging from less than 2% in dry years to over 12% in wetter years. That is, it is evident that the amount of rainfall that is simulated by AWRA-L to end up as deep drainage is variable (rather than a fixed percentage), and increases proportionally with increases in total annual rainfall. A long-term annual average deep drainage is calculated at 5.4% of average annual rainfall for the period 1998 to 2025.

[9] SILO is climate database facility operated by DETSI, based on data derived from the BoM.

24.5.4.3 Chloride Mass Balance

Recharge rates have been estimated using chloride mass balance (CMB) calculations. The CMB method estimates long-term mean recharge rates based on mean annual rainfall, atmospheric chloride accession, and chloride concentration in the groundwater, with the assumption of no other sources or sinks for the deposited chloride.

The CMB calculations are based on available groundwater quality results (chloride concentrations) collected from the monitoring bores in the Project monitoring network up until December 2025.

The results of the CMB analysis demonstrate calculated recharge rates generally range from 0.02 % to 4.96 % of long-term average annual rainfall, with highest recharge rates in the Isaac River alluvium and lowest recharge rates for the Leichhardt and Vermont coal seam. There is significant variability in calculated recharge rates within the alluvium, which reflects the heterogeneous nature of the alluvial sequence.

The long term average simulated deep drainage is higher than the long term average recharge rates calculated using the CMB. This is likely attributed to the scale of the data, as deep drainage is not aquifer specific and is simulated on a broad grid spacing, whereas the CMB calculation is local aquifer (and bore) specific.

24.5.5 Groundwater Distribution, Flow, Recharge and Discharge

Section 5.5 of **Appendix K** provides detailed information on groundwater distribution, flow, recharge and discharge, and is summarised below for each groundwater unit.

24.5.5.1 Alluvium

Saturation within the alluvial sediments across the study area is highly variable, suggesting that the alluvium does not form a continuous, high-yielding groundwater-bearing unit away from the immediate vicinity of the Isaac River and Cherwell Creek. Groundwater monitoring and ERI data indicate that significant saturation occurs primarily near the modern drainage channels of the Isaac River, Cherwell Creek, and at their confluence, where thicker and more permeable sediments are present. In contrast, areas further away from these channels often exhibit unsaturated or intermittently saturated conditions, reflecting the discontinuous nature of the aquifer system. This spatial variability suggests that the alluvium does not function as a single, laterally extensive groundwater-bearing unit across its mapped extent, but rather as a series of localised zones. Regionally, groundwater in the alluvium, where saturated, occurs between 10 - 12 metres below ground level (mBGL). The potential for alluvium to host groundwater is considered limited at depths shallower than this.

Within the Isaac River alluvium, bores MBIS01 (base screen 12 mBGL or 184.9), MBID03 (base screen 20 mBGL, 181.5 mAHD), MBID09 (base screen 8 mBGL, 187.8 mAHD), and MBID26 (base screen 8 mBGL, 184.4 mAHD) have all been dry since installation. MBID26, with a base of screen of 8 mBGL (184.4 mAHD) has been recorded as dry since January 2023. Other bores show a genermAHDal west to east decrease in groundwater level from approximately 192 mAHD to 183 mAHD, with some response to variation in rainfall.

In the Cherwell Creek alluvium, saturation is similarly sporadic. Project bore MBIS06 (base screen 10 mBGL, 175.5 mAHD) has remained dry since installation in November 2024, while MBIS07, monitored since May 2025, show groundwater levels between approximately 10 and 12.5 mBGL, respectively, with a subtle decline in groundwater levels of approximately 0.5 m since the start of monitoring coinciding with declining deep drainage. Groundwater level elevations decrease from southwest to northeast in the Cherwell Creek alluvium, in the direction of surface water flow.

MBIS14 (bottom of screen 12 mBGL or 184.7 mAHD), located at the confluence of Isaac River and Cherwell Creek, has been dry since installation in June 2025. This indicates that the State defined HES wetland at this location is not supported by groundwater hosted in the regional alluvium aquifer. Based on the GDE studies (see Section 24.6.3), the floor of the HES wetland is underlain by a roughly 2.5 m thick hardened clay sequence, which acts as an aquitard and contributes to perched surface water above that horizon during wetter periods.

At Conrock Gully, groundwater levels at MBID27 (May 2021 to January 2023) show limited fluctuations in response to deep drainage recharge events, with groundwater levels occurring around 12.5 mBGL (186 mAHD).

Hand-augering investigations for the GDE study, targeting the shallow alluvium along the Isaac River and Cherwell Creek, indicated that the majority of auger holes were dry (see Section 24.6.3). Only one hole, located within the Isaac River channel itself, intersected groundwater at a depth of 0.8 m below the current streambed. However, this is interpreted as a shallow perched groundwater system, derived from rainfall and surface water infiltration rather than the regional alluvial water table. The presence of an unsaturated zone beneath the streambed (besides limited perched groundwater systems) confirms that the river is a losing stream with no baseflow interaction at this location, and that the alluvial aquifer is hydraulically disconnected from the riverbed.

Figure 5-13 of **Appendix K** illustrates the interpreted alluvial potentiometric surface for the end of 2025. Groundwater flow within the Isaac River alluvium is directed to the southeast, consistent with the surface water flow. Groundwater elevations along Cherwell Creek exhibit a similar pattern, reflecting both surface water flow and local topography.

Recharge to the alluvium is considered to be mostly by infiltration from short lived stream flow or flooding (losing streams as demonstrated in Section 24.5.5.4), with direct infiltration of rainfall also occurring where there are no substantial clay barriers in the shallow subsurface.

The calculated CMB recharge estimates as a percentage of long term average annual rainfall ranged from 0.02% to 4.69% for the Isaac River alluvium. For the Cherwell Creek alluvium, three samples from two bores were analysed, showing recharge estimates between 0.33% and 0.89% of long term average annual rainfall.

Geological logs in in the alluvial sediments indicate the alluvium is underlain by low hydraulic conductivity strata, including claystones, siltstones (with only pockets of coarser grained sand). These layers restrict the rate of downward leakage to underlying formations and contribute to the overall low recharge percentage. Slight differences in recharge between the Cherwell Creek and Isaac River alluvium are primarily influenced by variations in river size, sediment characteristics, and hydrological connectivity. The Isaac River alluvium occurs as a larger river system with drill logs indicating larger floodplains and coarser sediments, which promote higher infiltration and more variable recharge rates. In contrast, Cherwell Creek is a smaller tributary with finer-grained sediments limiting infiltration from surface and lower recharge estimates.

Following significant rainfall and flood alluvial groundwater levels may rise, causing temporary discharge from the perched groundwater system as interflow contributions back into the Isaac River. The alluvial groundwater system has not been recorded to rise above stream bed elevations over the monitoring period. Groundwater discharge from the alluvium at the Project also occurs through the use of privately-owned bores within the region.

Some limited local-scale discharge from the alluvium to active mine pits may occur in the study area, where saturated alluvium is intersected by mining pits.

Localised perched groundwater systems within the alluvium (i.e. above and disconnected from the alluvial aquifer considered to form the alluvial aquifer) are evident where surface waterbodies continue to hold

water at times during dry periods (e.g. pools in the Isaac River and floodplain wetlands occur where clay layers slow the percolation of surface water (see Section 24.6.3)).

24.5.5.2 Regolith

Across the Project area, the colluvial material, Tertiary sediments, weathered Triassic strata and weathered Permian strata (< 30 m deep), collectively referred to as the Regolith, generally form the water table aquifer where saturated overlying alluvium is not present. Groundwater within the Regolith (where it is present) typically occurs at depths between 9 to 14 mBGL within the clayey sand and weathered horizons of Tertiary and Permian-aged sediments.

Bores MBID22, MBID06A, MBID07, MBID25A target the weathered Rewan Group strata. Groundwater levels in MBIS22 fluctuate by approximately 10 m in the monitoring record, likely in response to pumping for livestock water supply from a nearby landholder bore located about 5 m away. Similarly, bore MBID07, situated just northeast of MBIS22, exhibits comparable fluctuations, which are also attributed to landholder pumping activities. In contrast, historical data from MBID25 show relatively stable water levels around 183 mAHD, although a notable decline of 10 m was observed at the end of 2021.

Shallow bores within the upper weathered parts of the RCM are included with the Regolith. Recent monitoring at bores targeting the upper weathered RCM interburden shows groundwater levels ranging between 184 and 195 mAHD.

Groundwater flow within the Regolith, where it is saturated, is generally towards the south-southeast, following regional topographic gradients and the drainage direction of the Isaac River and Cherwell Creek.

The calculated CMB recharge estimates as a percentage of long term average annual rainfall ranged from a minimum of 0.03% to a maximum of 2.83%. Recharge to the Tertiary sediments and weathered strata (Regolith) is restricted by the presence of low hydraulic conductivity material (clays) which limit rainfall infiltration.

Regionally, groundwater discharge within the Regolith may occur primarily via evapotranspiration (which includes components of evaporation through the soil profile, and transpiration from terrestrial vegetation). However, transpiration from terrestrial vegetation appears unlikely in the Project area, as the GDE assessment did not identify any terrestrial groundwater-dependent ecosystems beyond the immediate vicinity of creek lines (see Section 24.6.3). There may be some limited local-scale discharge from the Regolith to active mine pits where saturated Regolith is intersected. Vertical seepage from the Regolith to deeper formations is expected to be limited by the underlying low hydraulic conductivity Rewan Group (where present) and other aquitards, such that the Regolith effectively forms a perched groundwater system above the Permian strata.

24.5.5.3 Permian Coal Measures

Groundwater within the Permian coal measures is confined and sub-artesian. Within the Leichhardt coal seam, groundwater levels generally range from approximately 179 to 191 mAHD (approximately 11 to 23 BGL) across the Project area and surrounds. Most bores with long-term (pre-2022) monitoring data show relatively stable groundwater levels, with gradual declines of up to 2 to 3 m over the monitoring period, likely reflecting the influence of nearby mining activities at IDM. More recent data from newly installed bores at the Project, further east-southeast from IDM, indicate subtle short-term fluctuations of 1–2 m, which appear to correspond with rainfall events.

Groundwater levels from bores targeting the Vermont coal seam indicate groundwater levels are between 186 and 189 mAHD (12 to 25 mBGL) and are generally stable over the monitoring record, with only minor fluctuations in response to rainfall. An exception is observed at MBIS16 in the south of the Project area, where groundwater levels are affected by an actively pumping landholder bore located approximately 10 m south of MBIS16, resulting in localised drawdown.

Historical data from Matrix+ Consultants (2008) give an insight to historical pre-mining groundwater levels recorded in 2006 within the IIPP area, which overlapped directly with the Project area. This historical data provides a comparison to more recent pre-mining groundwater levels. Bores 205S, 205DR, 592S and 592D record deeper groundwater levels in 2025 compared to those observed in 2006, with these declines likely attributed to the cumulative impacts of mining activities in and around the Project area. In contrast, bores 593 and 594 show shallower water levels in 2025 relative to 2006, which may possibly be attributed to historical landholder abstraction in the vicinity of these bores 593 and 594 which has now ceased.

The interpreted Permian coal measures potentiometric surface for the end-2025 shows that groundwater flow direction is consistent with regional topographic trends, with a localised inward gradient towards the active pits at IDM and PTM.

Recharge to the Permian coal measures occurs where the coal seams of the unit subcrop. Due to the low hydraulic conductivity of the interburden material, groundwater largely flows along the bedding plane of the coal seams. CMB recharge estimates for the Leichhardt coal seam were derived from 94 samples collected across 11 bores. The calculated recharge as a percentage of long term average annual rainfall ranged from 0.02% to 1.59%. For the combined Leichhardt and Vermont coal seams, 38 samples from a single bore were analysed, showing recharge estimates between 0.03% and 0.09% of long term average annual rainfall. Recharge estimates for the Vermont coal seam were based on 17 samples collected from five bores. The calculated recharge as a percentage of long term average annual rainfall ranged from 0.04% to 0.24%. For the Fort Cooper Coal Measures, eight samples from two bores were analysed, showing recharge estimates between 0.20% and 1.32% of long term average annual rainfall.

Recharge within the Permian formations is generally low because these units occur at significant depths and are overlain by thick interburden sequences composed of sandstone and siltstone, that have very low hydraulic conductivity, which restricts vertical water movement from the surface to the coal seams. The combination of depth and low-permeability barriers means that rainfall infiltration rarely reaches these formations, and recharge is limited to slow, localised processes such as leakage through fractures or faults. The limited correlation with deep drainage also supports this finding.

Groundwater discharge occurs predominantly via evaporation from pit faces in mining operations at neighbouring mines.

24.5.5.4 Vertical Connectivity and Hydraulic Gradient Between Aquifers

The Project's monitoring network includes several locations where two or more bores are installed at the same site, each screened in different aquifer units. These 'paired' bores enable direct comparison of groundwater levels between overlying and underlying aquifers, providing valuable insights into hydraulic connectivity and potential vertical flow gradients within the stacked aquifer system.

Figure 5-21 of **Appendix K** presents a series of graphs illustrating groundwater level trends observed in these paired bores across the Project area and surrounds. Overall, the data indicate that vertical hydraulic connectivity between the alluvium, Leichhardt coal seam, and Vermont coal seam is limited. This supports the conceptualisation of these aquifers as hydraulically distinct, with minimal potential for significant vertical groundwater movement under current conditions. Furthermore, groundwater levels within the alluvium and the Leichhardt and Vermont coal seams are below the stream bed elevations of the Isaac River and Cherwell Creek, indicating there is no potential for RCM groundwater discharge into these surface water features.

24.5.6 Groundwater Quality

24.5.6.1 Groundwater Types

Summary statistics for all monitoring bores, across the parameters assessed, are presented in Appendix A of **Appendix K**.

The proportions of major anions and cations were used to determine the hydrochemical facies of groundwaters sampled at the Project (as well as relevant groundwater sampled at IDM and PTM). The anion-cation balance, pH and electrical conductivity (EC) of historical data from all bores listed in Section 24.5.2 is displayed on the Durov diagrams in Figure 5-22 to Figure 5-25 of **Appendix K** for the alluvium, Regolith, Permian RCM and FCCM. Overall, groundwater quality shows a high degree of variability both between hydrostratigraphic units and among individual bores within the same unit.

Groundwater quality for majority of the monitoring bores screened within the alluvium indicates a sodium (Na) - chlorine (Cl) water type, with pH values ranging from weakly acidic to weakly alkaline. While some bores have a mixed water type with higher ratios of magnesium and bicarbonate. This chemistry is consistent with processes such as ion exchange on clays and the dissolution of saline or evaporitic material, which commonly influence groundwater in alluvial settings. In contrast, bores upstream along the Isaac River show a Na- magnesium (Mg) - calcium (Ca) water type and slightly lower EC, which reflects fresher groundwater with shorter residence times and stronger interaction with the surrounding sediments and rocks.

Monitoring bores within the Regolith include those installed into both Tertiary sediments/basalt, weathered Rewan Group and shallow weathered RCM overburden. The dominant water types are Na-Mg-Cl, with some Na-Mg- bicarbonate (HCO_3). Na-Mg waters usually form when silicate minerals like feldspars and pyroxenes break down, releasing sodium and magnesium into solution, which can occur as a result of weathering. The Na-HCO_3 water type points to ion exchange processes and carbonate inputs, with bicarbonate coming from both carbonate dissolution and carbon dioxide (CO_2) from soils.

In the shallow zones, some samples have higher salinity as EC, showing an evaporitic signature where salts are concentrating through evaporation. The pH is neutral to moderately alkaline, which is typical where carbonate reactions help buffer acidity.

Monitoring bores screened within the RCM mainly record Na-Cl type waters, with minor increases in carbonate (CO_3) and Mg. The dominance of Na-Cl waters likely reflects the influence of evaporite dissolution and long-term water–rock interaction in the coal-bearing formation. Salinity across the RCM varies widely, from brackish to highly saline, indicating compartmentalisation of the groundwater system. Groundwater pH also varies considerably, ranging from slightly acidic to strongly alkaline.

In the FCCM, monitoring bores consistently record strongly Na-Cl type waters, with minor contributions of HCO_3. The waters are generally slightly alkaline. The dominance of Na-Cl-HCO_3 suggests significant rock–water interaction and long residence times, allowing minerals to dissolve and release their ions into solution.

24.5.6.2 Salinity

Salinity is a key constraint to water management and groundwater use by receptors and can be described by total dissolved solid (TDS) concentrations. Figure 24-14 presents the TDS data associated with groundwaters screened in the various hydrostratigraphic units for Project monitoring bores.

The graph shows that available data for the alluvium indicates a large range in salinity, with TDS ranging from fresh to highly saline. Fresher salinities are considered indicative of relatively recent local recharge, whereas more saline areas of alluvium are considered indicative of relatively long groundwater residence times and significant evapo-concentration. These results indicate that groundwater in the alluvium is not well interconnected but rather somewhat isolated across the formation. It also indicates that some areas receive significant recharge from surface water whereas other areas experience a comparative lack of freshwater recharge, an increase in evapoconcentration, and longer groundwater residence times.

Groundwater from bores in the Regolith ranges from brackish to highly saline. Bores that screen the Leichhardt and Vermont coal seams of the RCM generally have higher salinities, recording groundwater ranging from brackish to highly saline. The FCCM have salinities in groundwater ranging from brackish to highly saline.

For the purposes of the void hydrogeochemical study (**Appendix M, Chapter 5**), a subset of the Project groundwater quality dataset was used to represent more localised conditions around the void as source terms for the modelling. This subset focuses on bores targeting non-coal interburden that will surround the spoil, as well as selected bores targeting coal seams near the void. Median field EC values were 3,492 µS/cm for the non-coal interburden and 11,216 µS/cm for the coal seams.

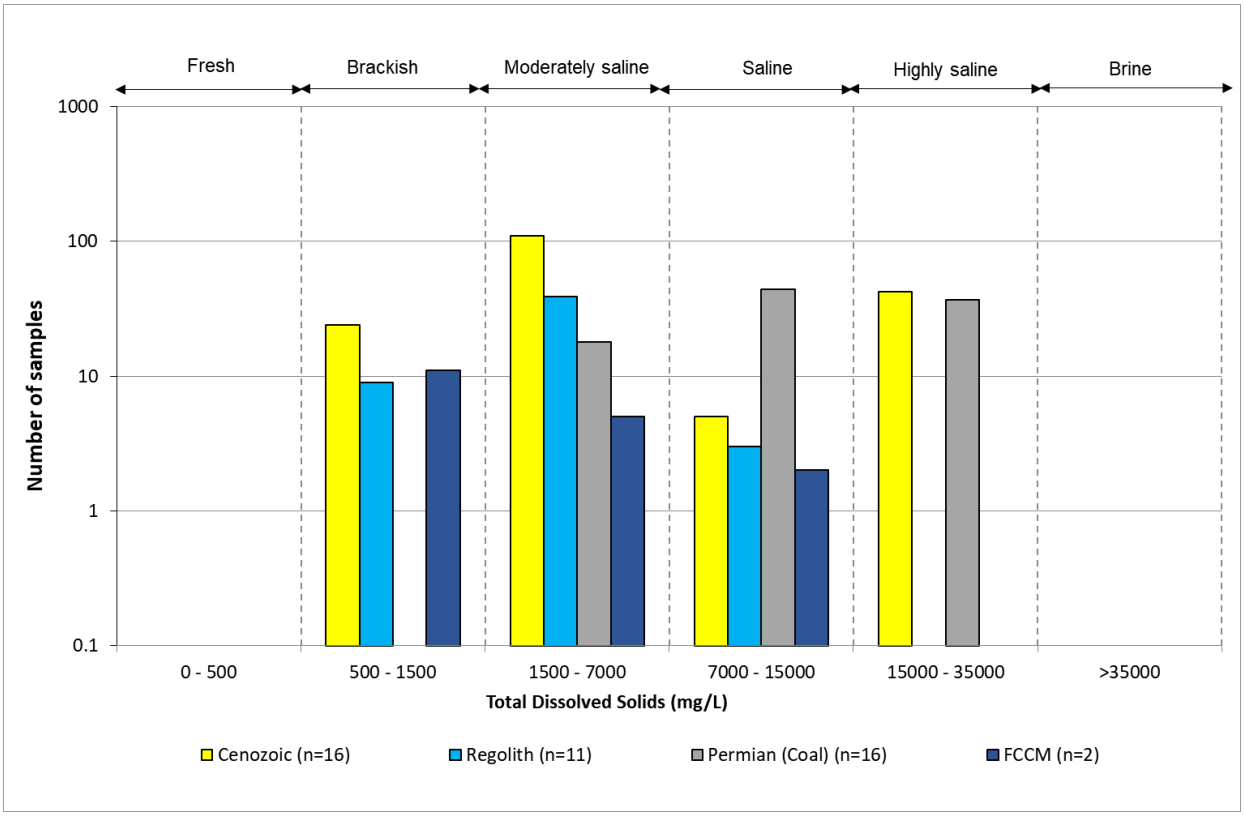


Figure 24-14 Salinity Ranking by Groundwater Unit

24.5.6.3 Water Quality Objectives

WQOs are scheduled under the EPP Water for Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin WP (WQ1310), as relevant to identified EVs.

WQOs has been defined in terms of:

- Australian Drinking Water Guidelines (ADWG) (NHMRC and NRMMC, 2011), despite there be no evidence that groundwater is utilised as drinking water supply (Table 24-6).
- Aquatic ecosystem protection for moderately disturbed system (ANZG, 2018) (95% protection) (Table 24-6).
- Isaac River Sub-basin EVs and WQOs for stock and irrigation (DEHP, 2011) (Table 24-6).
- Fitzroy Basin Groundwater Water Quality Objectives: Aquatic ecosystems (Zone 34) (DEHP, 2011) (Table 24-7).

Table 24-6 Water Quality Objectives for Isaac River Sub-basin Environmental Values

Water Quality Indicator	Unit	ADWG Guidelines		Isaac River Sub-basin EVs		
		Health	Aesthetic	Irrigation	Stock	Aquatic 95%
pH	-		6.5 to 8.5			6.5 to 8.5
Aluminium	mg/L		0.2		5	0.055
Calcium	mg/L				1000	
Chloride	mg/L		250			
Magnesium	mg/L				2000	
Manganese	mg/L	0.5	0.1	10		1.9
Sodium	mg/L		180			
Sulfate	mg/L				1000	
Zinc	mg/L		3			0.008
Arsenic	mg/L	0.01		2	0.5	0.024
Cadmium	mg/L	0.002			0.01	0.0002
Chromium	mg/L	0.05			1	0.001
Cobalt	mg/L			0.1	1	
Copper	mg/L	2	1		1	0.0014
Lead	mg/L	0.01			0.1	0.0034
Mercury	mg/L	0.001			0.002	0.0006
Nickel	mg/L	0.02			1	0.011
Selenium	mg/L	0.01			0.02	0.005
Silver	mg/L	0.1				0.05

Table 24-7 Isaac River Sub-basin Zone 34 WQOs for Groundwater Resources (Aquatic Ecosystem Protection)

Water Quality Indicator	Unit	Shallow Groundwater (<30m)			Deep Groundwater (<30m)		
Percentile	-	*20th*	*50th*	*80th*	*20th*	*50th*	*80th*
EC	µS/cm	498	2150	8910	3419	6100	16000
Hardness as CaCO3	mg/L	163	674	2228	359	919	3208
pH	-	7.1	7.75	8.1	7.4	7.8	8.03
Alkalinity	mg/L	154	435	752	156	275	536
Ca	mg/L	18	84	215	46	145	442
Mg	mg/L	27	108	389	35	115	491
Na	mg/L	135	747	1500	480	1100	2565
Cl	mg/L	171	1309	3185	753	1900	5905
SO4	mg/L	12	140	318	25	138	398

Water Quality Indicator	Unit	Shallow Groundwater (<30m)		Deep Groundwater (<30m)			
HCO3	mg/L	187	536	878	188	330	650
NO3	mg/L	0	0.95	5.3	0.01	2.15	14.92
SiO2	mg/L	21	36	52	16	25	36
F	mg/L	0.1	0.28	0.5	0.02	0.155	0.4
Fe	mg/L	0	0.03	0.14	0	0.05	0.246
Mn	mg/L	0	0.01	0.16	0	0.05	0.291
Zn	mg/L	0	0.015	0.06	0.01	0.025	0.317
Cu	mg/L	0	0.01	0.03	0.017	0.03	0.03

In order to understand the possible utilisation of groundwater resources within and proximal to the Project area, available Project groundwater quality data (80th percentile of available dataset at each bore) have been compared to various WQOs. Where groundwater quality analysis results exceed a particular WQO for a particular EV, it is considered indicative that the groundwater may be unsuitable for supporting that particular EV.

A comparison of these WQOs to the 80th percentile of available historical water quality data for the monitoring bores are presented as Appendix A of **Appendix K**.

Groundwater within the alluvial and regolith Project bores generally exceeds the WQO criteria for aquatic ecosystem protection (shallow groundwaters <30 m) for zinc, manganese, pH, and total alkalinity. Bores also exceed the aquatic ecosystem WQO criteria for cadmium, copper, mercury and selenium. However, bores MBIS05 and MBID07 targeting the alluvium along the Isaac River show no exceedances of WQO criteria. This difference may be attributed to the hydrogeological heterogeneity of the alluvium, which likely results in shorter groundwater residence times and a greater influx of recharged fresher water at these locations. Overall, the comparison suggests that alluvial and regolith groundwater typically exceeds one or more WQO criteria for aquatic ecosystem protection but is generally suitable for supporting stock watering and irrigation.

Groundwater in the Permian strata units, including the Leichhardt and Vermont coal seams, consistently exceeds multiple WQO criteria across all scheduled EVs. Key exceedances include pH, EC, and many major ions and dissolved metals such as manganese, chromium, iron, and zinc. A similar exceedance pattern is observed in groundwater from the FCCM. These results indicate that groundwater in the Permian coal measures is generally unsuitable to support any of the scheduled EVs.

24.6 Environmental Values – Groundwater Receptors

24.6.1 Overview

The potential groundwater receptors identified through Project related studies are:

- landholder groundwater bores utilised primarily for stock watering, with some bores utilised for water supply to a quarry to the west of the Project
- GDEs
- stygofauna.

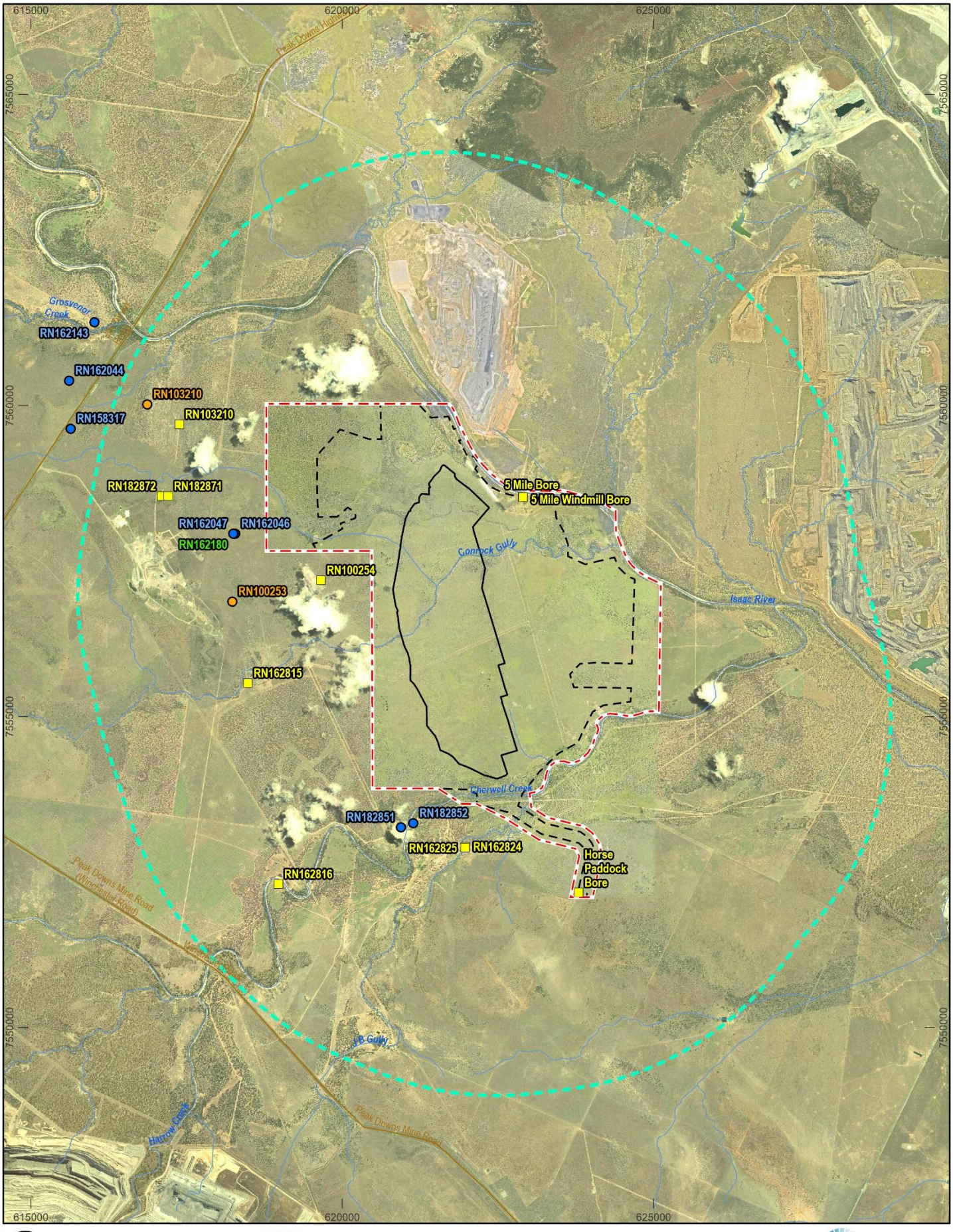
These potential groundwater receptors are described in the following sections.

24.6.2 Landholder Bores

A search of the State's registered groundwater bore database was carried out for registered bores within 5 km of the Project area, with these shown in Figure 24-15. A subsequent bore census was conducted (Appendix E of **Appendix K**). The bore census confirmed a total of 11 landholder supply bores within 5 km of the Project area. Of these, six were active supply bores, while the remaining five were inactive and not equipped with pumps at the time of the survey. Details of the 11 landholder bores are provided in Table 5-7 of **Appendix K**. Figure 24-15 shows all registered bores inspected during the census, including the 11 landholder bores. Non-landholder bores, associated with groundwater monitoring by other resource companies), RN162143 (MB06), RN158317 (MB08b), RN162046 (MB09B), RN162047 (MB09C) and RN182851 formed part of the baseline monitoring network for the Project. Other non-landholder bores shown in Figure 24-15 are historical monitoring bores.

Bores RN162815 (unknown aquifer), RN103210 (Permian coal measures), and the 5 Mile Windmill Bore (weathered Triassic / regolith) are stock supply bores, each supplying one or more storage tanks or cattle troughs. Measured flow rates at these bores during the site visit ranged from 0.05 to 0.25 L/s. The Horse Paddock Bore was not operational at the time of inspection, and the landholder was unable to activate the pump. No information regarding the pumping schedules of the stock supply bores was available from the landholder.

Bores RN182871 and RN182872 are active supply bores for a small basalt quarry just west of the Project area and drilled to 60 mBGL and 80 mBGL, respectively, indicating a likely groundwater source within the FCCM. Both are equipped with steel headworks and electro-submersible pumps. However, no depth or source aquifer information is available. These bores reportedly operate at rates of 0.2 and 0.3 L/s, respectively, for approximately 8 hours per day. Bore RN182871, drilled in October 2024, is more recent than RN182872, and the quarry manager reported elevated iron precipitate in this bore.



0 500 1000 1500 2000 2500

Metres

Datum:	GDA2020 Zone 55
Scale:	See Scale Bar
Date:	28/05/2026 8:08 AM
Drawn:	Minserve
Source:	SLR
File:	20260527 Bores Map.aprx

DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.

LEGEND

- Waterway
- Roads
- IDE Project MLAs
- Proposed Project Disturbance Area
- Project Pit Extent
- Proposed Project Pit 5km Buffer
- Landholder Bore

Registered Bore

- Monitoring
- Monitoring (VWP)
- Supply

stanmore

ISAAC DOWNS EXTENSION

Registered and Landholder Bores

Figure | **24-15**

24.6.3 Groundwater Dependent Ecosystems

24.6.3.1 Ecological Characteristics of GDE Species and Communities

As GDEs define a continuum between groundwater and surface ecology, Section 3 of **Appendix N** provides a description of both biotic factors and abiotic controls, enabling linkages to be drawn to assist in the assessment of risks to GDE function.

Field mapped regional ecosystems (REs) (see **Chapter 25**) were used to understand the vegetation within and surrounding the Project area, including threatened ecological communities (TECs).

Species sampled in the GDE survey include the four eucalypts associated exclusively with RE11.3.25, namely river red gum (*Eucalyptus camaldulensis),* forest red gum (*Eucalyptus tereticornis*), poplar box (*Eucalyptus populnea*), and coolabah (*Eucalyptus coolabah*), plus *Melaleuca fluviatilis*. The sampling of river and forest red gum occurred in all habitats that fringed watercourses (RE11.3.25) and wetlands (RE11.3.27b), while poplar box formed more laterally extensive habitats on elevated terraces. Brigalow (*Acacia harpophylla*) and coolabah (*Eucalyptus coolabah*) generally formed discrete patches, often mixing on the fringes of ephemeral watercourses.

A detailed description of the potential for various tree species to be GDEs is provided in Section 3 of **Appendix N**, and summarises as:

- All eucalyptus species are potential groundwater users, with varying degrees of adaptations or limitations. River red gum is a well-studied species known to have deep sinker roots, hypothesised to grow down towards zones of higher water supply, and the species mixes with forest red gum along the river frontage.
- Brigalow's shallow rooting habit is evident with the tendency of mature trees to topple because of churning in the upper soil profile with fallen trees universally exposing a well-developed lateral root system with little evidence for development of deeper sinker roots that would have capacity to propagate to deeper groundwater tables. Brigalow is not considered to represent groundwater dependent vegetation.
- Based on observations of matted tree roots concentrated in wet sands within river channel deposits, it is expected that melaleuca species will utilise mostly surface water, with the capacity to utilise residual moisture in river channel deposits as surface water recedes.
- Native grassland communities (i.e. RE11.8.11) are not considered in the GDE assessment as the shallow root system of native grasses precludes any likelihood of groundwater dependence.

Chapter 25 identifies that the Project area and surrounds does not support aquatic GDEs, due the ephemeral nature of the drainage systems and lack of persistent groundwater-supported pools in these systems.

24.6.3.2 Hydrogeological Setting

Section 24.5 describes the hydrogeological setting for the Project that has informed the GDE assessment, including the data from groundwater monitoring bores, as detailed in Section 3.2 of **Appendix N**. Key findings, as relevant to the GDE assessment include:

- The Isaac River alluvium is typically formed by thick, fluvial sand deposits which host a seasonally sustained unconfined groundwater table. Recharge to the alluvium is mostly from stream flow or flooding (i.e. a losing stream), with direct infiltration of rainfall also occurring where there are no substantial clay barriers in the shallow subsurface. Alluvium along Cherwell Creek is closely aligned with the modern creek channel, compared to the broader extent of alluvium associated with the Isaac River.
- The unconfined aquifer within the alluvium is referred to as the 'alluvial aquifer'.

- Perched groundwater systems are likely to occur within the alluvium. These are discrete groundwater units sitting above the alluvial aquifer / water table, and are separated by an unsaturated zone.

Section 24.3 provides a description of the surface waters catchments, and the hydrology and geomorphology of waterways, respectively, within and surrounding the Project area. Vegetation in the Project area and surrounds, including potential GDEs, will also rely on surface water flows.

24.6.3.3 GDE Assessment Findings - Leaf Water Potential

Figure 24-16 shows the average and range of LWP values reported for each of the 20 assessment areas, separated by key vegetation types and / or location. The black line approximates 'standard wilting point' where trees are moisture-limited and unlikely to be utilising groundwater. Low to very low moisture availability indicates vegetation that is utilising soil moisture sources in the vadose zone. High to moderate moisture availability suggests that riparian vegetation is utilising a brackish groundwater source. Very high moisture availability suggest the possible use of a fresh groundwater source.

Sites along the Isaac River vary from very low to very high moisture availability. Sites along Cherwell Creek have mostly low to very low moisture availability. The HES wetland demonstrated high to very high moisture availability. Brigalow and poplar box sites have considerably more negative LWP values in the low to extremely low range. Based on LWP values alone, this suggests that brigalow and poplar box habitats are moisture-limited and unlikely to be utilising groundwater.

Additional detail on LWP findings is provided in Section 5.1 of **Appendix N**.

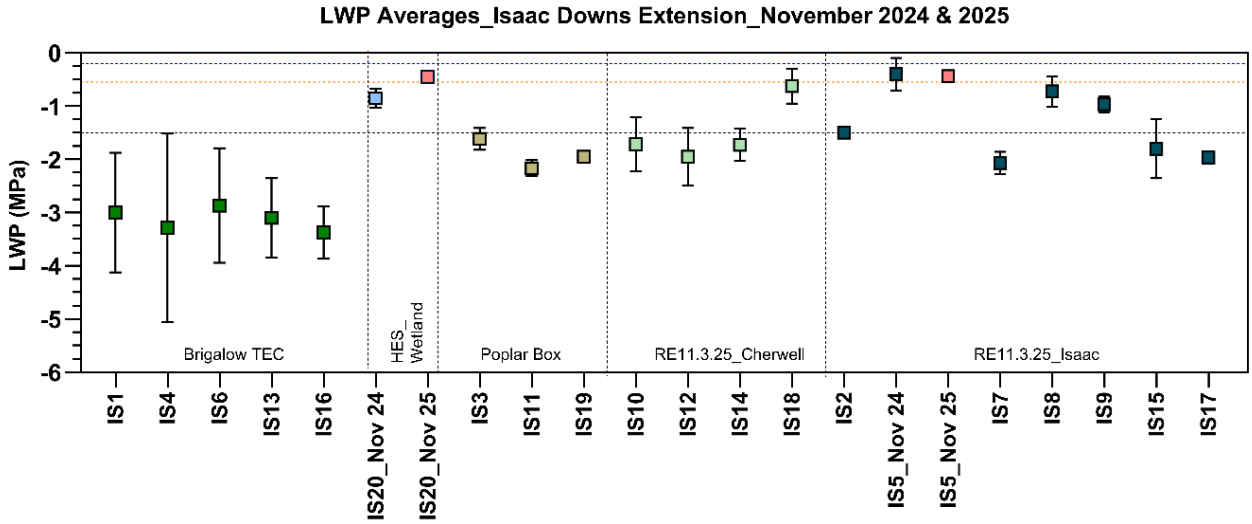


Figure 24-16 LWP for GDE Assessment Sites – Ranges and Averages

24.6.3.4 GDE Assessment Findings - Soil Auger Sampling

Seven auger profiles were completed in November 2024 assessment, plus an additional two auger samples in November 2025. These targeted riparian landforms associated with the Isaac River and Cherwell Creek, as well as the HES wetland.

Results from the Isaac River indicate that that soil moisture from the vadose zone can account for the reported LWP values at these sites, and the presence of shallow groundwater is not necessary to account for any measured high LWP values.

Results from Cherwell Creek indicate that LWP values can be readily accounted for by the moisture availability in the vadose zone, supporting the inference that groundwater is not contributing to the moisture sources.

Results from the HES wetland indicate that SMP values overlap with LWP values below deeper than 3 mBGL, which provides direct evidence that soil moisture within the sand provided the source of moisture for deep-rooted vegetation in November 2024, with no evidence for significant groundwater usage. In November 2025, the entire soil profile was potentially contributing to tree moisture sources.

Additional detail on soils auger and SMP results is provided in Section 5.2 of **Appendix N**.

24.6.3.5 GDE Assessment Findings - Stable Isotopes

An analysis of stable isotope data collected from soils, twig xylem, groundwater and surface water was used to inform vegetation groundwater dependence.

For Isaac River GDE assessment sites, the lack of overlap between isotopic clusters formed by twig xylem and groundwater indicates that groundwater was not a significant source of moisture for riparian trees. However, the twig xylem values tend to lie consistently between the soil and surface water values, indicating that both sources likely contribute moisture to riparian vegetation. At one site xylem isotopes were substantially lighter, reflecting the influence of the isotopically light perched groundwater unit.

For Cherwell Creek GDE assessment sites, the lack of overlap between isotopic clusters formed by twig xylem and groundwater indicates that groundwater was not a significant source of moisture for riparian trees.

For the HES wetland GDE assessment sites, twig xylem isotope values form clusters that are distinct from the groundwater clusters, and limited overlap with the soil isotope values. The lack of overlap between isotopic clusters formed by twig xylem and groundwater indicates that groundwater was not a significant source of moisture for riparian trees in November 2024. SMP and isotope sampling in November 2025 provide strong evidence that moisture was derived from the soil profile, with possible minor contribution from small quantities of groundwater perched above the basement contact.

Additional detail on the results from stable isotope analysis is provided in Section 5.3 of **Appendix N**.

24.6.3.6 GDE Assessment Findings - Radon Analysis

Radon concentrations in the river sand, riverbanks, and residual surface waters form a distinct cluster, with radon concentrations and EC values lower than those in the alluvial monitoring bores.

Additional detail on the results from radon analysis is provided in Section 5.4 of **Appendix N**.

24.6.3.7 Summary of Results

GDE data analysis demonstrates the following:

- Combined application of LWP and SMP measurements demonstrates riparian vegetation (RE11.3.25) fringing both the Isaac River and Cherwell Creek, was utilising soil moisture in the unsaturated portion of the soil profile to support transpiration at the time of the November 2024 assessment. The stable isotope composition of tree xylem is substantially enriched and distinct from other sources, possibly influenced by surface water usage where this is available. Isotopic data from one site on the Isaac River (IS5) in November 2025 indicates increased use of water in the perched groundwater unit by riparian vegetation, though soil moisture and surface water remained the dominant moisture sources.
- Similarly, deep-rooted woody vegetation both within and fringing the HES wetland (Site IS20) was utilising moisture sourced from the vadose zone in November 2024, preferably utilising moisture from an unsaturated interval of sand that formed a 3 m thick massive sequence above weathered basement rock. When sampled in November 2025, the soil profile carried substantially more

moisture, and wetland trees were using moisture held throughout the soil profile, including the potential use of small volumes of groundwater, attributed to surface infiltration, that was perched in sand above weathered Permian sediments.

- For the Poplar Box (RE11.5.3) and Brigalow threatened ecological community (TEC) habitats (RE11.3.1 and 11.4.9), the highly negative LWP measurements confirm that trees are utilising moisture tightly bound to soil grains within the vadose zone, and not groundwater.

Despite the lack of demonstrated groundwater use at the time of the November 2024 assessment for any habitats within and surrounding the Project area, the saturation of soil profiles and seasonal perching of groundwater above impervious strata and the regional water table is likely to occur during wetter climatic periods following moisture recharge by rainfall and surface flows. Increased volumes of groundwater from the perched groundwater unit (as distinct from the deeper alluvial aquifer) were demonstrated during sampling in November 2025, intersected in auger profiles at sites IS5 and IS20 in a lower terrace of the Isaac River and the HES wetland, respectively. Although seasonal in nature, and being discharged through evapotranspiration as the climate dries, the accumulation of groundwater (in the perched groundwater unit) in the root zone of woody vegetation is consistent with the definition of a 'terrestrial' GDE. Where groundwater use occurs, it is restricted to the immediate riverbanks where trees interact directly with perched groundwater unit, and not with the deeper alluvial aquifer.

Sandy soils facilitate the rapid infiltration of rainfall and surface flows, while also having the capacity to store and transmit groundwater, typically found within the channel and stream banks of the Isaac River and Cherwell Creek. The thick sandy interval lying below the HES wetland will be variably saturated during wet seasons through downward leakage of surface waters. The pervasive intense iron oxide staining evident in the thick sand interval suggests sustained wetting and moisture infiltration rather than prolonged saturation which would result in iron dissolution (Taylor and Eggleton, 2001). Perching of small volumes of groundwater at the base of the sandy interval was confirmed during November 2025 auger sampling, though groundwater perching only occurs following significant surface pondage and associated leakage. Perched groundwater in this wetland is not associated with the deeper alluvial aquifer.

Radon sampling provided additional context to the partitioning of groundwater with the alluvium, particularly the differentiation of the alluvial aquifer and the perched groundwater unit. Surface water was abundant in the Isaac River, consistent with ponding in the HES wetland in August 2025. Surface water from this sampling event is rainfall-derived on account of its low radon concentration and low EC. Most isolated residual pools sampled in the Isaac River in November 2025 had more elevated radon concentrations, consistent with groundwater in the perched groundwater unit (both in the river sand and the riverbank). The increased radon concentrations in November 2025 suggest that the residual waterbodies in the Isaac River are a surface expression of the perched groundwater unit, encompassing groundwater in the river sand and riverbank. The perched groundwater unit is distinct from the alluvial aquifer sampled in monitoring bores, and groundwater from the perched unit slowly leaks into the alluvial aquifer, providing a source of recharge to it. Data from stable isotopes suggests that leakage is diffuse and slow, with the first evidence of groundwater influx from the perched groundwater unit to the alluvial aquifer taking several months.

24.6.3.8 Ecohydrological Conceptual Site Models

Ecohydrological conceptual models for potential GDEs, as represented by terrestrial vegetation along the Isaac River and the HES wetland, are provided in Figure 24-17 for the dry season, Figure 24-18 for the wet season and Figure 24-19 for post wet season. These models have been developed based on the findings from GDE field studies for the Project.

The dry season model (Figure 24-17) demonstrates the partitioning of the perched groundwater unit and the alluvial aquifer, the slow leakage of groundwater from the perched groundwater unit to the alluvial aquifer, plus the use of the perched groundwater unit by fringing riparian vegetation. The hydrological function of the lower reaches of Cherwell Creek mimics the Isaac River, except for shorter flow duration

and more rapid discharge of water from the river sand. Further upstream (westward) in Cherwell Creek the alluvium shallows.

The wet season conceptualisation (Figure 24-18) demonstrates recharge of the perched groundwater unit hosted in recent/active alluvia on the inner banks of the Isaac River. Flooding drives surface water into the riverbanks during seasonal 'wet-ups' and associated flooding, creating a bulge in the perched groundwater table. This 'bank storage' is utilised by the bulk of the riparian vegetation fringing the Isaac River channel and the lower reaches of Cherwell Creek, with the degree of utilisation diminishing in trees positioned progressively higher upslope along the riverbanks. The seasonal bank storage has a weak unsaturated hydraulic linkage to the deeper alluvial aquifer. However, it predominantly discharges back into the river as surface flows subside or depletion occurs through evapotranspiration. The discharge of bank storage back into the river, as surface flows subside, extends the period of river flow and sustains water levels in the river sand in the post wet season (Figure 24-19). The persistence of surface pools depends on climatic variables and fluvial processes that form channel hollows to expose the perched groundwater unit. However, the residual pools are spatially restricted and rapidly diminish in size and extent as the perched groundwater unit discharges during dry climatic periods.

Data for the HES wetland indicates that it has formed on a river paleochannel, where the sand is moist to wet, depending on rainfall recharge. Small volumes of groundwater seasonally perch in the sand above the basement contact with weathered Permian sediments, where they may contribute to moisture use by deep-rooted wetland vegetation. The 2.5 m thick sequence of clay that forms the wetland floor limits surface water infiltration, facilitating surface water accumulation during the wet season. Wet season ponding of surface water in the HES wetland is also responsible for the most substantial moisture recharge of the wetland soil profile and associated perched groundwater.

Evapotranspiration regulates discharge from the perched groundwater units associated with both the Isaac River and the HES wetland during drying cycles. As perched groundwater depletes seasonally, reliance on soil moisture to support transpiration increases.

The GDE field assessment for the Project did not detected the current periodic use of groundwater from the regional alluvial groundwater table (as distinct from the perched groundwater unit) by woody riparian vegetation.

IDM, which adjoins the Project, is required to implement a GDE monitoring and management plan (GDEMMP) as a condition of its Commonwealth approval EPBC 2019/8413. The IDM GDEMMP Baseline Assessment (3d Environmental, 2023) concluded that periodic use of small quantities of groundwater from the regional alluvial groundwater table (as distinct from the perched groundwater unit) by woody riparian vegetation (RE11.3.25) occurs, particularly where this groundwater is <10 mBGL. Nevertheless, there remains a very low likelihood of sporadic use of groundwater from the deeper alluvial aquifer based on the data for the Project. Any use of alluvial aquifer water by riparian vegetation is not widespread and extensive. Immersion of the riparian tree root zone in a seasonally fluctuating perched groundwater unit will occur during seasonal flow events, where it is associated with bank recharge and storage, implying that groundwater dependence on the perched groundwater unit is seasonal. Away from the river, groundwater usage is restricted by the shallow rooting depth of vegetation, increased aquifer salinity, and increased depth of the regolith groundwater unit. The most significant control on groundwater dependence across the study area is a lack of well-developed alluvial deposits, except for the relatively narrow Isaac River floodplain and thin slivers of alluvium attenuating upstream along the larger tributary streams (e.g., Cherwell Creek). The lack of significant alluvium away from the Isaac River channel means that, away from the drainage channels, the base of the regolith or coal seams hosts the shallowest groundwater sources.

24.6.3.9 Mapped Extent of GDEs

GDE field data for the Project indicates groundwater partitioning in the alluvium, with a perched groundwater unit directly linked to recharge from Isaac River surface flows, and a deeper alluvial aquifer

linked through an unsaturated connection. Riparian vegetation on the Isaac River uses groundwater from the perched groundwater unit seasonally (when recharged). However, it shifts to predominantly using soil moisture when the perched groundwater unit dries. There was no evidence for vegetation use of the deeper alluvial aquifer. Reaches of Cherwell Creek within the Project area lack development of the perched groundwater unit, and riparian vegetation persists primarily due to its use of soil moisture.

Riparian vegetation associated with a mapped HES wetland demonstrated groundwater perched at the base of a thick sandy soil interval (paleochannel) following wet-season recharge, then discharged through transpiration during drier periods, after which transpiration is sustained solely by soil moisture. The HES wetland does not rely on water in the deeper alluvial aquifer.

In summary, the local extent of GDEs within and surrounding the Project area is restricted to the margins of the Isaac River, attenuating upstream along Cherwell Creek. The likelihood of GDEs along Cherwell Creek pinches out upstream due to shallowing of the sedimentary basement toward the west, associated with a thinning of the alluvium. Additional terrestrial GDE areas may coincide with the HES wetland near the confluence of the Isaac River and Cherwell Creek.

Based on the fieldwork findings, data from GDE studies at IDM (3d Environmental, 2020) and the ecohydrological conceptualisation for GDEs, the extent of GDEs within and surrounding the Project area is shown in Figure 24-20.

Figure 24-20 shows the location of riverine (Type 1) and wetland (Type 2) GDEs within and surrounding the Project area. Type 3 GDEs represent areas that have extended water availability through drier seasonal periods, as identified in the IDM GDE assessment (3d Environmental, 2020).

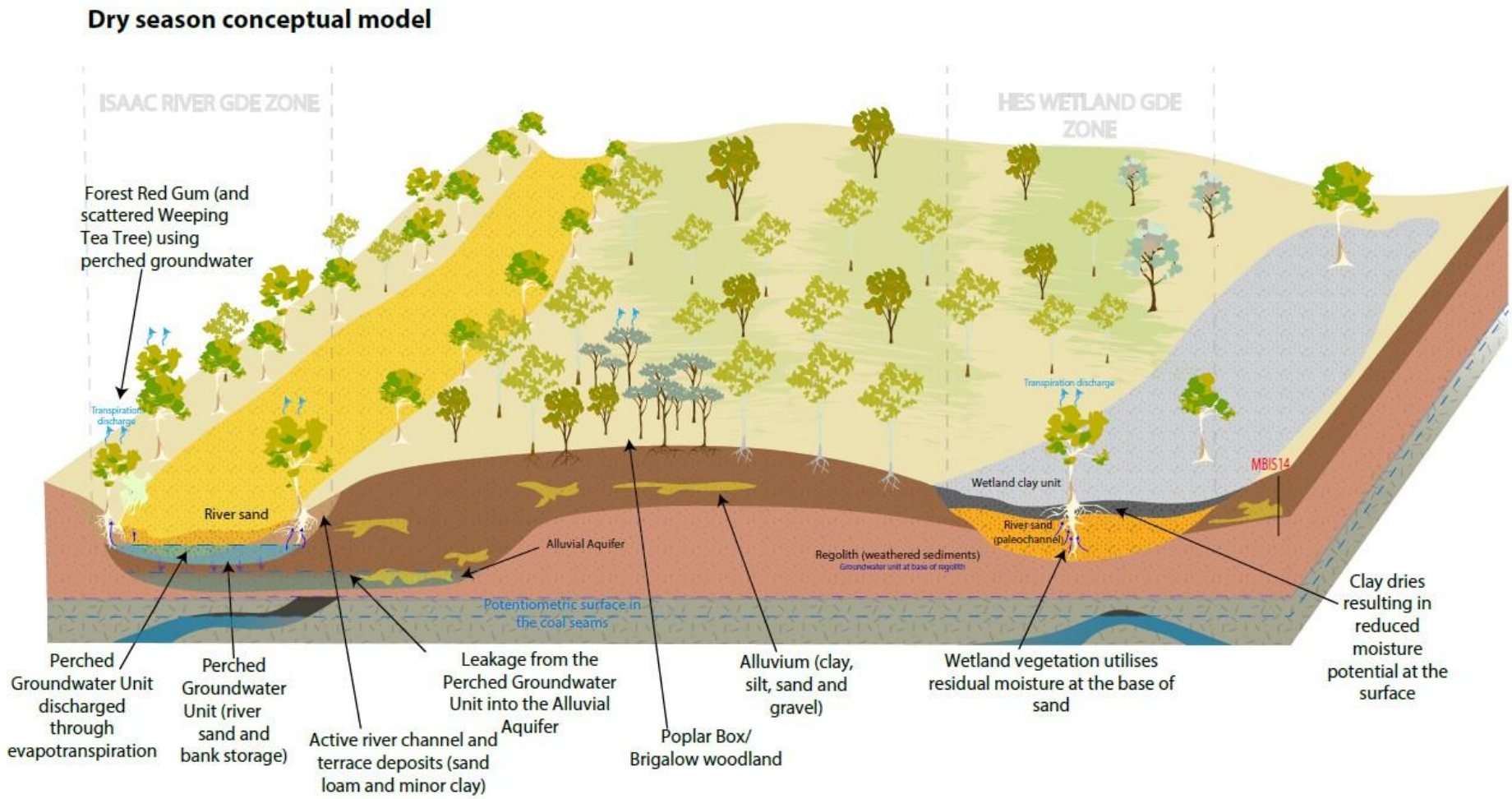


Figure 24-17 Conceptual Ecohydrological Model – Dry Season

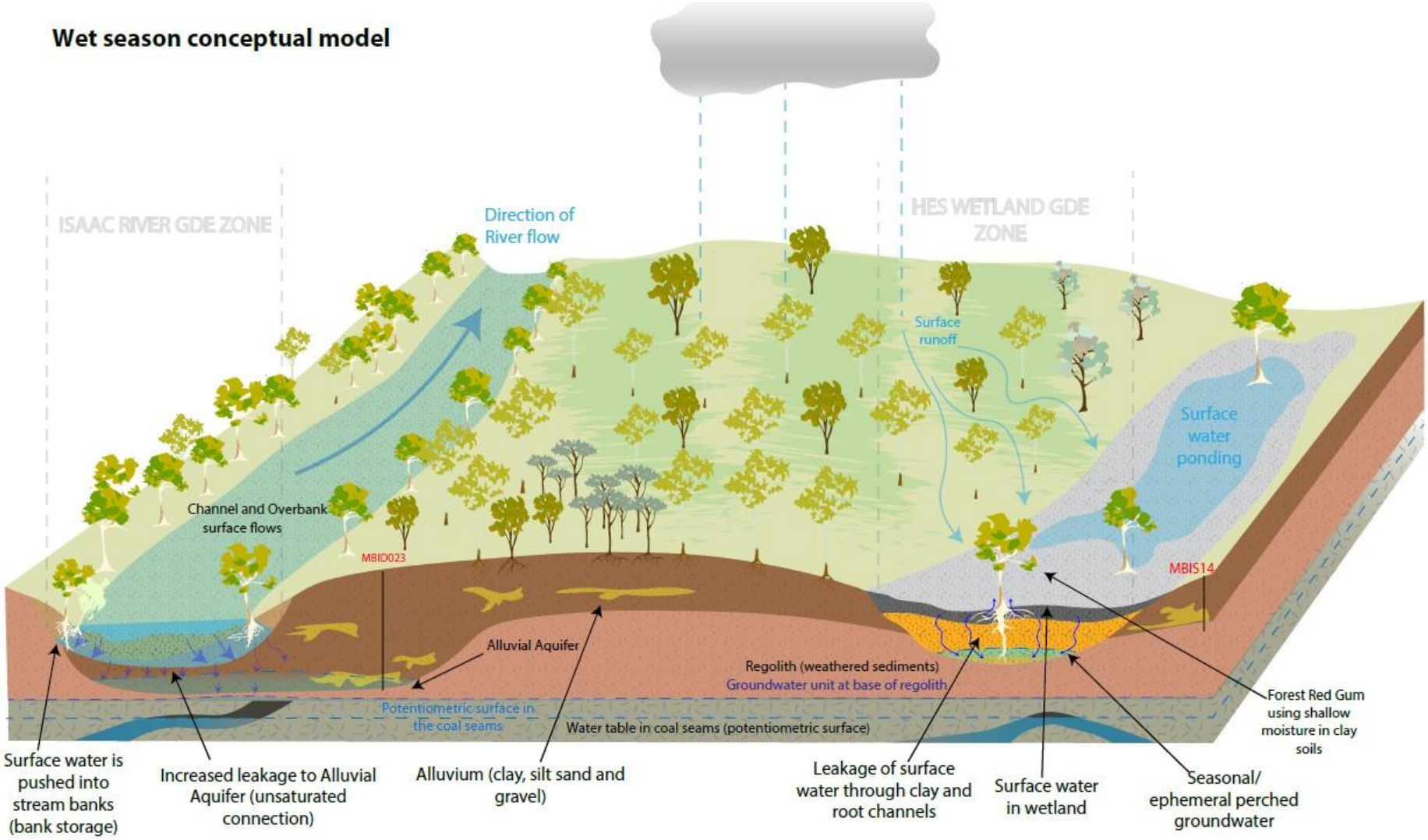


Figure 24-18 Conceptual Ecohydrological Model – Wet Season

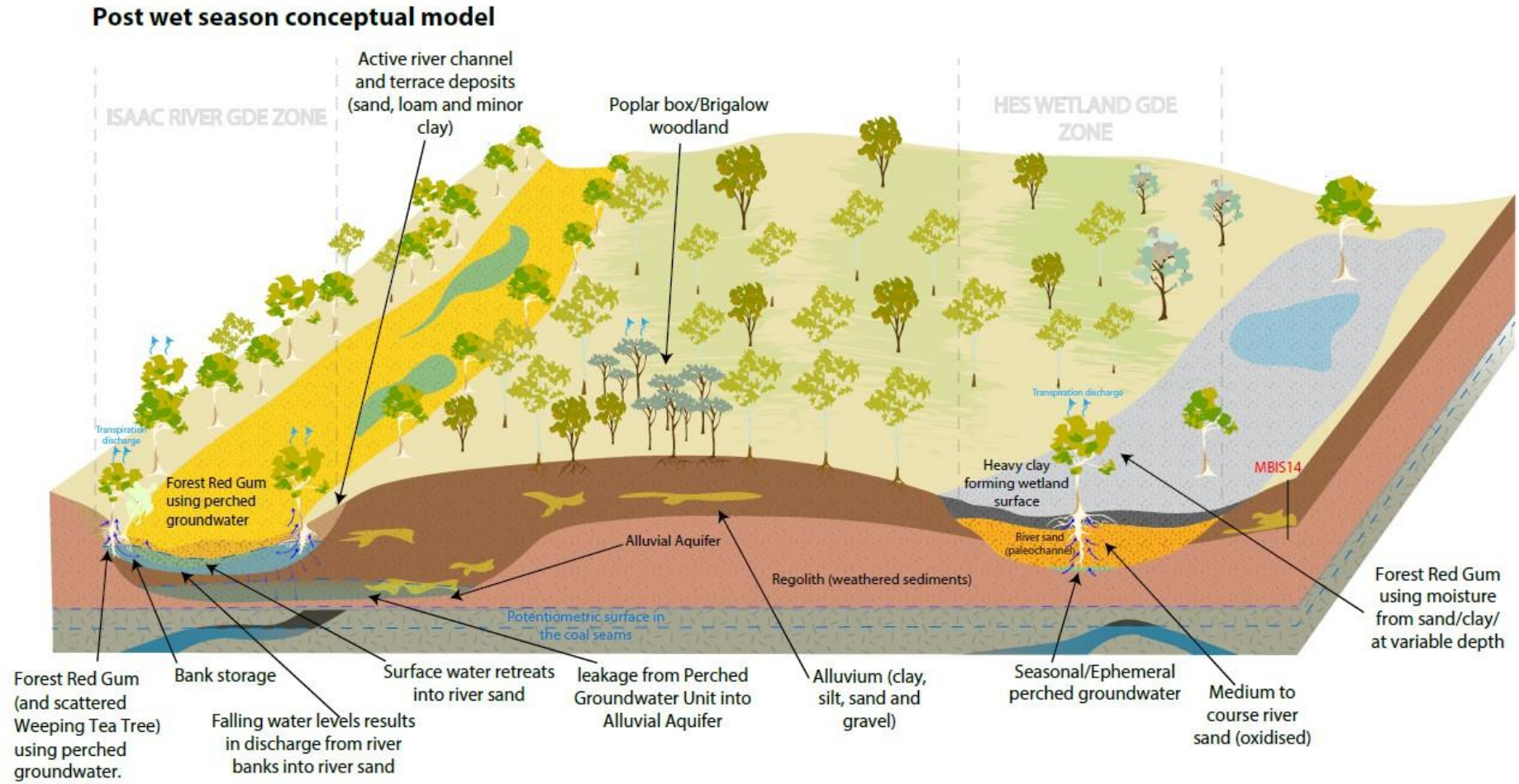
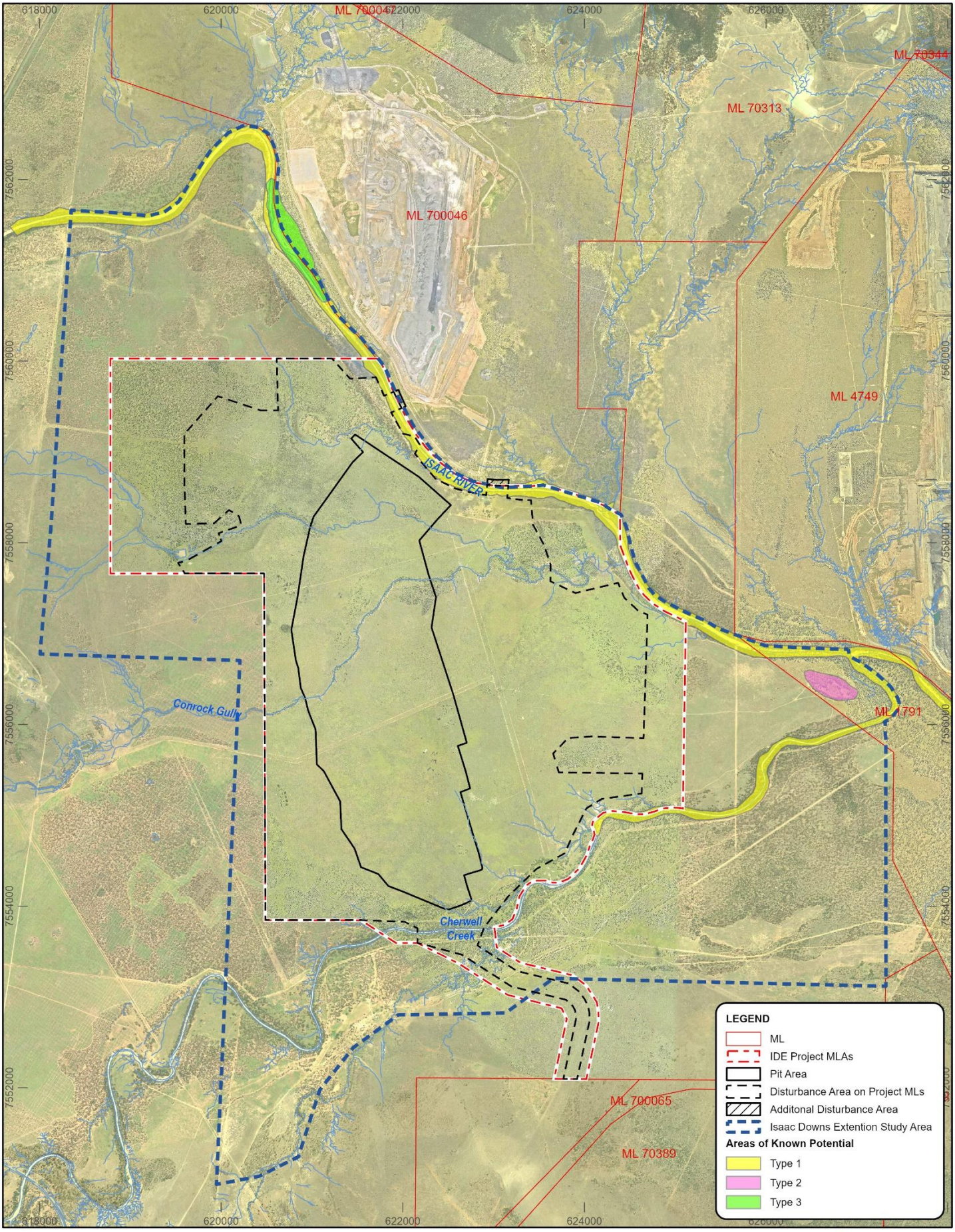


Figure 24-19 Conceptual Ecohydrological Model – Post Wet Season



0 250 500 750 1000 1250
Metres

Datum:	GDA2020 Zone 55
Scale:	See Scale Bar
Date:	11/05/2026 12:39 PM
Drawn:	Minserve
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DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.

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ISAAC DOWNS EXTENSION

GDE Areas

Figure | **24-20**

24.6.4 Stygofauna

24.6.4.1 Desktop Data

Stygofauna are aquatic subterranean animals that are found throughout Australian aquifers. The term stygofauna encompasses a variety of different types of organisms that are found in groundwater, and includes animals that are obligate, groundwater-adapted organisms (stygobionts), and those that are not specifically groundwater-adapted but are able to survive the harsh conditions in aquifers (stygoxenes).

A synthesis was undertaken across Australia by Hose et al. 2015, which summarised the key findings from 12 studies from the Bowen Basin. These studies identified stygofauna assemblages in alluvial aquifers that contain common stygobionts such as copepods, amphipods and syncarids, and to a lesser extent also from basalt aquifers and coal seams. In the Bowen Basin stygofauna were recorded where standing water level was between 1.4 and 45 m below ground level and from groundwaters with electrical conductivity ranging from 342 – 9,975 µS/cm, pH from 6.39 – 10.27 and dissolved oxygen from 0.93 – 6.54 mg/L.

A review of the Queensland Subterranean Aquatic Fauna Database identified 48 bores that had been sampled within a 50 kilometre radius of the Project's stygofauna study area. Several stygobionts, and likely stybionts, were recorded from 13 of the bores, with all but one bore intersecting the alluvium (that bore intersected basalt).

Several, more recent, stygofauna assessments have been conducted for environmental impact assessments in the vicinity of the Project. An assessment of two bores sampled for the Olive Downs South Project recorded no stygofauna. However, it was noted that suitable conditions existed in the bores to support stygofauna. Of 10 bores sampled for the Isaac Downs EIS, two stygoxenes were recorded but no stygobites (frc environmental 2019). Initial stygofauna sampling for the Winchester South Project EIS detected no stygofauna. However, two taxon (Bathynellidae and Candonidae – an ostracod) were recorded during supplementary surveys (ESP 2022).

Section 2 of **Appendix O** provides additional context about stygofauna, their ecological requirements and diversity.

24.6.4.2 Stygofauna Field Data

Abundance of stygofauna typically decreases with increasing EC above 5,000 µS/cm. EC recorded from bores in the stygofauna study area ranged from 1,570 – 23,140 µS/cm, with only 3 bores (MBID23, MBID28 and MBIS10) consistent within the preferred range for stygofauna. Stygofauna have been recorded from groundwater with pH range of 3.5 to 10.3, but diversity is highest between 6.5 and 7.5. The pH of groundwater from the stygofauna study area ranged from 6.9 – 8.9 and thus aligned with the range known to support stygofauna communities.

Stygofauna were recorded from three bores, MBID23, MBID28 and MBIS03, all of which are located immediately adjacent to the Isaac River. MBID23 and MBID28 are screened in the alluvial aquifer of the alluvium. The recording of stygofauna in bore MBIS03 (screened in the coal seam at 170 – 180 mBGL) is considered out of character with the historical sampling across the region due to the depth and strata. Further, the water quality recorded from this bore was not optimal for a diverse stygofauna assemblage and reflective of the extremes from which they have been recorded. In consideration of this bore having been installed only two months prior to sampling, it is likely that the stygofauna were not being recorded from the aquifer that the bore was slotted in and rather entered the bore from the alluvial aquifer during construction. This is supported by the similar taxa composition but lower abundance than bore MBID23. Therefore, the alluvial aquifer in the vicinity of the Isaac River is considered to be the primary location for stygofauna assemblages within and surrounding the Project area.

Stygofauna specimens were recorded from the three bores across five higher taxonomic groups, with nine taxa groups when considered at the lowest level of identification. Of these taxonomic groups only three

taxa were considered to be true stygobionts (obligate stygofauna), two as possibly stygobiont with the remaining taxa considered likely to be stygoxenes (facultative stygofauna not reliant on groundwater).

These results show a relatively diverse stygofauna assemblage within the alluvial aquifer adjacent to the Isaac River. This finding is due partially to the level of identification being lower than historical sampling across the region and in line with the DSITI (2015) sampling guidelines. At a taxonomic level, comparable with historical reporting and studies across the region, these results are consistent with those that have previously been recorded. The same taxonomic groups are the most commonly recorded across Queensland.

Additional details on the stygofauna identified during field sampling are provided in Section 6 of **Appendix O**.

24.6.4.3 Status under Commonwealth and State legislation

Stygofauna have no conservation listings at the Queensland level. At the Commonwealth level there are numerous stygofauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). However, all are confined to the Pilbara region in Western Australia. Stygofauna communities associated with Great Artesian Springs are also listed as endangered under the EPBC Act. However, the Project area is outside the Great Artesian Basin. Therefore, there are no species of stygofauna that occur in or surrounding the Project area that are Matters of National or State Environmental Significance.

24.7 Surface Water and Water Management System

24.7.1 Water Management System

24.7.1.1 Overview and Objectives

The water management system (WMS) is the primary management measure to mitigate Project impacts to surface water quality and flows. Hence the design of the system, as demonstrated in this and subsequent sections, is crucial to achieving its objectives.

This WMS forms the basis for a water management plan for the Project. It outlines specific, measurable and time-bound management measures for storage, transfers, releases and monitoring associated with the Project's water management system, and is designed to protect downstream EVs. These measures provide the necessary information to underpin operational controls that may be linked to the identified water management measures.

There are different water types for the purposes of developing the WMS:

- Mine-affected water – as defined in the Model Mining Conditions, is summarised as water that has come into contact with coal seams (e.g. groundwater or runoff in the pit, or runoff from run-of-mine (ROM) coal pads).
- Sediment water - runoff from areas that are disturbed by mining operations (including waste rock / overburden dumps)[10], which may contain high sediment loads but does not contain elevated levels of other water quality parameters (e.g. EC, pH, metals, metalloids, non-metals). This runoff must be managed to ensure adequate sediment removal prior to release to receiving waters.
- Clean or diverted water - surface runoff from areas unaffected by mining operations. Clean catchment water includes runoff from undisturbed areas and fully rehabilitated areas.
- Raw or external water - untreated water, generally from an external water supply, that has not interacted with mining activities. For the Project, raw water is supplied to IPC under an existing

[10] The terms 'overburden', 'spoil' and 'mine waste rock' are used synonymously in this EIS, and include interburden.

contract with Sunwater, with water coming from the Eungella / Burdekin dam pipeline (i.e. with a water quality that is typical of dams and watercourses).
- Contaminated water - runoff from areas potentially containing hazardous chemicals as well as flammable and combustible liquids (including petroleum products), generally associated with infrastructure areas. For the Project this is limited to local areas within the go-line area.
- Potable water - treated water suitable for human consumption. For the Project, potable water will be trucked to site for the limited office and crib room requirements during construction and operation. These requirements will not exceed existing potable water requirements for IPC, which is a supply managed under agreement with the Isaac Regional Council (IRC).

The are three key WMS objectives are as follows:

- Minimise mine-affected water accumulation within the Project's WMS and the risk of uncontrolled discharges.
- Maintain sufficient water for the operations during dry periods.
- Successfully engage with external stakeholders to be a good custodian of society's water resources.

Specific objectives for each water type are as follows:

- Mine-affected water: minimise generation, maximise reuse and prevent uncontrolled releases.
- Sediment water: minimise generation, maximise reuse and remove sediment prior to discharge.
- Clean/diverted water: separate the mine-affected and sediment water systems as much as reasonable and feasible and allow it to pass uninterrupted through the catchment.
- Raw/external water: Ensure that external water allocation and associated infrastructure is sufficient to meet site demands particularly under low rainfall conditions.
- Contaminated water: Ensure full separation from other water sources and manage to prevent contaminant release, including under the requirements of AS1940 – Storage and Handling of Flammable and Combustible Liquids.

These objectives are supported by the following management principles:

- Minimise land disturbance.
- Reduce the size of mine-affected, sediment, and contaminated catchments.
- Divert clean water around disturbed areas.
- Capture mine-affected and sediment-laden runoff in dams (with sediment dams designed to allow for sediment removal prior to discharge in accordance with erosion and sediment control best practice).
- Reuse mine-affected and sediment water on site for dust suppression activities.
- Conduct controlled releases of mine-affected water in accordance with the proposed EA conditions to protect downstream EVs.

24.7.1.2 Integration of the Water Management System into IPC

Crucially the Project's WMS has been integrated with the WMS for the rest of IPC. This integration allows for balancing of mine-affected water across the system as a whole, with excess water transferred from the Project to IPC during wet climatic conditions, and water transferred to the Project from the rest of IPC in dry climatic conditions. As mine-affected water would be transferred to and from IDM as the closest part of IPC to the Project, transfers are described as occurring with IDM.

As the Project will replace mining activities at IDM, controlled releases from the Project will not occur coincidently with any potential releases from IDM.

The integrated WMS also allows for the import of raw water, if required for the Project, from the existing Sunwater allocation.

24.7.1.3 Proposed Water Management Infrastructure

24.7.1.3.1 Overview

Figure 4.1 to Figure 4.6 of **Appendix I** (as taken from **Chapter 4**) shows the locations of the key water management features of the proposed Project area over the life of mine for a series of selected Project years or stages. These plans show the progression of the active mining pit from west to east.

Key water management infrastructure proposed as part of the Project and their indicative timing are described below. The majority of the proposed surface water infrastructure is constructed by Year 1, and remains generally constant throughout the life of the Project with the exception of the additional sediment dams constructed by Year 6 and Year 16:

- Constructed by Year 1
  - Three mine-affected water (MAW) dams - MAW1, MAW2 and MAW3.
  - Eight sediment dams (SD) that collect runoff from the out-of-pit dumps, low wall spoil emplacements and non-coal contact disturbed areas - SD1, SD3, SD4, SD5, SD6, SD7, SD10 and SD11.
  - A clean water dam (CWD) that collects runoff from undisturbed and cleared areas ahead of the mining pit - CWD.
  - A proposed diversion of Conrock Gully, with associated flood protection bunds and waterway channel plugs.
- Constructed by Year 6
  - Two additional sediment dams that captures runoff from out-of-pit dumps – SD2 and SD8.
- Constructed by Year 16
  - One additional sediment dam that captures runoff from disturbed land – SD9.

24.7.1.3.2 Mine-affected Water Management

MAW2 (235 ML) is the primary MAW storage, with an operating configuration that:

- receives pit dewatering from the active pits
- receives pumped inflows from MAW1 and MAW3
- supplies dust suppression water demands
- can pump excess MAW to IDM (i.e. transfers of MAW in the integrated WMS)
- can import water from IDM if there is a shortfall of water at the Project
- has a proposed controlled release point to the receiving environment (release to Conrock Gully diversion about 900 m from confluence with the Isaac River).

MAW1 (40 ML) and MAW3 (20 ML) capture water from ROM pads and go-line areas, and pump water to MAW2.

Controlled releases will only occur in accordance with the controlled release strategy described in Section 24.7.3.7.

Importantly, as the Project will replace mining activities at IDM, controlled releases from the Project will not occur coincidently with any potential releases from IDM. Project operations will occur following the cessation of operations at IDM, when mine water will accumulate in the approved IDM void and not be released to the environment. That is, there will be no simultaneous release of water from both IDM and the Project. The intent of the Project's controlled release strategy is to adopt the same release conditions as currently approved at IDM.

MAW will be supplied via a dedicated pipeline from IDM should mine-affected water reserves at the Project be depleted. This dedicated pipeline will also be used to transfer excess mine-affected water from the Project to IDM as required. The mine water transfer pipeline will be installed in a linear infrastructure corridor adjacent to the haul road, and will be fitted with leak detection shut-off valves. Where the water

pipeline crosses the Isaac River, the pipe will either be located with the bridge or will be trenched and buried below predicted scour depth with the pipe encased through a larger diameter pipe (enveloper) to protect it from damage. The mine water pipeline will be approximately 300 – 400 mm diameter polyethylene pipe. Pumps will used to transfer water along the pipelines. Mine water transfer pipelines will include engineered controls such as isolation valves, pressure release valves and flow meters, to prevent or minimise any accidental releases of water during transfer between IDM and the Project.

24.7.1.3.3 Sediment Water Management

Sediment water will be managed in accordance with the ESCP, as provided in **Appendix AD**, and summarised in Section 24.12.9. The proposed sediment dams are a key design feature of the ESCP.

Eleven sediment dams are proposed to be constructed over the life of mine to capture runoff from dumps, haul roads and cleared areas in advance of the highwall progression.

The proposed sediment dams have been sized in accordance with the International Erosion Control Association (IECA) method (IECA, 2018), based on the following design standards and methodology:

- 'Type D' sediment dams.
- Total sediment dam volume = settling zone + sediment storage volume. The sediment storage volume is the portion of the basin storage volume that progressively fills with sediment until the basin is de-silted. The settling zone is the minimum required free storage capacity that must be restored within 5 days after a runoff event.
- Sediment dam settling volume based on 85th percentile 5-day duration rainfall (32.9 mm, calculated per eq. B8 in IECA guidelines) with an adopted volumetric event runoff coefficient for disturbed catchments of 0.54 (Group C soils – loamy clay with a 20% factor for steep catchments).
- Solids storage volume = 50% of settling zone volume.

The adopted design standard does not provide 100% containment for runoff from disturbed areas. Hence, it is possible that overflows will occur from sediment dams if rainfall exceeds the design standard. To minimise passive releases from sediment dams and maximise water reuse, the water collected by the sediment dams will be reused on-site where possible (e.g. dust suppression).

A summary of the conceptual sediment dam capacities is provided in Table 4.2 of **Appendix I**, ranging in size from 3 ML to 63 ML.

24.7.1.3.4 Clean Water Management

The infrastructure for clean water management at the Project comprises:

- diversion of Conrock Gully
- levee along the Isaac River and levee plug along Cherwell Creek
- clean water catchment reporting to the CWD, comprising undisturbed catchment between the mining operations and the Isaac River levee.

Section 24.10 provides a detailed assessment of the diversion of Conrock Gully and the proposed levees. In the context of the Project's WMS, this infrastructure separates clean water, including flood flows, in Conrock Gully, the Isaac River and Cherwell Creek from Project operations (i.e. mine pit, dumps, MAW dams, infrastructure areas). The diversion and levees are sized to prevent a 0.1% AEP (1 in 1,000 year) flood event from interacting with mining operations.

The CWD is approximately 200 ML. Following rainfall events clean water will be pumped over the levee into the remnant Conrock Gully downstream of the levee.

24.7.1.3.5 Raw Water

Raw water will be supplied via a separate pipeline from the raw water dam at IPM, which is supplied under a contract with Sunwater for offtake from the existing Eungella Burdekin water supply pipeline. Raw water

is only required to supply vehicle washdown and firefighting requirements. However, it could potentially provide an emergency supply of water should mine-affected water reserves at the Project be depleted. Controls will be installed on raw water pipelines to manage any accidental releases, noting that this water is 'fresh'.

24.7.1.3.6 Potentially Contaminated Water

Facilities at the go line for the storage of fuels and minor maintenance requirements will be constructed and bunded in accordance with the relevant Australian Standard specifications, including but not limited to the provisions of AS 3780:2008 – The storage and handling of corrosive substances, AS 1940:2004 – The storage and handling of flammable and combustible liquids (AS 1940), AS 3833:2007 – Storage and handling of mixed classes of dangerous goods in packaged and intermediate bulk containers.

Hazardous substances Safe Operating Procedures (SOP) will be in place at these operations. A register will be maintained on site for all chemicals. Where appropriate, material safety data sheets will be kept in storage areas or available for on-line access, as required.

Fuel storage areas are a potential source of hydrocarbons, and fuel storage areas will be constructed and bunded in accordance with the relevant specifications of AS1940. Fuel storage areas will be inspected regularly, with repair and maintenance work completed as required. Bunds filled with stormwater will be drained or pumped out by a licensed contractor as soon as practicable to maintain the bund volume.

A waste oil system will collect all waste oils for transfer offsite or recycling onsite, so that waste oils are not released to the environment. Lubricants will be stored in a bunded concrete area with a sump to collect any spills.

All runoff from areas with potential contaminants will pass through water management controls such as an oily water separator or sediment trap before entering the mine affected water management system.

Incident reporting and the management of spills will be undertaken in accordance with the site operational incident reporting forms and procedures. A spill response protocol will be developed and implemented. Spills management procedures will be designed to contain and remediate any spills of fuels or chemicals to prevent impacts to surface waters. Spill kits will be available close to areas where chemicals are being regularly used or stored.

Specific waste bins and bunding will be used to isolate waste liquids, chemicals and hazardous wastes.

Hazardous liquid wastes awaiting disposal, such as hydrocarbons and oils, will be stored appropriately in accordance with AS1940:2004 'The storage and handling of flammable and combustible liquids'.

All areas containing potential contaminants or hazardous wastes will be protected from flooding by levees with flood protection for a 0.1% AEP (1:1,000 year) flood event. Hence, they will have a negligible risk of releasing contaminants during flood events.

24.7.2 Preliminary Consequence Category Assessment

A preliminary consequence category assessment (CCA) to inform the design of the Project's water storages has been undertaken in accordance with the Manual. Section 5 of **Appendix I** provides the details of the CCA.

The CCA considers the following scenarios to determine if the dams have a 'significant' or 'high' consequence, and hence should be considered regulated structures:

- failure to contain – overtopping
- failure to contain – seepage
- dam break.

Each of these potential failure modes is assessed in terms of potential for harm to humans, general environmental harm, and general economic loss or property damage. The Project context (i.e. regional location with limited potential for human or third party infrastructure interactions) and potential impacts on water quality if a failure were to occur, were assessed.

This preliminary CCA determined that none of the Project's water storages are regulated structures. As such, there are no required hydraulic performance criteria for water storages at the Project.

This preliminary CCA for the Project was based on conceptual design information for the proposed water storages. The CCA will be reviewed and revised during detailed design as more information becomes available for the design of dams, at which time certified copies of the consequence category determination from a Registered Professional Engineer of Queensland will be provided to the administering authority.

24.7.3 Water Balance Model

24.7.3.1 Methodology

A computer-based operational simulation model, GoldSim, was used to assess the dynamics of the water balance under varying rainfall and catchment conditions throughout the operation of the Project. Water balance modelling pertains to the operational period of mining activities.

The Project is interconnected with the historical and ongoing mining operations at IPC. Therefore, to accurately assess the behaviour of the Project, as well as the adequacy of the connected IPC infrastructure, IPM and IDM have been considered in the Project water balance model. The Project is integrated with IPC through the ability to transfer mine-affected water between the sites and through supply of raw water (external supply) from IPC.

Section 6 of **Appendix I** describes the water balance model in detail. In the description of modelling, the 'IPC water management system' refers to the existing water management systems at IPM and IDM, prior to the integration of the Project into IPC; and the term 'IDE' is used interchangeably with 'the Project'.

The GoldSim model dynamically simulates the operation of the water management system and keeps account of all site water volumes and salt loads on a daily time step. The simulated inflows and outflows included in the model are:

- inflows:
  - direct rainfall on water surface of storages
  - catchment runoff
  - groundwater inflows to the open cut pit
  - external water supply from IPC
- outflows:
  - evaporation from water surface of storages
  - dust suppression demand
  - miscellaneous water demand
  - water transfer to IPC
  - offsite releases from sediment dams in accordance with design criteria
  - controlled releases in accordance with the proposed release strategy.

The Project's water management system will change over the approximate 16-year mine life, including changes in catchment areas, mining progression and site water demands. To represent the evolution of the mine layout over time, the Project was modelled in six discrete phases. One-year to five-year representative periods have been selected to reflect the average conditions over the mine phase, being:

- Year 1 / Phase 1(construction year)
- Year 2 / Phase 2

- Year 4 / Phase 3
- Year 6 / Phase 4
- Year 11 / Phase 5
- Year 16 / Phase 6 (final year of operations).

24.7.3.2 Climate and Climate Change

Rainfall and evaporation information was obtained from the Scientific Information for Land Owners (SILO) climate database facility operated by DETSI, based on data derived from the Bureau of Meteorology.

The potential changes to climate within the operational life of the Project were assessed using the Australian Government Consistent Climate Scenarios (CCS) project (see Section 7.4 of **Appendix I**). This was used to generate climate change adjusted rainfall and evaporation data, which transformed historical climate data from the period 1960 and 2024 (64 years).

The Shared Socioeconomic Pathway SSP2-8.5 was selected as the emission pathway for the Intergovernmental Panel on Climate Change assessment report AR5, with a base case global warming sensitivity for the Year 2050. The Year 2050 was selected as it represents the general period of time by when Project mining operations cease, conservatively overestimating the degree of climate change during the proposed operational period ending 2043.

The 64 years of CCS data was compared with the baseline SILO rainfall and evaporation dataset, with the following observations:

- The CCS data predicts an overall 15% decrease in rainfall over the 65-year period.
- The CCS data predicts an overall 8.5% increase in Morton's Lake evaporation over the 65-year period.

These factors have been applied to the baseline 136 years of SILO data that has been used for the forecast operational water balance assessment with climate change. This is considered a highly conservative approach, as it applies the 2050 climate change factors to the climate data from the commencement of operations in 2029.

24.7.3.3 Catchment Yield Parameters and Catchment Areas

The Australian Water Balance Model (AWBM) model was used to represent the runoff characteristics of mine site catchments. To adequately simulate the site water balance, the runoff characteristics of the various catchment surface types were defined. Catchments were characterised into the following land use types:

- 'natural', representing areas undisturbed by mining
- 'hardstand', representing hauls roads and hardstand/cleared areas
- 'spoil', representing uncompacted dumped overburden material
- 'rehab'; representing rehabilitated emplacement areas
- 'pit', representing the pit floor
- 'cleared', representing areas disturbed ahead of mining (e.g. pre-strip).

Catchment areas for each modelled phase of operations were based on the staged mine plans provided in Figure 4-21 to Figure 4-26 of **Chapter 4**. The adopted catchment areas and land use types for each modelled phase of the Project are provided in Figure 24-21 to Figure 24-25 for each Project phase. A summary of adopted catchment areas and land use types for each modelled phase is provided in Table 6.4 of **Appendix I**.

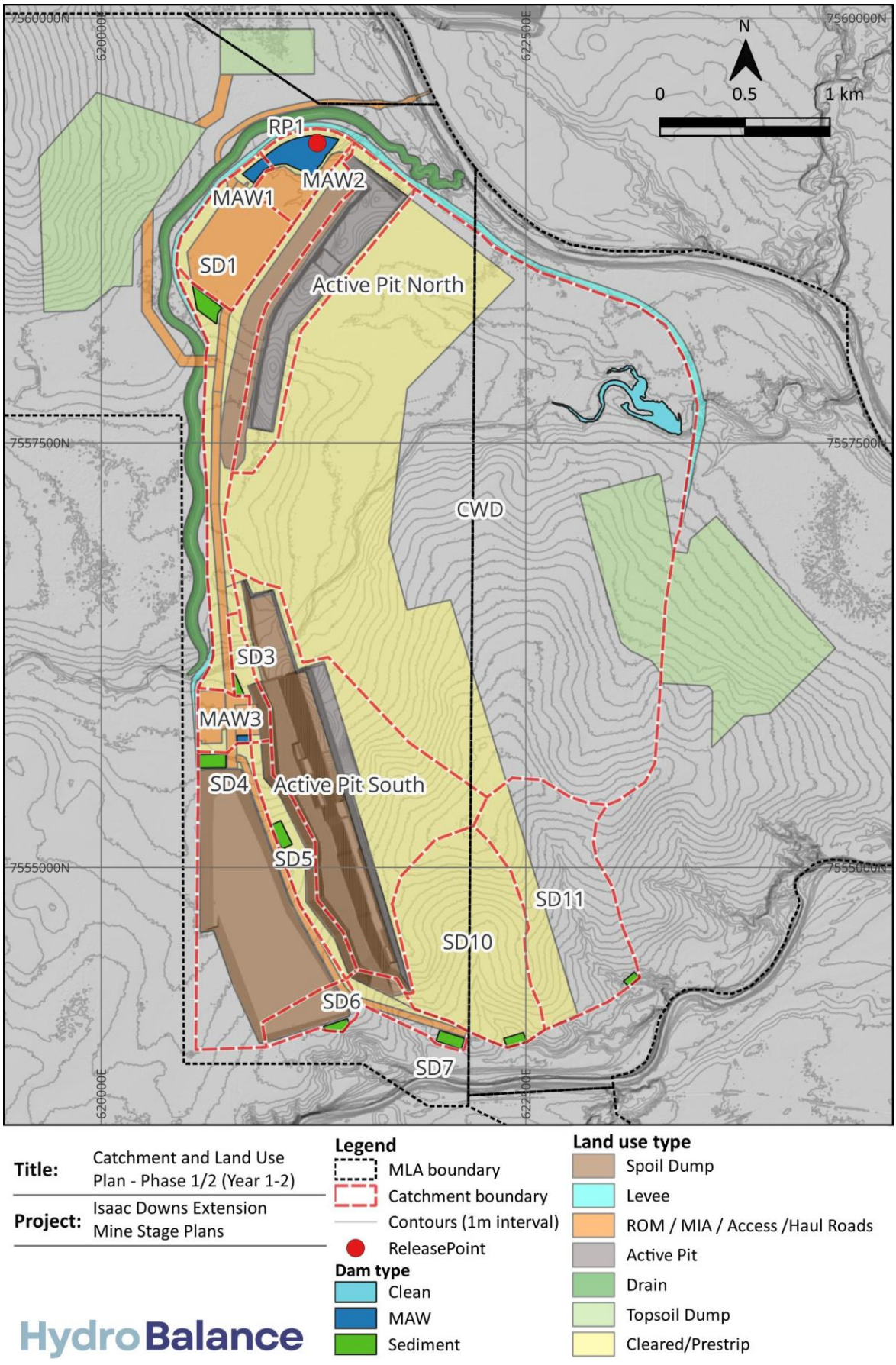


Figure 24-21 Catchment and Land Use Plan - Phase 1 and 2

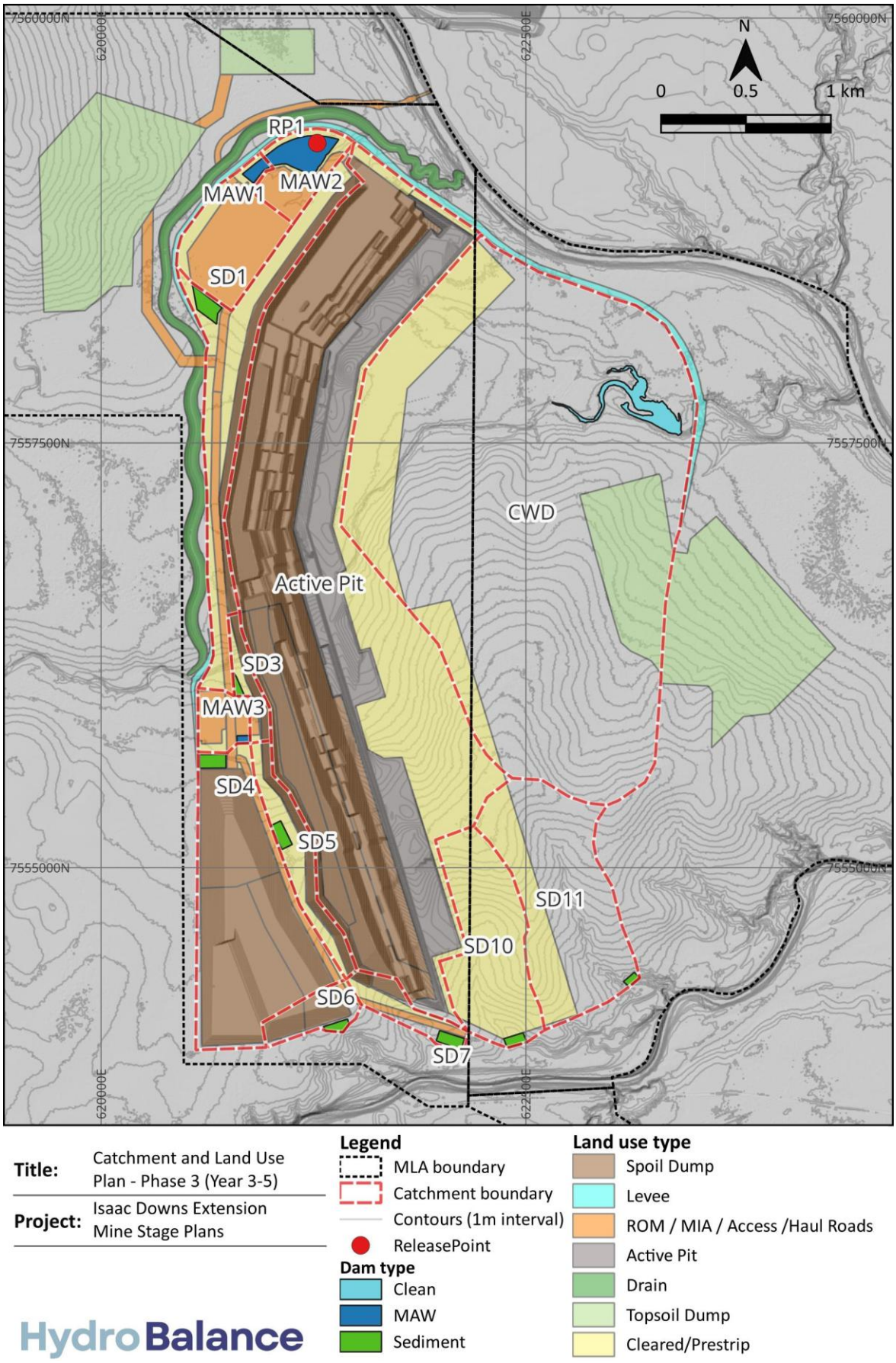


Figure 24-22 Catchment and Land Use Plan - Phase 3

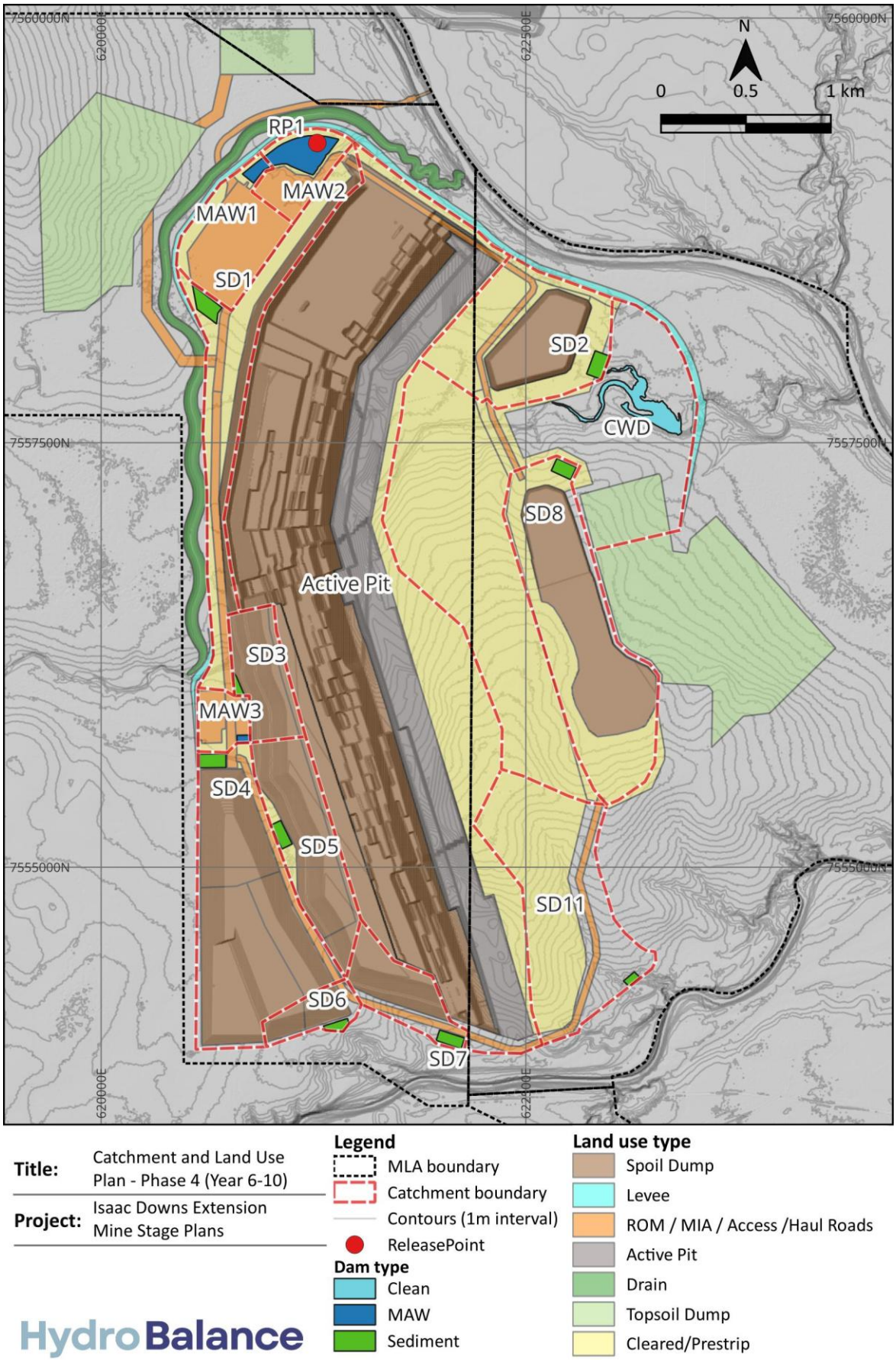


Figure 24-23 Catchment and Land Use Plan - Phase 4

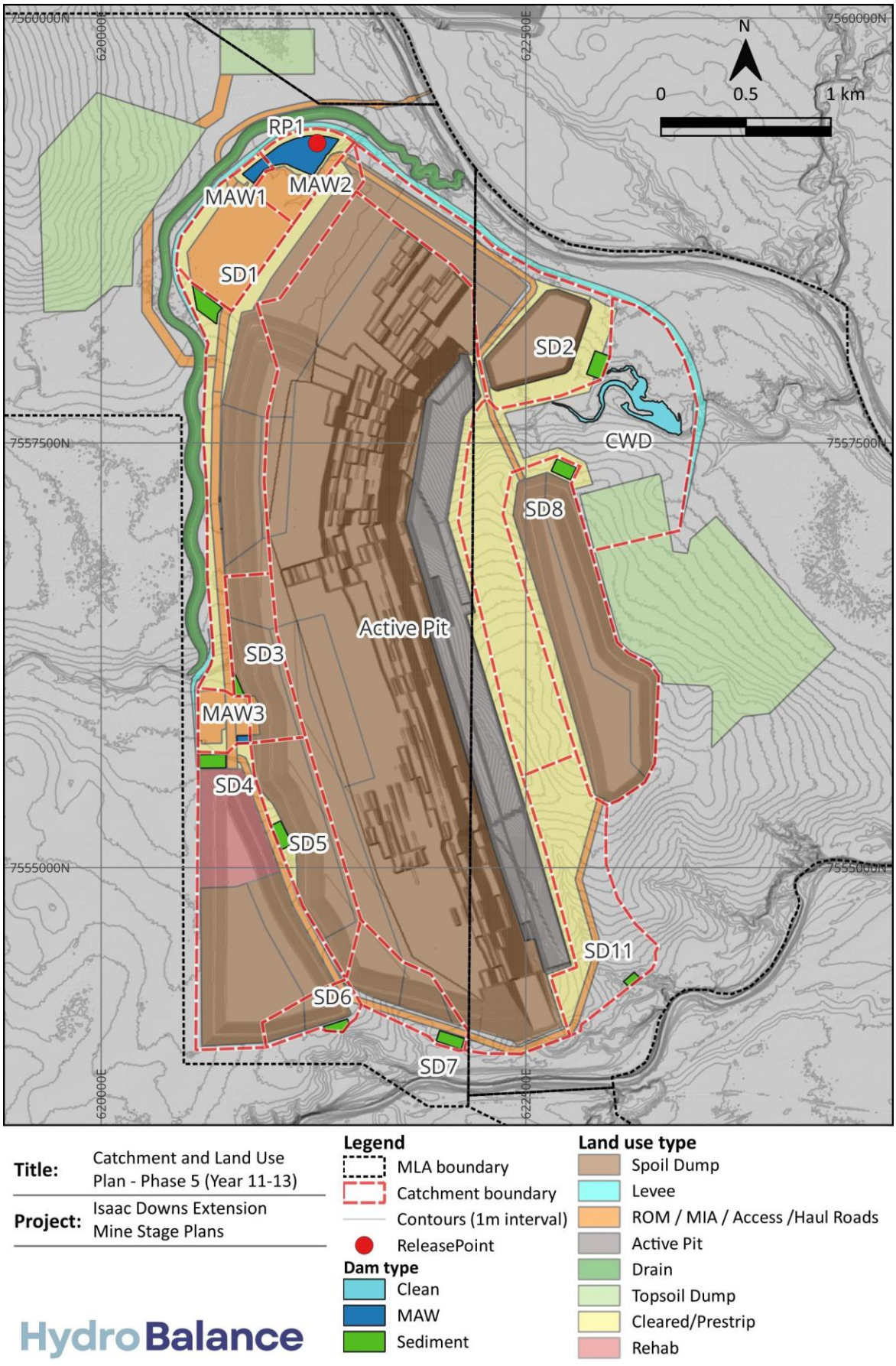


Figure 24-24 Catchment and Land Use Plan - Phase 5

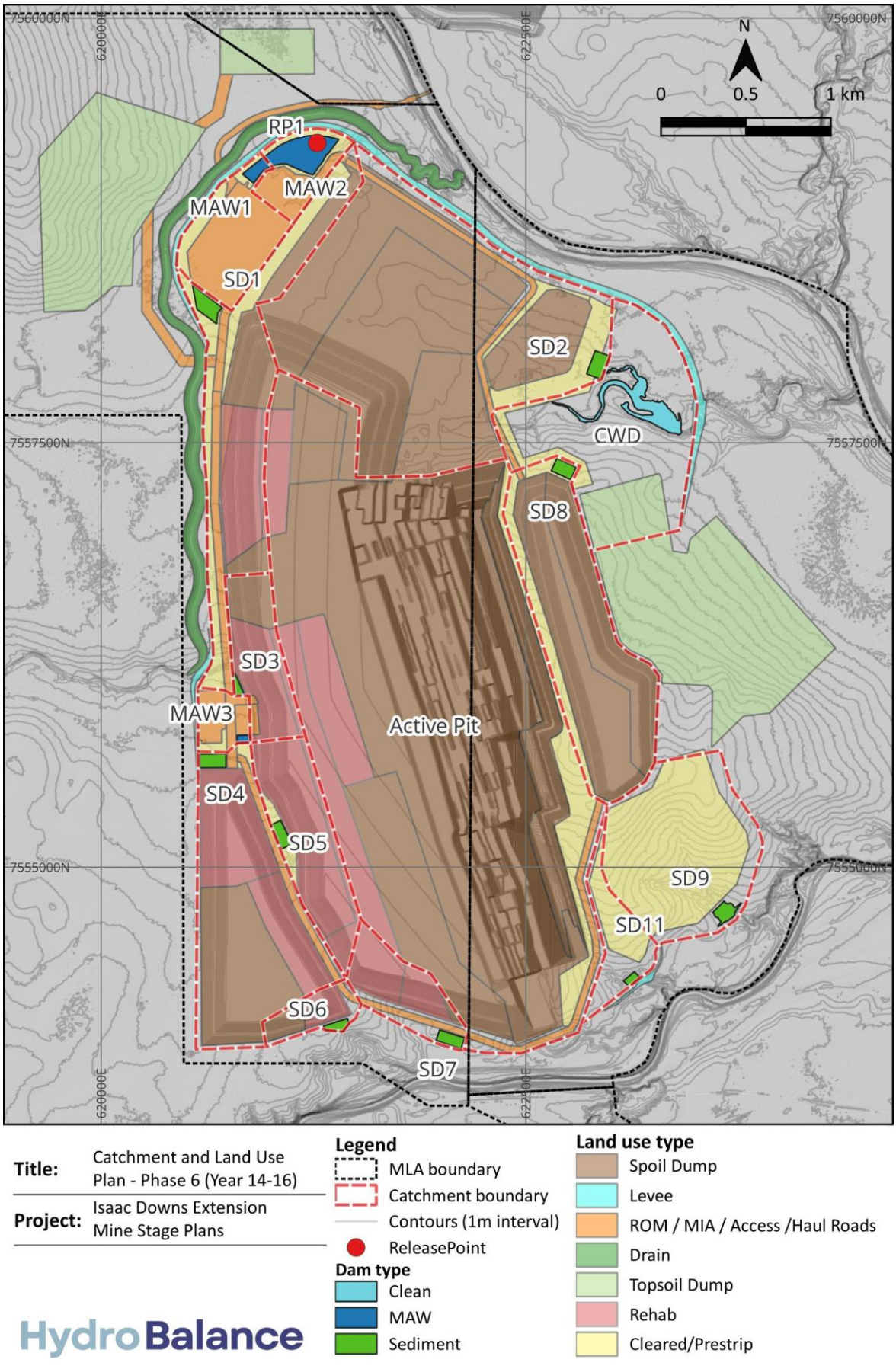


Figure 24-25 Catchment and Land Use Plan - Phase 6

24.7.3.4 Water Management System Configuration

A schematised plan of the proposed water management system configuration is shown in Figure 24-26. A summary of the modelled water management system operating rules for each component of the system is provided in Table 6.5 of **Appendix I**.

To prevent uncontrolled discharges from the mine water storages, maximum operating volumes (MOVs) have been set for the out-of-pit MAW storages. The MOV is the volume at which pumping from the pit and sediment dams to the mine-affected water storages ceases (specifically MAW2). This was included as an operating rule in the water balance model.

24.7.3.5 Water Demands

ROM coal extracted at the Project will be processed at the existing IPC coal handling and preparation plant (CHPP). As the water balance model is integrated into IPC, the water demands of the CHPP are included in the water balance model. In order to assess the performance of the integrated IPC water management system, including the Project, the total ROM coal throughput from all sources at IPC has been included in the water balance model. The key parameters for the CHPP water balance are provided in Section 6.7 of **Appendix I**. The net CHPP water demand is between 150 to 340 megalitres per annum (ML/a).

Water for haul road dust suppression at the Project will be sourced from MAW2. Daily haul road dust suppression watering rates were estimated based on haul road surface area and daily rainfall and evaporation rates. Average daily dust suppression demand is between 3.1 and 9.3 ML/d.

Predicted industrial/miscellaneous usage (includes usages such as washdown, fire circuit, pump gland seals and sprays) has been based on advice from site personnel. The adopted industrial/miscellaneous usage for the simulation period is 50 ML/a, with a net 50% loss.

24.7.3.6 Groundwater Inflows

The adopted groundwater inflows into the Project's mine pit are based on predictions from the groundwater modelling (see Section 24.11.5 and **Appendix K**) and have been provided annually between 2029 and 2043. A summary of the predicted annual groundwater inflows is provided in Figure 6.10 of **Appendix I**, with a round 100 – 150 ML/a during operations.

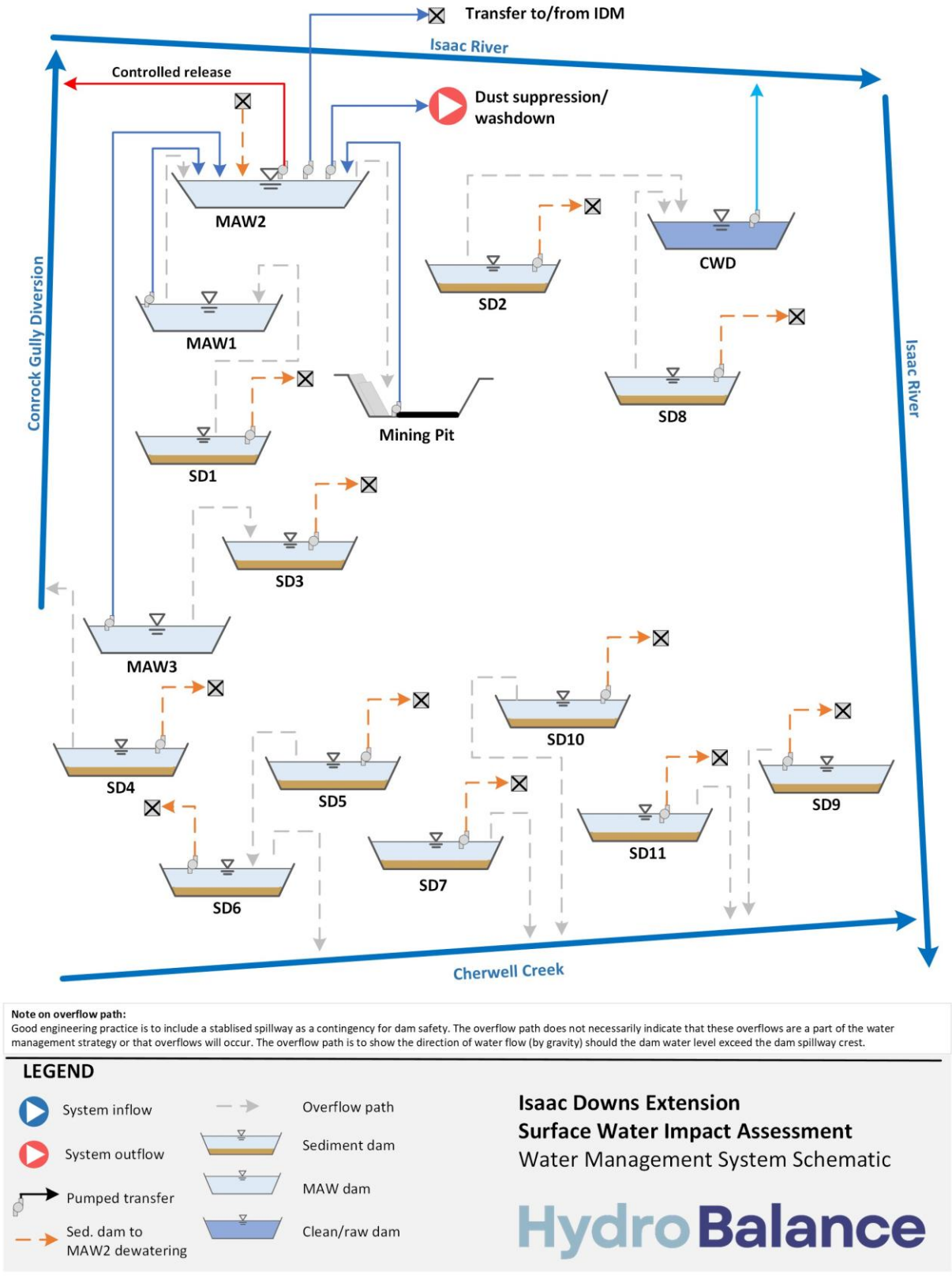


Figure 24-26 Water Management System Schematic

24.7.3.7 Controlled Releases

IDM's EA authorises releases of mine water, based on the established methodology from DETSI's Model Mining Conditions. The proposed release conditions for the Project have been based on the approved IDM release conditions, as any releases from the Project would be offset by the reduction in releases from IDM. The water balance model has been configured to simulate these proposed release conditions, using EC as the target contaminant. The controlled release point will be located on MAW2.

Table 24-8, Table 24-9 and Table 24-10 show the proposed variable contaminant release conditions and receiving water contaminant release trigger levels. Under these conditions, the release of mine-affected water from authorised release points to receiving waters must not exceed those values (dependant on receiving water flow for some contaminants). The proposed receiving water contaminant trigger levels are based on approved EA conditions at IPM, IDM and other nearby operating coal mines (as developed from the Model Mining Conditions), and allow for an accurate evaluation of the impact of any releases from the Project.

Table 24-8 Mine-affected Water Release Limits

Quality characteristic	Units	Minimum	Maximum
EC	µS/cm	n/a	Variable[1]
pH	pH units	6.5	9.0
TSS	mg/L	n/a	Variable[1]
Sulphate (SO_4^{2-})	mg/L	n/a	Variable[1]
1: Release limits for EC, TSS and SO_4 are dependent on receiving water flow. Refer to Table 24-9.			

Table 24-9 Mine-affected Water Release Conditions

Receiving Waters	Release Point (RP)	Gauging Station	Gauging Station Longitude (GDA2020)	Gauging Station Latitude (GDA2020)	Receiving Water Flow Recording Frequency	Receiving Water Flow Criteria for Discharge (m^3/s)	Maximum Release Rate (for all Combined RP Flows)	Release Limits
Isaac River (via Conrock Gully Diversion)	RP1	Isaac Downs	148.175979	-22.066880	Continuous (minimum daily)	**Very Low Flow** <4m^3/s for a period of 28 days after natural flow events that exceed 4m^3/s	< 2 m^3/s	EC: 720 µS/cm SO_4^{2-}: 250 mg/L TSS: 55 mg/L
						Low Flow 4 m^3/s	0.142 m^3/s	EC: 3,000 µS/cm SO_4^{2-}: 300 mg/L TSS: 55 mg/L
						Medium Flow 10 m^3/s	0.257 m^3/s	EC: 4,000 µS/cm SO_4^{2-}: 300 mg/L TSS: 200 mg/L
						High Flow 50 m^3/s	1.09 m^3/s	EC: 5,000 µS/cm SO_4^{2-}: 400 mg/L TSS: 200 mg/L
						Very High Flow 100 m^3/s	2.02 m^3/s	EC: 5,000 µS/cm SO_4^{2-}: 400 mg/L TSS: 300 mg/L
						Flood Flow 250 m^3/s	3.07 m^3/s	EC: 8,000 µS/cm SO_4^{2-}: 400 mg/L TSS: 400 mg/L

Table 24-10 Proposed Receiving Water Contaminant Trigger Levels

Quality Characteristic	Units	Trigger Level	Monitoring Frequency
EC	µS/cm	1,000 (maximum)[1]	Daily during the release
pH	pH units	6.5 - 8.5 (range)[2]	
TSS	mg/L	1,050 (maximum)[3]	
SO_4^{2-}	mg/L	250 (maximum)[1]	
1: Model Water Conditions for Coal Mines in the Fitzroy Basin[11] 2: Isaac River Sub-basin Water Quality Objectives 3: 80th percentile of local water quality samples – see Table 24-3			

24.7.3.8 Isaac River Streamflows

To simulate flows in the Isaac River, AWBM parameters have also been developed for Isaac River catchments. The adopted AWBM parameters have previously been developed to reflect the recorded river flow conditions at each of the Isaac River locations. The Isaac River AWBM parameters have been used to estimate the future flow conditions based on the modelled climate and hence determine the controlled release opportunities.

24.7.3.9 Salinity Parameters

The water balance model has been configured to use EC as an indicator for water quality. Each runoff type has been assigned an EC concentration that has been based on the available historical water quality monitoring data at IPC, as well as additional information provided as part of the geochemical assessment for overburden / spoil (see Section 4.3 of **Appendix F**, also described in **Chapter 23**) and the groundwater assessment for inflows from the Rangal Coal Measures (see Section 24.5.6). The adopted EC concentrations for each land use or inflow contributing to the water balance model, and the source of the EC data, is provided in Table 6.13 of **Appendix I**.

EC has been continuously monitored and recorded at the Deverill gauging station since August 2011. This monitoring data has been analysed and a relationship between EC and discharge has been developed. This flow-EC relationship for the Isaac River has been incorporated into the water balance model as the EC source for the flows in the Isaac River upstream of the Project. Flow and salinity are used by the water balance model to assess whether controlled releases can occur, as well as assessing the potential impact of discharges on the receiving water salinity.

24.7.4 Water Management System Assessment

24.7.4.1 Overview

Assessment of the proposed WMS, as integrated into IPC, has been undertaken using the water balance model with the adopted rainfall runoff parameters, against the following key performance indicators:

- overall water balance
- mine-affected water inventory
- pit inundation characteristics
- controlled water releases
- uncontrolled spillway discharges

[11] https://www.detsi.qld.gov.au/_global/policy-register/policy-register-pdf?getdoc=1561&name=rs-gl-water-conditions-mines-fitzroy.pdf

- mine-affected water transfers to IPC
- imported mine-affected water from IPC
- IPC mine-affected water inventory
- IPC raw water take
- overall salt balance.

The 'IPC water management system' refers to the existing water management systems at IPM and IDM, prior to the integration of the Project (also referred to as 'IDE') into IPC. An assessment of the overall mine affected water inventory at IPC was also undertaken. The purpose of this assessment is to confirm that the existing IPC infrastructure (including dam and pit storages) is able to accommodate the additional water demands, transfers and processing requirements resulting from the Project.

24.7.4.2 Interpretation of Results

In interpreting the results of the water balance assessment, it should be noted that the results provide a statistical analysis of the water management system's performance over the 16 years of operations at the Project, based on 121 realisations with different climatic sequences.

The model results are presented as a probability of exceedance. For example, the 10th percentile represents 10% probability of exceedance and the 90th percentile results represent 90% probability of exceedance. There is an 80% chance that the result will lie between the 10th and 90th percentile traces.

Whether a percentile trace corresponds to wet or dry conditions depends upon the parameter being considered. For site water storage, where the risk is the storage capacity will be exceeded, the lower percentiles correspond to wet conditions. For example, there is only a small chance that the 1 percentile storage volume will be exceeded, which would generally correspond to wet conditions.

For external site water supply volumes (for example), where the risk is that insufficient water will be available, there is only a small chance that more than the 1 percentile water supply volume would be required. This would generally correspond to dry climatic conditions.

It is important to note that a percentile trace shows the likelihood of a particular value on each day and does not represent continuous results from a single model realisation. For example, the 50th percentile trace does not represent the model time series for median climatic conditions.

The assessment outcomes are dependent on the accuracy of input assumptions. There is inherent uncertainty with respect to some key site characteristics (e.g. catchment yield/rainfall runoff, mining area groundwater inflows). The use of a large number of climate sequences reflecting the full range of historical climatic conditions provides an indication of the system performance variance under very wet, very dry and average climatic conditions.

24.7.4.3 Overall Water Balance

Water balance results for the Project are presented in Table 7.1 of **Appendix I**, averaged over each model phase. The results presented are the average of all realisations and will include wet and dry periods distributed throughout the mine life. A more detailed analysis of the performance of the various components of the water management system is provided in the following sections.

24.7.4.4 Mine-affected Water Inventory

Figure 24-27 shows the combined forecast inventory for MAW1, MAW2 and MAW3 over the 16-year forecast. To prevent uncontrolled discharges from the mine water storages, MOVs have been set for the out-of-pit MAW storages. Also shown is the combined full supply volume (FSV), which is the combined capacity of these dams.

MAW1, MAW2 and MAW3 will be decommissioned and rehabilitated following the cessation of mining operations at the Project, in accordance with the PRCP schedule.

The model results show the following:

- For the 1%ile results (very wet climatic conditions), the peak inventory in the out-of-pit MAW storages reaches a volume of around 280 ML.
- For the 10%ile results (wet climatic conditions), the peak inventory in the out-of-pit MAW storages reaches a volume of around 185 ML.
- For the 50%ile results (median climatic conditions), the peak inventory in the out-of-pit MAW storages reaches a volume of around 65 ML.
- The combined out-of-pit mine MAW inventory is maintained below the combined capacity of all the MAW dams.

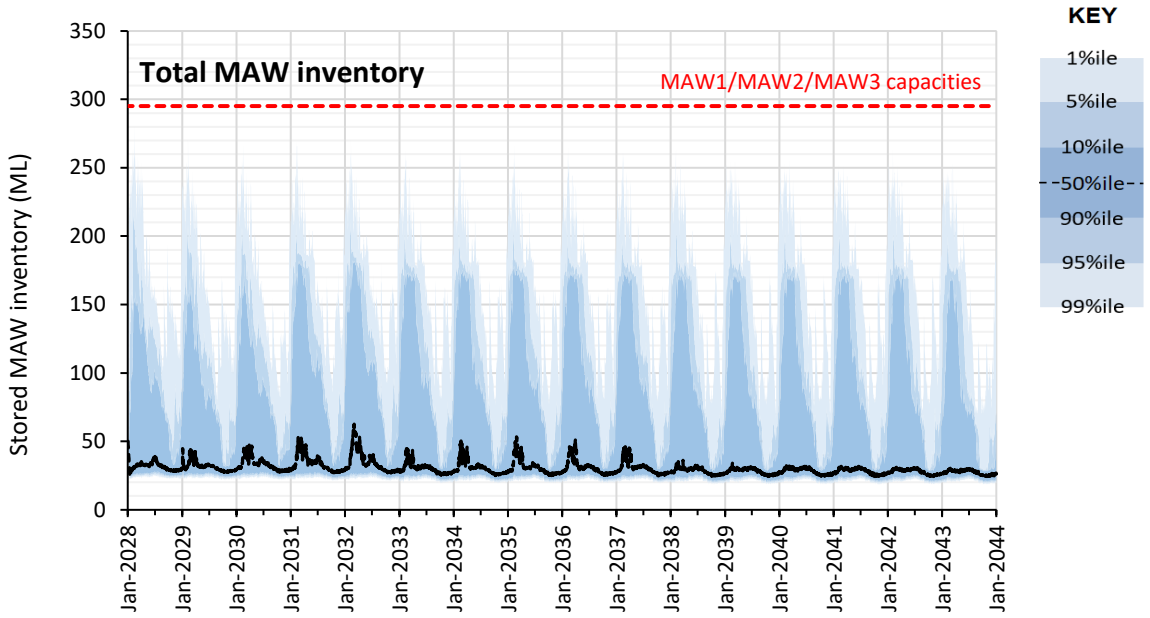


Figure 24-27 Forecast Mine-Affected Water Inventory

24.7.4.5 Pit Inundation Characteristics

Figure 7.2 of **Appendix I** shows the forecast inventory for the Project's mining pit over the 16-year simulation. The pit recovers (i.e. becomes dry) after each wet season when the Project is operational. The pit will become a final void after operations cease and hence will accumulate water from 2043 onwards. An assessment of the final void water balance is provided in **Chapter 5**.

These modelling results demonstrate that the pit is able to continuously operate under all but the most extreme rainfall conditions.

24.7.4.6 Controlled Mine-affected Water Releases

The water balance model is configured to release mine-affected water in accordance with the proposed controlled release conditions outlined in Section 24.7.3.7. The predicted annual controlled release volumes from MAW2 are provided in Figure 24-28. The results show that:

- For very wet climatic conditions (99%ile), the maximum annual controlled release will be 130 ML.
- For wet climatic conditions (90%ile), the maximum annual controlled release will be 40 ML.
- No controlled releases are predicted to occur in median and drier climatic conditions.

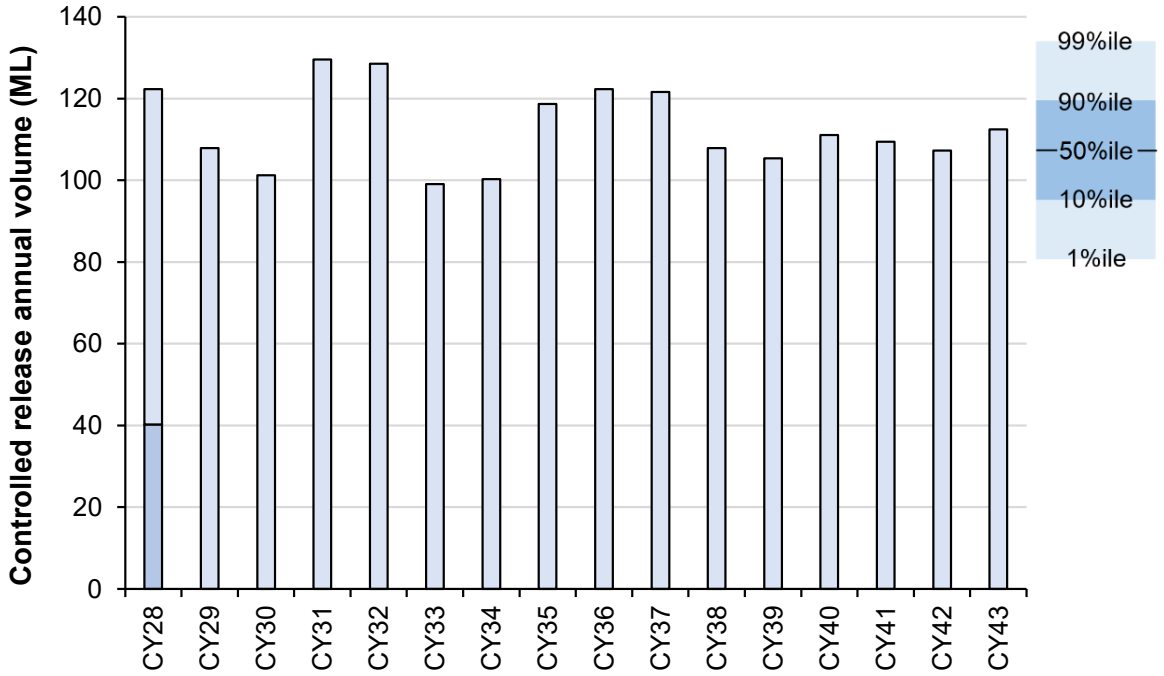


Figure 24-28 Forecast Annual Mine Water Controlled Release Volumes

24.7.4.7 Uncontrolled Releases - Mine-affected Water Dams

There are no predicted uncontrolled releases. There are no MAW dams that overflow directly to the receiving environment. Therefore, there is nil risk of uncontrolled spillway discharges of mine-affected water to the receiving environment.

24.7.4.8 Sediment Dam Overflows

Consistent with the IECA design standard (see Section 24.7.1.3.3), the Project's sediment dams do not provide 100% containment for captured runoff. Hence overflows will occur from sediment dams when rainfall exceeds the design standard. The potential for overflows from the proposed sediment dams has been assessed using a forecast assessment simulation. There are six sediment dams that overflow to the environment: SD4, SD6, SD7, SD9, SD10 and SD11.

The predicted annual combined sediment dam overflows under this scenario are provided in Figure 24-29. The results show that:

- During very wet climatic conditions (99%ile) where rainfall events can exceed the dam design standard, modelled sediment dam overflows are between 565 ML/year and 770 ML/year.
- During wet climatic conditions (90%ile) where rainfall events sometimes exceed the dam design standard, modelled sediment dam overflows are between 190 ML/year and 405 ML/year.
- During median climatic conditions (50%ile) where rainfall events sometimes exceed the dam design standard, modelled sediment dam overflows are between 0 ML/year and 10 ML/year.
- There are no predicted overflows from the sediment dams during dry and very dry climatic conditions.

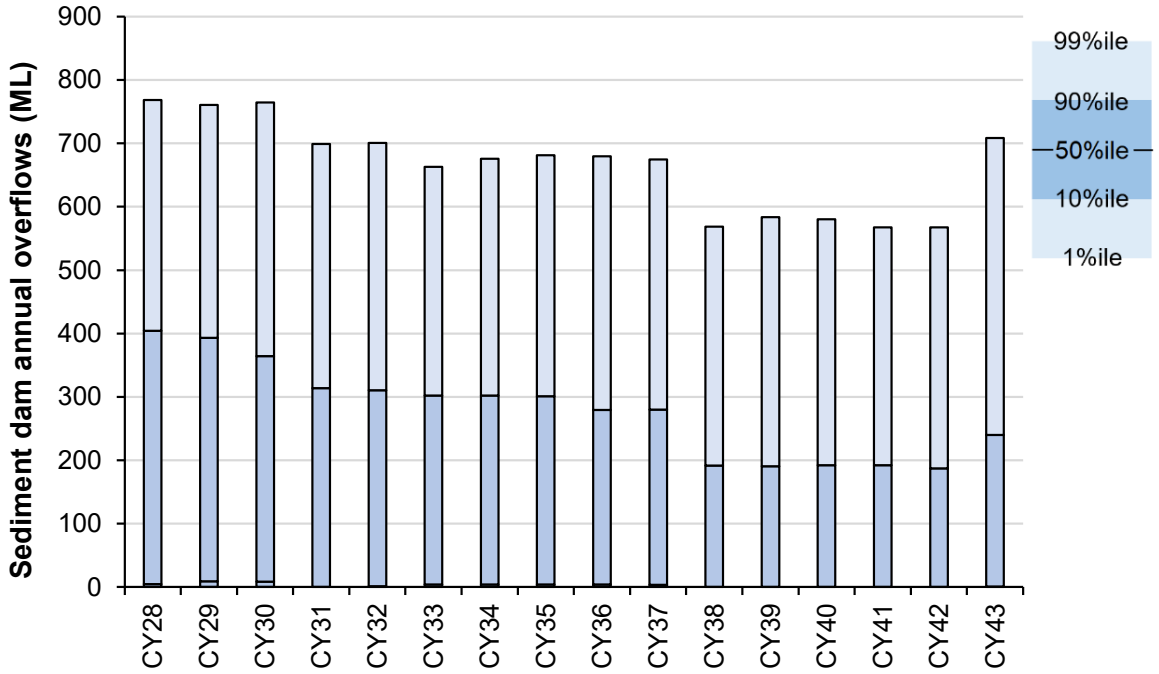


Figure 24-29 Forecast Annual Sediment Dam Overflow Volumes

24.7.4.9 Mine-affected Water Transfers to IPC

The ability of the Project's pit to recover after each wet season is largely attributed to the capacity of the WMS system to transfer water to IPC (i.e. IPM and IDM) when required. Modelling results show the following:

- For the 1%ile results (very wet climatic conditions), a maximum of 1,660 ML/a will be transferred from the Project to IPC.
- For the 10%ile results (wet climatic conditions), a maximum of 710 ML/a will be transferred from the Project to IPC.
- For the 50%ile results (median climatic conditions), there are no modelled transfers of MAW from the Project to IPC.

24.7.4.10 Imported Mine-affected Water from IPC

Net water demands at the Project will be sourced from IPC (i.e. IPM and IDM). A key objective of the WMS is to maximise the reuse of captured surface water runoff and groundwater inflows. Recycling mine water will minimise the volume of water from IPC that is required to satisfy Project site demands. However, the volume of water captured on site is highly variable dependent upon climatic conditions and groundwater inflows. Hence, the required makeup water volume from IPC will vary from year to year.

Figure 24-30 shows the total annual modelled demand for mine-affected water from IPC over the 16-year simulation. The modelling results show that the Project is dependent on the pipeline to IPC to supplement shortfalls in water, even during very wet climatic conditions. This is a function of designing an integrated WMS, with reduced dam storage footprint at the Project, and hence with limited storage capacity available at the Project to hold a significant volume of mine-affected water during the dry season.

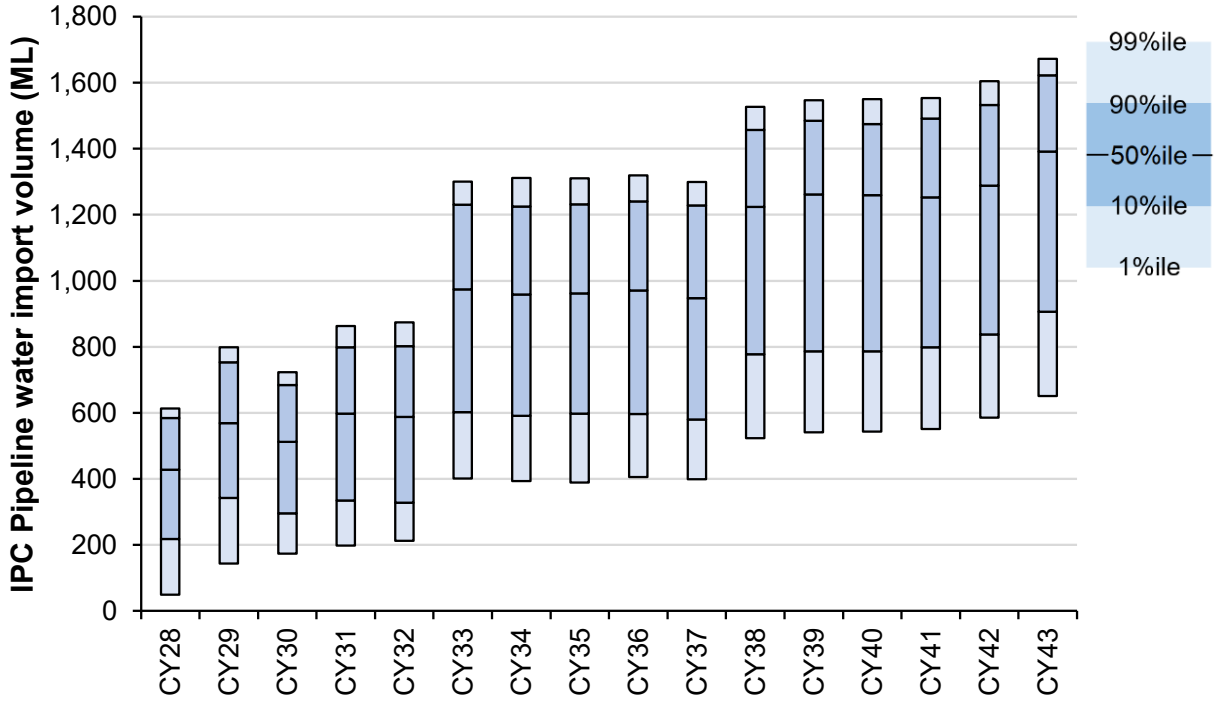


Figure 24-30 Annual Mine-affected Water Demand from IPC

24.7.4.11 IPC Mine-affected Water Inventory

The total IPC mine water inventory, inclusive of transfers to and from the Project, is shown in Figure 24-31. This figure also shows combined maximum operating volumes for the IPC storages (existing voids) at various stages of Project life, ranging between 38,900 ML and 87,000 ML. These results demonstrate that the IPC WMS can manage the addition of Project water transfers and demands, with the peak inventory in the IPC mine water system during very wet climatic reaching a volume of around 11,100 ML, which is well below the combined capacity for the system, under the most extreme climatic conditions.

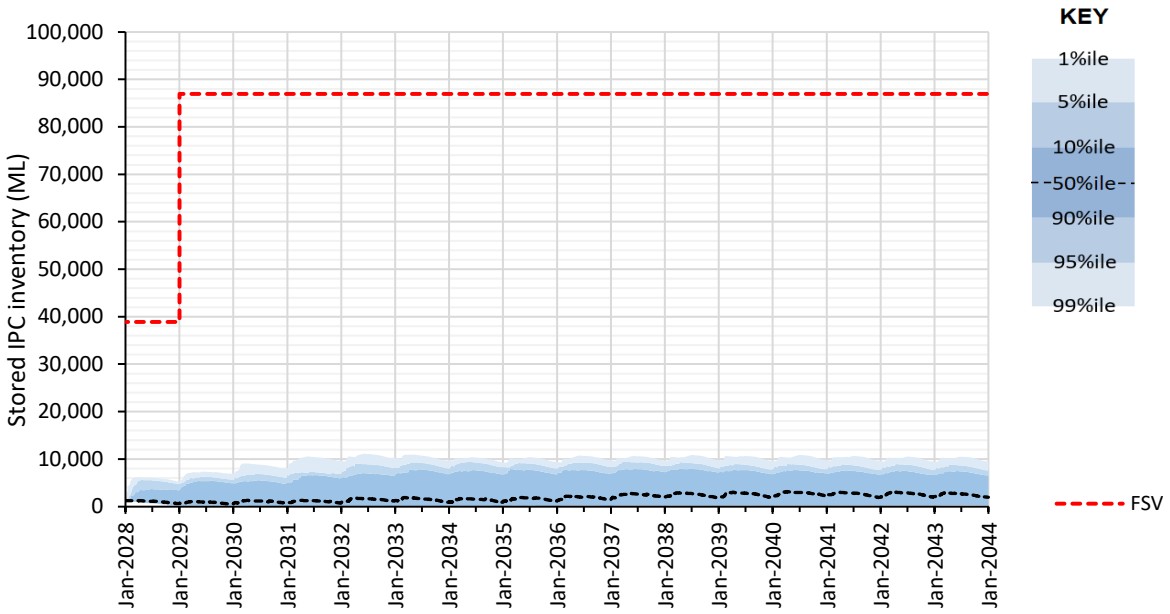


Figure 24-31 Forecast Total IPC Mine-affected Water Inventory

24.7.4.12 IPC Raw Water Take

The additional raw water demands due to the Project are as follows:

- The 40 ML/a raw water demand associated with the IDE washdown/fire water circuit.
- If the mine-affected water supplies at IPM, IDM and the Project are exhausted, then additional raw water will be required to supply site demands at IPM, IDM and the Project.

The current annual raw water allocation (see Section 24.7.1.3.5) available to IPC is 1,287 ML/a (938 ML/a for the existing IPC allocation, and 349 ML/a for Stanmore's non-operational Millenium mine adjoining IPC). The modelled external water requirements at IPC are shown in Figure 24-32, which shows that neither the existing allocation at IPC of 938 ML/a, or the combined allocation of 1,287 ML/a, will be exceeded for any climatic realisations.

The Project's mine water demands will be adequately supplied from the mine-affected water stored within the integrated WMS under most climatic conditions. However, there is a small probability (around 10% AEP) that the mine-affected water reserves in the integrated WMS be depleted, and additional external raw water will be required to satisfy site demands. Even when this occurs, as shown in Figure 24-32, the existing raw water allocation would not be exceeded.

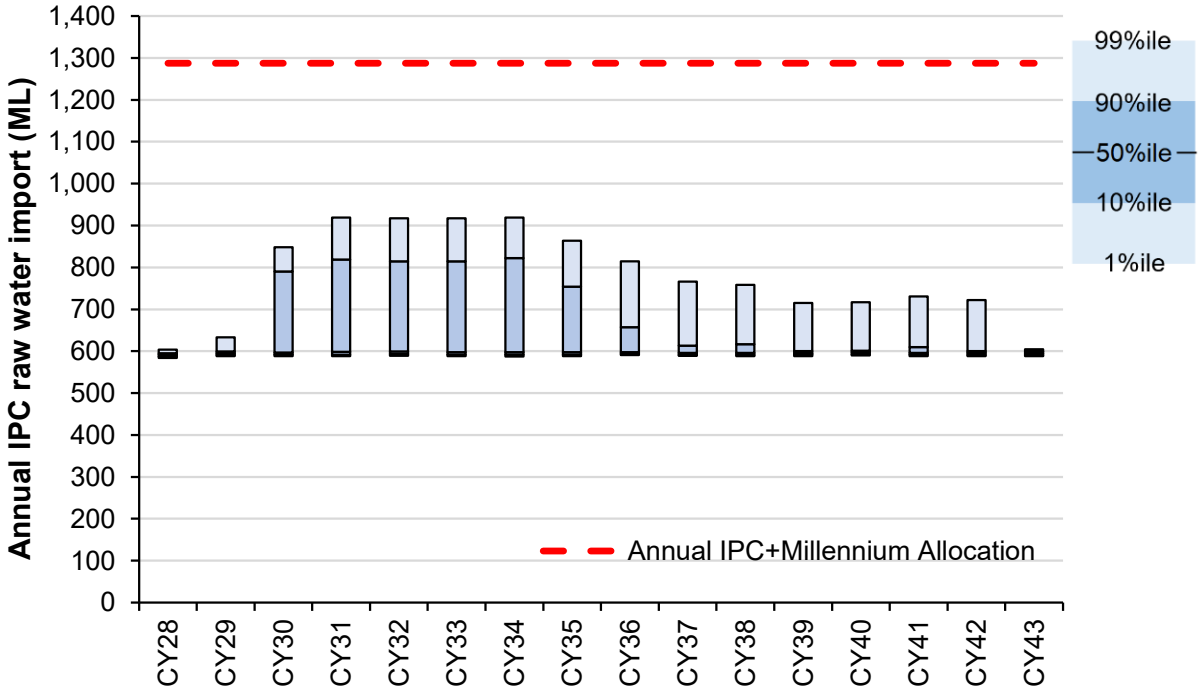


Figure 24-32 External Raw Water Demand for IPC (Including Project Demands)

24.7.4.13 Overall Salt Balance

Table 7.3 of **Appendix I** provides an indication of the long-term average annual salt inputs and outputs from the Project WMS, during each phase of the Project.

24.7.4.14 Climate Change Assessment

The methodology for assessing the influence of climate change on the modelled WMS is described in Section 24.7.3.2. The water balance model developed for the Project was used to simulate the performance of the WMS using the climate change factors, as described in Section 7.4 of **Appendix I** and summarised below.

The climate change model results show no material change to the operations of the mine-affected water storages in comparison to base case modelling provided in Section 24.7.4.4.

These climate modelling results demonstrate that the Project pit is able to continuously operate under all but the most extreme rainfall condition, which is the same as for the base case modelling.

For controlled releases of mine-affected water, the model results show that in comparison to the base case modelling provided in Section 24.7.4.6:

- For very wet climatic conditions (99%ile), the maximum annual controlled release volume (85 ML) is around 45 ML lower than under base case conditions (130 ML).
- For wet climatic conditions (90%ile), the maximum annual controlled release is less than 2ML, compared with 40 ML under base case conditions.
- No controlled releases are predicted to occur in median and drier climatic conditions.

There are no MAW dams that overflow directly to the receiving environment using the factored climate dataset. Therefore, there is nil risk of uncontrolled spillway discharges of mine-affected water to the receiving environment under the conservative climate change scenario.

For sediment dam overflows, the model results show that in comparison to the base case modelling provided in Section 24.7.4.8:

- During very wet climatic conditions (99%ile) where rainfall events can exceed the dam design standard, modelled sediment dam overflows are between 350 ML/year and 550 ML/year (up to 220ML/yr less than under base case conditions).
- During wet climatic conditions (90%ile) where rainfall events sometimes exceed the dam design standard, modelled sediment dam overflows are between 100 ML/year and 200 ML/year (up to 200ML/yr less than under base case conditions).
- There are no predicted overflows from the sediment dams during median, dry and very dry climatic conditions.

The impacts of the climate change projections on the performance of the operational water management system are summarised as follows:

- Overall, there is less mine-affected water and sediment water in the WMS due to the higher evaporation and lower rainfall.
- There is a corresponding lower risk of pit inundation, controlled release volumes and sediment dam overflow volumes.

24.7.4.15 Adaptative Management of the WMS

The site water balance model results represent the application of the proposed WMS rules over the life of the Project, regardless of climatic conditions. In reality, there are numerous options for adaptive management of the WMS to respond to climatic conditions and the site water inventory in a way that would further reduce the risks of impacts to surface water resources and quality.

The integrated IPC water balance model will be updated once operations commence at the Project to reflect any changes in the WMS over the life of the operation.

24.8 Flood Modelling Assessment

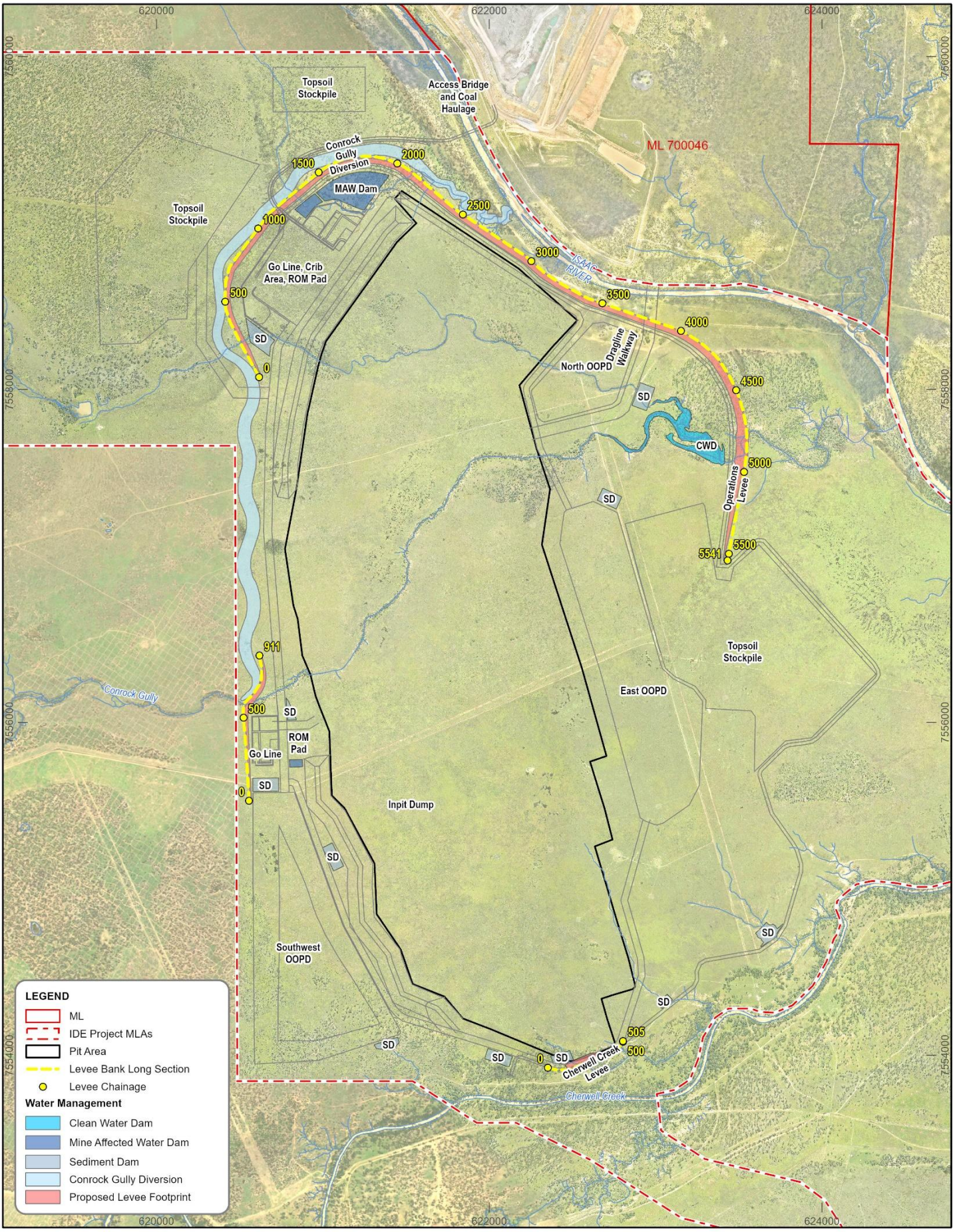
24.8.1 Proposed Surface Water Infrastructure

The proposed Project infrastructure that will interact with flows in local watercourses and drainage features includes:

- a diversion of Conrock Gully with associated levee plug
- a levee along the Isaac River
- a levee plug along a section of backwater flow from Cherwell Creek
- a bridge crossing of the Isaac River for the Project's primary access via IDM
- a bridge crossing of Cherwell Creek for the Project's secondary access to the Eagle Downs project
- a temporary dragline crossing of the Isaac River
- a bed-level crossing of JB Gully along the secondary access road to the Eagle Downs project.

The proposed infrastructure is designed to allow the safe and efficient operation of the Project, while minimising potential impacts on the receiving environment and sensitive ecological receptors.

The layout of the Project's key surface water infrastructure elements is presented in Figure 24-33. A description of this infrastructure is provided in **Chapter 4** and **Chapter 23**.



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Proposed Surface Water Infrastructure Layout

Figure | **24-33**

24.8.2 Preliminary Consequence Category Assessment

24.8.2.1 Overview

A preliminary consequence category assessment (CCA) for the Project's levees and levee plugs was undertaken in accordance with the Dams Manual.

This assessment is based on preliminary design information, and therefore, relies on a number of assumptions. This assessment will be updated during detailed design.

Certified copies of the consequence category determination for each of the proposed structures will be provided following detailed design.

24.8.2.2 Assessable Infrastructure

24.8.2.2.1 Water Storages

A preliminary consequence category assessment of the Project's water storages is summarised in Section 24.7.2 and provided in a surface water impact assessment report (**Appendix I**).

24.8.2.2.2 Levee and Levee Plugs

The Dams Manual specifies the following requirement with respect to levees:

- Where a levee is designed to prevent ingress of non-mine affected floodwater into an operational area, or catchment of a containment system, the suitably qualified and experienced person conducting and certifying the assessment and construction would declare that the levee is a regulated structure where the flood modelling shows that the pit would be encroached by a flood event with a probability more likely than or equal to 1:1000 AEP.

The Isaac River, Cherwell Creek and the downstream 3.2 km reach of Conrock Gully are the only defined watercourses that flow immediately past the Project mining activities, and therefore, were assessed as part of the Project's preliminary CCA.

24.8.2.3 Assessment Outcomes

The Isaac River flows past the eastern side of the Project, from northwest to southeast. Cherwell Creek flows past the southern boundary of the Project, from west to east. The alignments of these watercourses have not been modified as part of the Project's mining activities.

Conrock Gully currently flows through the Project's proposed mining area towards the Isaac River. A diversion of Conrock Gully is proposed to divert the local creek flows around the Project's proposed mining area and into the Isaac River.

The Project's flood modelling assessment shows that under pre-mining conditions, the Isaac River's, Cherwell Creek's and Conrock Gully's 0.1% AEP flood extents (1:1000 AEP) will interact with the Project's operational mining pit (Section 24.8). Based on this outcome, the Isaac River flood protection levee, the Cherwell Creek levee plug and the Conrock Gully levee plug are classified as 'regulated structures' in accordance with the Dams Manual.

The Project's flood modelling results for developed conditions with the levee and levee plugs in place demonstrate that the levee and levee plug designs protect the Project's mining operations from a 0.1% AEP flood event (plus freeboard), and therefore, are compliant with the hydraulic performance requirements for regulated levees outlined in the Dams Manual.

24.8.3 Overview

A TUFLOW hydraulic model was used to assess the impacts of the Project on Isaac River, Cherwell Creek and Conrock Gully flooding for a range of design flood events. The development of the hydrological and

hydraulic models is documented in Appendix A and Appendix B, respectively, of **Appendix J**. The following development scenario/event combinations were modelled for the Project:

- Existing (approved) conditions:
  - 50%, 10%, 2%, 1% and 0.1% AEP.
- Developed (operational) conditions:
  - 50%, 10%, 2%, 1% and 0.1% AEP.
- Post-closure (final landform) conditions:
  - 1% AEP, 0.1% AEP and probable maximum flood (PMF).

The existing conditions represent the approved conditions prior to the commencement of construction and operation of the Project, and includes the surface water infrastructure described in Section 24.3.9.

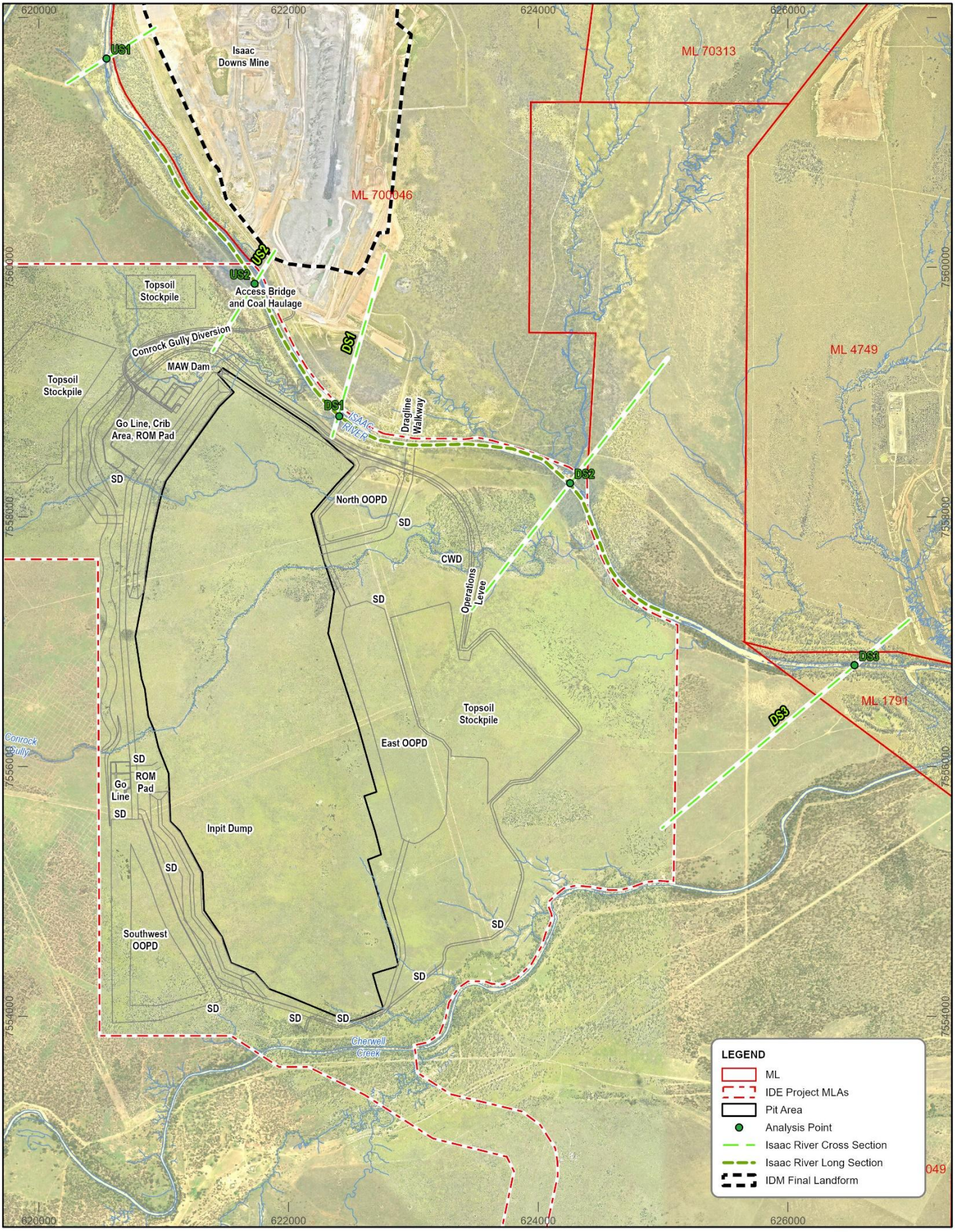
The developed conditions include the proposed water management structures for the Project as described in Section 24.8.1.

The layout of the Project's post-closure landform is shown in **Chapter 5**. The Conrock Gully diversion will remain post-closure. However, the levees will be decommissioned and rehabilitated as they are not required for final void protection because the void is not located within a 0.1% AEP floodplain. The raised haul road located at the upstream end of the Conrock Gully diversion would be rehabilitated, stabilised and incorporated into the final landform dump structure, effectively replacing the functionality of the Conrock Gully levee plug. The Project's final landform includes backfilling of the northern section of the pit to natural topographical levels and rehabilitated overburden dumps.

In the absence of agreement by a third party for retention of infrastructure, bridge and crossing infrastructure will be decommissioned and rehabilitated as part of the final landform.

For the Project's flood impact assessment, the modelled existing conditions flood levels and velocities were subtracted from the flood levels and velocities modelled under the developed and post-closure scenarios. Therefore, a 'positive value' of impact represents an increase in the relevant hydraulic parameter (e.g. level, velocity), and conversely, a 'negative value' of impact represents a reduction in the relevant hydraulic parameter.

The key reporting locations for the Project's flood modelling assessment are presented in Figure 24-34, which includes a long section along the Isaac River (6,000 m) and five cross sections through the Isaac River and surrounding floodplain upstream (US1 and US2), and adjacent and downstream (DS1, DS2, DS3) from the Project.



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Key Reporting Locations for Flood Modelling Assessment

24.8.4 Existing Conditions

Modelled 1% AEP and 0.1% AEP flood depths and extents for the existing conditions scenario are shown in Figure 24-35 and Figure 24-36, respectively. Modelled flood velocities for the existing conditions for the 1% AEP and 0.1% AEP flood events are shown in Figure 24-37 and Figure 24-38, respectively.

In summary, the modelled existing Isaac River flood depths and velocities show the following characteristics:

- A perched overbank channel runs along the west bank of the Isaac River from upstream of US1 to immediately upstream of DS1.
- The width of the Isaac River floodplain ranges been 700 m at US1 upstream of the Project to 2,500 m at DS2 downstream of the Project.
- For the 1% AEP depths and velocities:
    - The maximum flood depths in the Isaac River channel adjacent to the Project typically ranges between 11 m to 12 m.
    - The western floodplain depths vary in the vicinity of the Project, with the perched overbank channel experiencing depths up to 4 m to 5 m and the depths in the flatter regions of the floodplain ranging from 1.0 m to 1.5 m.
    - The depths in the eastern floodplain adjacent to the Project range between 1.8 m to 2.2 m.
    - The maximum flood velocities in the Isaac River main channel in the vicinity of Project range between 2 m/s to 2.5 m/s. The floodplain velocities generally remain below 1 m/s, aside from the western perched overbank channel, where velocities may reach up to 2 m/s.
- For the 0.1% AEP depths and velocities:
    - The maximum flood depths in Isaac River channel adjacent to the Project typically ranges between 13 m to 14 m.
    - The western floodplain depths vary in the vicinity of the Project, with the perched overbank channel experiencing depths up to 5 m to 6 m and the depths in the flatter regions of the floodplain ranging from 1.5 m to 2.5 m.
    - The depths in the eastern floodplain adjacent to the Project range between 3 m to 4 m.
    - The maximum flood velocities in the Isaac River main channel in the vicinity of Project range between 2.5 m/s to 3.0 m/s. The floodplain velocities generally remain below 1.5 m/s, aside from the western perched overbank channel, where velocities may reach up to 2.4 m/s.
    - The IDM final void will not be encroached by the 0.1% AEP Isaac River flood.

In summary, the modelled existing Cherwell Creek flood depths and velocities show the following characteristics:

- A number of minor breakout channels occur along Cherwell Creek, particularly along the southern bank and in the reach downstream of the JB Gully confluence. The number of breakout channels increases during the 0.1% AEP flood event and rarer, suggesting that the Cherwell Creek main channel generally has a conveyance capacity of equivalent to the 1% AEP flood event.
- Cherwell Creek is generally well confined during the 1% AEP flood event. The Cherwell Creek floodplain width during the 0.1% AEP flood event ranges between 600 m to 1,000 m.
- Cherwell Creek is impacted by the Isaac River flood, with river backwater flowing 3.0 km into Cherwell Creek during major flood events (1% AEP and 0.1% AEP).
- The JB Gully channel is poorly defined in comparison to Cherwell Creek. JB Gully is impacted by Cherwell Creek flood backwater.
- For the 1% AEP depths and velocities:

  - The non-backwater affected reaches of Cherwell Creek in the vicinity of the Project generally range between 6 m to 8 m.
  - The non-backwater affected reaches of Cherwell Creek in the vicinity of the Project generally range between 2.0 m/s and 3.0 m/s.
- For the 0.1% AEP depths and velocities:
  - The non-backwater affected reaches of Cherwell Creek in the vicinity of the Project generally range between 8 m to 12 m deep.
  - The non-backwater affected reaches of Cherwell Creek in the vicinity of the Project generally range between 2.5 m/s and 4.0 m/s.

In summary, the modelled existing Conrock Gully flood depths and velocities show the following characteristics:

- The Conrock Gully floodplain width ranges between 150 m and 300 m in the vicinity of the Project.
- Conrock Gully is impacted by the Isaac River flood, with river backwater flowing 2.5 km to 3.5 km into Conrock Gully during major flood events (1% AEP and 0.1% AEP).
- The flood behaviour in Conrock Gully does not change significantly between the 1% AEP and 0.1% AEP flood events.
- The depth in non-backwater affected reaches of Conrock Gully in the vicinity of the Project generally range between 1.0 m to 2.0 m in the upstream reach and 2.0 m to 3.5 m in the downstream reach.
- The velocity in non-backwater affected reaches of Conrock Gully in the vicinity of the Project generally ranges between 1.0 m/s and 3.0 m/s.

In addition, mapping of 50% AEP, 10% AEP, 2% AEP and PMF results of the flood modelling for existing conditions are presented in Appendix C of **Appendix J**.

24.8.5 Developed Conditions

Modelled 1% AEP and 0.1% AEP flood depths and extents for the developed conditions scenario are shown in Figure 5.7 and Figure 5.8, respectively, of **Appendix J**. Modelled flood velocities for the developed conditions for the 1% AEP and 0.1% AEP flood events are shown in Figure 5.9 and Figure 5.10, respectively, of **Appendix J**.

In summary, the modelled developed Isaac River flood depths and velocities show the following characteristics:

- The Isaac River floodplain is partially reduced around US2, between the proposed Project Isaac River levee and the IDM final landform. The width of the Isaac River floodplain in this location is less than 900 m. The proposed levee, along the western bank of the Isaac River interacts with Isaac River floodwaters to around DS2.
- The proposed Isaac River levee has sufficient height to provide flood immunity to the Project's operational pit area and other mine infrastructure for a 0.1% AEP flood event.
- Infrastructure associated with the haul road bridge crossing of the Isaac River will interact with flood waters. The topsoil stockpiles have been located so that they are almost entirely outside the 1% AEP flood event, with flexibility to modify the locations of these stockpiles during operations and as topsoil is recycled for use in rehabilitation.
- For the 1% AEP depths and velocities:
  - The maximum flood depths in the Isaac River channel adjacent to the Project are typically greater than 12 m.
  - The depths in the western perched overbank channel range between 4 m to 5 m and the depths in the flatter regions of the western floodplain upstream of the proposed levee range between 1 m to 2 m.
  - The eastern floodplain depths range between 2.0 m to 2.6 m.

  - The maximum flood velocities in the Isaac River main channel in the vicinity of Project range between 1.8 m/s to 2.4 m/s. The western floodplain velocities upstream of the proposed levee generally remain below 1.0 m/s, aside from the perched overbank channel, where velocities may reach up to 1.8 m/s. The velocities in the eastern floodplain generally remain below 1.0 m/s.
- For the 0.1% AEP depths and velocities:
  - The maximum flood depths in Isaac River adjacent to the Project are typically greater than 13 m.
  - The depths in western perched overbank channel range between 5 m to 7 m and the depths in the flatter regions of the western floodplain upstream of the proposed levee range between 2.5 m to 3.5 m.
  - The eastern floodplain depths range between 3 m to 4 m.
  - The maximum flood velocities in the Isaac River main channel in the vicinity of Project range between 2.2 m/s to 3.0 m/s. The western floodplain velocities upstream of the proposed levee generally remain below 1.3 m/s, aside from the perched overbank channel, where velocities may reach up to 2 m/s. The velocities in the eastern floodplain generally remain below 1.8 m/s.

In summary, the modelled developed Cherwell Creek flood depths and velocities show the following characteristics:

- There is no interaction between the Project operations and infrastructure, other than the secondary access road and bridge crossing, for the 1% AEP flood event, and only minor interaction between the northern floodplain and the proposed Cherwell Creek levee plug during a 0.1% AEP flood event.
- The Cherwell Creek flood depths and velocities for the developed conditions are generally similar to the existing conditions levels.

In summary, the modelled developed Conrock Gully flood depths and velocities show the following characteristics:

- The proposed drainage infrastructure, including the Conrock Gully diversion and levee plug, and Isaac River levee, have sufficient capacity to convey the 0.1% AEP flood event.
- For the 1% AEP depths and velocities:
  - The depths in Conrock Gully upstream of the diversion generally range between 1 m in the upper reaches to 4 m as it meets the diversion.
  - The depths in the Conrock Gully diversion generally range between 4 m and 6 m.
  - The velocities in Conrock Gully upstream of the diversion generally range between 0.6 m/s and 2.2 m/s.
  - The velocities in the Conrock Gully diversion generally range between 1.0 m/s and 2.0 m/s.
- For the 0.1% AEP depths and velocities:
  - The depths in the Conrock Gully upstream of the diversion generally range between 1 m in the upper reaches to 5 m as it meets the diversion.
  - The depths in the Conrock Gully diversion generally range between 4 m and 8 m.
  - The velocities in the Conrock Gully upstream of the diversion generally range between 1.0 m/s and 2.5 m/s.
  - The velocities in the Conrock Gully diversion generally range between 1.3 m/s and 2.5 m/s.

In addition, mapping of 50% AEP, 10% AEP and 2% AEP results of the Project's flood modelling for developed conditions are presented in Appendix C of **Appendix J**.

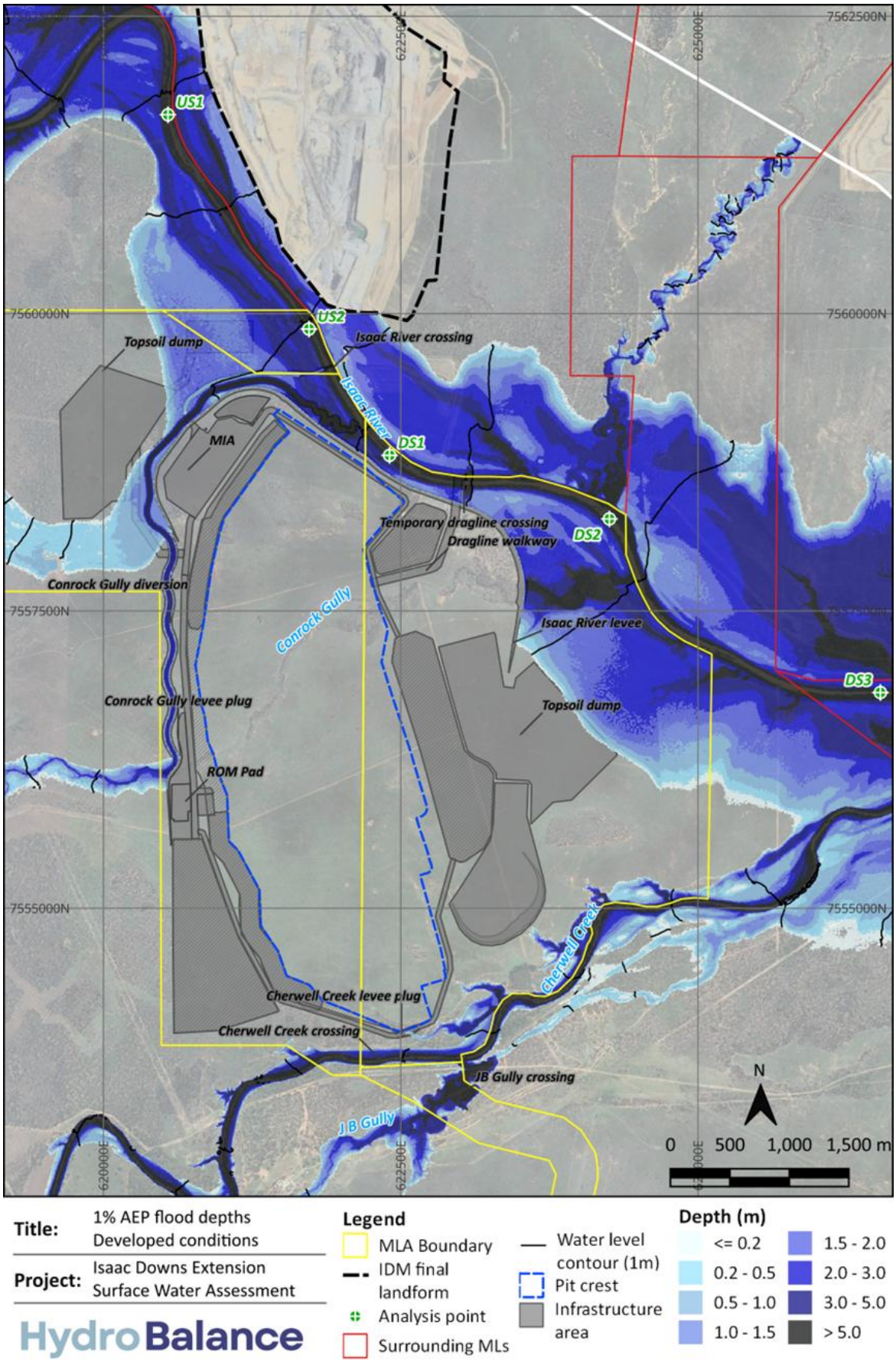


Figure 24-35 Developed Conditions – 1% AEP Flood Depths and Heights

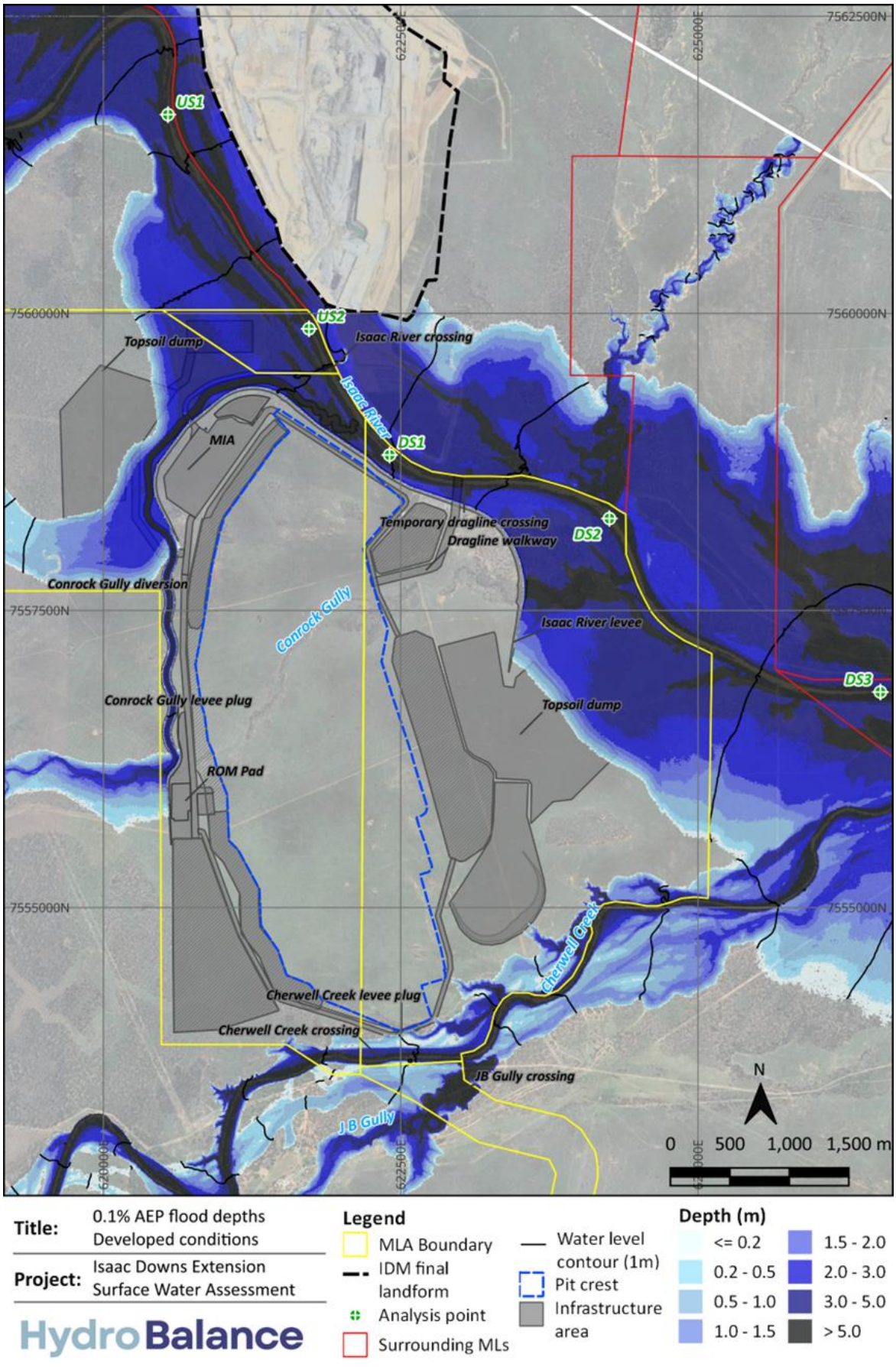


Figure 24-36 Developed Conditions – 0.1% AEP Flood Depths and Heights

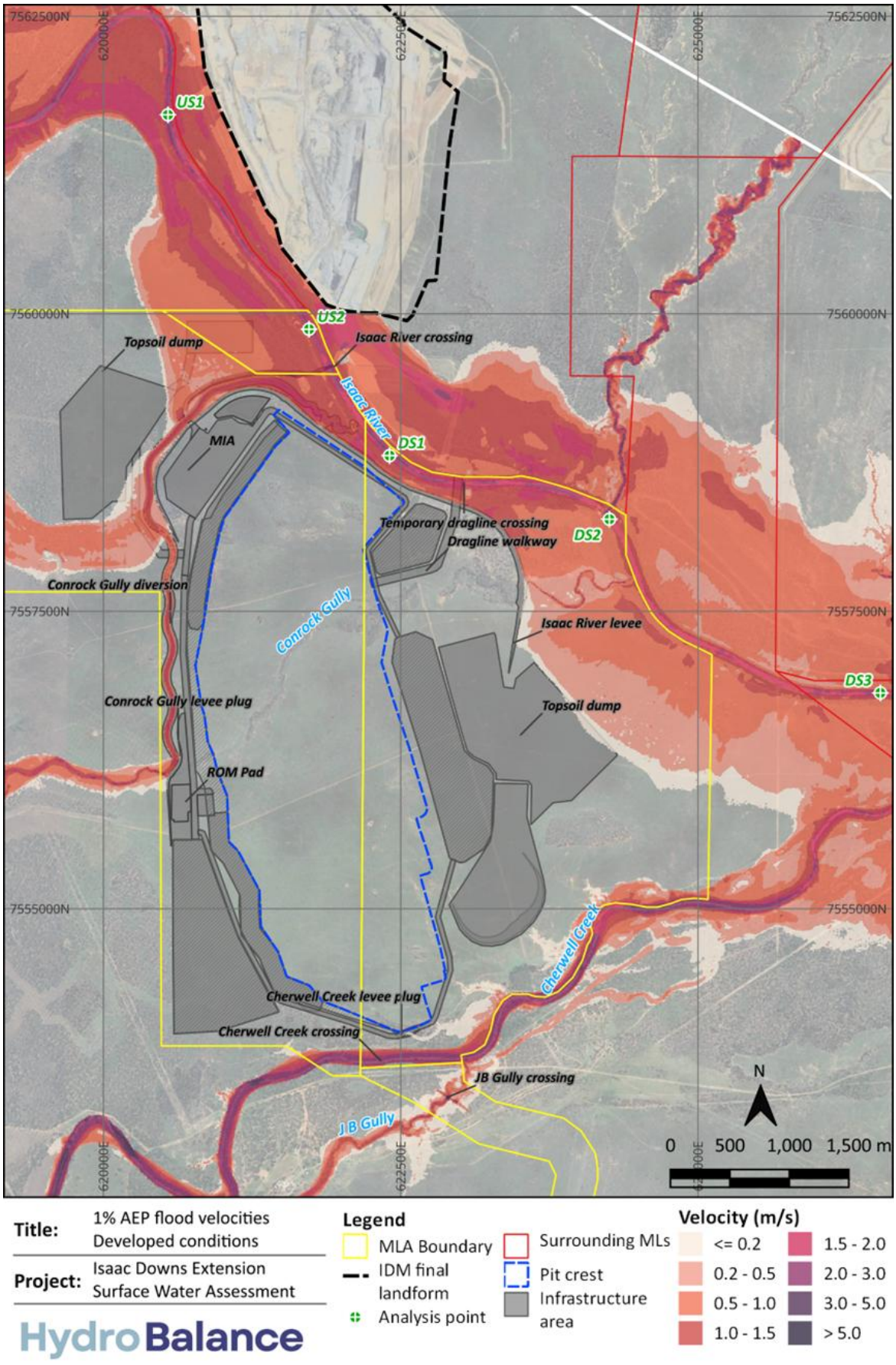


Figure 24-37 Developed Conditions – 1% AEP Flood Velocity

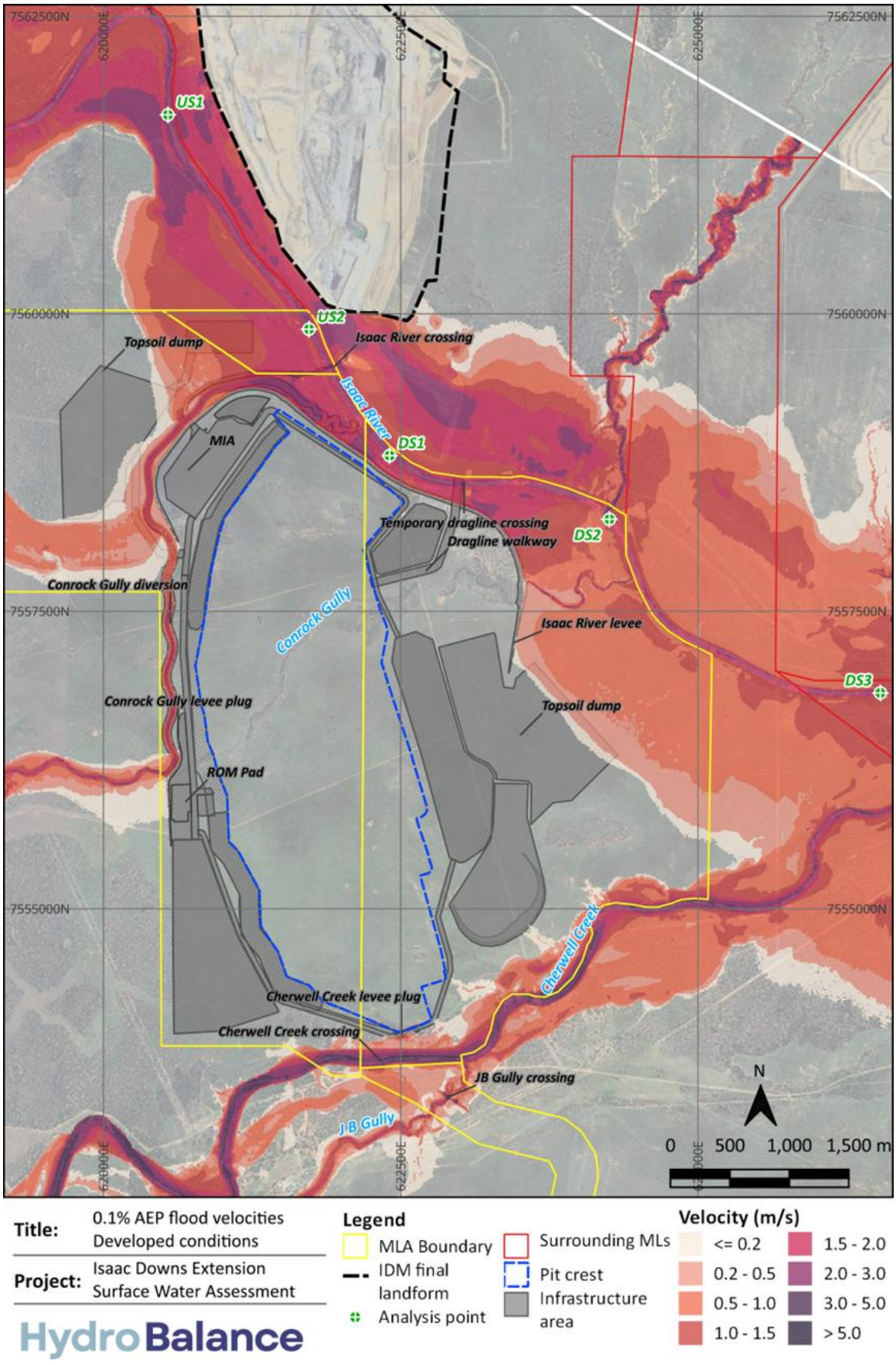


Figure 24-38 Developed Conditions – 0.1% AEP Flood Velocity

24.8.6 Developed Conditions – Levee Water Levels and Velocities Impact Assessment

The locations and chainages along the following proposed levees are presented in Figure 24-33:

- Isaac River levee
- Cherwell Creek levee plug
- Conrock Gully levee plug.

Figure 24-39, Figure 24-40 and Figure 24-41 show proposed levee heights and 0.1% AEP water levels for the Isaac River levee, Cherwell Creek levee plug and the Conrock Gully levee plug, respectively. These figures shows that the 0.1% AEP water levels along the proposed levees do not overtop the levee crests and will maintain a freeboard of at least 300 mm along the length of all levees and plugs. Consequently, the Project's mining operations, including dams, will be protected from a 0.1% AEP flood event by the Project's planned levee and levee plugs.

Figure 24-39, Figure 24-40 and Figure 24-41 also show the modelled 0.1% AEP, 1% AEP and 10% AEP velocities for the respective levees / plugs.

In terms of potential impacts, the following results are described:

- In relation to the Isaac River levee:
    - The 1% AEP and 10% AEP velocities are consistently less than 1.7 m/s, and therefore, are unlikely to cause scour if the levee is fully vegetated.
    - For the 0.1% AEP, the highest risk of scour occurs in the centre of the levee, which is closest to the Isaac River. Rock protection could be implemented between chainage 1,700 m and 4,200 m, if required, equating to a 2.5 km rock protected section. However, the occurrence of the 0.1% AEP flood event, by definition, is highly infrequent and scour is not expected to occur for a vegetated levee for events more frequent than the 0.1% AEP. The remaining sections of the levee would experience velocities less than 1.7 m/s during the 0.1% AEP, and therefore, are unlikely to cause scour if these sections are fully vegetated.
- In relation to the Cherwell Creek levee plug:
    - The 0.1% AEP, 1% AEP and 10% AEP velocities are consistently less than 1.7 m/s, and therefore, are unlikely to cause scour if the levee is fully vegetated.
- In relation to the Conrock Gully levee plug
    - The 0.1% AEP, 1% AEP and 10% AEP velocities are consistently less than 1.7 m/s, with the exception of a small section at chainage 590 m for the 0.1% AEP flood event, where velocities may reach up to 2.1 m/s. Rock protection may be applied in this section if required. Velocities along the remainder of the levee are unlikely to cause scour if the levee plug is fully vegetated.

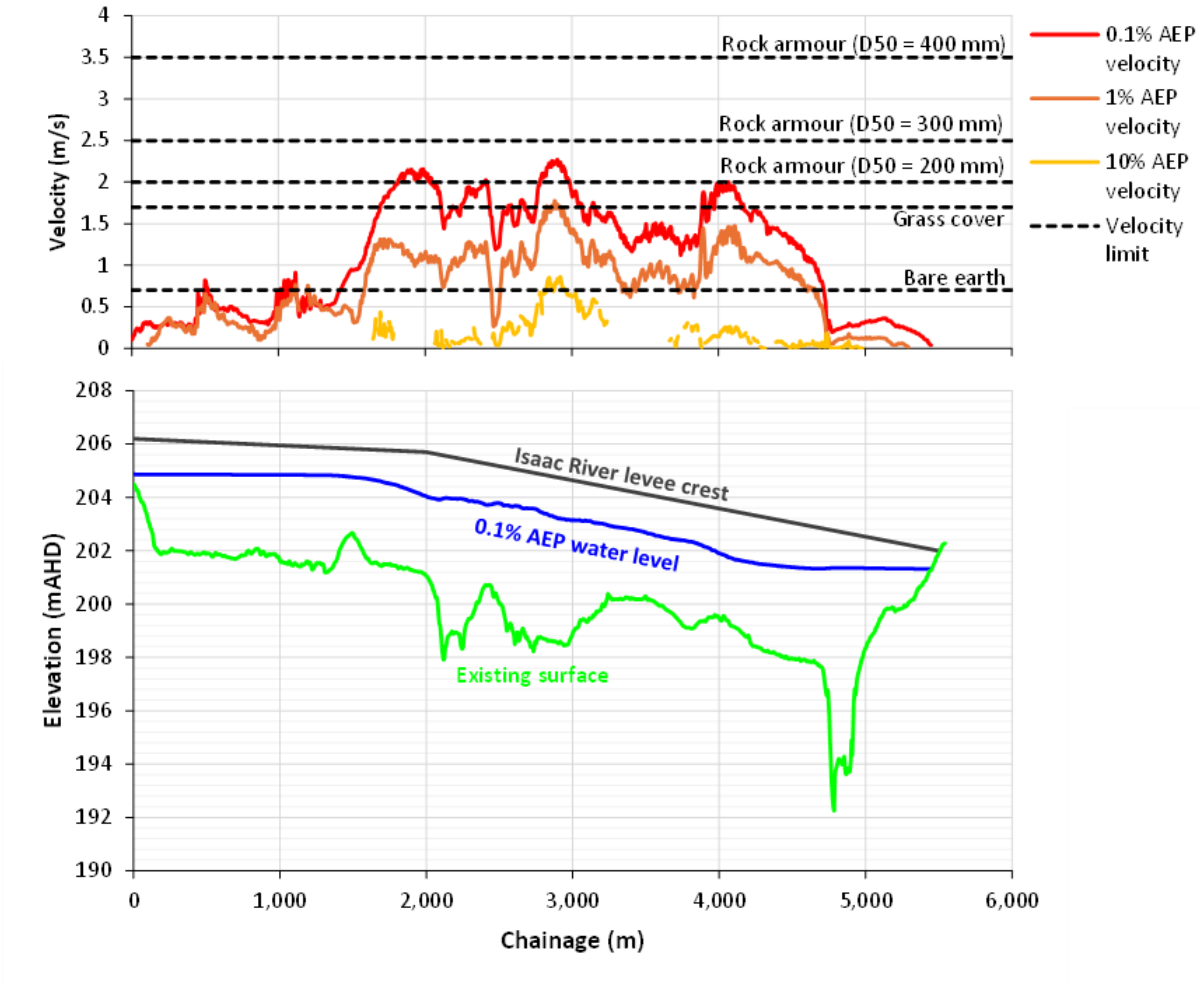


Figure 24-39 Isaac River Levee - Long Section - 0.1% AEP Water Levels and Velocities

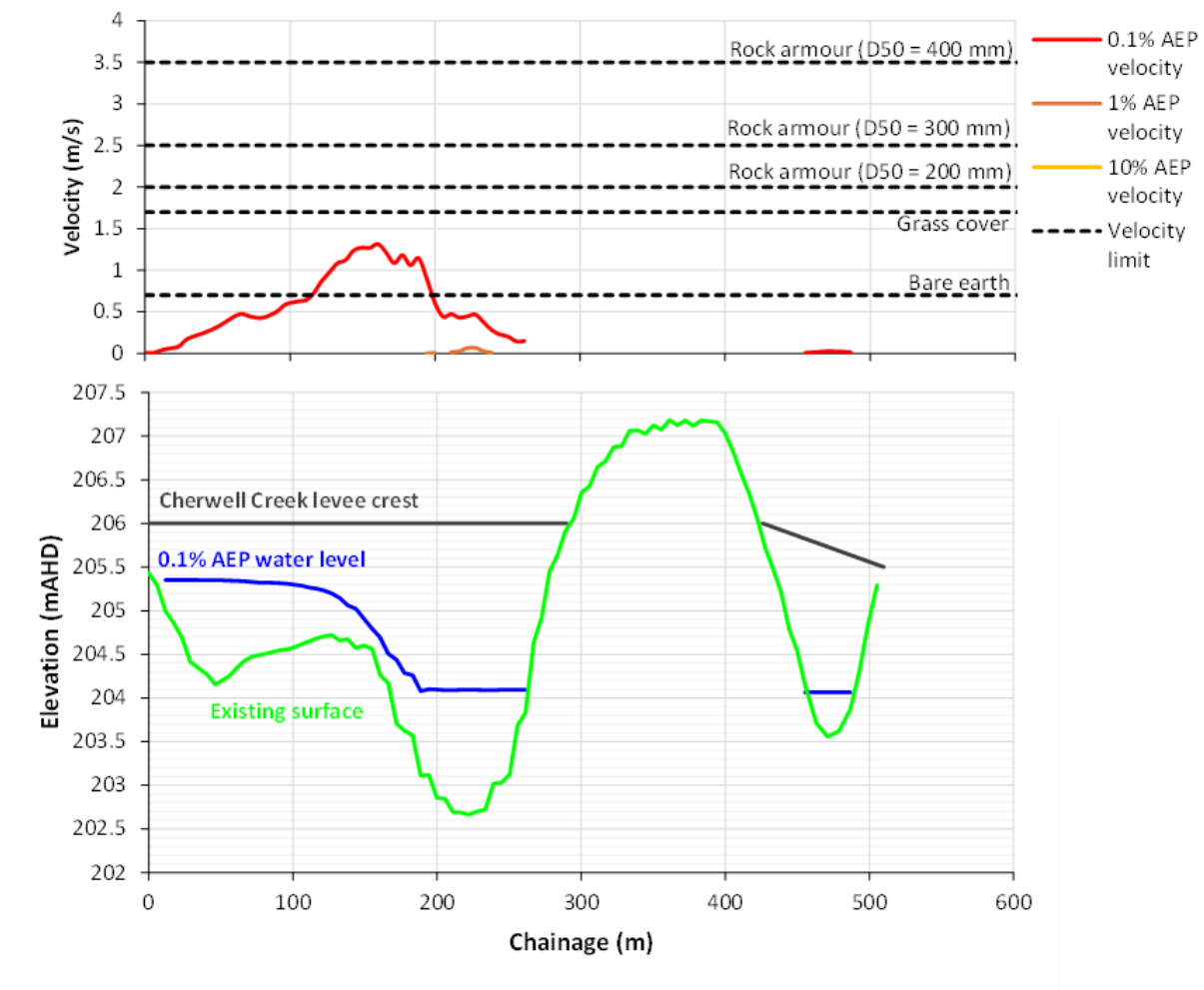


Figure 24-40 Cherwell Creek Levee Plug - Long Section - 0.1% AEP Water Levels and Velocities

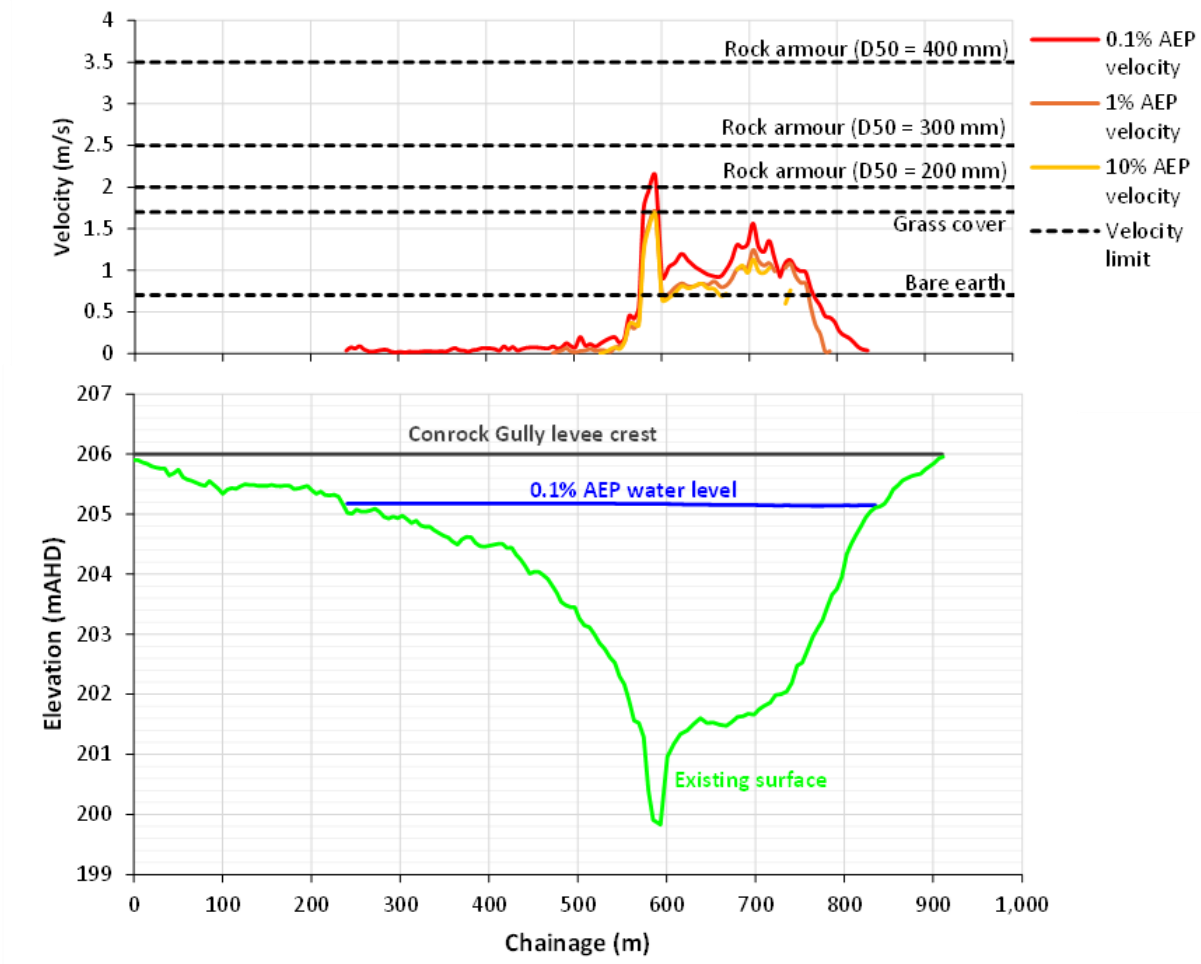


Figure 24-41 Conrock Gully Levee Plug - Long Section - 0.1% AEP Water Levels and Velocities

24.8.7 Developed Conditions – Flood Level Change Assessment

The modelled Isaac River and local creek flood level changes or afflux for developed conditions for the 1% AEP and 0.1% AEP flood events are shown in Figure 24-42 and Figure 24-43, respectively. This section summarises the impacts across all modelled events. In addition, flood level change (afflux) mapping of the 50% AEP, 10% AEP, and 2% AEP flood events is presented in Appendix C of **Appendix J**.

Changes in flood levels are considered in the context of the regional landscape in which the change occurs, notable a pastoral landscape with surrounding mining activity, and without residences or infrastructure.

In summary, the findings of the modelled Isaac River flood level changes for developed conditions are as follows:

- The flood levels in Isaac River channel and floodplain increase up to:
  - 1 m (generally less than 0.5 m) along a 4 km reach for the 1% AEP flood event.
  - 1.2 m (generally less than 1 m) along a 5.4 km reach for the 0.1% AEP flood event.
- Changes in flood level adjacent the IDM final landform are generally around 0.5 m.
- The flood level impacts do not extend downstream beyond the Project footprint and changes in flood levels are considered to be minor.
- The greatest increase in the Isaac River flood levels occur near US2, where the floodplain width is reduced by both the approved IDM levee and the Project's proposed Isaac River levee. The flood

levels may be increased by up to 0.5 m for the 1% AEP flood event and 1.2 m for the 0.1% AEP flood event.

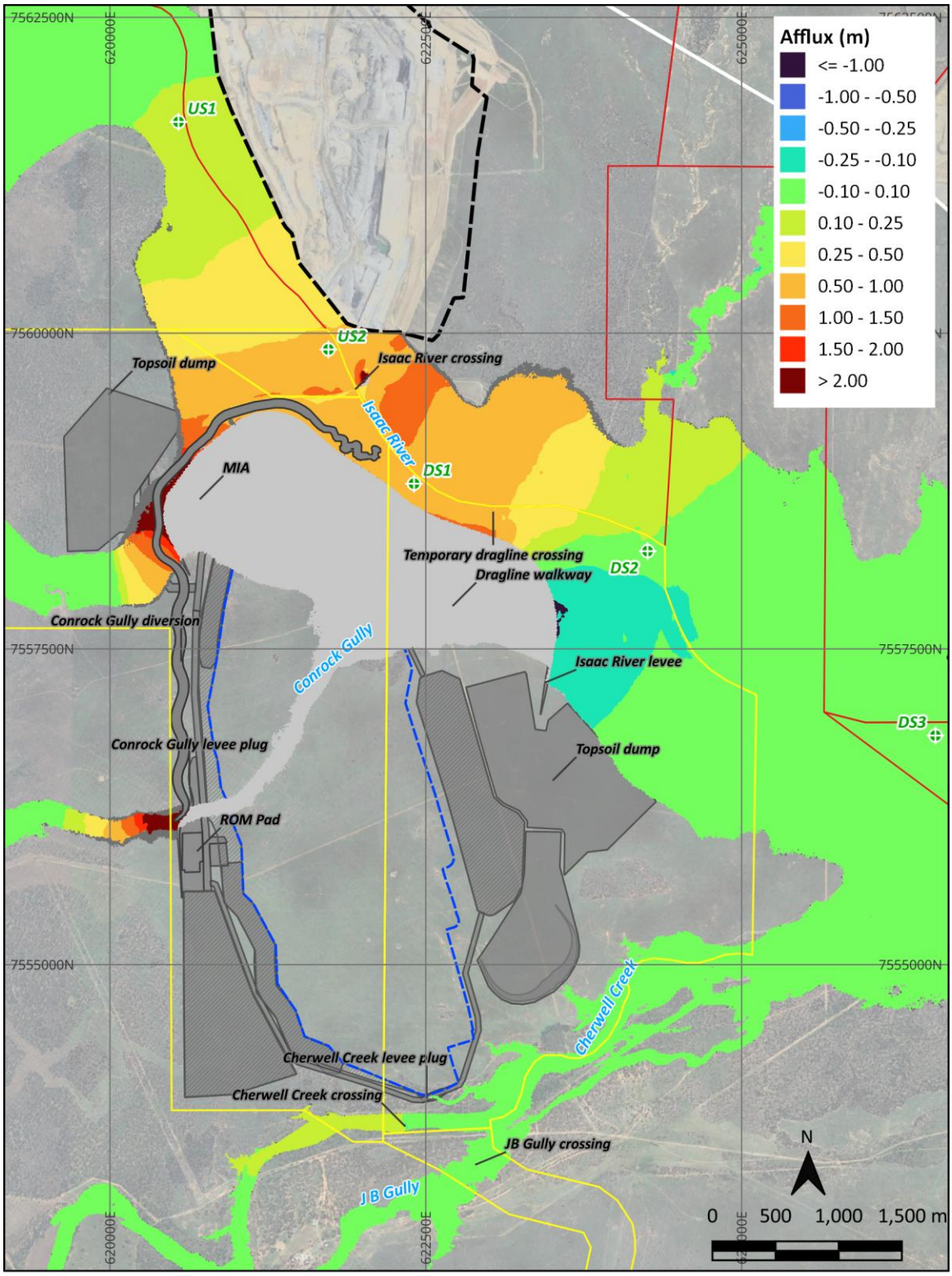
- There are minor decreases in flood levels on the downstream face of the Project's proposed Isaac River levee for the 0.1% AEP flood event, due to reduced conveyance past this location.
- The magnitude of changes in flood levels reduces for more frequent flood events.
- Reducing the extent of the floodplain behind the Project's proposed Isaac River levee has negligible to minor impact on the expansion of the floodplain into areas that were previously not flooded.
- The proposed Isaac River bridge and the temporary dragline crossing have negligible impacts on the 1% and 0.1% AEP flood events, as the structures are inundated by these flood flows. Minor water level changes of up to 0.5 m at the Isaac River bridge and 0.25 m at the temporary dragline crossing can be observed for smaller events (e.g. the 10% AEP). The minor water level increases at the temporary dragline crossing are primarily a result of the bed level crossing. The bed level crossing will be removed and stabilised once the dragline walk is completed. Therefore, the water level impacts in this area are highly unlikely to occur.
- The IDM final void will not be encroached by the 0.1% AEP flood during the Project's developed conditions, because the IDM final landform is sufficient to hold back 0.1% AEP Isaac River flood water, with the Project's Isaac River levee in place.
- There are no material water level impacts to the Peak Downs Highway bridge or the Goonyella Railway bridge for any of the modelled events.

In summary, the findings of the modelled Cherwell Creek flood level changes for developed conditions are as follows:

- The proposed Cherwell Creek bridge may increase water levels upstream of the bridge by up to 0.1 m for the 1% AEP flood event and 0.2 m for the 0.1% AEP flood event.
- During the 0.1% AEP flood event, flows are pushed towards the proposed Cherwell Creek levee plug by the bridge, causing a localised increase of up to 0.6 m at the proposed levee plug. The 0.1% AEP flows do not overtop the Cherwell Creek levee plug. Flows do not interact with the Cherwell Creek levee plug for any events more frequent than a 0.1% AEP flood event.
- The JB Gully bed-level crossing has a negligible impact on all modelled flood events, because the structure is inundated by flood flows.

In summary, the potential impacts from the modelled Conrock Gully flood level changes for developed conditions are as follows:

- The flood levels immediately upstream of the diversion will be increased by up to 1.2 m for the 1% AEP flood event and 2.2 m for the 0.1% AEP flood event. Water level increases up to 0.1 m would propagate 800 m upstream for the 1% AEP flood event and 1,200 m upstream for the 0.1% AEP flood event. The magnitude of changes in flood levels reduces for more frequent flood events. Changes in flood levels are considered to be minor and localised.
- The remainder of the existing Conrock Gully channel will be excised by the Project. However, downstream of the Project area, in the remnant Conrock Gully channel, there is no change in flood levels for the 1% AEP and 0.1% AEP flood events, and up to the 10% AEP flood event, because these areas continue to be flooded by backwater flow from the Isaac River.



Title: 1% AEP flood level impact

Project: Isaac Downs Extension Surface Water Assessment

HydroBalance

Legend

- MLA Boundary
- IDM final landform
- Analysis point
- Surrounding MLs
- Pit crest
- Infrastructure area
- Was wet, now dry
- Was dry, now wet

Figure 24-42 1% AEP Flood Level Impacts

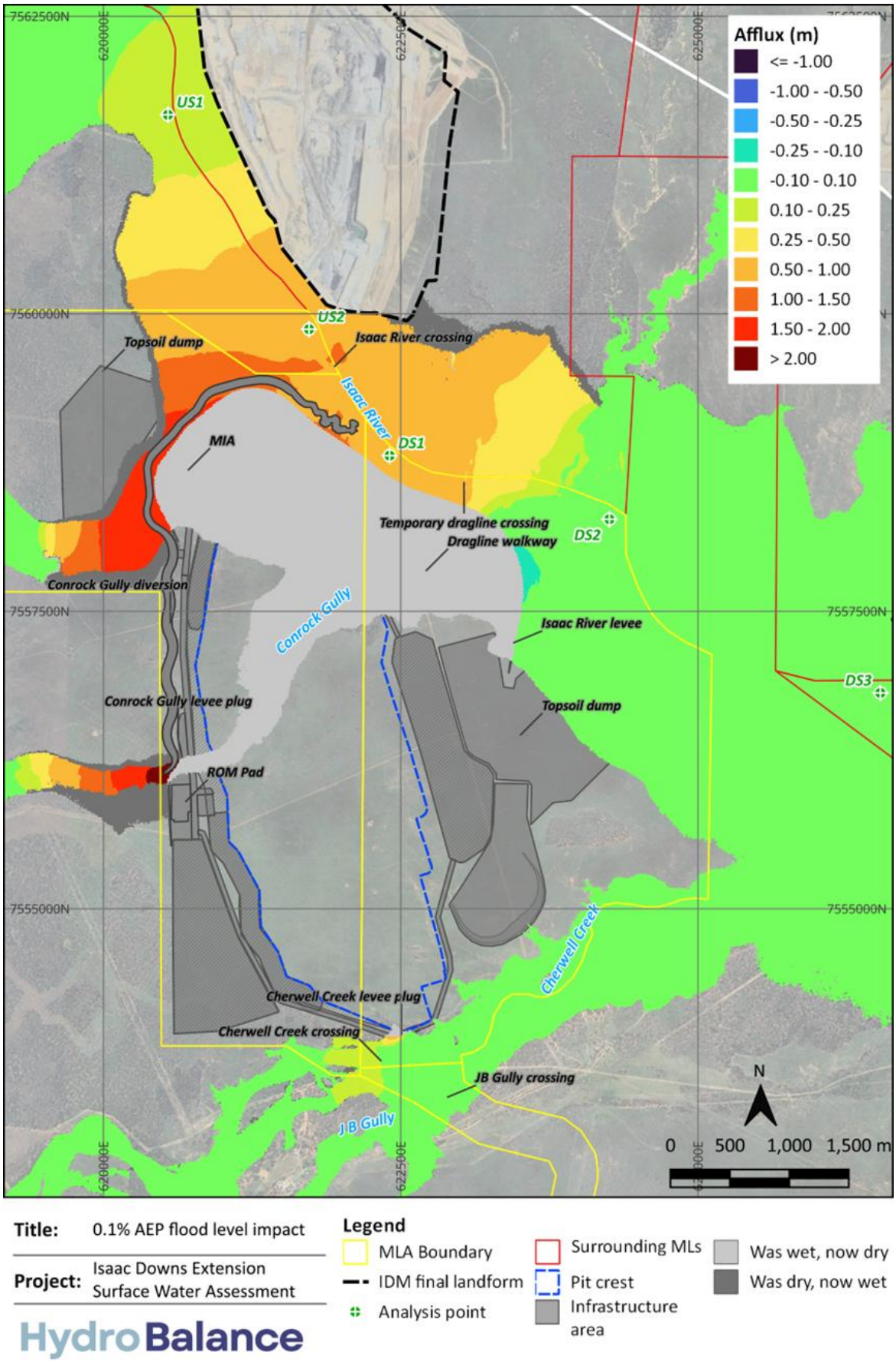


Figure 24-43 0.1% AEP Flood Level Impacts

24.8.8 Developed Conditions – Flood Duration Impact Assessment

Table 24-11 presents an assessment of the potential impacts on the duration of floodplain inundation along the Isaac River. The developed conditions were compared to the existing conditions to represent the potential impact on floodplain residence times, because the developed conditions represent the greatest potential change to the Isaac River floodplain. The locations of the assessment points are shown in the flood maps (Figure 24-34, and Figure 5.3 to Figure 5.22 of **Appendix J**). The rationale applied to select the assessment points is as follows:

- US1: upstream location in the vicinity of mapped regional ecosystems (REs) and groundwater dependent ecosystems (GDEs).
- US2: upstream of the proposed Isaac River bridge crossing and mapped REs located upstream of the proposed Conrock Gully diversion.
- DS1: downstream of proposed Conrock Gully diversion and located in the vicinity of mapped GDEs.
- DS2: downstream of old Conrock Gully channel and in the vicinity of mapped GDEs and Poplar Box threatened ecological communities (TECs).
- DS3: located at the wetland near the confluence of Isaac River and Cherwell Creek.

Cross sections of the Isaac River floodplain and main channel at each of the assessment points are shown in Figure 24-44 to Figure 24-48. These figures also show the modelled flood water levels at each of the assessment points. The locations of the Isaac River floodplain cross sections are shown on Figure 24-34. These cross sections show that the impact to water level is greatest at the US2 and DS1 locations, with water level differences of up to 1 m for the 0.1% AEP flood event. For more frequent flood events (e.g. 10% AEP) at US2 and DS1 flood level changes are negligible. However, at other locations upstream and downstream (US1, DS2, DS3) water level changes are negligible for all modelled flood events.

The duration of floodplain inundation was derived from the TUFLOW hydraulic model. The Isaac River floodplain is considered inundated when the water level increases above the Isaac River main channel top of bank. In summary, the findings regarding the floodplain inundation are as follows:

- Under existing conditions, the Isaac River floodplain may be inundated by between 5 to 22 hours for the 10% AEP flood event, and between 40 and 50 hours for the 0.1% AEP flood event.
- The floodplain inundation duration is generally the greatest at US2 and DS1, both of which are adjacent to IDM.
- The Project results in negligible change to the duration of floodplain inundation, with less than 1 hour change in duration for all AEP flood events, and generally less than 0.5 hours.

Overall, the Project has a negligible impact on the Isaac River floodplain residence times.

Table 24-11 Floodplain Inundation Time Impact Assessment

Design event AEP	Condition	Duration of floodplain inundation (hrs)				
		US1	**US2**	**DS1**	**DS2**	**DS3**
10% AEP	Existing	5.0	15.1	21.2	8.4	5.0
	Developed	5.6	15.4	21.4	8.5	5.2
	Difference	**0.6 (13%)**	**0.3 (2%)**	**0.2 (1%)**	**0.1 (1%)**	**0.2 (2%)**
1% AEP	Existing	28.9	35.8	40.4	31.1	28.8
	Developed	29.2	36.1	40.8	31.2	28.7
	Difference	**0.3 (1%)**	**0.3 (1%)**	**0.4 (1%)**	**0.1 (<1%)**	**-0.1 (<1%)**
0.1% AEP	Existing	39.6	45.3	49.1	41.6	39.6
	Developed	39.9	45.6	49.4	41.7	39.5
	Difference	**0.3 (1%)**	**0.3 (1%)**	**0.3 (<1%)**	**0.1 (<1%)**	**-0.1 (<1%)**

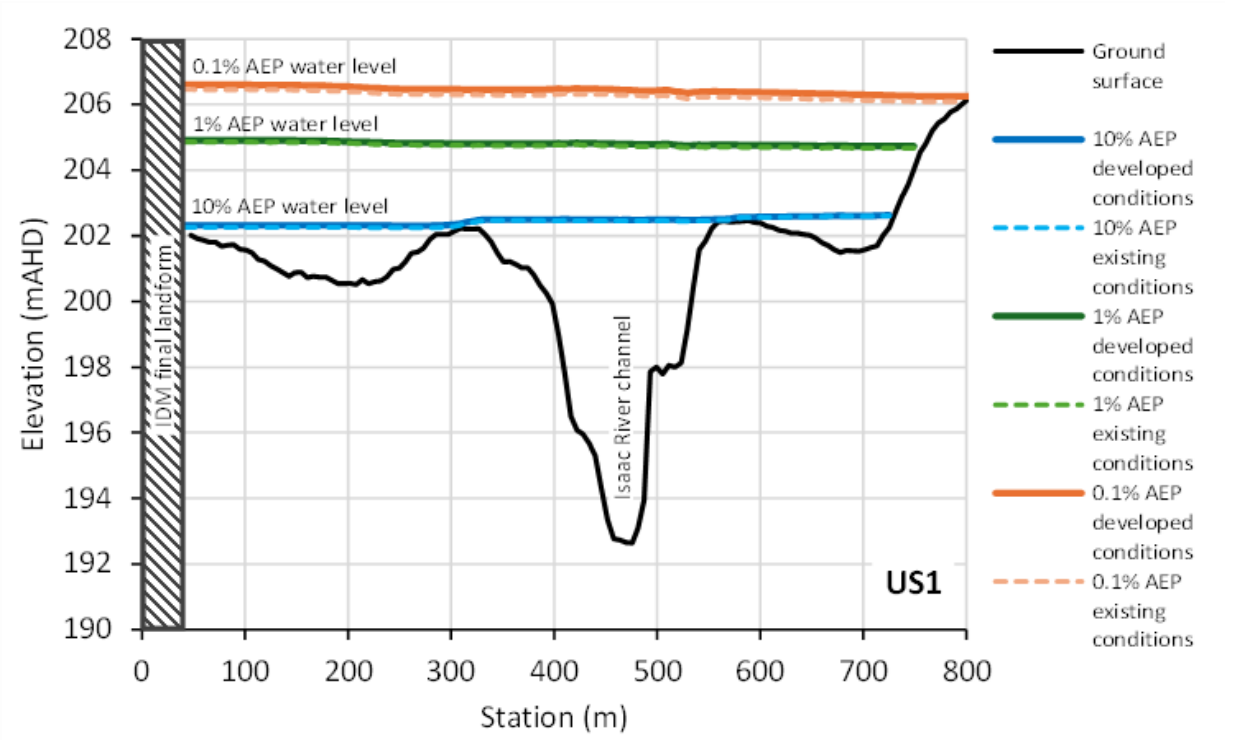


Figure 24-44 Assessment Point Cross-sections in the Isaac River, US1

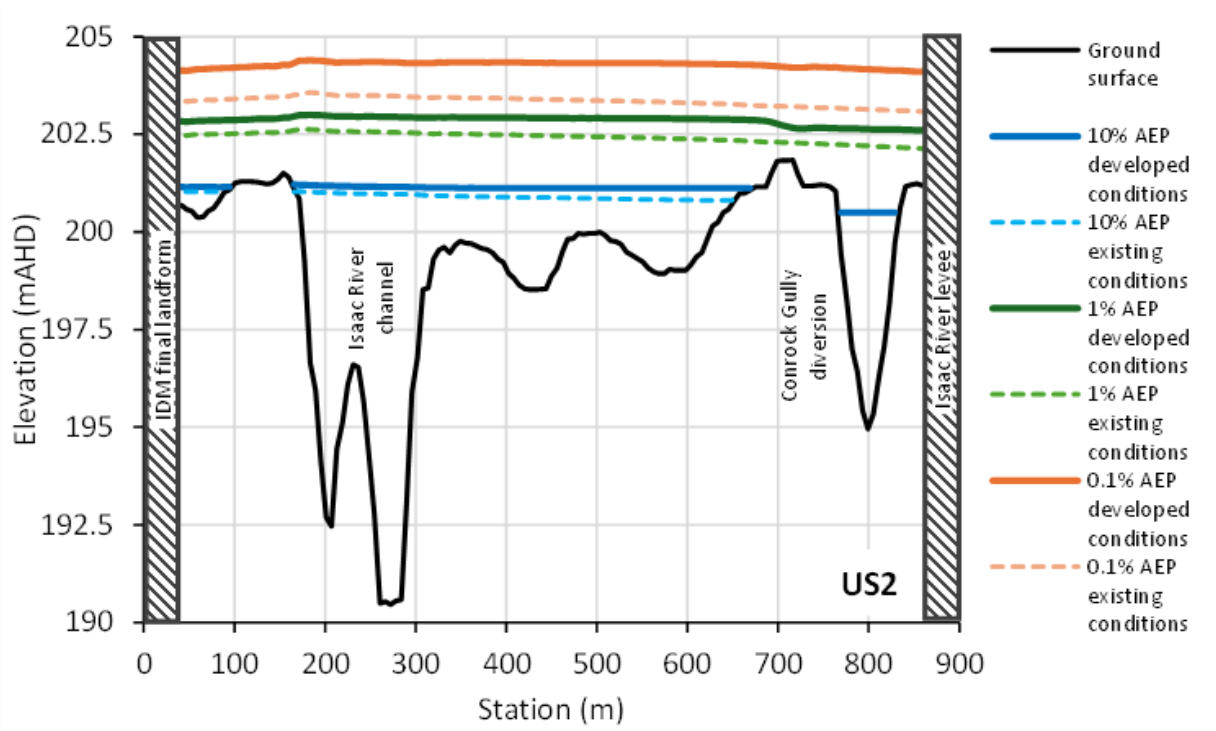


Figure 24-45 Assessment Point Cross-sections in the Isaac River, US2

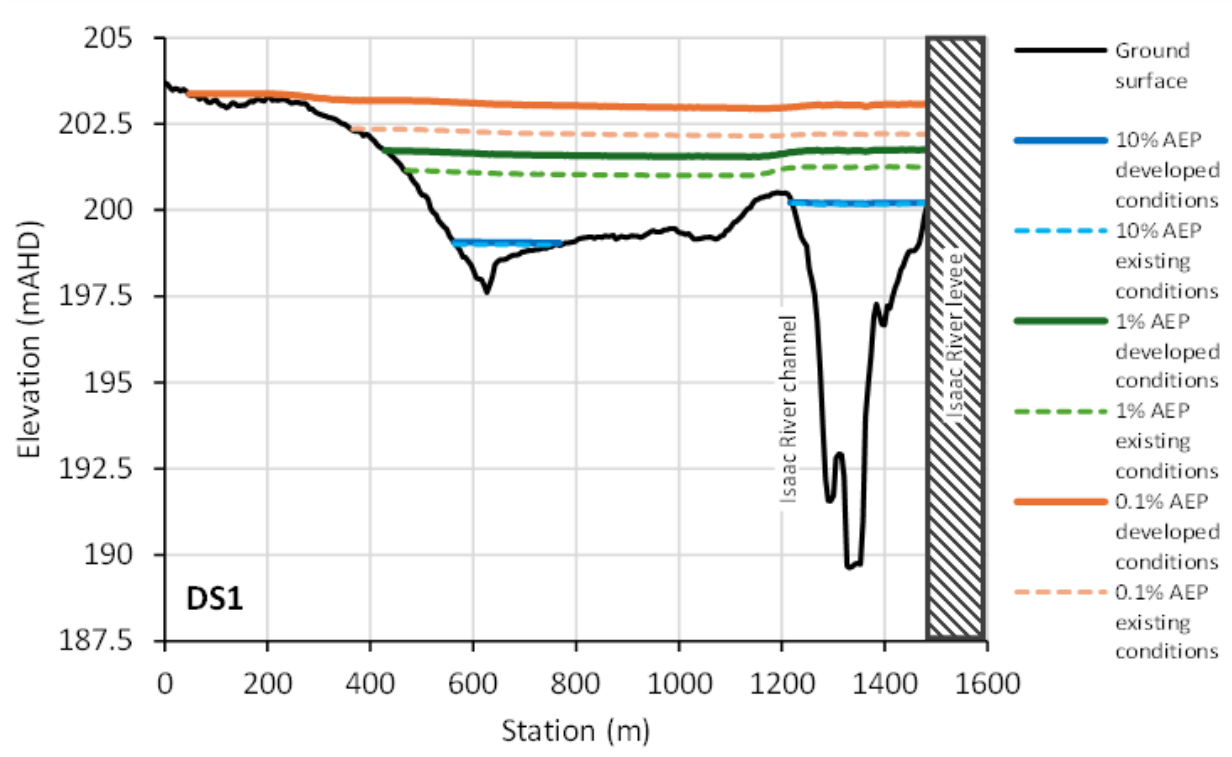


Figure 24-46 Assessment Point Cross-sections in the Isaac River, DS1

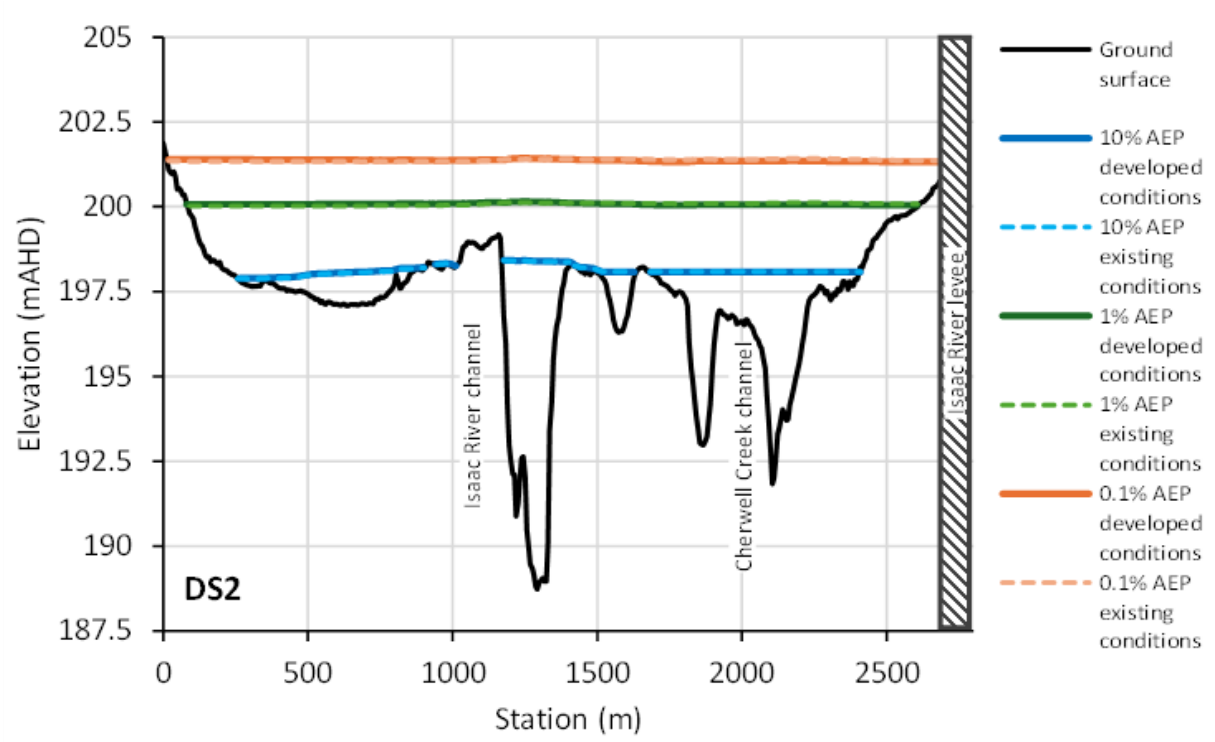


Figure 24-47 Assessment Point Cross-sections in the Isaac River, DS2

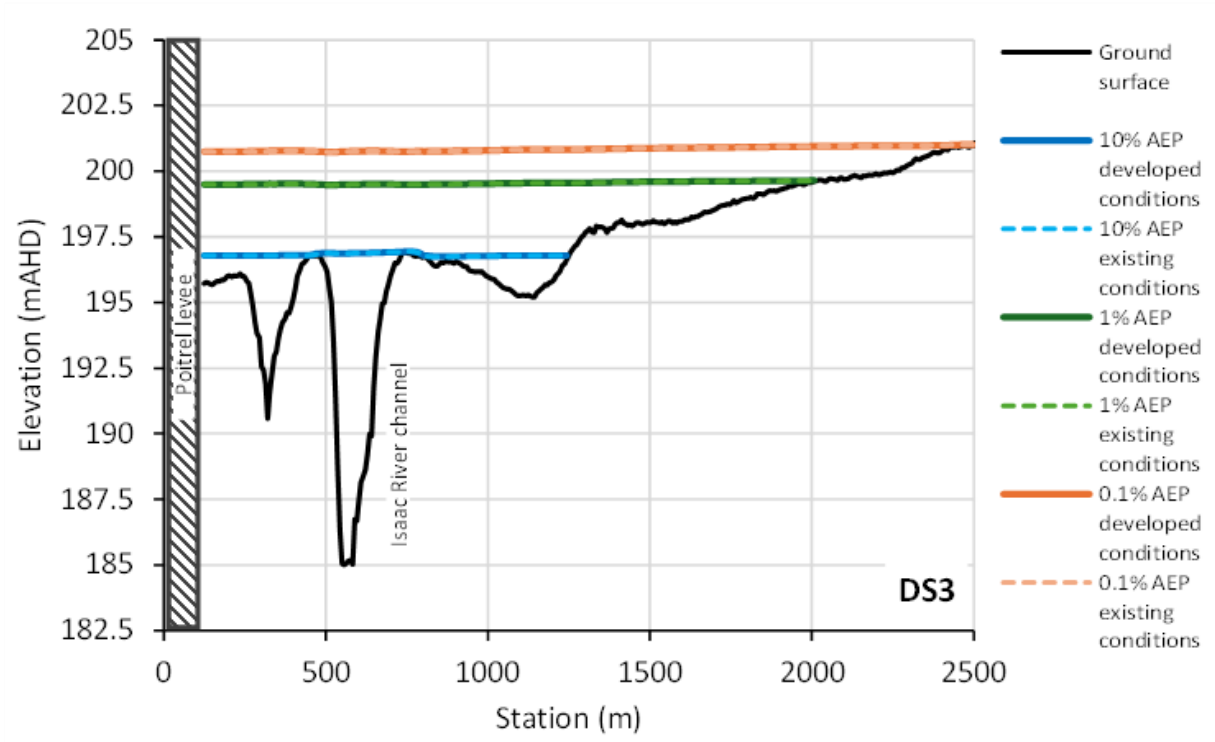


Figure 24-48 Assessment Point Cross-sections in the Isaac River, DS3

24.8.9 Developed Conditions – Velocity Change Assessment

The modelled Isaac River and local creek flood velocity changes for developed conditions for the 1% AEP and 0.1% AEP flood events are shown in Figure 24-49 and Figure 24-50, respectively. In addition, the flood velocity change mapping of the 50% AEP, 10% AEP, and 2% AEP flood events is presented in Appendix C of **Appendix J**.

Changes in flood velocities are considered in the context of the regional landscape in which the change occurs, notable a pastoral landscape with surrounding mining activity, and without residences or infrastructure.

In summary, the findings of the modelled Isaac River flood velocity changes for developed conditions are as follows:

- The flood velocities are generally decreased upstream of the Project, including adjacent the IDM final landform. The greatest decreases are located around the proposed Isaac River bridge, with modelled decreases reaching up to 0.9 m/s for the 1% AEP flood event and 1.1 m/s for the 0.1% AEP flood event. Velocity decreases also occur in the Isaac River floodplain adjacent to the Conrock Gully diversion, due to reduced conveyance in this location.
- The flood velocities in the eastern floodplain adjacent to the Project and the floodplain downstream of IDM, between DS1 and DS2, would be increased. This increase occurs due to the increased conveyance through this section and the upstream reduction of the floodplain width due to the proposed Isaac River levee. The velocity increases in these sections may reach up to 0.7 m/s for the 1% AEP flood event and 1.0 m/s for the 0.1% AEP flood event. The potential geomorphic impacts of the velocity increases on the Isaac River floodplain are discussed in Section 24.9.4.
- There are decreases in flood velocities on the downstream face of the Isaac River levee, due to reduced conveyance past this location. The velocity reduction in this location is up to 1.0 m/s for the 1% AEP flood event and 1.2 m/s for the 0.1% AEP flood event.
- The flood velocity changes do not extend downstream beyond the proposed levee.
- There are no material velocity impacts to the Peak Downs Highway bridge or the Goonyella Railway bridge for any of the modelled events.
- The magnitude of change in velocity reduces for more frequent flood events.

In summary, the findings of the modelled Cherwell Creek flood velocity changes for developed conditions are as follows:

- There are minor localised changes in velocities for the 1% AEP and 0.1% AEP flood events downstream of the proposed Cherwell Creek bridge and JB Gully bed-level crossing. The velocity impacts do not propagate downstream.
- Velocity impacts in Cherwell Creek in the vicinity of the Project are more apparent for flood events more frequent than the 1% AEP flood event. For example, for the 10% AEP flood event, velocities may be impacted for up to 660 m downstream of the Cherwell Creek bridge and 400 mm downstream of the JB Gully bed-level crossing. The velocities downstream of the Cherwell Creek bridge are generally increased and the velocities downstream of the JB Gully bed-level crossing are generally decreased. The velocities for the developed conditions are within the range of the expected existing condition velocities for this reach of Cherwell Creek.

In summary, the findings of the modelled Conrock Gully flood velocity changes for developed conditions are as follows:

- The flood velocities upstream of the diversion would be decreased by up to 0.4 m/s for the 1% AEP flood event and 0.5 m/s for the 0.1% AEP flood event. The velocity reduction would propagate 700 m upstream for the 1% AEP flood event and 900 m upstream for the 0.1% AEP flood event. The magnitude of change would reduce for more frequent flood events.

- The remainder of the existing Conrock Gully channel will be excised by the Project. However, the remnant Conrock Gully channel will continue to be flooded by the Isaac River backwaters, with lower velocities than pre-mining.

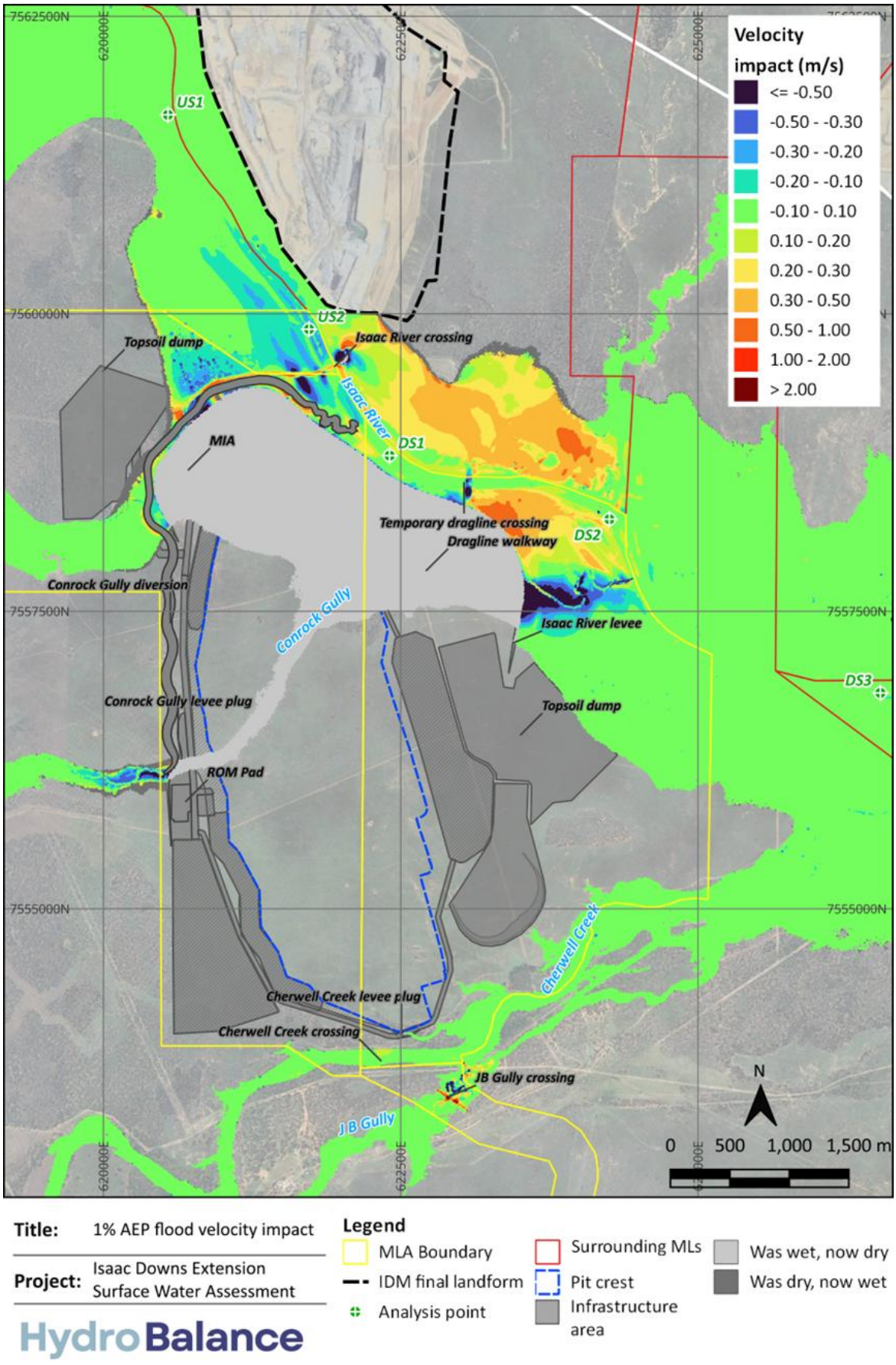


Figure 24-49 1% AEP Flood Velocity Impacts

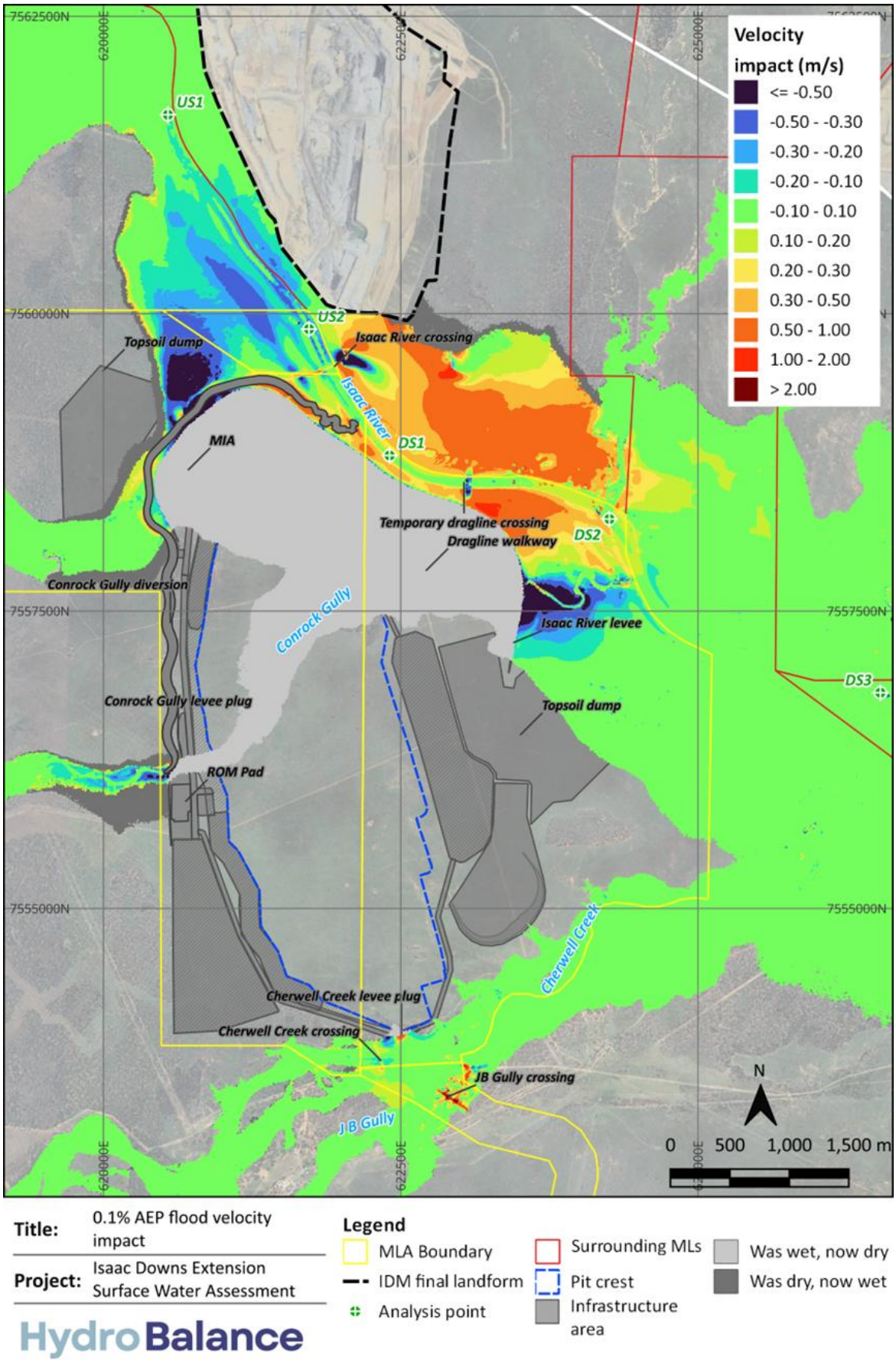


Figure 24-50 0.1% AEP Flood Velocity Impacts

24.8.10 Final Landform Conditions

Modelled 0.1% AEP flood depths and velocities for the final landform scenario are shown in Figure 24-51 and Figure 24-52, respectively. There would be insignificant interactions between floodwaters and the final landform for an event more frequent than the 2% AEP.

In summary, the findings of the modelled 0.1% AEP final landform flood depths and velocities are as follows:

- The flood does not interact with the proposed final void. The final void crest has a freeboard of at least 1.1 m above the flood level.
- The Isaac River floodwaters interact with the main spoil dump. The flood does not interact with either the eastern or southwestern out-of-pit dumps. Conrock Gully floodwaters will be directed to the diversion by a stabilised final landform design, incorporating the rehabilitated raised haul road and adjacent spoil dump.
- The Isaac River floodwaters may reach up to 3.3 m against the main spoil dump. Conrock Gully may reach up to 3.6 m against the final landform.
- Velocities range between 0.5 and 2.0 m/s may occur along the northern face of the main spoil dump within the Isaac River floodplain. Velocities do not exceed 0.8 m/s for the 1% AEP along this face and there is minimal interaction for the 2% AEP flood event and more frequent events. Therefore, potentially erosive flows will be very infrequent and only occur for short durations. For the vast majority of Isaac River flood events, interaction between floodwaters and the final landform will be either minimal or non-existent. The final landform will be revegetated, with vegetation cover providing sufficient protection against interaction with infrequent flood events.
- Velocities up to 1.1 m/s may occur in an approximate 25 m wide section of the stabilised final landform where the existing Conrock Gully channel is redirected to the diversion. The velocities within the remainder of the Conrock Gully where it interacts with the stabilised final landform are typically 0.1 m/s or lower (i.e. minor). The vegetation cover on the final landform is expected provide sufficient scour protection in this section for the flood events up to and including the 0.1% AEP.

Modelled PMF flood depths for the final landform scenario are shown in Figure 24-53. The PMF event is a hypothetical extreme and unlikely event that is larger than the 0.1% AEP flood event, with the Isaac River floodwaters being 3 m to 5 m higher during the PMF. It should be noted that assessment of a PMF event is normally used as a design safety standard for infrastructure where there is a threat to human life (e.g. a dam), which is not the case for the Project. The larger PMF event may cause floodwater to encroach on the northern end of the final void. However, the final void will possess a safety bund as a component of its closure requirements, which will also provide immunity to a PMF flood event.

Modelled 1% AEP flood depths and velocities for the final landform scenario are shown in Appendix C of **Appendix J**. The final void will not be inundated by a 0.1% AEP flood event.

24.8.11 Final Landform – Flood Level and Velocity Change Assessment

The modelled Isaac River and local creek 0.1% AEP flood level changes (afflux) and flood velocity changes for the final landform are shown in Figure 24-54 and Figure 24-55, respectively.

In summary, the findings of the modelled 0.1% AEP flood level changes for the final landform are as follows:

- The final landform results in negligible change to flood levels in the Isaac River. There are minor increases in water levels, up to 0.2 m, in the reach where the Conrock Gully diversion meets the floodplain.
- The flood levels upstream of the diversion will be increased by up to 1.9 m, with changes up to 0.1 m localised and propagating up to 1.1 km upstream.

- There are no water level changes in Cherwell Creek in the vicinity of the final landform.
- The magnitude of change in flood level is reduced compared to the developed conditions scenario, as the final landform allows for the expansion of the floodplain into areas previously protected by the Isaac River levee.
- There are no changes in flood levels in the downstream remnant section of Conrock Gully as this area is subject to backwater flooding from the Isaac River.

In summary, the findings of the modelled 0.1% AEP flood velocity changes for the final landform are as follows:

- The final landform results in negligible change to velocity in the Isaac River channel.
- Velocities within the Conrock Gully diversion are increased compared to the pre-mining/existing scenario without a diversion. Section 24.13 and Appendix D of Appendix J provide an assessment of the Conrock Gully diversion hydrology and geomorphology which demonstrates that the planned design meets accepted operational standards.
- There are decreased velocities in the existing Conrock Gully channel downstream of the Project, noting that these areas will continue to receive flood flows from Isaac River backwater flooding, but at reduced velocities.
- The flood velocities upstream of the diversion will be decreased by up to 0.8 m/s, propagating up to 1.1 km upstream.
- There are no flood velocity changes in Cherwell Creek in the vicinity of the final landform.
- The magnitude of velocity change is generally reduced compared to the developed conditions scenario.

The magnitude of flood level and velocity change reduces for more frequent flood events.

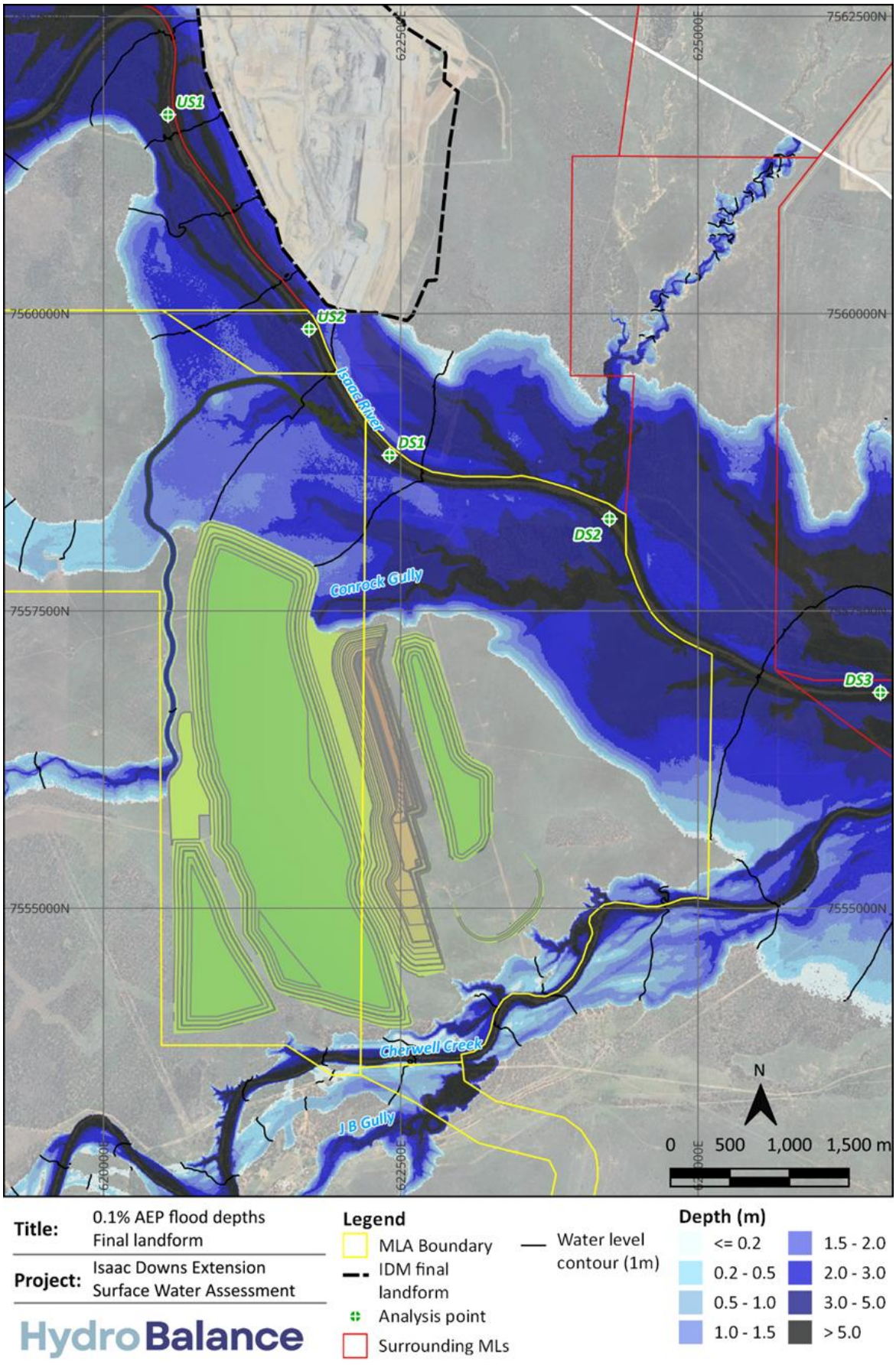


Figure 24-51 Final Landform – 0.1% AEP Flood Depths and Heights

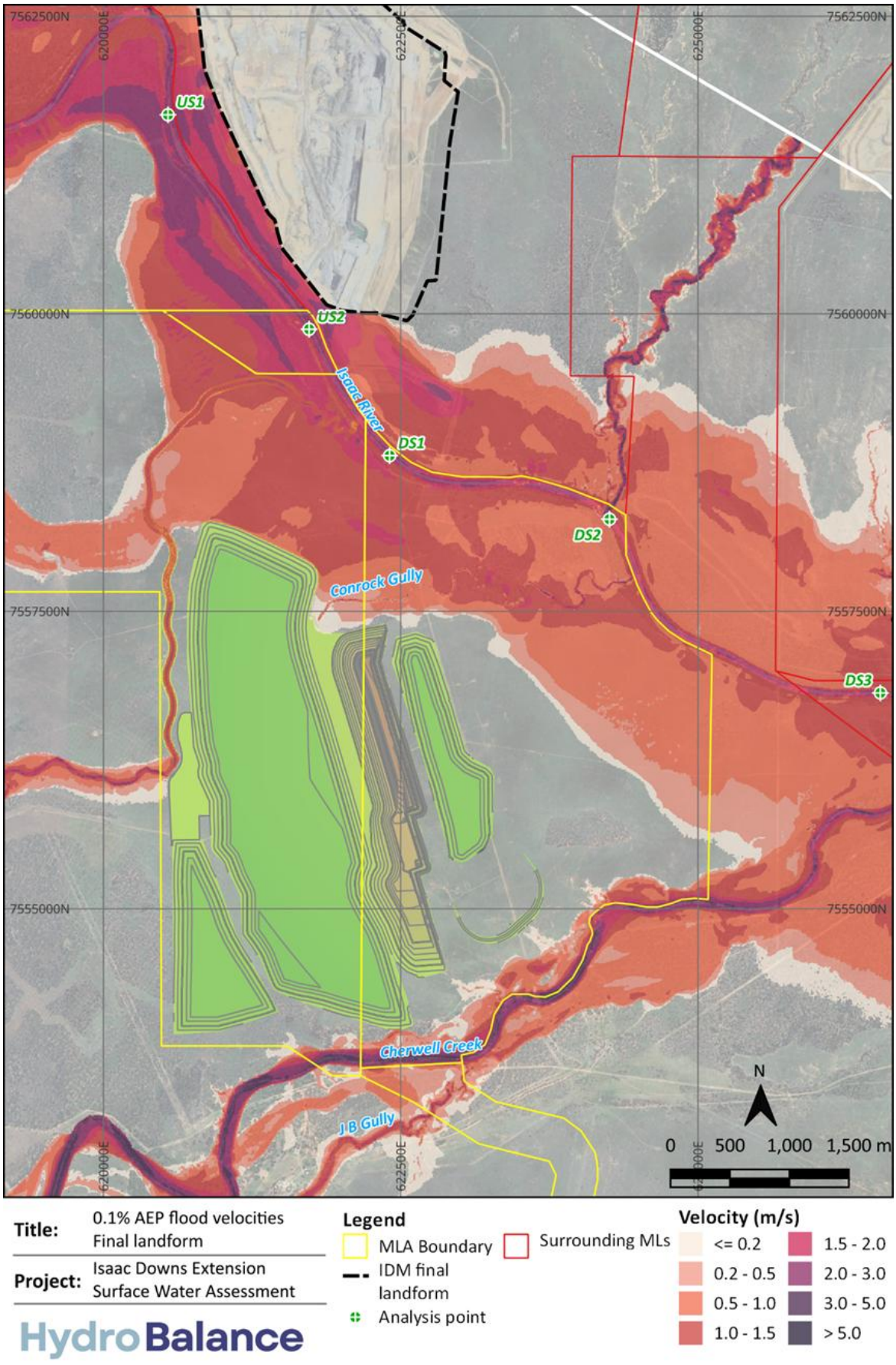


Figure 24-52 Final Landform – 0.1% AEP Flood Velocities

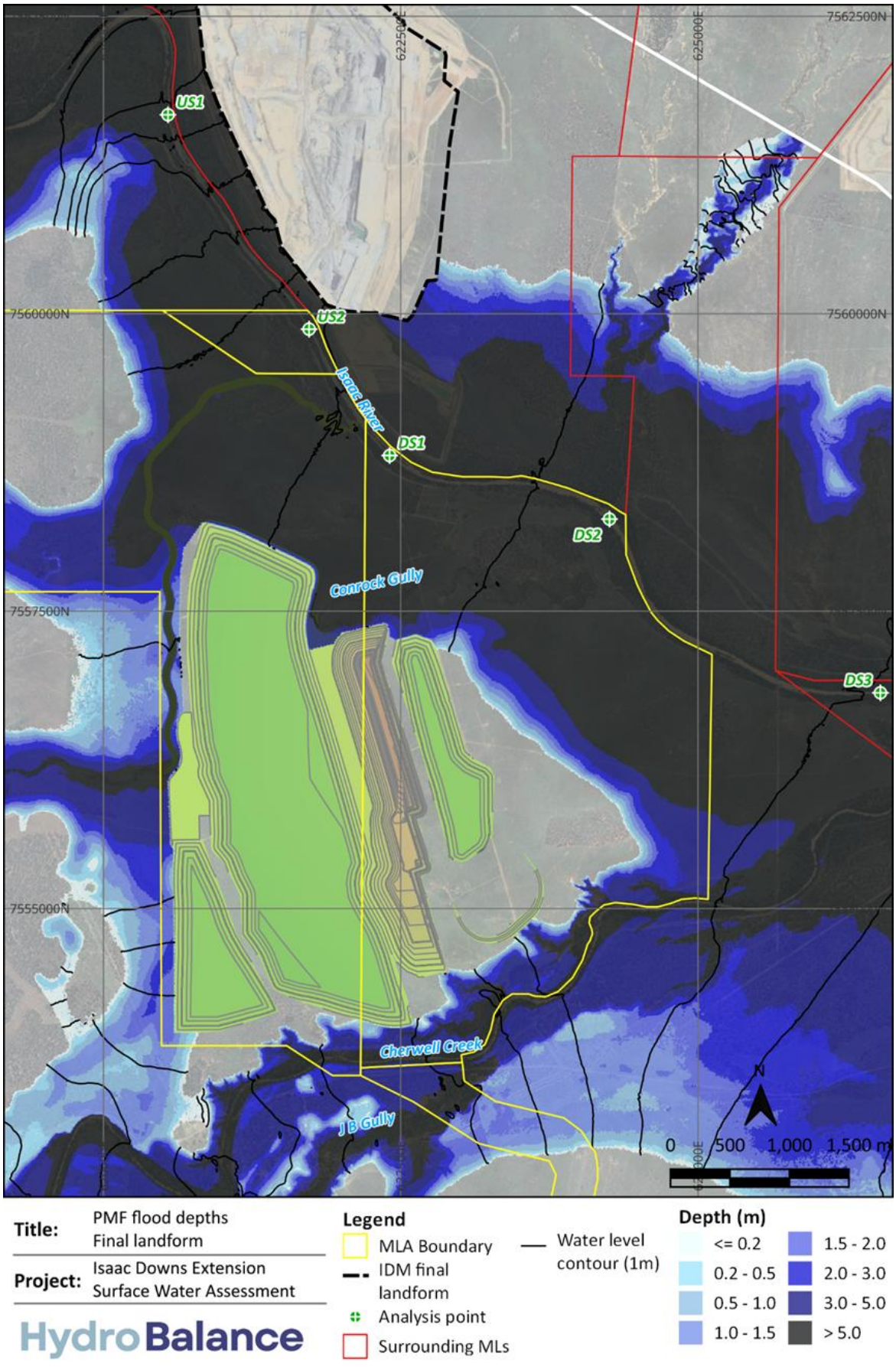


Figure 24-53 Final landform – PMF Flood Depths and Heights

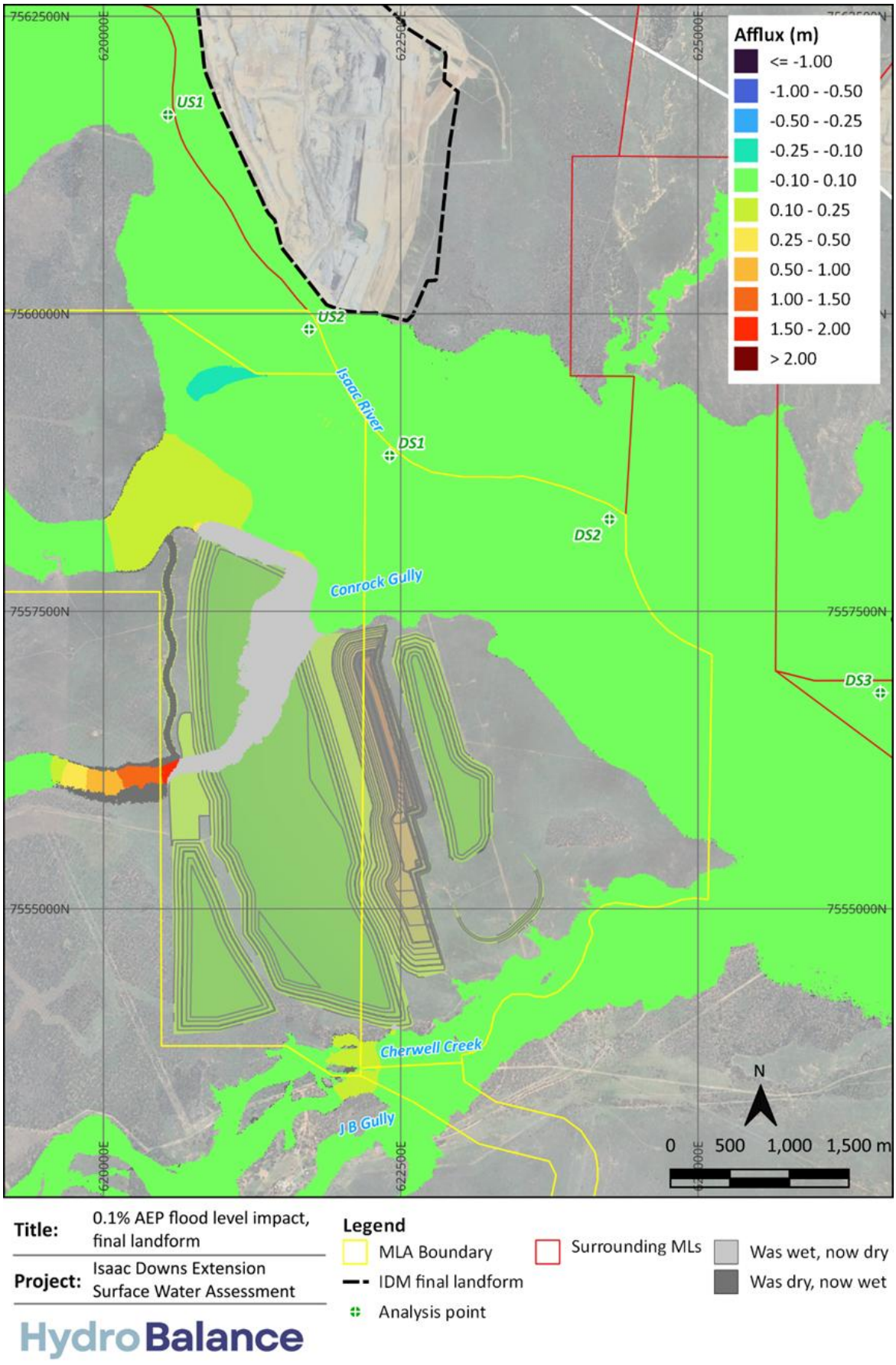


Figure 24-54 Final Landform – 0.1% AEP Flood Level Impacts

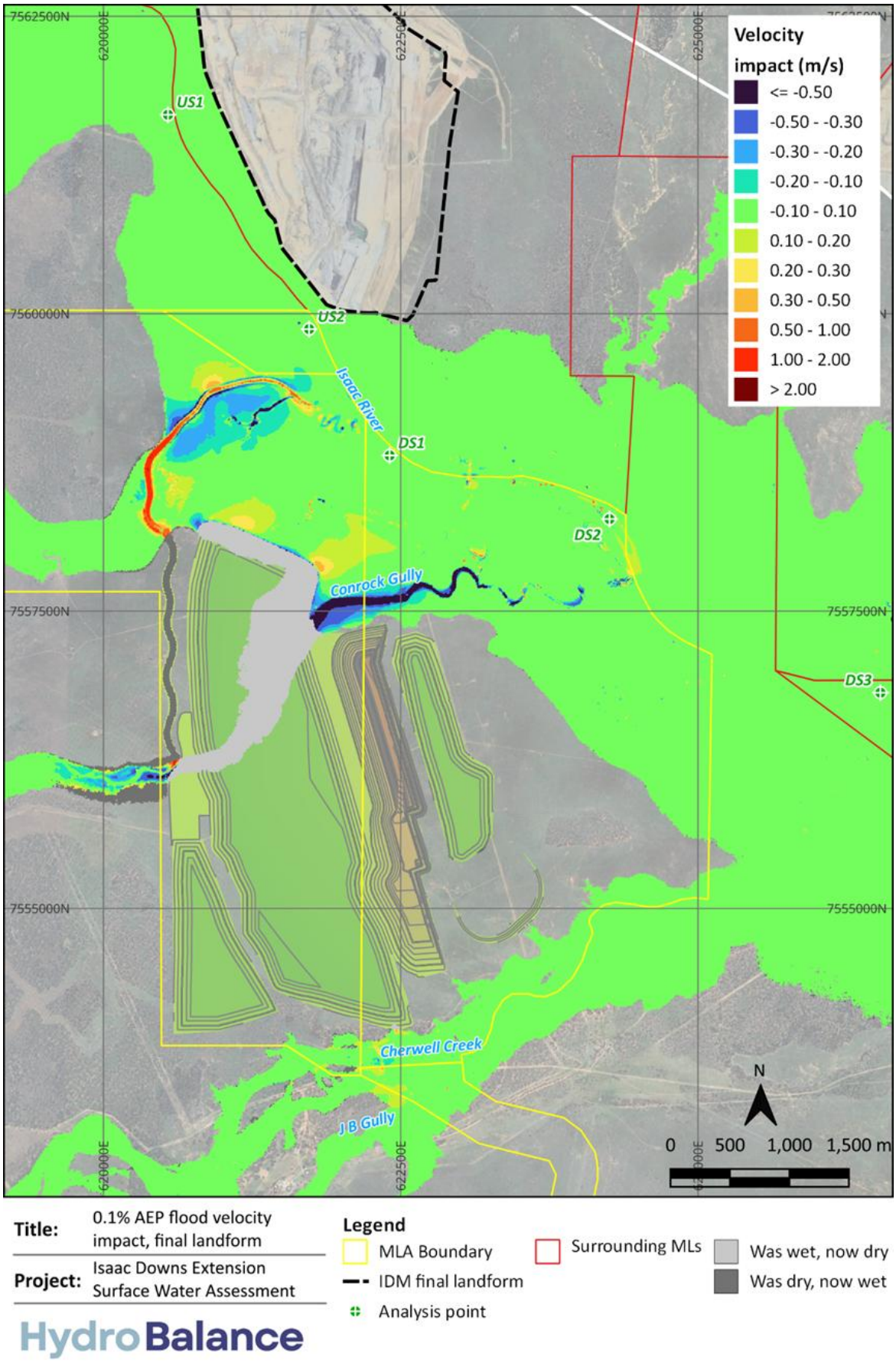


Figure 24-55 Final Landform – 0.1% AEP Flood Velocity Impacts

24.8.12 Climate Change Assessment

24.8.12.1 Overview

To assess the potential impacts of climate change on the flood behaviour, the 0.1% AEP design rainfall intensities were increased by a climate change factor, which is presented in Table A.14 of Appendix A of **Appendix J**.

Year 2050 climatic conditions were used to assess the impact of climate change on the Project's developed conditions. The year 2050 was selected as the representative year, being the period within 5 – 10 years of the end of the Project's mining operations. This is a conservative approach as it represents changes in climate greater than what is likely to be experienced during mining operations when the levee or levee plugs are operational.

Year 2100 climatic conditions were used to assess flooding of the final landform conditions. The year 2100 was selected as it is the furthest time horizon for which climate change factors are available from Australian Rainfall and Runoff: A Guide to Flood Estimation (Ball et al., 2019).

24.8.12.2 Developed Conditions – Climate Change Flood Assessment

Figure 24-56, Figure 24-57 and Figure 24-58 display the impact the year 2050 climate conditions have on the predicted peak flood levels along the Isaac River levee, Cherwell Creek levee plug and Conrock Gully levee plug, respectively. The climate change flood assessment indicates that the predicted peak flood levels along the Isaac River levee and Conrock Gully levee plug will increase by up to 0.5 m, and the predicted peak flood levels along the Cherwell Creek levee plug will increase by up to 0.8 m. However, the levee crests are not overtopped by the predicted flood levels.

In summary, the climate change flood assessment results demonstrate that the proposed flood protection levee and levee plugs for the Project's developed conditions adequately protects the mining operations from flooding during the 0.1% AEP climate change flood event, even under conservative assumptions about changes in climate during the operational life of the Project. Therefore, no specific mitigation strategies are required to manage climate change impacts during mining operations.

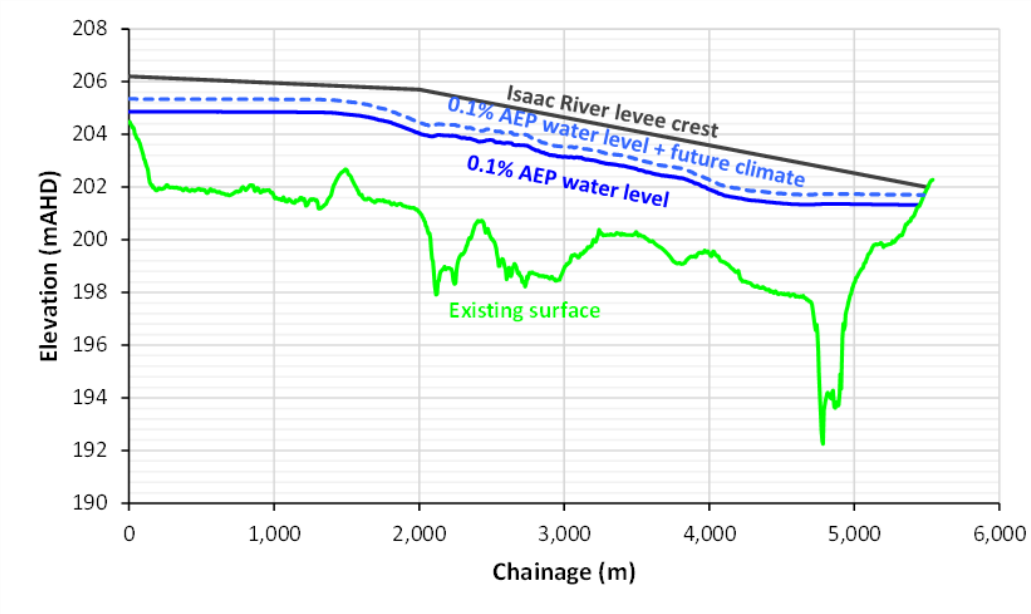


Figure 24-56 Isaac River Levee – Long Section – 0.1% AEP Water Levels plus Year 2050 Climatic Conditions

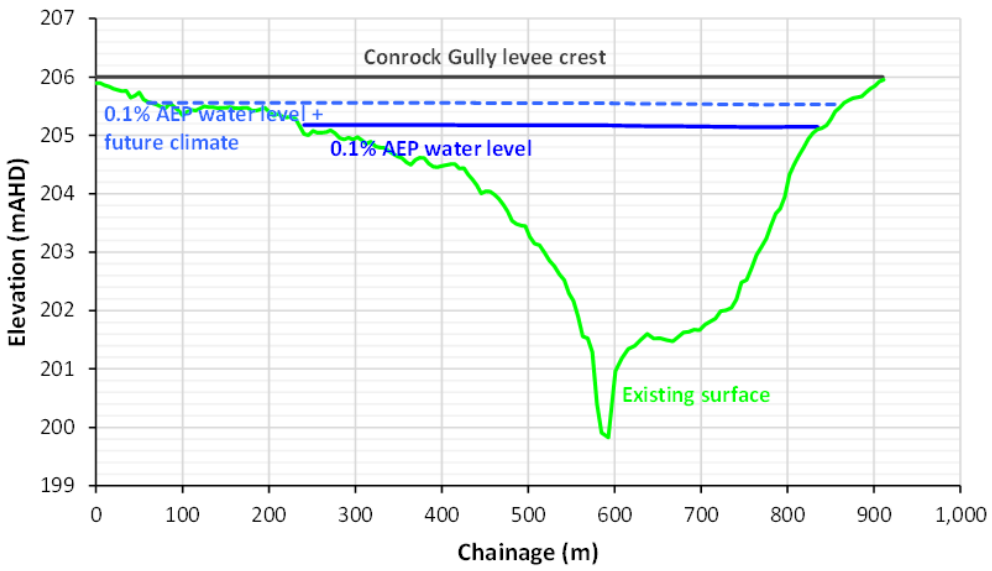


Figure 24-57 Cherwell Creek Levee Plug – Long Section – 0.1% AEP Water Levels plus Year 2050 Climatic Conditions

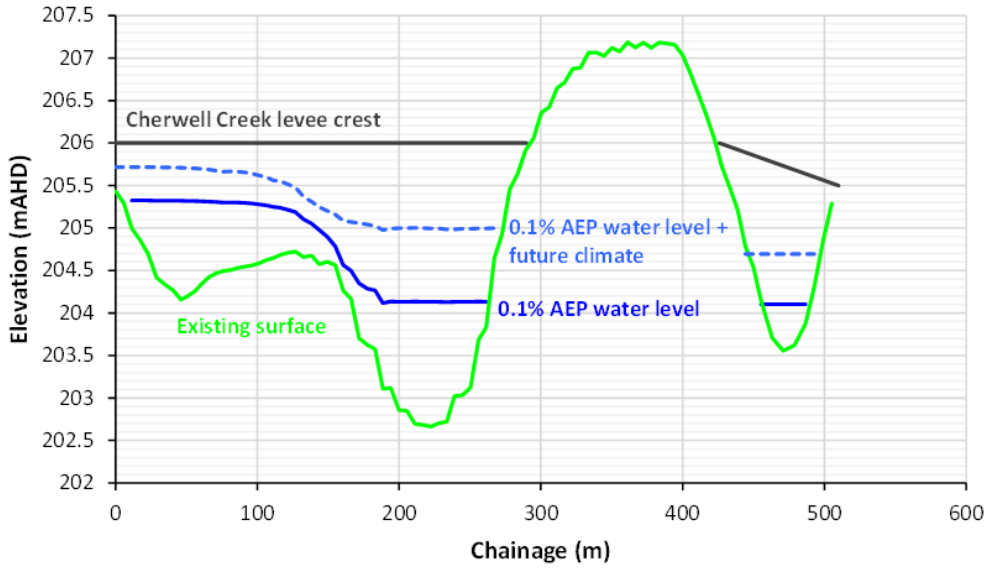


Figure 24-58 Conrock Gully Levee Plug – Long Section – 0.1% AEP Water Levels plus Year 2050 Climatic Conditions

24.8.12.3 Final Landform Conditions – Climate Change Flood Assessment

Figure 5.46 shows for final landform conditions the extent of the year 2100 0.1% AEP climate change flood event and Figure 5.47 shows for final landform conditions the peak year 2100 0.1% AEP climate change velocities.

The modelling results indicate that the Project's final void will not be inundated following mine closure during a year 2100 0.1% AEP climate change flood event. The predicted velocities under this future

climatic change condition are similar to the predicted velocities under the climatic conditions described in Section 24.8.10.

In addition, the modelled final landform will include at least a 0.5 m high safety bund adjacent to the final void that will be part of the normal void safety requirements for mine closure under the Project's PRCP. The safety bund will provide additional protection from a year 2100 0.1% AEP climate change flood event. Therefore, no specific mitigation strategies are required for the final landform to manage possible future climate change impacts.

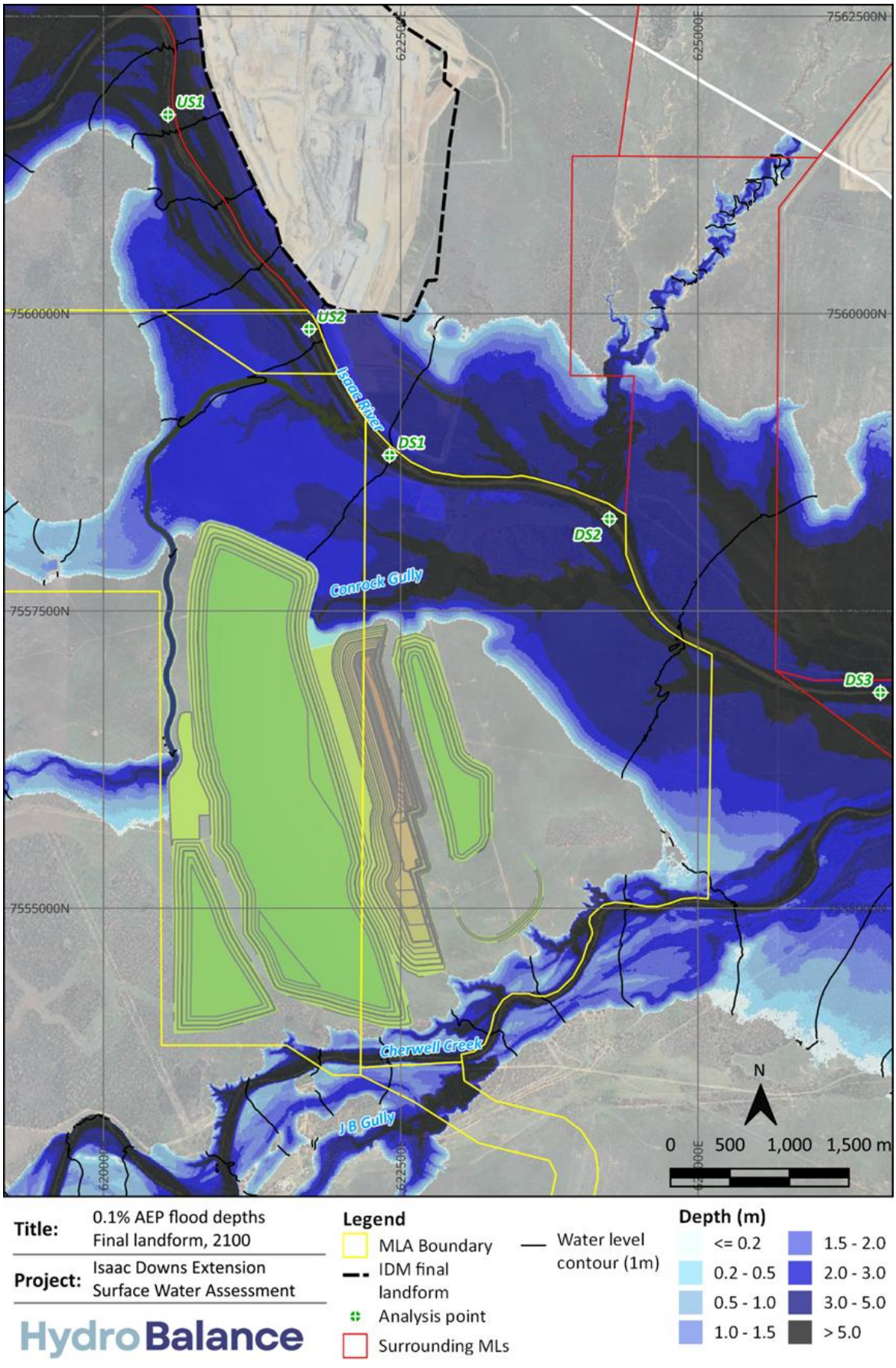


Figure 24-59 Final Landform Conditions – 0.1% AEP Climate Change Flood Event – Flood Depths

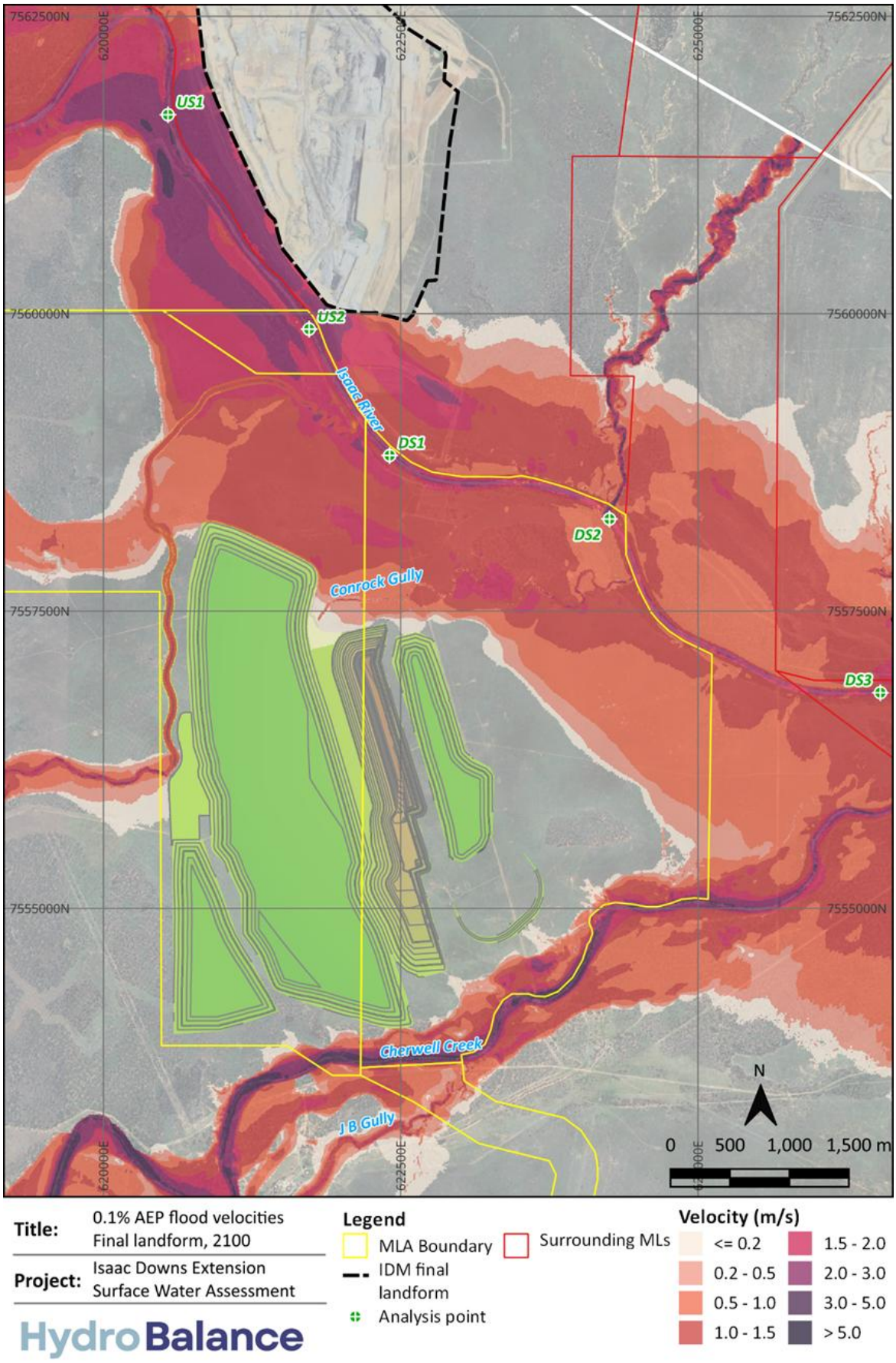


Figure 24-60 Final Landform Conditions – 0.1% AEP Climate Change Flood Event – Flood Velocities

24.9 Isaac River Geomorphic Impact Assessment

24.9.1 Overview

The hydraulic model results were used to assess the potential impacts of the Project's mining and post-closure phases on the geomorphic behaviour of the Isaac River, including the potential to increase erosion and/or sedimentation, and impact on the morphology of the adjacent floodplains. The geomorphic impacts were assessed through comparative analysis of the peak velocity, bed shear stress and stream power for existing conditions (current environment), developed conditions (mining), and the post-mining final landform.

The hydraulic criteria to assess the impacts on geomorphology were adopted from the ACARP guideline. It should be noted that changes in channel geomorphology are generally controlled by regular flows, not extreme low-probability events.

An assessment of floodplain geomorphology was undertaken for out-of-channel 2% and 0.1% AEP flood events. The 50% AEP flood event was excluded because Isaac River flows are generally within the channel for this event.

The geomorphological impacts on the Cherwell Creek and JB Gully main channels and floodplains due to the Project are negligible, apart from highly localised changes near the proposed crossings. Figure 5.33 to Figure 5.40 of **Appendix J** support this finding. Therefore, the Project's impacts on the geomorphology of Cherwell Creek and JB Gully are not further discussed due to the negligible geomorphic impacts.

A geomorphic assessment of Conrock Gully and the proposed Conrock Gully diversion is provided in Appendix D of **Appendix J**.

24.9.2 Hydraulic Criteria

Shear stress provides a measure of the tractive force acting on sediment particles at the boundary of the stream and is used to determine the threshold of motion for bed material. It provides an indication of the potential for erosion of cohesive sediments or movement of non-cohesive sediments at the channel boundary.

The DNRME guideline provides guidance on design parameters for watercourse diversions and constrictions of watercourses due to levee banks. The DNRME guideline states that the hydraulic criteria of a watercourse should be used as first preference to develop design parameters for a watercourse diversion. Additionally, DNRME guideline provides some nominal hydraulic threshold values to compare against for floodplain geomorphology.

Table 24-12 summarises Bowen Basin watercourse diversion design values for velocity, stream power and shear stress levels, from the ACARP guideline. The minimum requirement when undertaking a hydraulic analysis is to review the watercourse and diversion energy conditions for 2% and 50% AEP flood events.

The ACARP guideline does not include relevant guideline values for events rarer than a 2% AEP flood event with respect to assessing floodplain morphology. For the Project's geomorphic assessment, 2% and 0.1% AEP flood events were used. Conclusions for the 0.1% AEP flood event were drawn from the impacts caused to the hydraulic criteria on the Isaac River floodplain as a result of the Project's proposed infrastructure compared to existing conditions.

Table 24-12 ACARP Design Criteria for Bowen Basin Stream Diversions

Scenario	Stream Power (W/m^2)	Velocity (m/s)	Bed Shear (N/m^2)
50% AEP (no vegetation)	<35	<1.0	<40

Scenario	Stream Power (W/m^2)	Velocity (m/s)	Bed Shear (N/m^2)
50% AEP (vegetated)	<60	<1.5	<40
2% AEP	<150	<2.5	<50

24.9.3 Impacts on Channel Morphology

The reach of the Isaac River assessed for the Project's impacts on channel morphology is presented in Figure 24-34.

24.9.3.1 Existing Conditions – Hydraulic Characteristics

The Project's existing conditions model results show the following properties:

- In relation to a 50% AEP flood event (Figure 24-61):
  - Velocities are highest within the main channel banks and are generally under 2.0 m/s, with peak velocities occurring along the centre of the Isaac River channel up to 2.4 m/s.
  - The bed shear stress levels along the centre of the Isaac River channel are generally less than 30 Newton per square metre (N/m^2), with some localised areas exceeding 40 N/m^2.
  - The stream power levels along the centre of the Isaac River channel are generally less than 50 Watts per square metre (W/m^2), with some localised areas exceeding 60 W/m^2.
  - The highest hydraulic parameters occur at around chainage 4,000 m where the Isaac River main channel is constricted to a base width of about 20 m, due to an instream island. The main channel width in the vicinity of the Project is generally around 45 m. Bed shear stress reaches up to 57 N/m^2 in this location, and stream power reaches up to 120 W/m^2.
  - Compared to the ACARP guideline values, the Isaac River channel velocities are higher than the guideline value of 1.5 m/s. Whilst this guideline value is for frequent flood events, 50% AEP, it indicates that stream velocities generally exceed the guideline value for existing conditions.
  - Bed shear stress and stream power levels are generally within the ACARP guideline values except for localised areas.
- In relation to a 2% AEP flood event (Figure 24-62):
  - Velocities are highest within the main channel banks and are consistently less than 2.5 m/s.
  - The bed shear stress levels along the centre of the Isaac River channel are generally less than 40 N/m^2, with some localised areas exceeding 50 N/m^2.
  - The stream power levels along the centre of the Isaac River channel are generally less than 100 W/m^2, with some localised areas reaching up to 150 W/m^2.
  - Compared to the ACARP guideline's hydraulic criteria, under existing conditions, Isaac River channel velocities are lower than the guideline value of 2.5 m/s.
  - Velocity and stream power levels are below the ACARP guideline values.
  - Bed shear stress levels are generally within the ACARP guideline values except for localised areas.
- In relation to a 0.1% AEP event (Figure 24-63):
  - Velocities are highest within the main channel banks and are generally under 2.5 m/s. However, where there are major bends in the Isaac River channel, velocities can reach up to 3.3 m/s.
  - The bed shear stress levels along the centre of the Isaac River channel are generally less than 60 N/m^2.

- The stream power levels along the centre of the Isaac River channel are generally less than 150 W/m^2, with some localised areas reaching up to 240 W/m^2.

24.9.3.2 Developed Conditions – Channel Impact Assessment

A longitudinal section along the centre of the Isaac River channel was taken to compare the velocities, bed shear stress and stream power under developed conditions to those under existing conditions. The results are provided in Figure 24-61, Figure 24-62 and Figure 24-63, with chainage starting from approximately 1.3 km upstream of the Isaac River levee and finishing 1.7 km downstream of the Isaac River levee.

In summary, the channel impact assessment of the developed conditions presented the following findings:

- In relation to a 50% AEP flood event (Figure 24-61):
  - Velocities are increased by up to 0.2 m/s at the downstream end of the levee. However, the velocities in this area are lower than the peak velocities along the channel under existing conditions.
  - Bed shear stress levels increase by up to 5 N/m^2 at the downstream end of the levee. However, levels are still generally within the ACARP guideline values to a similar degree as the existing conditions.
  - Stream power levels increase by up to 20 W/m^2 at the downstream end of the levee. However, levels remain below the ACARP guideline values to a similar degree as the existing conditions.
  - Overall, there is negligible to minor change in velocities, bed shear stress and stream power.
- In relation to a 2% AEP flood event (Figure 24-62):
  - Velocities are increased by up to 0.4 m/s at the downstream end of the levee. However, levels are still below the ACARP guideline values.
  - Bed shear stress levels increase by up to 5 N/m^2 at the downstream end of the levee. However, levels are still generally within the ACARP guideline values to a similar degree as the existing conditions.
  - Stream power levels increase by up to 21 W/m^2 at the downstream end of the levee. However, levels remain below the ACARP guideline values to a similar degree as the existing conditions.
  - Overall, there is negligible to minor change in velocities, bed shear stress and stream power.
- In relation to a 0.1% AEP flood event (Figure 24-63):
  - Velocities are increased by up to 0.2 m/s at the downstream end of the levee, with velocities peaking at 3.3 m/s.
  - Bed shear stress levels increase by up to 4 N/m^2 at the downstream end of the levee. However, bed shear stresses in this area are lower than peak bed shear stresses in the channel under existing conditions.
  - Stream power levels increase by up to 15 W/m^2 at the downstream end of the levee, peaking at to 210 W/m^2. However, stream power levels in this area are lower than peak stream power levels in the channel under existing conditions.
  - Overall, there are minor changes in velocities, bed shear stress and stream power.

The impact assessment demonstrates that under the Project's developed conditions the proposed Isaac River levee causes negligible to minor impacts to flood velocities, bed shear stress and stream power along the centre of the Isaac River channel compared to existing conditions, and are appropriate when compared to the ACARP guideline values for 50% and 2% AEP flood events.

In addition, under developed conditions, during a 0.1% AEP flood event, the proposed Isaac River levee causes minor impacts to peak velocities at the downstream end of the levee. However, these velocities are well within the range of velocities normally experienced in the Isaac River's main channel in this reach of the river.

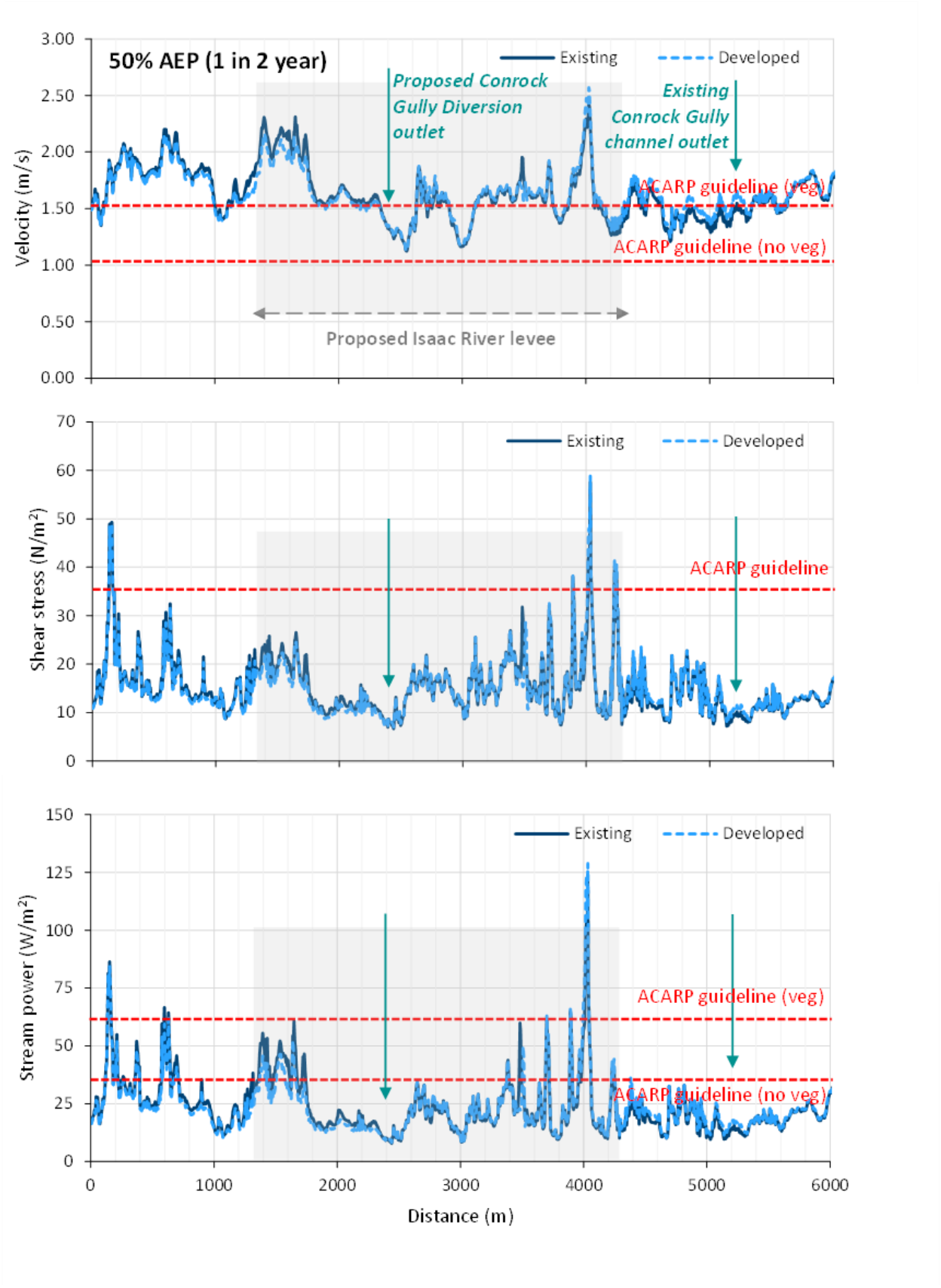


Figure 24-61 50% AEP Flood Event – Developed Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)

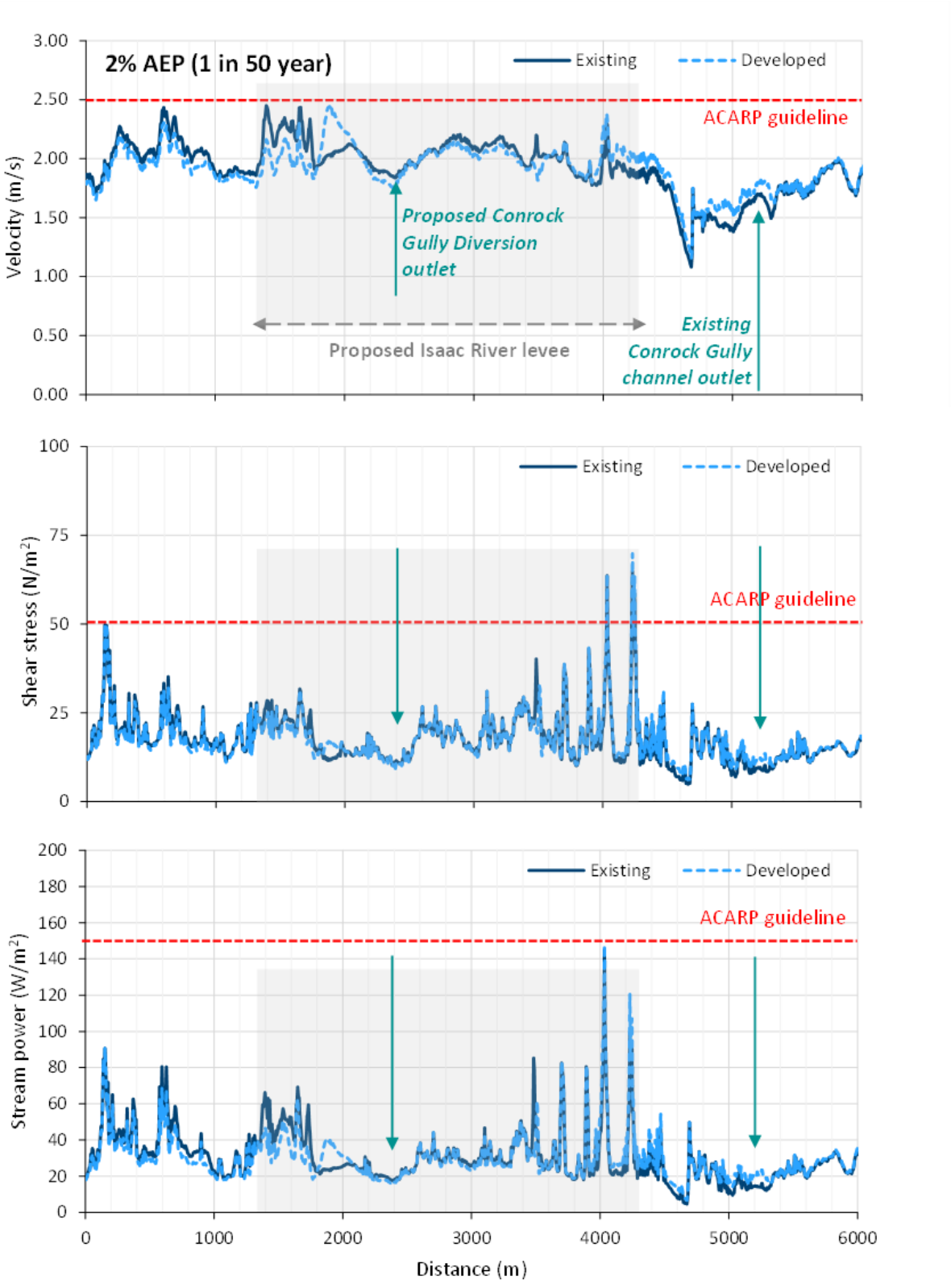


Figure 24-62 2% AEP Flood Event – Developed Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)

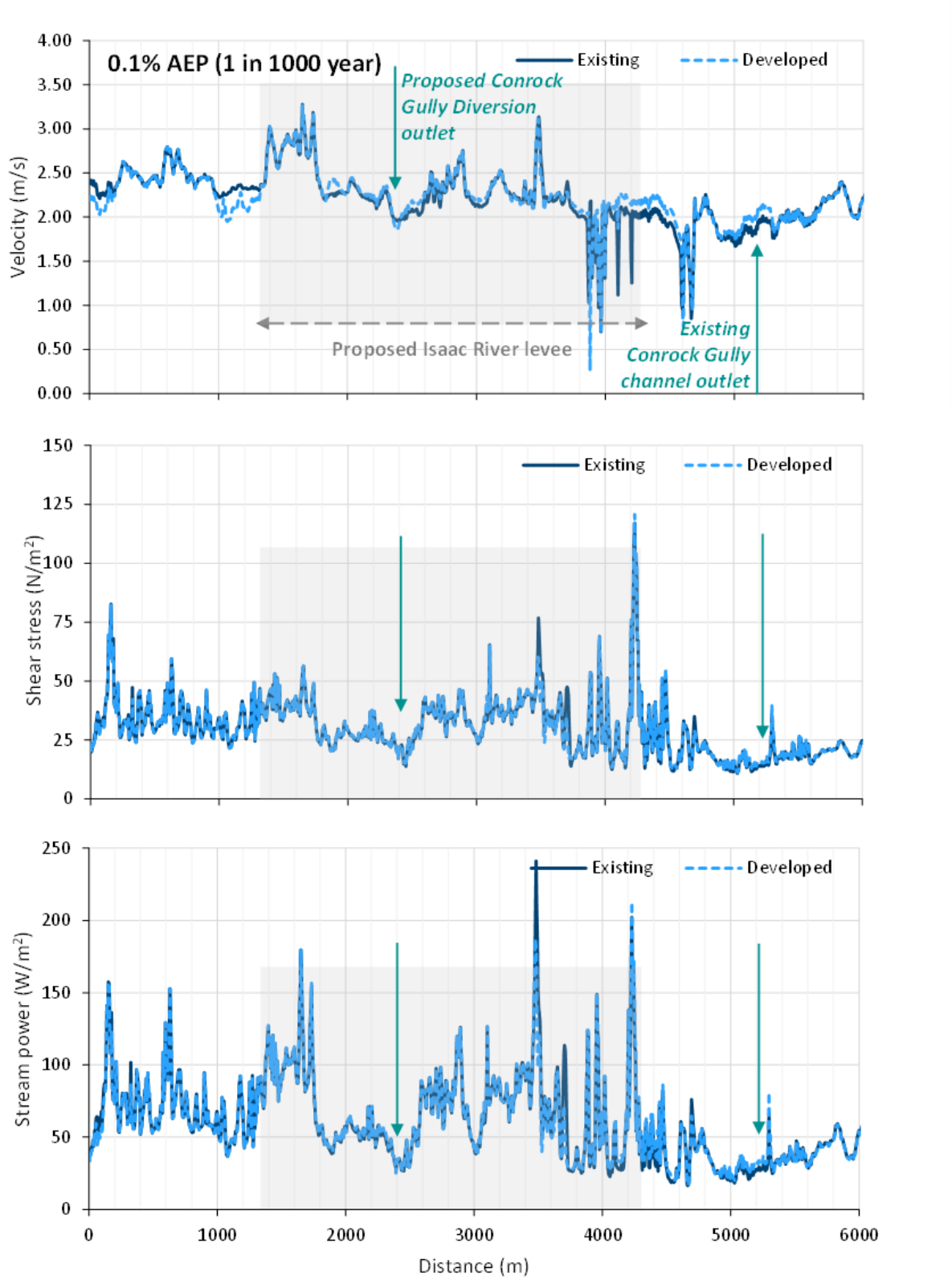


Figure 24-63 0.1% AEP Flood Event – Developed Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)

24.9.3.3 Final Landform Conditions – Channel Impact Assessment

A longitudinal section along the centre of the Isaac River channel was taken to compare the velocities, bed shear stress and stream power under final landform conditions to those under existing conditions. The results are provided in Figure 24-64, Figure 24-65 and Figure 24-66.

In summary, the channel impact assessment of the final landform conditions presented the following findings:

- In relation to a 50% AEP flood event (Figure 24-64):
  - Velocities are increased by up to 0.1 m/s downstream of the final landform. However, the velocities in this area are lower than the peak velocities along the channel under existing conditions.
  - Bed shear stress levels increase by up to 1 N/m^2 downstream of the final landform. However, levels are still generally within the ACARP guideline values to a similar degree as the existing conditions.
  - Stream power levels increase by up to 3 W/m^2 downstream of the final landform. However, levels remain below the ACARP guideline values to a similar degree as the existing conditions.
  - Overall, there is negligible change in velocities, bed shear stress and stream power.
- In relation to a 2% AEP flood event (Figure 24-65):
  - Velocities are increased by up to 0.2 m/s downstream of the final landform. However, the velocities consistently remain below the ACARP guideline values.
  - Bed shear stress levels increase by up to 3 N/m^2 downstream of the final landform. However, levels are still generally within the ACARP guideline values to a similar degree as the existing conditions.
  - Stream power levels increase by up to 7 W/m^2 downstream of the final landform. However, levels consistently remain below the ACARP guideline values.
  - Overall, there is negligible change in velocities, bed shear stress and stream power.
- In relation to a 0.1% AEP flood event (Figure 24-66):
  - Velocities are increased by up to 0.15 m/s downstream of the final landform.
  - There are negligible impacts on bed shear stress or stream power levels under final landform conditions.
  - Overall, there is negligible change in velocities, bed shear stress and stream power.

The impact assessment demonstrates that the Project's final landform conditions will have even less impact on velocities, bed shear stress and stream power than developed conditions, because the Isaac River levee is decommissioned and rehabilitated.

The proposed final landform causes negligible impacts to flood velocities, bed shear stress and stream power along the centre of the Isaac River channel compared to existing conditions, and are appropriate when compared to the ACARP guideline values for 50% and 2% AEP flood events.

The impacts of the proposed final landform during a 0.1% AEP flood event are also negligible.

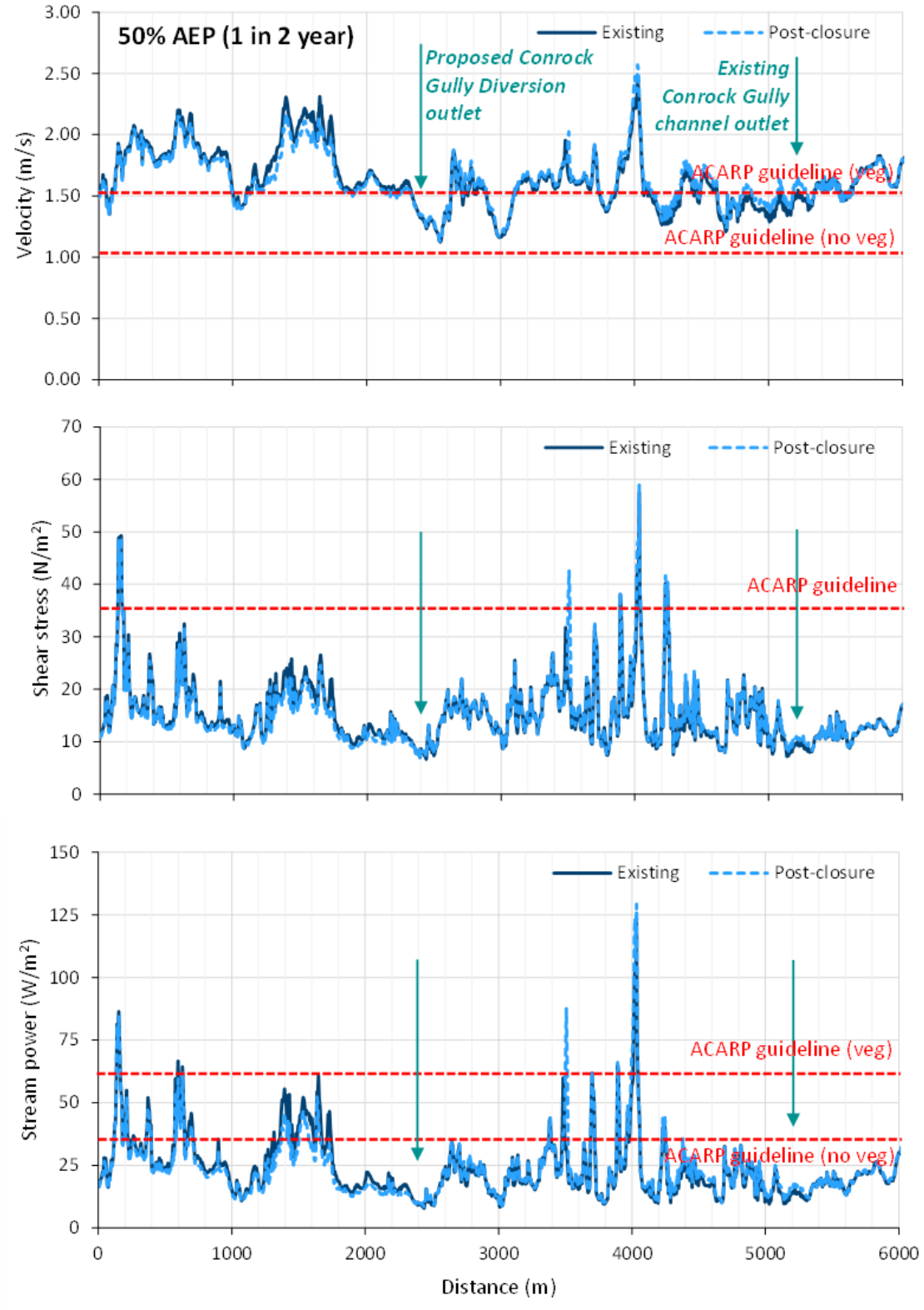


Figure 24-64 50% AEP Flood Event – Final Landform Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)

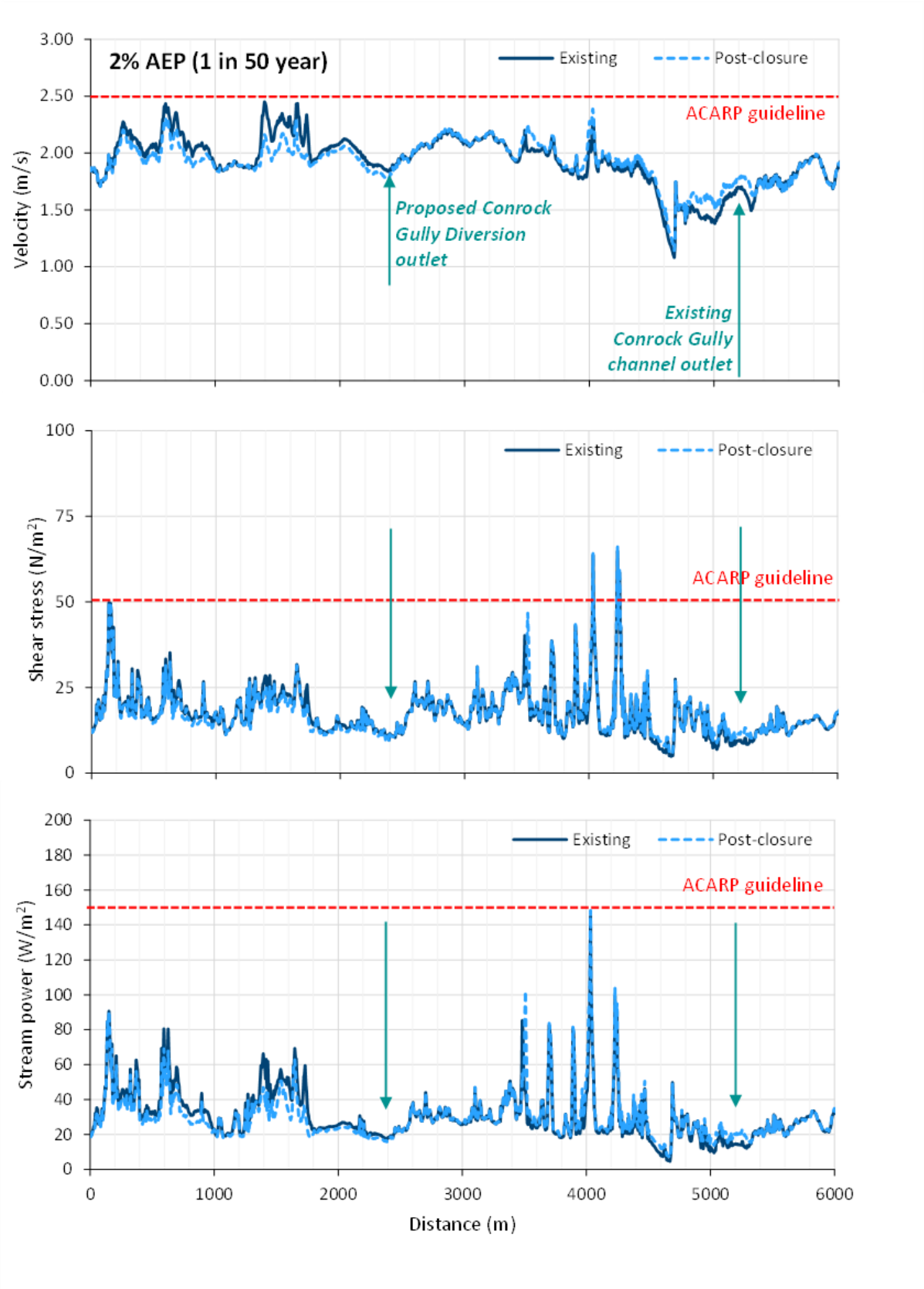


Figure 24-65 2% AEP Flood Event – Final Landform Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)

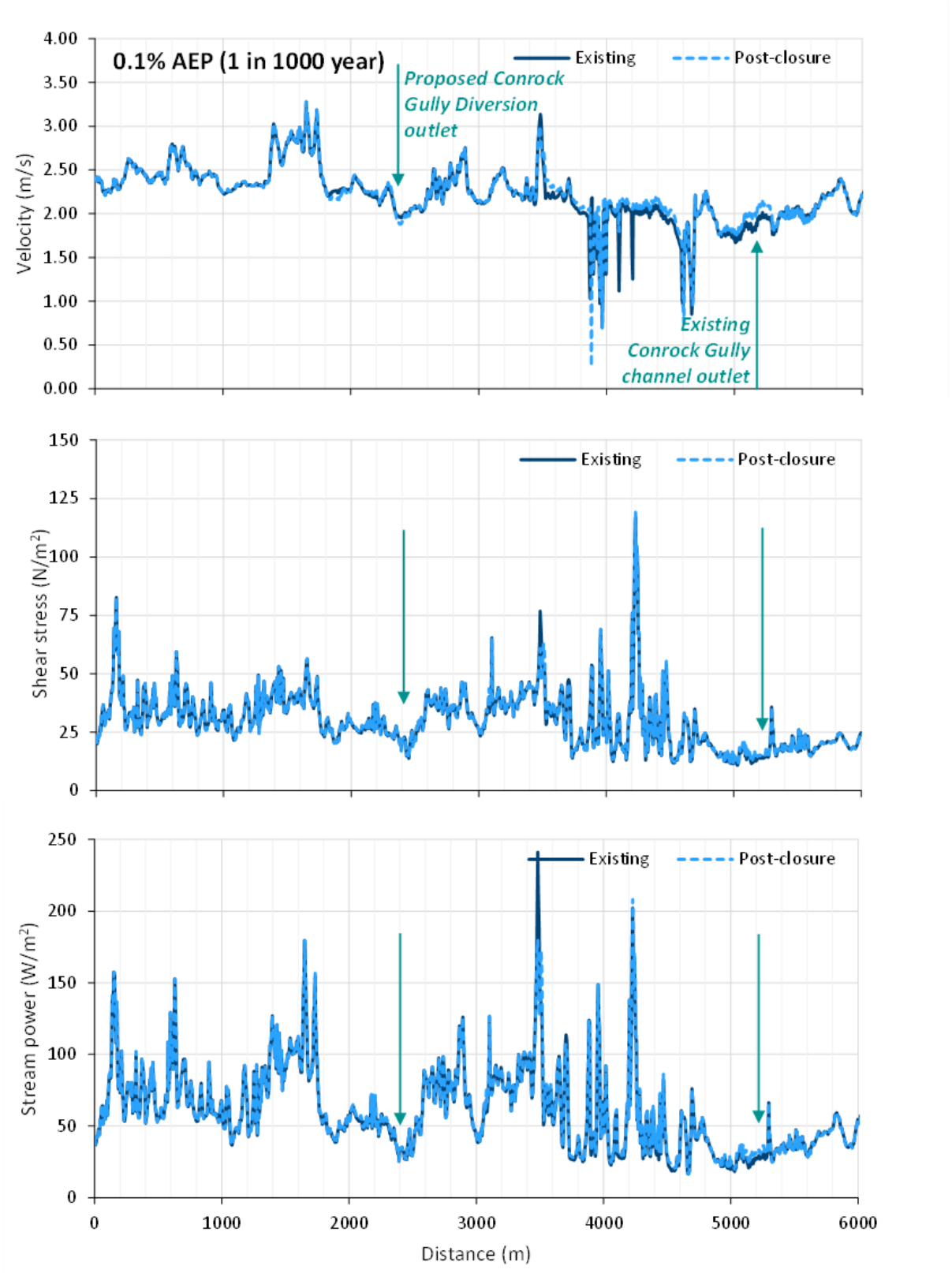


Figure 24-66 0.1% AEP Flood Event – Final Landform Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)

24.9.4 Impacts on Floodplain Morphology

The hydraulic characteristics of velocity, shear stress and stream power for the Isaac River floodplain for the existing, developed and final landform conditions were assessed for 2% AEP and 0.1% AEP flood events. The 50% AEP flood event was excluded as the Isaac River flow is generally contained within the river channel for this event, and therefore, does not interact with the floodplain.

24.9.4.1 Existing Conditions – Hydraulic Characteristics

The Project's existing conditions model results show the following properties:

- In relation to a 2% AEP flood event (Appendix C.2 of **Appendix J**):
    - Floodplain velocities are generally less than 2 m/s and peak along floodplains adjacent to the major bends in the Isaac River channel.
    - Floodplain bed shear stresses are generally less than 35 N/m^2, with some localised areas adjacent to the channel reaching 60 N/m^2.
    - Floodplain stream power levels are generally less than 60 W/m^2, with some localised areas peaking to values greater than 100 W/m^2.
    - Velocities, bed shear stresses and stream power levels are generally below the ACARP guideline values, with the exception of small localised areas along the floodplain directly adjacent to the Isaac River channel where previous scour is evident and levels can exceed guideline values.
- In relation to a 0.1% AEP flood event (Appendix C.2 of **Appendix J**):
    - Floodplain velocities are generally less than 2.6 m/s and peak along floodplains adjacent to the major bends in the Isaac River channel.
    - Floodplain bed shear stresses are generally less than 60 N/m^2, with some localised areas reaching 80 N/m^2.
    - Floodplain stream power levels are generally less than 150 W/m^2, with some localised areas exceeding 200 W/m^2.

24.9.4.2 Developed Conditions – Floodplain Impact Assessment

In summary, the floodplain impact assessment of the developed conditions presented the following findings:

- In relation to a 2% AEP event (Figure 24-67, Figure 24-69 and Appendix C.2 of **Appendix J**):
    - Velocities are increased by up to 0.5 m/s along the floodplain to the south of IDM and by up to 0.8 m/s along the downstream reach of the Isaac River levee. However, the floodplain velocities in these areas are generally lower than 2 m/s and below the ACARP guideline values.
    - Bed shear stresses are increased by up to 15 N/m^2 along the floodplain to the south of IDM and by up to 30 N/m^2 along the downstream reach of the Isaac River levee. However, levels are generally similar to existing conditions along the floodplain adjacent to the Isaac River levee.
    - Stream power levels are increased by up to 35 W/m^2 along the floodplain to the south of IDM and by up to 50 W/m^2 along the downstream reach of the Isaac River levee. Levels are generally unchanged from existing conditions along the floodplain adjacent to the Isaac River levee and below the ACARP guideline values.
    - Overall, bed shear stress and stream power experience negligible change across the majority of the floodplain, with some minor localised changes.
- In relation to a 0.1% AEP flood event (Figure 24-68, Figure 24-70 and Appendix C.2 of **Appendix J**):
    - Velocities are generally increased by around 0.7 m/s in the floodplain adjacent to the Project, with some areas increasing by up to 1.1 m/s downstream of IDM and adjacent to

the downstream reach of the Isaac River levee. However, the velocities in this area are lower than the peak velocities along the floodplain under existing conditions.

- Bed shear stresses increase by up to 25 N/m^2 along the floodplain adjacent to the Project. However, increases in shear stress of up to 35 W/m^2 are observed in the floodplain downstream of IDM and adjacent to the downstream reach of the Isaac River levee.
- Stream power levels are generally increased by less than 60 W/m^2 in the floodplain adjacent to the Project. However, increases in stream power of up to 100 W/m^2 are observed in the floodplain downstream of IDM and adjacent to the downstream reach of the Isaac River levee.
- The bed shear stress and stream power levels in the Isaac River floodplain are higher than the levels typically experienced during the 0.1% AEP flood event for existing conditions with potential localised floodplain changes downstream of IDM, and adjacent to the downstream reach of the Isaac River levee, which will have rock protection to prevent scour.

The impact assessment demonstrates that under the Project's developed conditions, the peak velocities, bed shear stresses and stream power levels along the floodplain adjacent to Isaac River are generally similar to the peak levels under existing conditions and are appropriate compared to the ACARP guideline values during a 2% AEP flood event.

For the extremely rare 0.1% AEP flood event, it is possible that some impacts to the Isaac River floodplain geomorphology may occur in localised areas: the sections downstream of IDM and in the downstream section of the Isaac River levee. Geomorphological changes are most likely to occur due to frequent and repeated flood flows, rather than a 0.1% AEP flood event. Therefore, it is considered unlikely that these changes will occur within the Project's 15-year mine life when the Isaac River levee is in place. The proposed Isaac River levee will be decommissioned and rehabilitated following mining operations.

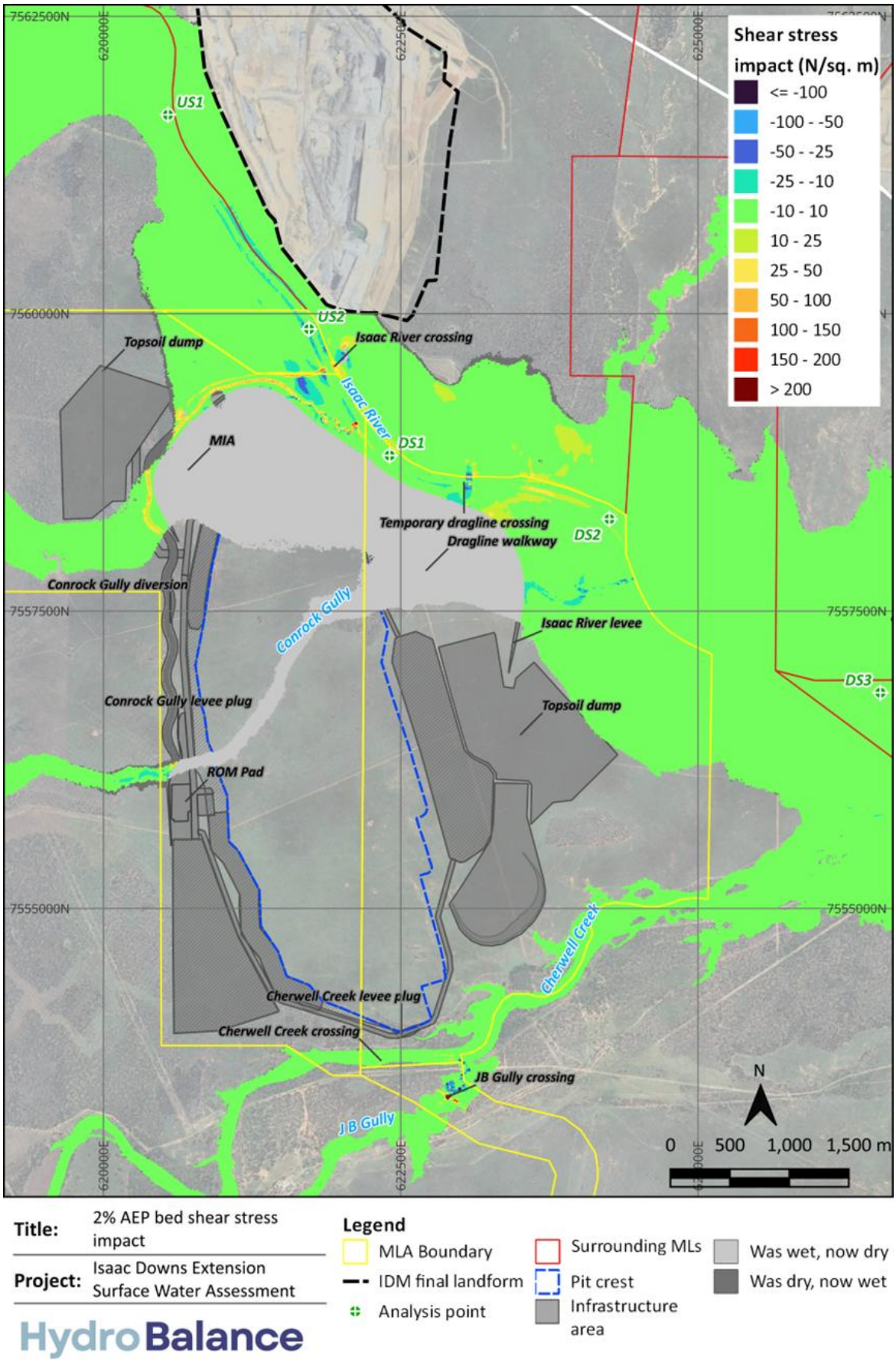


Figure 24-67 2% AEP Flood Event – Bed Shear Stress Impacts (Developed minus Existing Conditions)

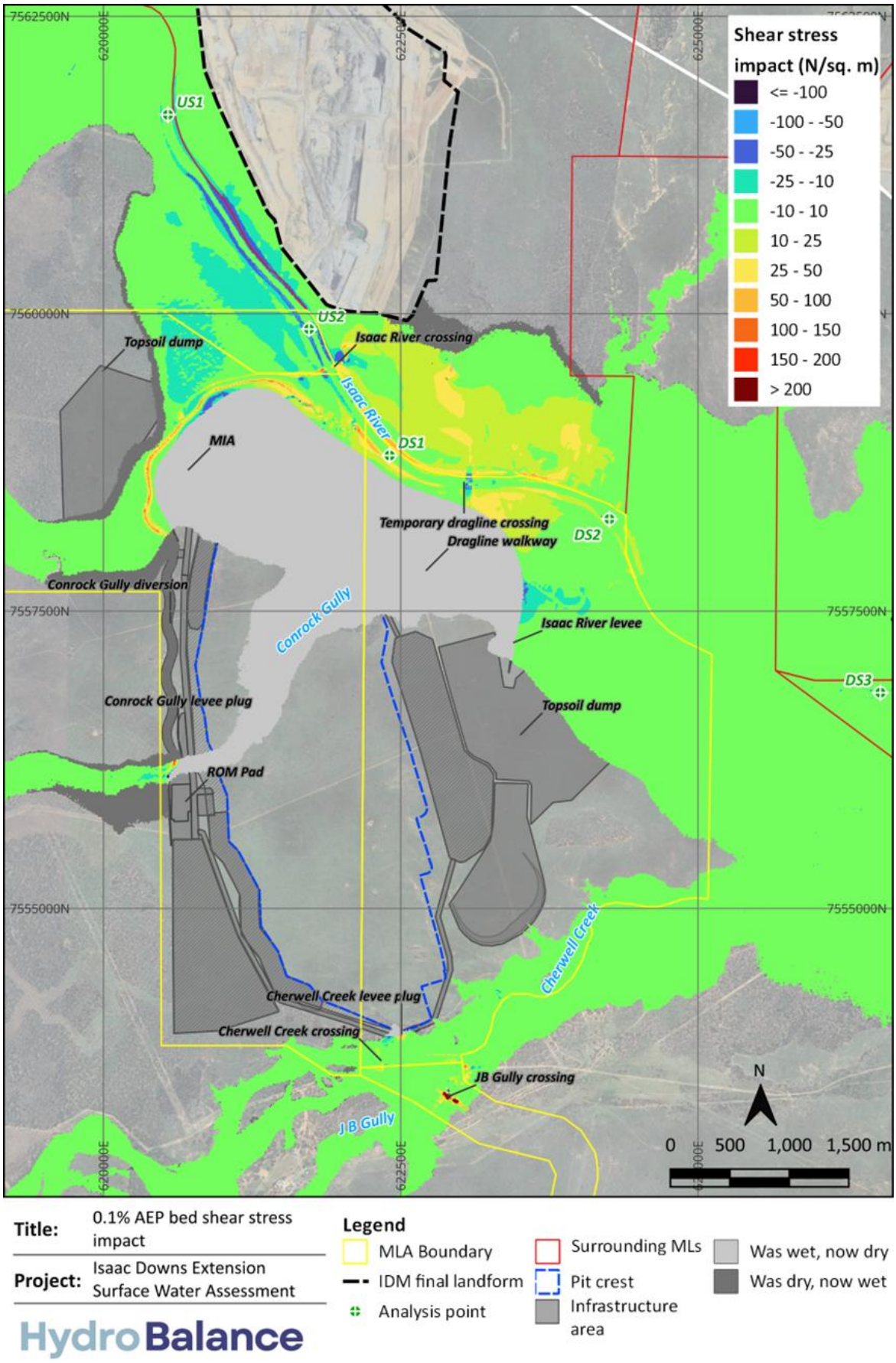


Figure 24-68 0.1% AEP Flood Event – Bed Shear Stress Impacts (Developed minus Existing Conditions)

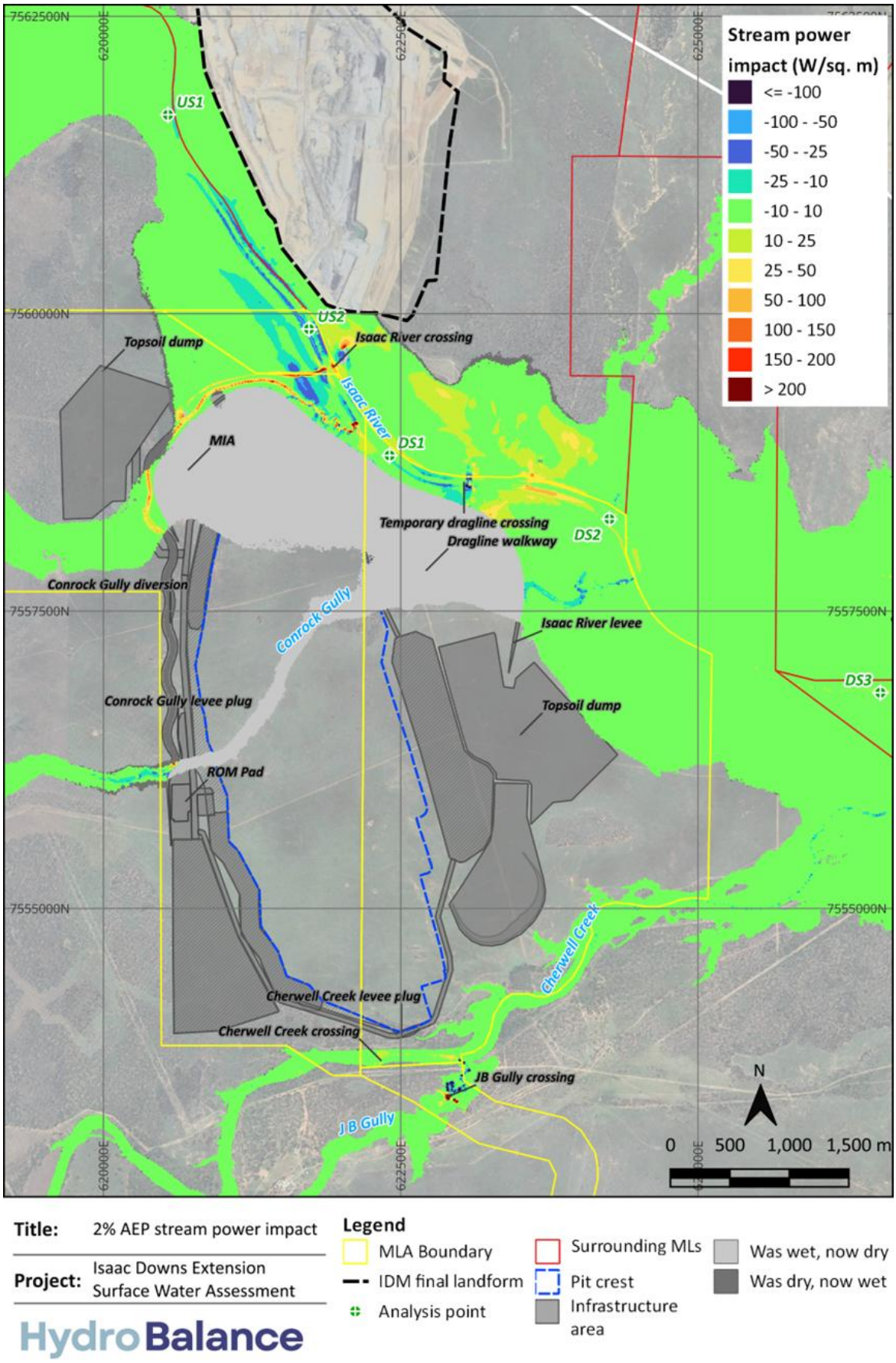


Figure 24-69 2% AEP Flood Event – Stream Power Impacts (Developed minus Existing Conditions)

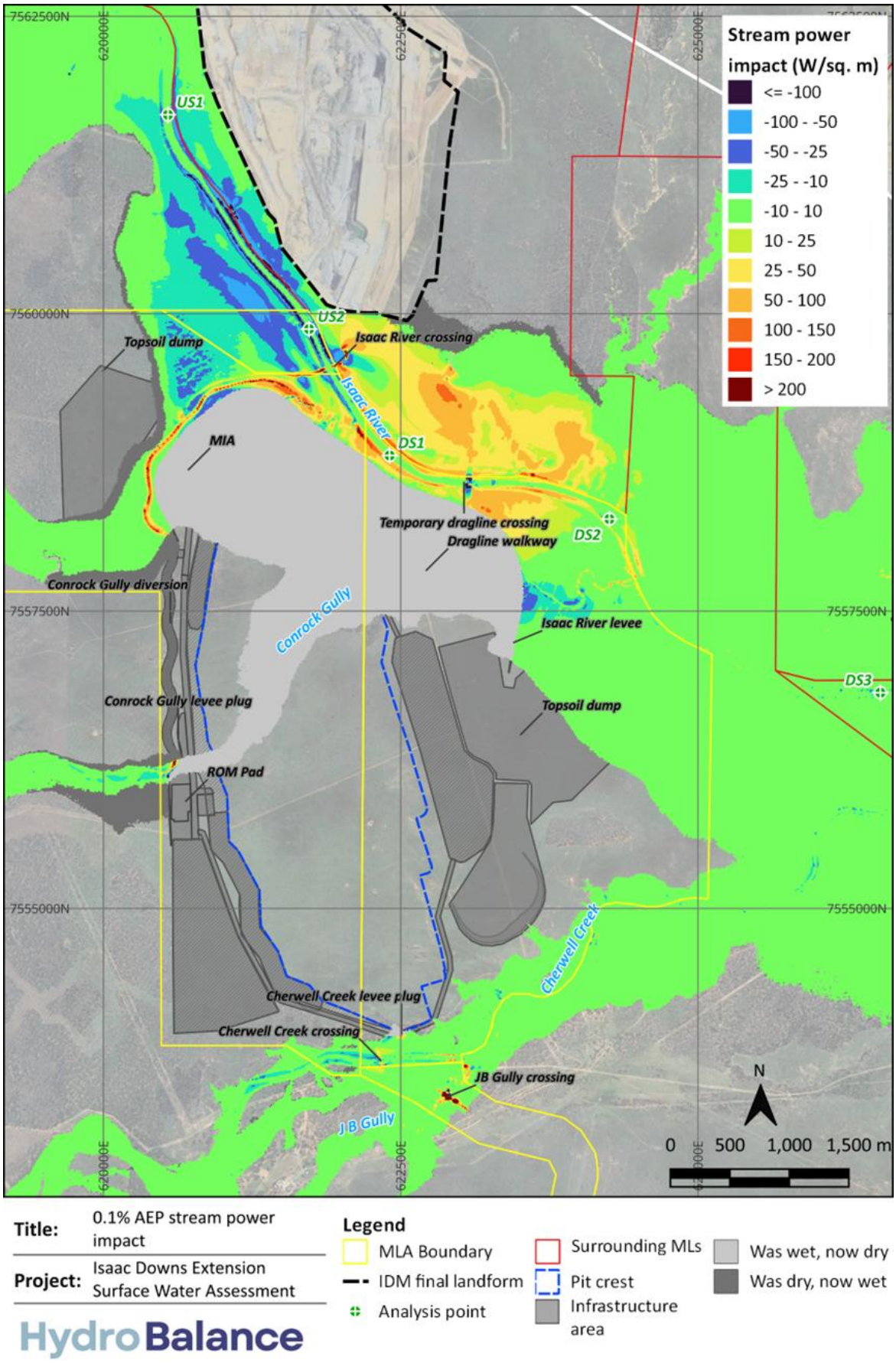


Figure 24-70 0.1% AEP Flood Event – Stream Power Impacts (Developed minus Existing Conditions)

24.9.4.3 Final Landform Conditions – Floodplain Impact Assessment

The Isaac River levee will be decommissioned and rehabilitated following mining operations, and therefore, any impacts on the floodplain morphology under final landform conditions would be even less than during mining operations. An assessment of the floodplain morphology for the Project's final landform conditions under rare and extreme flood events was undertaken for 2% and 0.1% AEP flood events.

In summary, the floodplain impact assessment of the Project's final landform conditions presented the following findings:

- In relation to a 2% AEP flood event (Figure 24-71, Figure 24-73 and Appendix C.2 of **Appendix J**):
  - There are negligible impacts to velocity, bed shear stress and stream power levels in the Isaac River floodplain due to the proposed final landform.
- In relation to a 0.1% AEP flood event (Figure 24-72, Figure 24-74 and Appendix C.2 of **Appendix J**):
  - Velocities may increase by up to 0.4 m/s along the floodplain adjacent to the out-of-pit dump emplacement. However, the velocities in this area are generally consistent with peak velocities along the floodplain under existing conditions.
  - Bed shear stress impacts along the western floodplain are generally less than 10 N/m^2. There are no material impacts along the eastern floodplain.
  - Stream power level impacts along the western floodplain are generally less than 20 W/m^2. There are no material impacts along the eastern floodplain.
  - Overall, there are negligible changes in bed shear stress and stream power across the entire floodplain.

The impact assessment demonstrates that there are negligible to minor increases in velocity, and negligible changes in shear stress and stream power within floodplain of the Isaac River, as a result of the Project's proposed final landform. Therefore, the geomorphic impact on the Isaac River floodplain due to the Project's proposed final landform is expected to be negligible.

As part of final landform preparation required under the Project's PRCP, floodplain surfaces will be stabilised and rehabilitated to achieve a self-sustaining vegetation cover. This vegetation cover will increase erosion resistance and enhance landform stability.

The hydraulic characteristics of flow within the Project's backfilled pit area are similar to or lower than under existing conditions, and therefore, the Project's backfilled pit area is expected to remain a stable landform with revegetation of the floodplain surface.

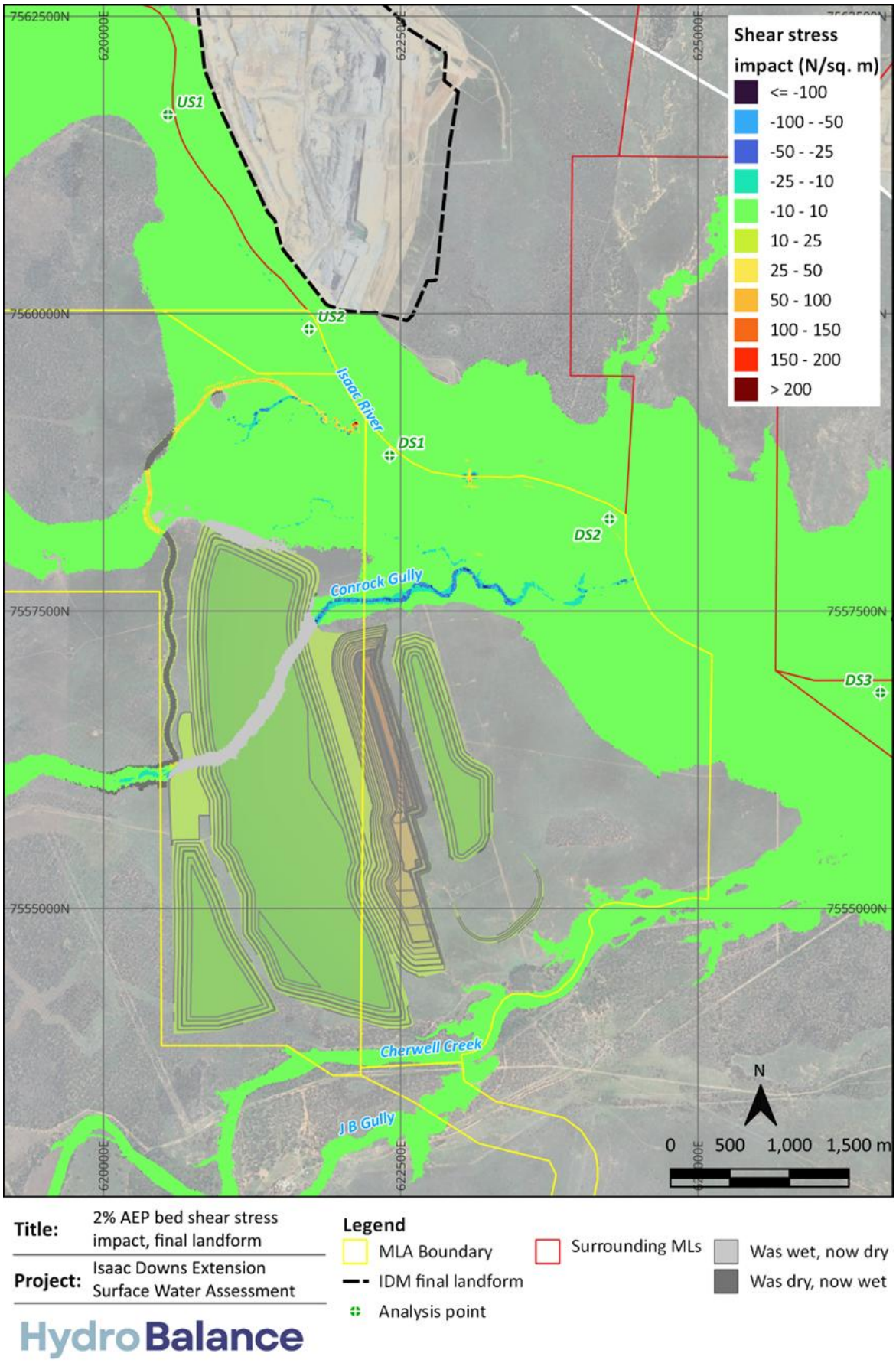


Figure 24-71 Final Landform – 2% AEP Flood (Minus Existing Conditions) – Bed Shear Stress Impacts

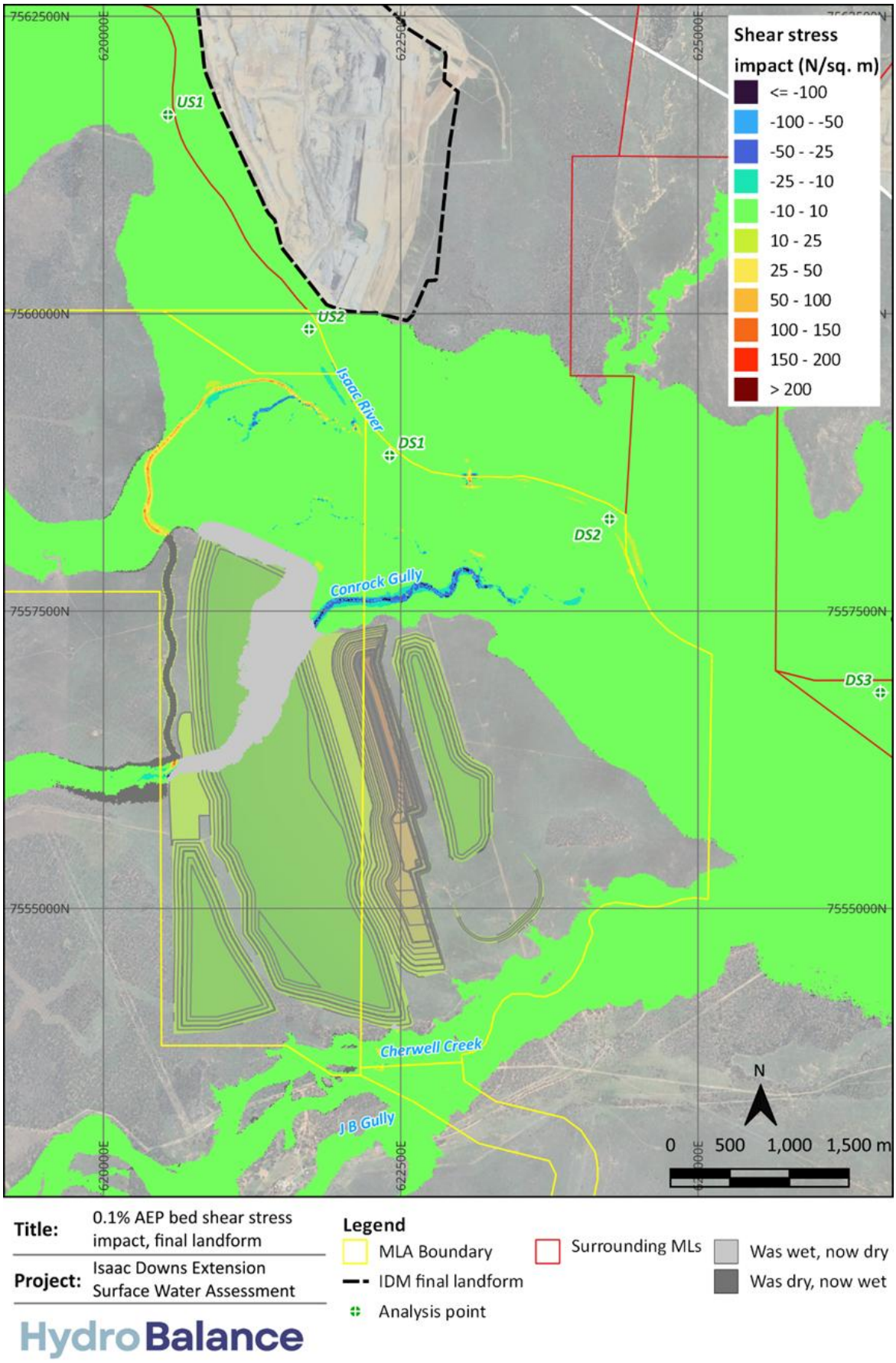


Figure 24-72 Final Landform – 0.1% AEP Flood (Minus Existing Conditions) – Bed Shear Stress Impacts

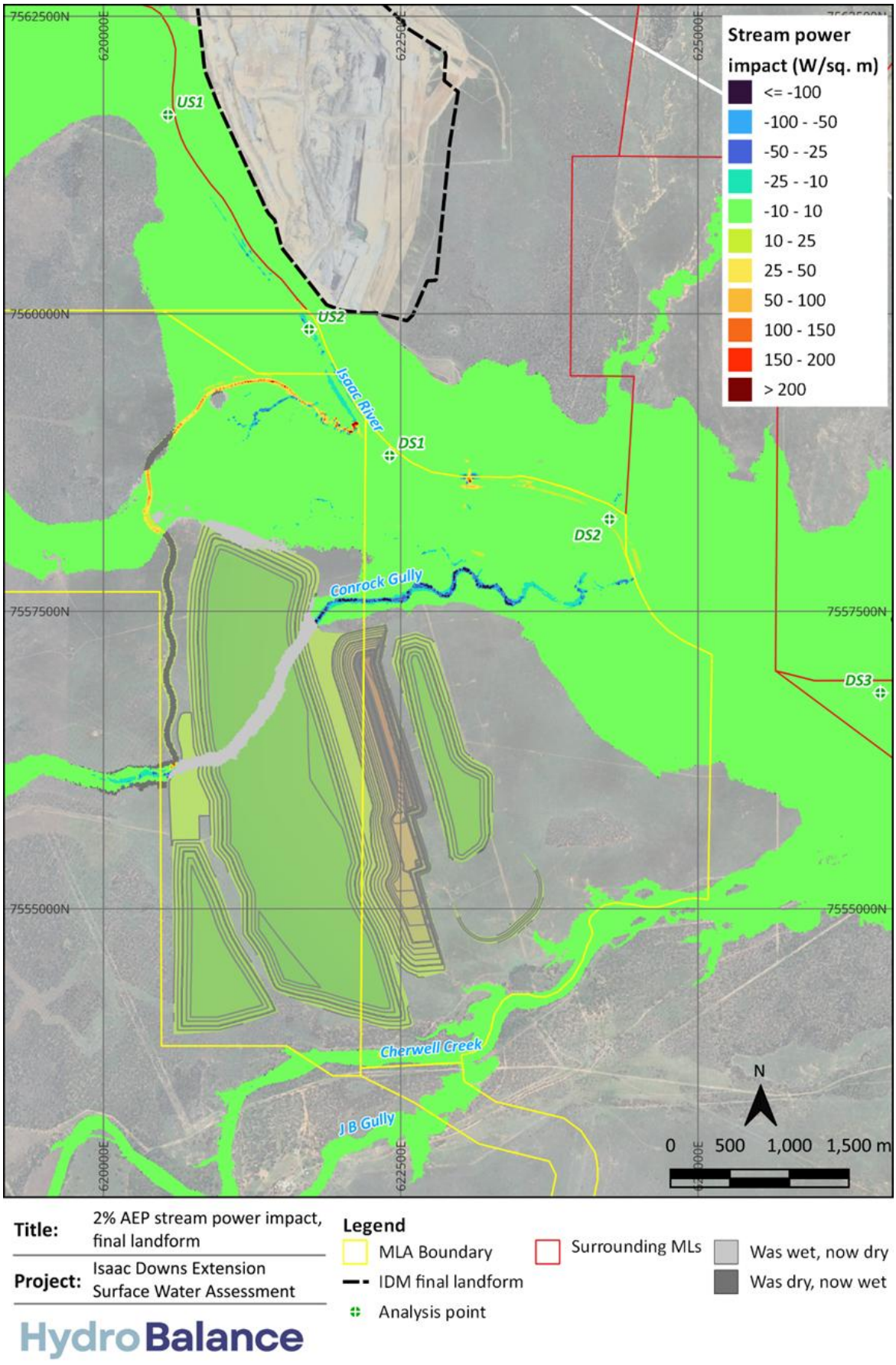


Figure 24-73 Final Landform – 2% AEP Flood (Minus Existing Conditions) – Stream Power Impacts

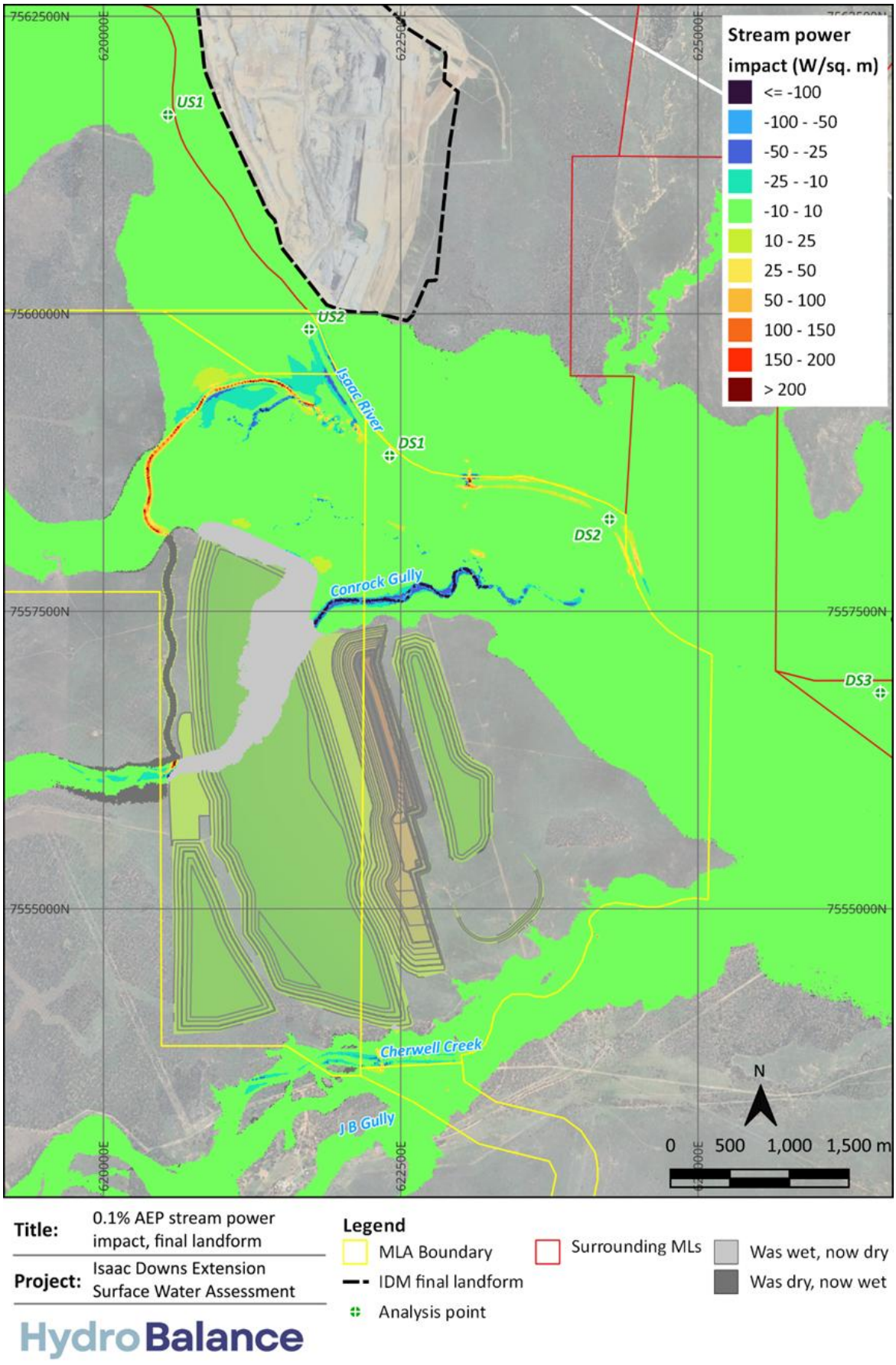


Figure 24-74 Final Landform – 0.1% AEP Flood (Minus Existing Conditions) – Stream Power Impacts

24.9.4.4 Geomorphic Impact Assessment Summary

The Project's geomorphic impact assessment of channel morphology identified the following conclusions:

- In relation to existing conditions:
  - Velocities within the main channel are generally higher than the ACARP guideline values for a 50% AEP flood event. The 2% AEP flood velocities are consistently less than the ACARP guideline values.
  - Bed shear stress and stream power are generally within the ACARP guideline values, except for small, localised areas.
- In relation to developed conditions:
  - The Isaac River levee causes negligible to minor impacts to flood velocities, bed shear stress and stream power along the Isaac River channel.
  - The proposed Project infrastructure is unlikely to materially impact on the geomorphology of the Isaac River channel in the vicinity of the Project.
- In relation to final landform conditions:
  - Following the decommissioning and rehabilitation of the Isaac River levee, the proposed final landform causes negligible impacts to flood velocities, bed shear stress and stream power along the Isaac River channel.
  - The proposed final landform is unlikely to impact on the geomorphology of the Isaac River channel in the vicinity of the Project.

The Project's geomorphic impact assessment of floodplain morphology identified the following conclusions:

- In relation to existing conditions:
  - Velocities along the Isaac River floodplain are generally within the ACARP guideline values for a 2% AEP flood event.
  - Shear stress and stream power are generally within the ACARP guideline values, except for small, localised areas.
- In relation to developed conditions:
  - The peak velocities, bed shear stresses and stream power levels along the floodplain adjacent to Isaac River are generally similar to the peak levels under existing conditions and are appropriate compared to the ACARP guideline values during a 2% AEP flood event.
  - For the extremely rare 0.1% AEP flood event, it is possible that some localised impacts to the Isaac River floodplain geomorphology may occur in the sections downstream of IDM and downstream of the Isaac River levee. However, it is considered unlikely that these localised impacts will occur within the relatively short 15-year period of mining operations. The Isaac River levee will be decommissioned and rehabilitated prior to closure.
- In relation to final landform conditions:
  - There are negligible to minor changes in the hydraulic characteristics within the floodplain of the Isaac River as a result of the proposed final landform.

As part of final landform preparation required under the Project's PRCP, floodplain surfaces will be stabilised and rehabilitated to achieve a self-sustaining vegetation cover. This vegetation cover will increase erosion resistance and enhance landform stability.

24.10 Conrock Gully Assessment

24.10.1 Functional Design Report

The existing Conrock Gully main channel flows into the Isaac River from the west. To provide safe and efficient access to the Project's underlying coal resource, the gully channel will be diverted to the northwest. The Isaac River levee will be constructed along the southern edge of the diversion to protect the Project's mining operations from Isaac River flood events, which results in Isaac River backwater entering the diversion similar to current circumstances where the Isaac River backwater enters the existing Conrock Gully channel. The Project's functional design report for the Conrock Gully diversion is provided in Appendix D of **Appendix J**. The Project's functional design report comprises the following sections:

- Section 1: Introduction
- Section 2: Design Approach
- Section 3: Existing Geomorphic and Vegetation Conditions
- Section 4: Existing Hydrologic and Hydraulic Conditions
- Section 5: Design Details
- Section 6: Hydraulic Assessment
- Section 7: Monitoring
- Section 8: Conclusions

The hydraulic assessment was used to assess the potential hydraulic impacts and demonstrate the suitability of Conrock Gully diversion's functional design.

Cross sections of Conrock Gully in the reach to be diverted are provided in Section 3 of Appendix D of **Appendix J.** The typical channel is described as having a base width of approximately 4 m, a side slope of 1V in 6H for the channel and a side slope of 1V in 30H on the channel overbank. The diversion geometry, designed to be similar to the existing gully geometry is provided in Section 5 of Appendix D of **Appendix J**.

24.10.2 Design Approach

A functional design for the Conrock Gully diversion was prepared to address the objectives and design criteria of the DNRME guideline and achieve the following required outcomes:

- Outcome 1 - The design incorporates natural features present in the local watercourses, and it replicates the channel length, slope and cross-sectional shape. It incorporates meanders with radii, amplitude and magnitude similar to existing meanders in the adjacent reaches and the reach to be diverted. A revegetation plan will be established which will incorporate local vegetation to achieve bank stability.
- Outcome 2 - As the diversion is located on the edge of the floodplain, and it incorporates the above features, it maintains the existing hydrologic characteristics of surface water systems.
- Outcome 3 - The hydraulic characteristics of the design are comparable with those in the existing watercourse, and it is therefore suitable for the region in which the diversion is located.
- Outcome 4 - As the hydraulic characteristics are largely unchanged, the sediment transport will allow the watercourse diversion to be self-sustaining and is unlikely to result in material or serious environmental harm on upstream and downstream reaches.
- Outcome 5 - The watercourse diversion and associated structures maintain stability and functionality and are appropriate for all substrate conditions they encounter. This will be confirmed in later design phases.

The ACARP guideline design criteria recommended for Bowen Basin stream diversions are provided in Table 24-12. The terms 'ACARP guideline' and 'DNRME guideline' are used interchangeably when comparing hydraulic performance to design criteria.

24.10.3 Hydraulic Assessment Methodology

For Conrock Gully diversion's hydraulic assessment, the existing conditions TUFLOW hydraulic model was amended to include the Conrock Gully diversion and the proposed levees required to protect the Project's mining area from local gully and Isaac River flooding. Further details of the hydraulic assessment's methodology are provided in Section 6.1 within Appendix D of **Appendix J**.

24.10.4 Diversion Depths and Velocities

24.10.4.1 Summary – Depths and Velocities

The developed conditions flood depths for the 50% and 2% AEP design local flood events, with no regional flood event within the Isaac River, are shown in Figure 6.1 and Figure 6.2, respectively, within Appendix D of **Appendix J**. The 0.1% AEP design regional flood extent for developed conditions is shown in Figure 6.3 within Appendix D of **Appendix J**. The flood depths are relatively uniform throughout the 4.0 km upstream reach of the diversion. The depths fluctuate slightly (± 1 m) within the downstream 1.2 km reach due to the changes to the diversion base slope and meander radii. The flood depth within the diversion is generally around 2.2 m and 3.9 m for the 50% AEP and 2% AEP local flood events, respectively.

The modelled flood velocity for the 50% and 2% AEP design local flood events and the 0.1% AEP design regional flood events are shown in Figure 6.4, Figure 6.5 and Figure 6.6, respectively, within Appendix D of **Appendix J**. Overall, the velocities are relatively uniform throughout the Conrock Gully diversion, increasing slightly as the Conrock Gully diversion joins the Isaac River. Velocities within the Conrock Gully diversion are generally around 2 m/s or lower.

The flood modelling presented in Section 24.8 includes the diversion and hence this shows any changes in flood depth and velocity attributable to the diversion.

24.10.4.2 Outlet Velocities

The Conrock Gully diversion outlet is located at the Isaac River bank, at an existing confluence between a minor drainage line and the Isaac River. At the outlet, the diversion may experience higher than average diversion velocities when there are low or no flows in the Isaac River. The modelled velocities at the outlet are shown in Figure 6.7 within Appendix D of **Appendix J**. The peak velocities at this location range between 3.2 m/s (50% AEP flood event) and 4.6 m/s (2% AEP flood event). The peak velocities at the outlet would be far lower during Isaac River flow events due to tailwater effects, generally below 2 m/s. Isaac River flows would submerge the diversion outlet during flood events greater than or equal to the 10% AEP regional flood event. Conrock Gully flow events are expected to occur independently of Isaac River flow events infrequently.

The velocities during local creek flow events at the diversion outlet are similar to those experienced in the existing waterways and drainage lines at their respective confluences with the Isaac River. Table 6.1 within Appendix D of **Appendix J** shows a comparison between the post-development and existing velocities. The results show that the velocities at the diversion outlet would be close to or within the range of those experienced at the existing Conrock Gully confluence locations.

In summary, the velocities at the proposed Conrock Gully diversion outlet are considered acceptable, given the following considerations:

- High velocities are only expected to occur when Conrock Gully flows independently of the Isaac River, which is unlikely to occur frequently.

- The velocities at the diversion outlet during local flows with no regional flooding are within the range of the velocities at the existing Isaac River confluences.

24.10.5 Comparison to DNRME Guideline Hydraulic Criteria

The main channel section-averaged results of the hydraulic modelling of the Conrock Gully diversion in a 50% AEP flood event is shown in Figure 24-75. Generally, due to the uniform diversion channel shape, the values within the diversion channel vary more uniformly than in the existing channel.

In summary, the following results were identified for a vegetated diversion channel:

- In relation to velocity:
  - At most locations, the existing Conrock Gully velocity is below the DNRME guideline value of 1.5 m/s, with atypical range of 0.75 m/s to 1.5 m/s.
  - The velocity in the Conrock Gully diversion channel is lower than the existing Conrock Gully channel and consistently below the guideline value of 1.5 m/s, with a typical range of 0.7 m/s to 1.2 m/s.
  - In the downstream section of the Conrock Gully diversion, there is a slight increase in velocity as flows traverse down the Isaac River bank, although this is still below the DNRME guideline value. Vegetation, including trees and shrubs, will be established in this location, to manage the potential scour risk and to be consistent with the existing Isaac River banks in this location.
- In relation to shear stress and stream power:
  - The values in the existing Conrock Gully channel fluctuate and periodically exceed the DNRME Guideline values throughout the length of Conrock Gully.
  - The values in the Conrock Gully diversion are relatively uniform and are below the existing gully channel and well within the envelope of naturally occurring values. There is an exceedance of the DNRME guideline values at the confluence with the Isaac River, which also occurs in the existing channel. The confluence shear stress and stream power is improved in the Conrock Gully diversion compared to the existing channel.
  - The shear stress and stream power levels are improved in comparison to the existing Conrock Gully channel.

For a non-vegetated diversion channel, the DNRME guideline includes hydraulic criteria for un-vegetated conditions, which would be representative of potential conditions immediately post-construction of the Conrock Gully diversion for a 50% AEP flood event.

The modelled velocities and stream power in the Conrock Gully diversion may exceed the DNRME Guideline value for un-vegetated conditions in some local areas, similar to, although less frequent than, the existing Conrock Gully channel.

The results indicate that post-construction there will be an elevated erosion risk, which will be managed through revegetation planning. Stabilisation works may need to be considered to manage the potential for damage during early flows. However, this potential for damage is likely to be mitigated by the relatively cohesive nature of the local soils. The proposed rehabilitation and revegetation for the diversion is included the PRCP schedule. Initial vegetation cover will be established before accepting overland flow from the Conrock Gully catchment.

The main channel section-averaged results of the hydraulic modelling of the Conrock Gully diversion in a 2% AEP flood event is shown in Figure 24-76. In summary, the following results were identified:

- In relation to velocity:
  - The existing Conrock Gully velocity is less than the DNRME guideline value of 2.5 m/s, with a typical range of 1.0 m/s to 1.5 m/s.

- In the Conrock Gully diversion, the velocity is well below the DNRME guideline values and are consistently within or better than the typical range of the existing Conrock Gully channel.

- In relation to shear stress and stream power:
  - The existing Conrock Gully channel shear stress and stream power level are generally below the DNRME guideline values aside from some exceedances, particularly as the existing channel meets the Isaac River.
  - The shear stress and stream power in the Conrock Gully diversion is generally similar to the existing Conrock Gully condition, and below the DNRME guideline values. At the confluence with the Isaac River the Conrock Gully diversion has lower shear stress and stream power than the existing Conrock Gully confluence, although with minor exceedances of the DNRME guideline values.
  - Overall, the shear stress and stream power levels for the Conrock Gully diversion are improved in comparison to the existing Conrock Gully channel.

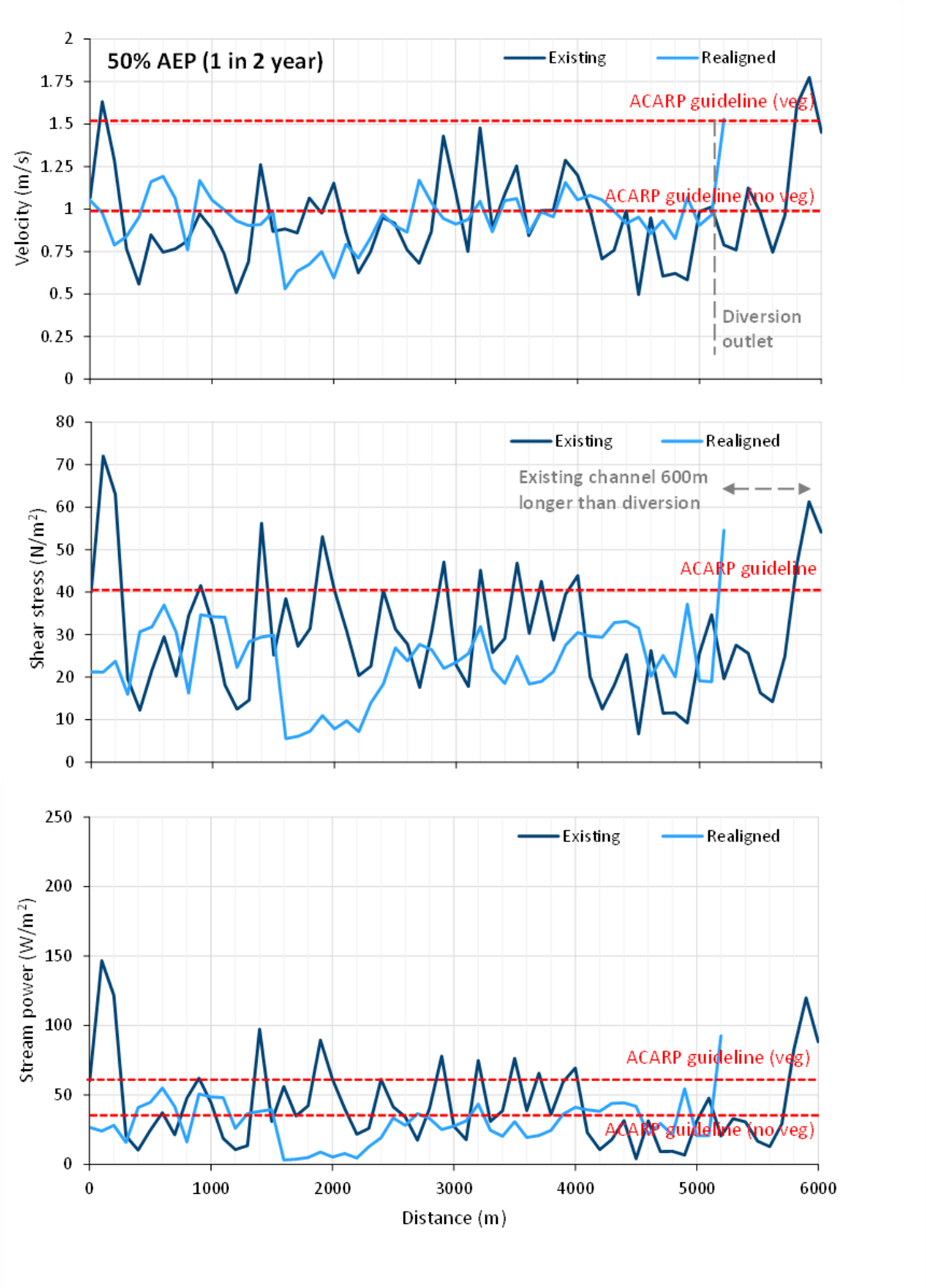


Figure 24-75 Longitudinal Profiles: 50% AEP Section-averaged Velocity, Stream Power and Bed Shear Stress

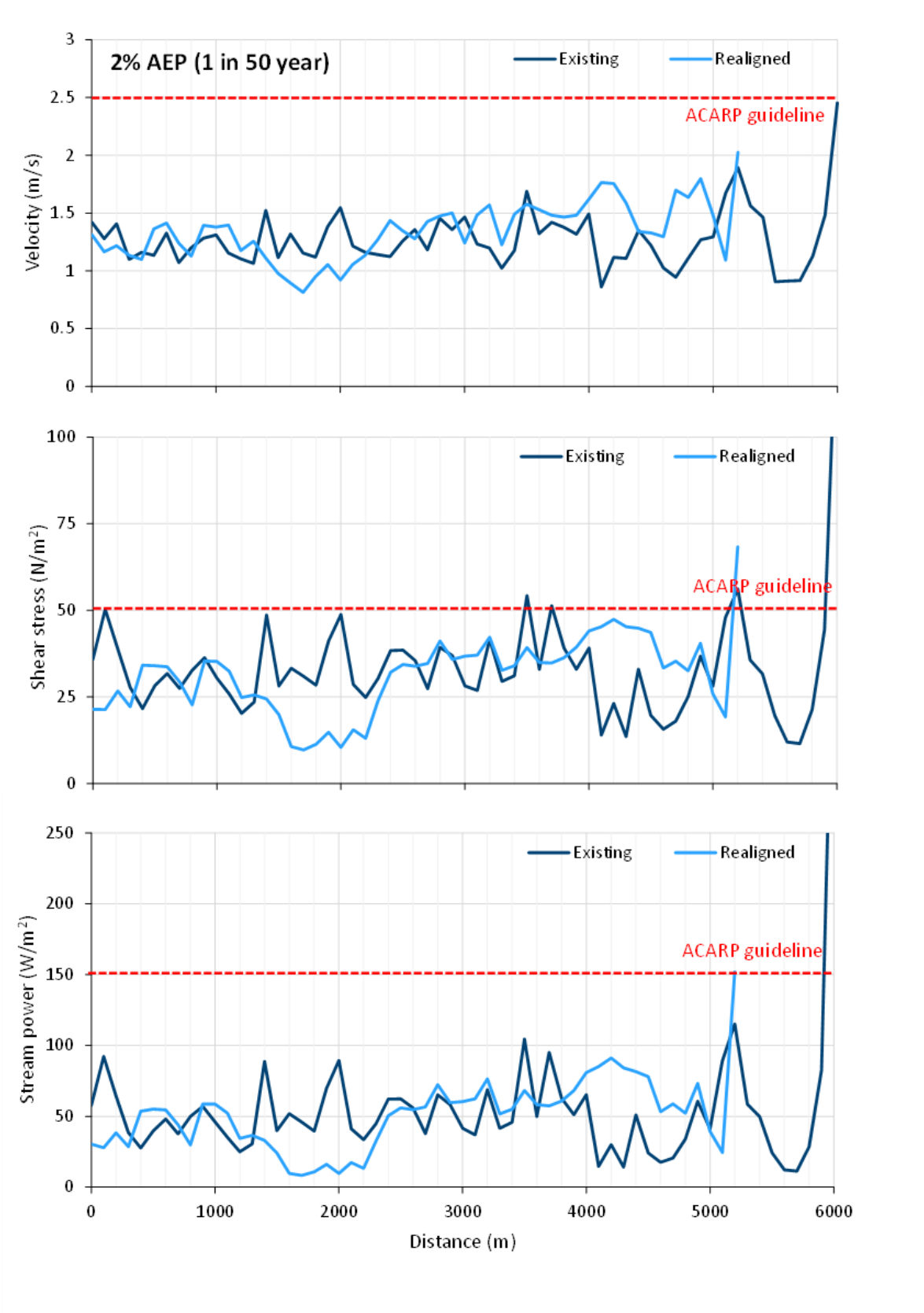


Figure 24-76 Longitudinal Profiles: 2% AEP Section-averaged Velocity, Stream Power and Bed Shear Stress

24.10.6 Project Site Access Road Assessment

A one-dimensional HEC-RAS (USACE, 2024) model was developed to assess the proposed crossing that would allow the Project's site access / haul road to traverse the Conrock Gully diversion. The crossing has been designed to have immunity from the 10% AEP local Conrock Gully flows. The road would be overtopped by design events rarer than the 10% AEP local Conrock Gully event. The location of the proposed road crossing is shown in Figure 24-33.

The HEC-RAS model was used to determine a conceptual crossing configuration to convey the 10% AEP local Conrock Gully flows, utilising the conceptual culvert crossing design.

The culvert hydraulic assessment demonstrates that during frequent 50% AEP local flood events within the immunity of the structure, the velocities upstream of the crossing may be increased by a negligible to minor change of 3%, due to the efficient flow regime through the culverts. During rarer 2% AEP local flood events outside of the immunity of the crossing, velocities upstream of the crossing may be reduce by a negligible to minor change of 3%, due to the reduced conveyance. The velocity downstream of the crossing is not impacted by the culverts.

Longitudinal sections of the modelled maximum channel velocity and channel water level in the Conrock Gully diversion are provided in Section 6.7 of Appendix D of **Appendix J**, with and without the Project's site access road crossing in place. These figures show that the impact on velocities and water levels in the Conrock Gully diversion due to the crossing is negligible to minor for the 50% AEP and 2% AEP local flow events. The minor impacts propagate for a short distance upstream or downstream of the crossing. The Project's site access crossing would be fully drowned by 10% AEP regional Isaac River flood flows.

24.10.7 Monitoring

The Conrock Gully diversion will be monitored regularly to collect data for use in evaluating the performance of the diversion during construction and operations. Collection of monitoring data will help identify any issues with the construction of the diversion and assist with achieving rehabilitation milestones for a stable landform in accordance with the Project's PRCP schedule. The monitoring program will be conducted using the process documented in the DNRME guideline.

Further details on the planned monitoring of the Conrock Gully diversion, including monitoring parameters and schedule, are provided in Section 7 of Appendix D of **Appendix J**.

24.10.8 Assessment Summary

To achieve the design outcomes, the following criteria were considered when developing the Conrock Gully diversion design:

- The diversion ties in with the existing watercourse within the Project area. The proposed diversion alignment has been selected to minimise interference with mining infrastructure, whilst being within the Project MLAs.
- The stability and performance of the diversion will be assisted by vegetation within the watercourse diversion and adjoining floodplain and will not include artificial structures for grade control.
- The proposed diversion channel has similar dimensions to the existing channel and thus has similar design capacity (Table 24-13).
- The existing channel includes a large meander which contributes significantly to the length of channel being diverted. A number of meanders have been introduced at the upstream end of the diversion which results in a length of channel and bed slope similar to the existing channel. The meanders have similar amplitude, wavelength, sinuosity, and bend radius to bends found in the existing creek channel (Table 24-13).

- The main channel has a similar geometry to the existing channel, but with slightly steeper side slopes to reduce the extent of disturbance required. The hydraulic conditions within the existing Conrock Gully channel and proposed diversion channel have been compared for conditions before and after the proposed development, and to the guideline conditions within the DNRME guideline (Table 24-14).

Table 24-13 compares the average geomorphic characteristics of the existing and proposed channels of Conrock Gully. In summary, the diversion design reasonably matches the existing Conrock Gully geometry.

Table 24-13 Conrock Gully Diversion – Channel Geomorphic Characteristics Comparison

Parameter		Existing Gully	Proposed Diversion
Length (km)		5.8	5.2
Bed Grade (%) – floodplain reach		0.140	0.147
Bed Grade (%) – downstream reach		0.330	0.341
Bed Width (m)		4	4
Top Width (m)		26	28
Depth to floodplain (m)		7	5
Meander Radius (m)		240 (median)	240 (median)
Meander Sinuosity Index		1.2-1.7	1.1
Meander Wavelength (m)		250-1,200	140-350
Meander Amplitude (m)		150-330	75-170
50% AEP	Mean Velocity (m/s)	0.95	0.93
	Mean Bed Shear Stress (N/m^2)	30.1	23.66
	Mean Stream Power (W/m^2)	42.7	29.3
	Hydraulic Gradient (%)	0.17	0.14
2% AEP	Mean Velocity (m/s)	1.28	1.33
	Mean Bed Shear Stress (N/m^2)	33.5	30.9
	Mean Stream Power (W/m^2)	55.7	49.6
	Hydraulic Gradient (%)	0.16	0.15

Within the Conrock Gully diversion, the design hydraulic conditions are similar, and generally improved, to those in the existing Conrock Gully channel, and are consistent with the ACARP guideline for channel-averaged shear stress, stream power and velocity. The assessment results are summarised in more detail in Table 24-14.

Table 24-14 Conrock Gully Diversion – Modelled Guideline Hydraulic Conditions Comparison

Shear stress	Stream power	Velocity
50% (1 in 2 year) AEP Flood Event		
Upstream		

Shear stress	Stream power	Velocity
Decreased, due to ponding upstream.	Decreased, due to ponding upstream.	Decreased, due to ponding upstream.
Diversion Reach Generally similar to the existing channel. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for the proposed diversion.	Slight decrease mid diversion. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for proposed diversion.	Slight decrease mid diversion. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for proposed diversion.
Downstream Overall decrease and within range of existing values.	Overall decrease and within range of existing values.	Overall decrease and within range of existing values.
2% (1 in 50 year) AEP Flood Event		
Upstream Decreased, due to ponding upstream.	Decreased, due to ponding upstream.	Decreased, due to ponding upstream.
Diversion Reach Generally similar to the existing channel. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for the proposed diversion.	Slight decrease mid diversion. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for proposed diversion.	Generally similar to the existing channel. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for the proposed diversion.
Downstream Overall decrease and within range of existing values.	Overall decrease and within range of existing values.	Overall decrease and within range of existing values.

Under close to bank-full conditions, there are small reductions in shear stress, stream power and velocity predicted for the Conrock Gully diversion channel itself compared to the existing Conrock Gully channel. In the downstream diversion reaches shear stress, stream power and velocity will increase, compared to the rest of the diversion, as flows enter Isaac River, but they will be similar to or lower than those occurring in the existing Conrock Gully.

Revegetation of the Conrock Gully diversion will occur to achieve the ACARP guideline criteria. Rehabilitation of the Conrock Gully diversion will be scheduled to align with the Project's operational requirements for the Conrock Gully diversion and to achieve a long term stable landform in accordance with the PRCP schedule.

24.11 Groundwater Modelling

24.11.1 Conceptual Hydrogeological Model

A conceptual hydrogeological model of the groundwater regime has been developed based on hydrogeological information obtained for the Project area and surrounds (see Section 24.5), as well as information from the GDE assessment (see Section 24.6.3). The conceptual model is shown in Figure 24-77. The conceptual model builds upon the groundwater conceptualisation presented in the groundwater assessments for other surrounding projects that occur in the same hydrogeologic environment (e.g. IDM, PTM and Winchester South project), and overall is consistent with those other conceptualisations. That is, no information has come to light through Project specific studies that would suggest that the Project area is hydrogeologically unique to any of these surrounding mine or project sites.

The key geology and hydrogeology relevant to the Project are described in Section 24.4.5 and Section 24.5, respectively.

Where present, the alluvial aquifer is disconnected from the riverbed elevation. Spatially, the alluvial aquifer is locally variably saturated and drilling results close to the Project have indicated it is dry and/or comprised only of clay in several locations, with groundwater hosted only in the deeper coarser grained intersections of alluvium that are likely representative of incised paleochannels.

Shallow perched groundwater systems occur locally within recent channel sands and bank deposits, typically within 1–2 m of the ground surface. These perched systems are transient, seasonally recharged during flow and flood events, and are hydraulically disconnected from the deeper alluvial aquifer. Perched groundwater is facultatively accessed by riparian vegetation, predominantly River Red Gum, fringing the Isaac River and lower reaches of Cherwell Creek. Away from the immediate proximity of the river channel, the alluvial aquifer occurs at depth generally between 10 and 12 mBGL and not accessible by terrestrial vegetation. Groundwater levels within the alluvial aquifer and the Leichhardt and Vermont coal seams are all below the stream bed elevations of the Isaac River and Cherwell Creek, indicating there is no potential for groundwater discharge into these surface water features.

Regionally, groundwater flow within the alluvial aquifer is a subdued reflection of topography, with groundwater flowing in a southeasterly direction consistent with the alignment of the Isaac River and northeasterly along Cherwell Creek. Groundwater levels within the alluvium are also highest close to the main surface water features, indicating losing conditions from the surface water features to the underlying alluvium aquifer during flow periods. Over 50% of flow events are shorter than 10 days, highlighting that most flow events are relatively brief. Recharge to the unconsolidated sediments is primarily from stream flow losses or flooding (i.e. losing streams), with direct infiltration of rainfall also occurring rapidly where there are no substantial clay barriers in the shallow sub surface.

Hydraulic connection between the Cenozoic unconsolidated sediments (including alluvium) and the underlying formations is limited to areas where relatively high hydraulic conductivity units (e.g. coal seams) subcrop beneath the unconsolidated sediments, although the weathering horizon at the interface of the Permian and overlying Cenozoic units may reduce this connectivity. General downwards recharge to deeper units is limited by the low hydraulic conductivity (confining) coal measure interburden sequences. Water quality in the Cenozoic sediments (including alluvium) ranges from brackish to highly saline and is indicated to be unsuitable for aquatic ecosystem protection. However, it is considered suitable for stock watering and irrigation.

The Triassic aged Rewan Group, present across the eastern extent of the Project area is considered a regional scale aquitard, though it still contains some saturated horizons. Due to its typically fined grained nature, the Rewan Group generally exhibits a low vertical hydraulic conductivity, resulting in limited hydraulic connection between the unit and the underlying/overlying units. However, local permeability testing indicates hydraulic conductivity values may be higher in the upper weathered zone of the unit.

In the Permian aged coal measures strata, groundwater is encountered mainly in the coal seams, and only occasionally in the sandstone/siltstone units. As with the rest of the Bowen Basin, the coal seams are the main groundwater bearing units within the Permian sequences, with low hydraulic conductivity interburden generally confining the individual seams. Hydraulic conductivity of the coal decreases with depth due to increasing overburden pressure reducing the aperture of fractures. Vertical movement of groundwater (including recharge) is limited by the confining interburden layers, meaning that groundwater flow is primarily horizontal through the seams with recharge only occurring at subcrop where the overlying strata permits. Regionally, groundwater within the Permian coal measures flows in a southeasterly direction with local flow towards the active mining areas proximal to the Project.

The Permian coal measures within and surrounding the Project area have undergone extensive deformation, including folding and faulting. The main northwest-southeast trending fault is the Isaac Thrust Fault. Faults significantly compartmentalise the Permian groundwater system, particularly the major northwest-southeast trending faults. Hydraulic testing of faults at sites near to the Project area indicate that faulting zones tested are not pathways for preferential flow but rather act as hydraulic barriers. Testing of the Isaac Thrust Fault immediately east of the Project has supported the previous findings that the fault zone is 'healed' by mineralisation and the fault does not provide a higher permeability pathway for groundwater flow in the Permian coal measures, with hydraulic conductivity values several orders of magnitude lower than the coal seams.

Recharge to the Permian coal measures occurs where the unit subcrops. Due to the low hydraulic conductivity of the interburden material, groundwater largely flows horizontally, along the bedding plane of the coal seams. Groundwater discharge occurs predominantly via evaporation from pit faces in mining operations. Water quality in the Permian units ranges from brackish to highly saline and is indicated to be generally unsuitable to be used for stock watering, irrigation, and aquatic ecosystem protection.

During mining, excavation of open-cut pits and depressurisation of the coal seams will create strong localised hydraulic sinks, resulting in a change of natural hydraulic gradients in the vicinity of mining area. Groundwater flow will become directed toward the pit from the surrounding coal seams, and regolith. This inward flow regime causes localised drawdown and depressurisation. However, the extent of these changes is constrained by the low permeability interburden. In the alluvial aquifer, the conceptual model indicates that changes to groundwater flow direction will be minimal. The discontinuous nature of the alluvial aquifer, combined with its weak hydraulic connectivity to deeper units, means that regional flow directions (aligned to drainage) are largely maintained.

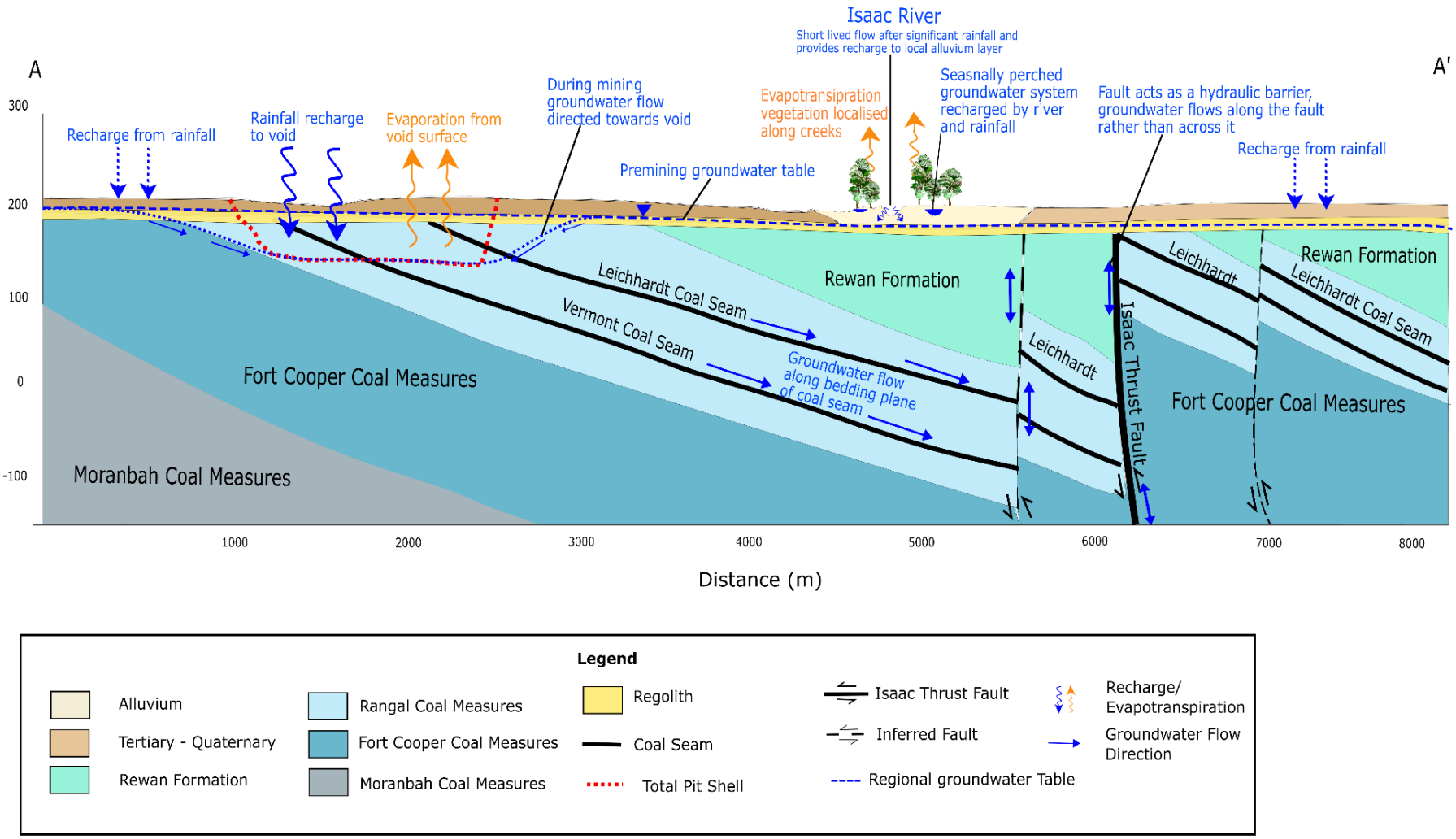


Figure 24-77 Conceptual Hydrogeological Model of the Project Groundwater System

24.11.2 Numerical Groundwater Model

24.11.2.1 Overview

This section provides a summary of the design and development of the numerical groundwater model used to support the groundwater assessment. The design and development of the Central Bowen Basin regional numerical groundwater model (CBB Model) is provided in Appendix I of **Appendix K**. The Project's groundwater modelling calibration and prediction report (Appendix H of **Appendix K**) presents the Project specific scenarios, updates, and results derived from the established CBB model. In this way, the CBB model informs and underpins the Project's numerical groundwater model, with the core model architecture remaining consistent and only targeted refinements and scenario applications varying between the two models.

24.11.2.2 Central Bowen Basin Regional Numerical Groundwater Model

The CBB model was adopted for assessing the Project's impact on groundwater (Appendix I of **Appendix K**). This is a regional scale model that has been developed as part of data share agreements between some mining operators within the model domain. The CBB model is based upon information owned by different operators and supplied for use in the model development, calibration, and prediction of future groundwater conditions that account for cumulative impacts. The model mesh boundary conditions and 'approved' operations (i.e. all existing resource operations and proposed projects, as identified in Section 24.4.4) are shown in Figure 24-78. Over time, the CBB model has been enhanced to reflect improved geological and hydrogeological understanding. Updates have included domain extension to incorporate additional mining areas, mesh refinements around key mine areas, the incorporation of additional mine footprints, revised modelling packages, expanded calibration datasets, and an updated calibration method. The primary objective of the CBB model is to provide a consistent tool for assessing potential hydrogeological impacts associated with mining activities across the central Bowen Basin (i.e. within the model domain).

Appendix I of **Appendix K** provides information on CBB model construction and development such as model software codes, model extent and mesh design, model layers, hydrogeological parameterisation, model stresses and boundary conditions, model calibration and model limitations. The CBB model provides a comprehensive and well established model basis for assessing cumulative impacts from resource operations in the Bowen Basin.

The CBB model that has been subject to multiple independent peer reviews, as well as State and Commonwealth regulator reviews as part of groundwater assessments for other projects.

24.11.2.3 Project's Numerical Groundwater Model

The Project's numerical groundwater model is described in Appendix H of **Appendix K**, and summarised in Section 7 of **Appendix K**. This includes model objectives and design, model calibration, model predictions, sensitivity and uncertainty analysis, and model performance and limitations. Information from the numerical groundwater model is provided below.

The model was deemed appropriate for the purposes of the Project for the following reasons:

- Adoption of the MODFLOW-USG code in the existing model allows for sufficient refinement of the model grid around the Project's proposed mining activities, such that the limitations of a CBB model in terms of the grid design are mitigated.
- The model incorporates the Project's geologic model with model layer representation consistent with the geologic model.
- The stochastic model is calibrated using an extensive regional dataset, including data collected at IDM and other neighbouring mines. Calibration targets were selected from the regional dataset

based on monitoring locations that are within or proximal to the Project, and the model realisation with the best fit to these targets was selected for the Project assessment.

- The model incorporates regional influences that may interact with the groundwater system (and model predictions) post-closure, including operations at the IDM and PTM that are considered likely to interact with the Project voids given their proximity.
- The version of the model adopted for the Project is the latest update to the CBB model.

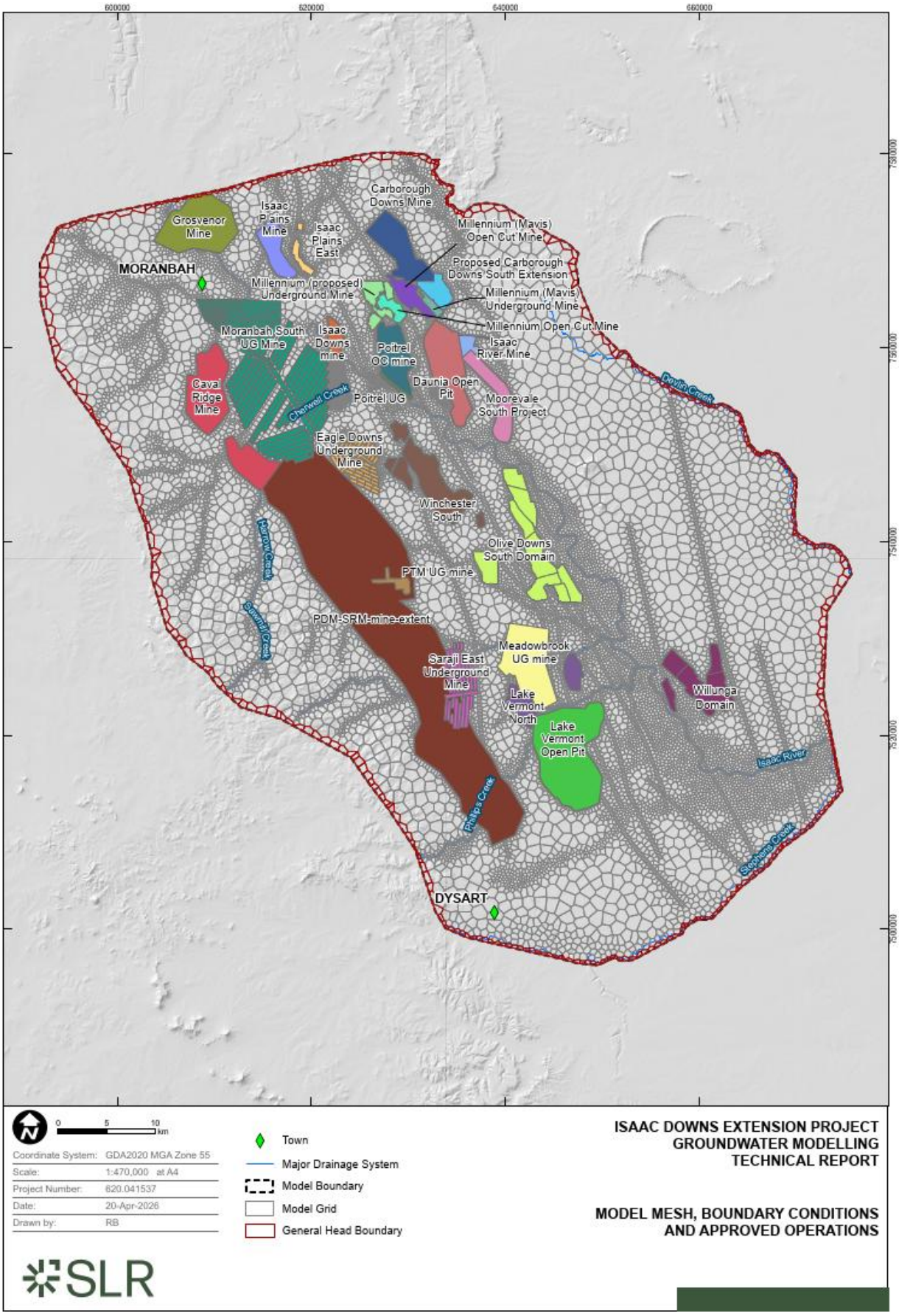


Figure 24-78 Model Mesh, Boundary Conditions and Approved Operations

24.11.2.4 Model Objectives

Numerical modelling was undertaken in support of the groundwater assessment for the Project to assess the potential impacts due to mining on the local groundwater regime. The objectives of the predictive modelling were to:

- Predict groundwater levels during the lifecycle of the Project (operation and closure) and the extent of groundwater drawdown/depressurisation due to mining at the Project and cumulatively with existing mines and proposed resource projects, including those at IPC.
- Predict changes in groundwater levels at identified groundwater receptors (see Section 24.6), during operations and closure, due to mining at the Project and cumulatively with existing and proposed resource projects.
- Predict induced changes in water budgets including groundwater fluxes to and from alluvial sediments during Project mining operations and mine closure (via the use of zone budgets).
- Predict potential changes in surface water flow due to Project mining operations (i.e. the reduction in baseflow to, or induced leakage from, watercourses).
- Identify where groundwater impact mitigation/control measures may be required for the Project.
- Estimate direct water take (groundwater removed during mining) and final void inflows (groundwater fluxes to the final void post mining) of the Project.
- Estimate post-mining recovery conditions.

The predictions are required to assess potential groundwater from the Project only (i.e. incremental) and cumulatively.

24.11.2.5 Model Design

Modelling software (i.e. MODFLOW-USG), and its suitability for use for the Project, as well as model layering to represent different hydrogeological units, is described in Section 7.3 of **Appendix K**.

24.11.2.6 Model Calibration

Model calibration was performed using a Sequential Monte Carlo approach, which incrementally refines parameter distributions through a series of resampling and adjustment steps. Model calibration is described in detail in Section 1.2 of Appendix H of **Appendix K**, and summarised in Section 7.4 of **Appendix K**.

24.11.2.7 Model Performance and Limitations

The groundwater modelling has been conducted in accordance with the Australian groundwater modelling guidelines (Barnett et al., 2012) and the MDBC Groundwater Flow Modelling Guideline (MDBC, 2001). These are mostly generic guides and do not include specific guidelines on special applications, such as open cut mine modelling.

The model confidence level (Class 1, Class 2 or Class 3 in order of increasing confidence) based on the Australian Groundwater Modelling Guidelines (Barnett et al., 2012) was previously widely used in the industry. The latest version of the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023) introduces a new concept on how model confidence can be assessed. The document also indicates that this change will follow in the next iteration of the Australian Groundwater Modelling Guidelines and the new concept for assessing model confidence is hence applied for this groundwater model.

The latest version of the IESC Explanatory Note for Uncertainty Analysis defines a model fit for purpose when model results are:

- Usable -- Relevant to the decision-making process, providing information about the uncertainty in conceptualisations and modelling simulations in a way that allows decision-makers to understand the effects of uncertainty on project objectives and the effects of potential bias. The

relevant Quantities of Interests in this context are the groundwater inflows and drawdowns to assess licensing, site water management and drawdown impacts.

- Reliable -- Demonstrate that the range of model outcomes is consistent with the system knowledge and honours historical observations and provides objective evidence that uncertainties affecting decision-critical predictions of impacts on aquifer resources and dependent systems are not underestimated. The calibration performance was deemed acceptable.
- Feasible -- Trade-offs due to budget, time and technical constraints are reasonable and justifiable within the risk context of the Project. This study is an update of an earlier model, which shows that there are several model revisions therefore mitigating budget and time trade-offs. Updated technical datasets are included in the most recent revision. The model has been peer reviewed for each revision. The model builds and associated review process are deemed commensurate with the Project related risk to the groundwater environment.

In order to assess these three points above, the four sources of scientific uncertainty (structural, parametrisation, measurement error, predictions) have been qualitatively assessed with regards key aspects of the groundwater model, as presented in Table 7-2 of **Appendix K**. Overall, the model is considered 'fit for purpose' to achieve the model objectives.

24.11.3 Peer Review

24.11.3.1 Overview

An independent technical peer review of the groundwater impact assessment and the associated numerical groundwater modelling has been undertaken by Manewell Groundwater, and is provided in **Appendix L**.

The technical review process was staged, involving numerous presentations, conversations and checkpoints at the model build, calibration, and prediction stages, between the groundwater modellers and the peer reviewer. The groundwater reporting process was iterative, undergoing numerous reviews to ensure technical competency.

This review was undertaken in accordance with the principles and guidelines outlined in the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). The technical review incorporates the latest guidance on best practices for uncertainty analysis methods as presented in Uncertainty analysis - Guidance for groundwater modelling within a risk management framework (Peeters and Middlemis, 2023). The technical review is also based on a combination of professional expertise and modelling methodology, together with the model appraisal checklist provided in the Australian Groundwater Modelling Guidelines (Barnett et al., 2012) and principles outlined by the Groundwater Modelling and Decision Support Initiative (Doherty and Moore, 2021).

The technical peer review consults the following federal regulatory guidelines to assess the sufficiency of the groundwater impact assessment and confirm compliance:

- Information guidelines for proponents preparing coal seam gas and large coal mining development proposals, issued by the Independent Expert Scientific Committee of the Commonwealth of Australia (IESC, 2024).
- Significant impact guidelines 1.3, issued by the Department of the Environment and Energy of the Commonwealth of Australia.

24.11.3.2 Peer Review Findings

The peer review assessed the groundwater impact assessment and the associated numerical groundwater modelling against the criteria described as follows, with findings, as summarised:

The model level classification is 'Class 2-3', which is reliable for use with major approvals projects.

The peer review applied a newer concept for assessing model confidence, in accordance with the 2023 IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023). This involved an assessment of the four sources of uncertainty (structural, parameterisation, measurement error, predictions). Overall, the review found that the model is useable and reliable, with some areas for improvement in future phases of modelling, that would aim to further reduce predictive uncertainty upon the onset of mine dewatering.

The peer review distilled the key guiding principles from Doherty and Moore (2021) into checklist items to ensure the model is not overly complex, and the model is a useful tool that appropriately assesses the Project's impacts. Overall, the review found that the model serves as a blunt but suitable decision support tool.

The Compliance Checklist from the Australian Groundwater Modelling Guidelines (Barnett et al., 2012) was used to judge whether a model is fit for purpose, and describes 10 questions which cover the essential aspects that any groundwater model needs to satisfy, independent of model objectives or confidence-level classification. The results conclude that the groundwater model is 'fit for purpose', where the primary purpose is to develop upon an existing model that is reasonably well calibrated to historical groundwater levels, drawdown, flow changes, and landholder impact. The model is a suitable tool for decision support where the purpose is to provide predictions on potential impacts due to mining caused by the Project.

The peer review of the model found the following:

- The groundwater conceptualisation is generally consistent with the model objectives, which are focused on predicting Project-related and cumulative effects on groundwater levels, groundwater users, alluvial aquifers, river/baseflow systems, mine inflows and post-mining recovery. The disconnected nature of the Isaac River alluvium and deeper groundwater system is well described and presented. The conceptualisation is fit for purpose, with future improvement possible.
- The model extent and mesh design is fit for purpose.
- The modelling report presents model-wide average layer thicknesses.
- The model timing is fit for purpose. The use of annual predictive stress periods during mining is reasonable for an open-cut coal assessment at the model's scale.
- The representation of low volume groundwater extraction by private users is unlikely to materially affect the predictions given the objective of assessing mining-induced impacts.
- The mining approach adopted in the model is acceptable and well documented.
- The model calibration is fit for purpose. Head and head change statistics are at acceptable levels, and key impact trends are generally replicated. The main limitation is that some local head responses and recharge signatures are difficult to reproduce with a regional model and simplified recharge/surface water representation. This is expected and is appropriately carried through into uncertainty analysis.
- The model water balance appears numerically stable and within acceptable error thresholds.
- The likelihood of landholder bore groundwater level impacts, and duration they are affected are suitably presented, with future monitoring required to validate results.
- The uncertainty analysis appears fit for purpose.
- This review concurs with the findings that the final void is predicted to remain a long-term groundwater sink and is unlikely to become a groundwater source for the migration of contaminants.
- Model limitations are adequately recognised, and do not prevent the model from being used for the stated objectives. They do, however, support the need for continued monitoring and future model updates.

The peer review of the groundwater impact assessment and associated reporting found that the report is fit for purpose and written to a high standard. Figures, hydrographs, prediction plots and uncertainty

outputs are clear and useful. Key assessment requirements have been considered and presented. The assessment addresses the key State and federal requirements, including Project description, conceptualisation, groundwater systems, surface water-groundwater interaction, water-dependent assets, risk assessment, cumulative impacts, uncertainty and monitoring.

24.11.3.3 Conclusion

The review determined that the groundwater modelling meets professional industry standards. The conceptual model is appropriate and supported by sufficient Project-specific and regional data. The use of the CBB Model is appropriate due to the significant potential cumulative impacts.

The model is fit for purpose, which is to produce a calibrated groundwater model and predict groundwater inflows, drawdown, and flow changes. The ensemble of predictive models is suitable for use as a decision support tool to predict future impacts due to the Project.

This review determined that the model and groundwater impact assessment are suitable for supporting the Project's EIS.

24.11.4 Model Predictions – Drawdown

24.11.4.1 Overview

The predictive groundwater modelling was conducted to assess the potential groundwater impacts of the Project. As such, predictive modelling was used to simulate the Project as well as mining at other approved and foreseeable mines within the model domain (see Section 24.4.4).

The predictive model has been set up to simulate Project mining activities from the end of calibration (2025) through to the end of operations (2043), after which the post-mining period begins for the Project. The predictive recovery starts from the end of mining at the Project (2043) up to 2519. Predictive models have been developed for three model scenarios:

- Null run – no mining within the region.
- Approved - all approved and foreseeable mining operations within the model domain that are likely to have model prediction effects, excluding the Project.
- Proposed – all approved and foreseeable mining with the addition of the proposed Project.

Project only (i.e. incremental impacts) are calculated as the difference between the 'Proposed scenario' model and the 'Approved scenario' model.

Cumulative impacts are calculated as the difference between the 'Proposed scenario' model and the 'Null run' model.

The process of mining reduces groundwater levels and pressures in surrounding geological units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and the nature and extent of the extractive activities and is referred to as the zone of depressurisation in a confined aquifer and zone of drawdown within unconfined aquifers, including the water table (i.e. the upper surface of the saturated zone where pore water pressure equals atmospheric pressure).

Depressurisation and drawdown are greatest at the working coal-face and reduce with distance from the Project.

This chapter provides a selection of drawdown figures for different aquifer units. Section 8 of **Appendix K** provides additional drawdown figures, as referenced below.

24.11.4.2 Maximum Incremental Drawdown

The maximum incremental drawdown represents the maximum drawdown recorded at each model cell at any time over the model simulation duration time from the start of the calibration period (1960) to the

end of recovery (2519). Predicted incremental drawdown figures show where maximum drawdown impacts are predicted to exceed 1 m as a result of the Project.

As shown in Figure 24-79, no incremental drawdown impacts exceeding 1 m are predicted for the alluvium as a result of the proposed Project (as shown by the absence of drawdown contours).

The predicted maximum incremental drawdown within the regolith is less than 2m and is shown in Figure 24-80. The incremental drawdown extent within the regolith is confined to a small area directly south of the Project area.

The coal seams of the Rangal Coal Measures are the primary groundwater bearing strata targeted by mining at the Project and experience drawdowns as a direct result of mining at the Project. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents.

Figure 24-81 and Figure 8-5 of **Appendix K** show the predicted maximum incremental drawdown for the Leichhardt and Vermont seams in the Rangal Coal Measures. These occur along the western margin of the Project pit area in both seams, with the Leichhardt seam exhibiting the highest magnitudes adjacent to the mined areas. In the Vermont seam, the footprint of drawdown extends further north and south relative to the Leichhardt seam.

Figure 8-1 of **Appendix K** shows that the predicted maximum incremental water table drawdown is concentrated around the Project mining area. The small areas of drawdown shown to the west of the Project area are the result of numerical effects within the model and do not represent any physical depressurisation beyond the Project.

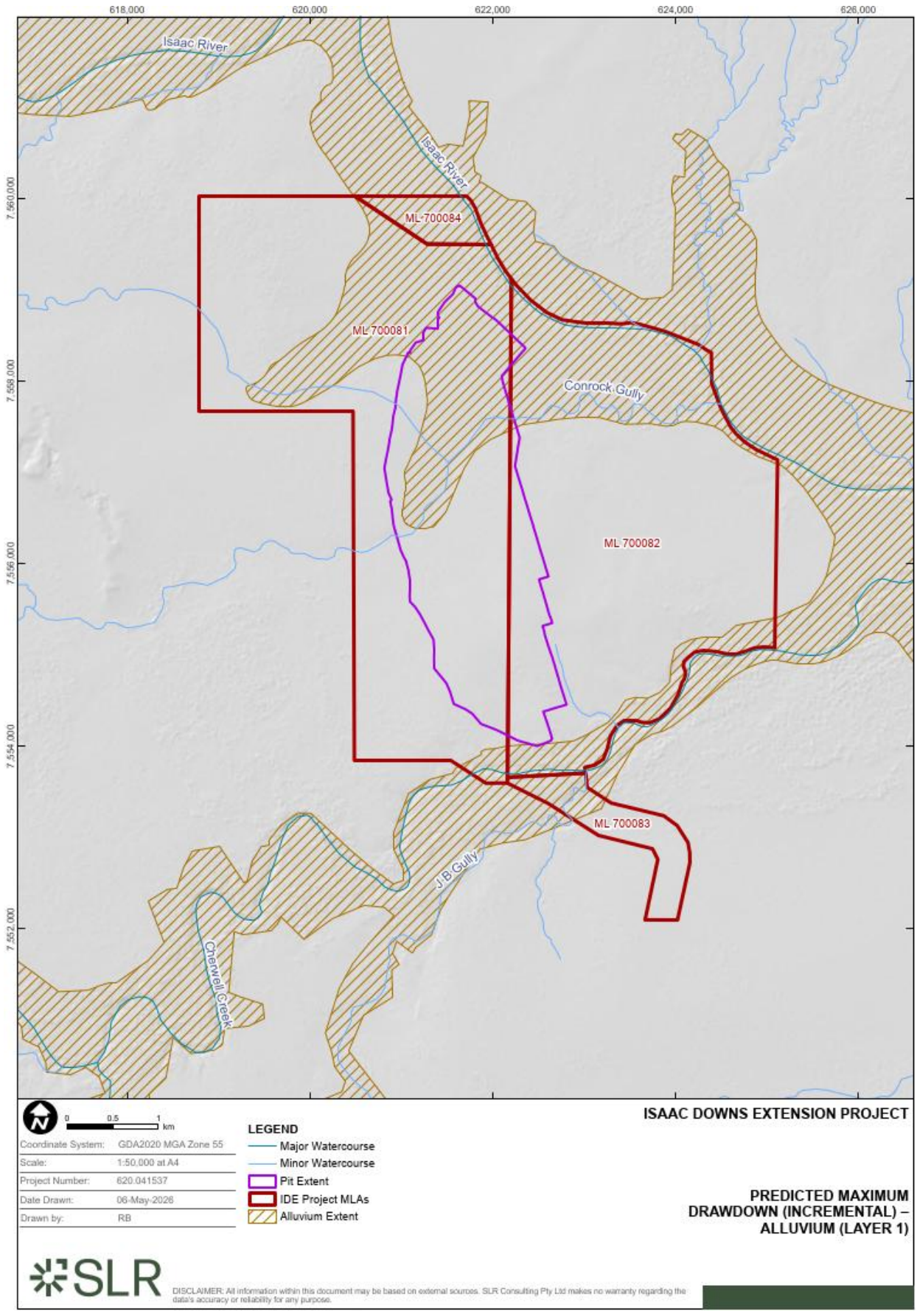


Figure 24-79 Predicted Maximum Drawdown (Incremental) – Alluvium

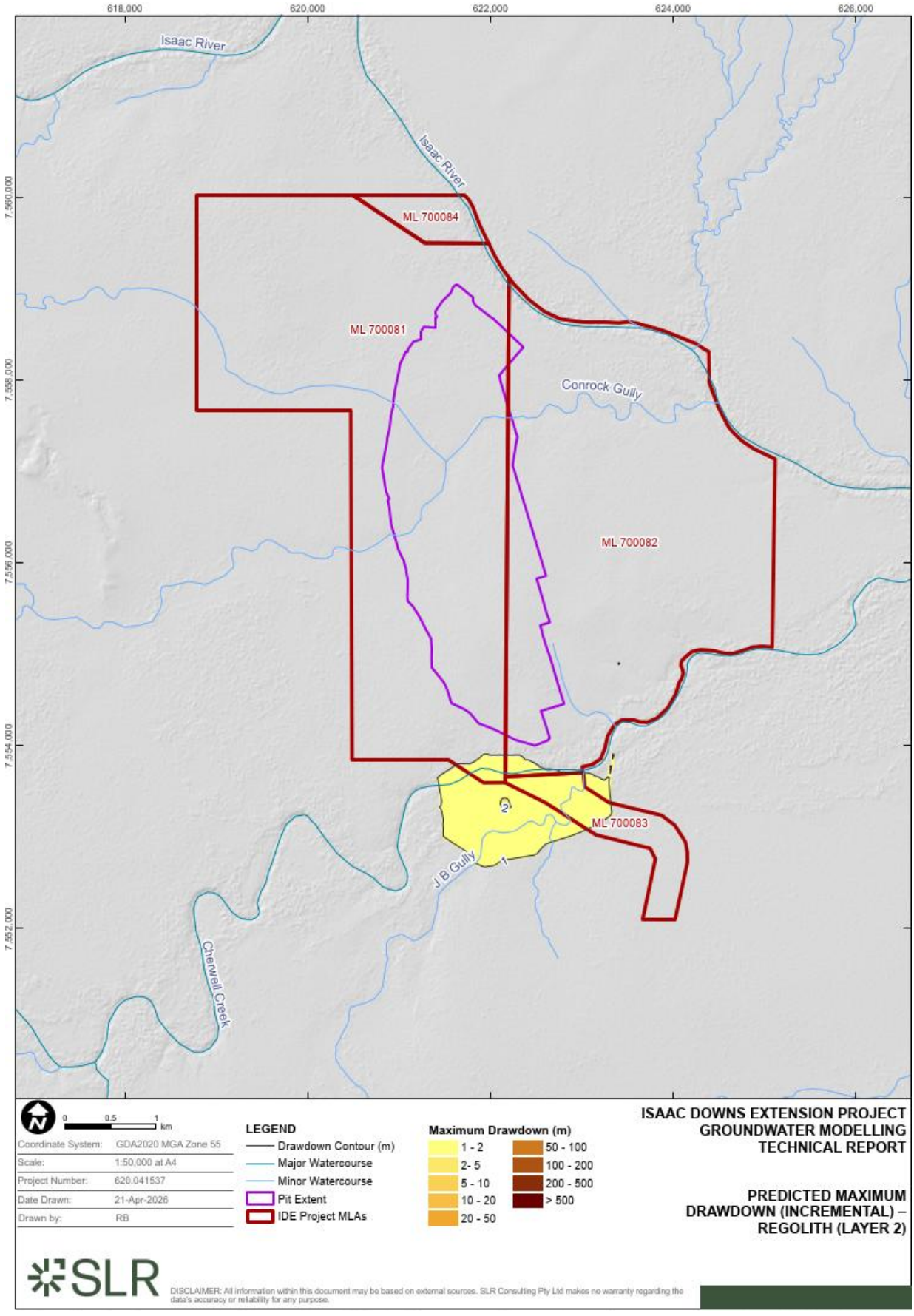


Figure 24-80 Predicted Maximum Drawdown (Incremental) – Regolith

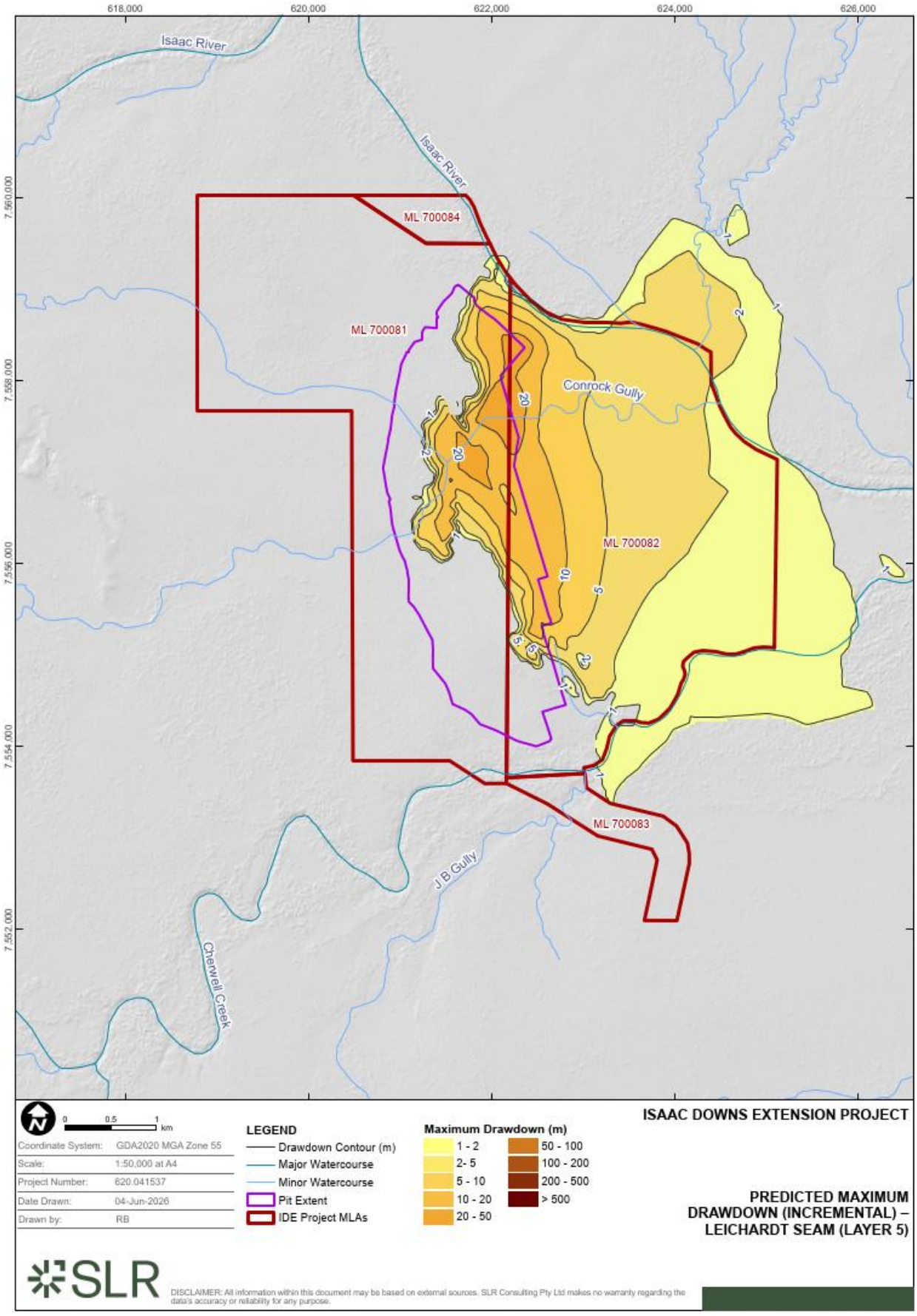


Figure 24-81 Predicted Maximum Drawdown (Incremental) – Leichardt Seam

24.11.4.3 Maximum Cumulative Drawdown

The predicted maximum cumulative drawdowns are obtained by calculating the maximum difference in heads from the start of the calibration period (1960) to the end of recovery (2519). Maximum cumulative drawdown is shown in:

- Figure 24-82 for the alluvium
- Figure 24-83 for the regolith
- Figure 24-84 for the Leichhardt Seam
- Figure 8-6 of **Appendix K** for the water table
- Figure 8-10 of **Appendix K** for Vermont Seam.

The results indicate that cumulative drawdown increases with depth, with the most pronounced depressurisation occurring within the mined coal seams, particularly the Vermont Seam. Shallower units exhibit broader but lower-magnitude drawdown patterns.

The spatial extent of cumulative drawdown reflects the combined influence of long-term mining activities within the Project area and neighbouring operations.

In the deeper coal seams, drawdown extends beyond the immediate Project footprint, indicating cumulative hydraulic interaction between adjacent mining areas.

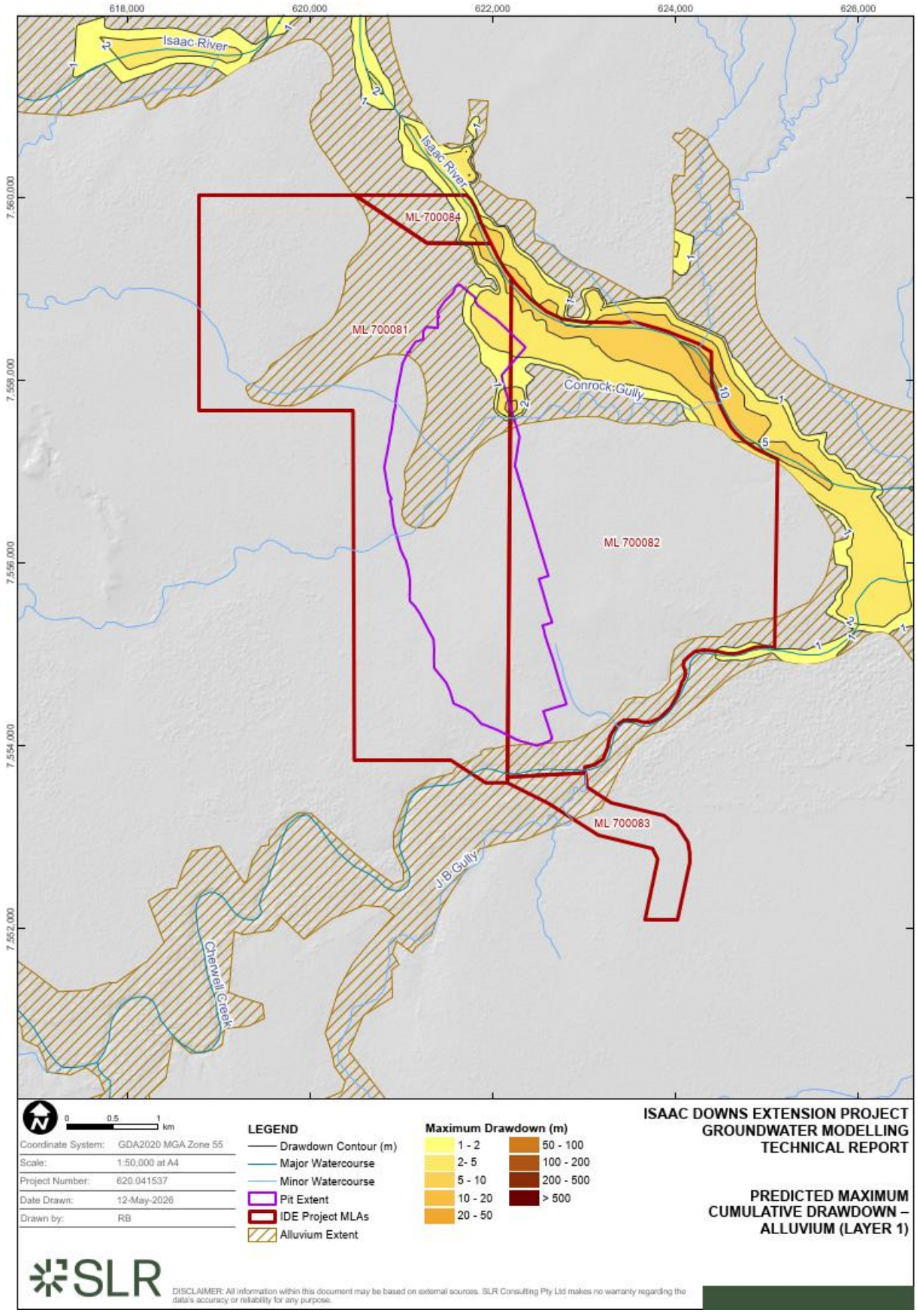


Figure 24-82 Predicted Maximum Drawdown (Cumulative) – Alluvium

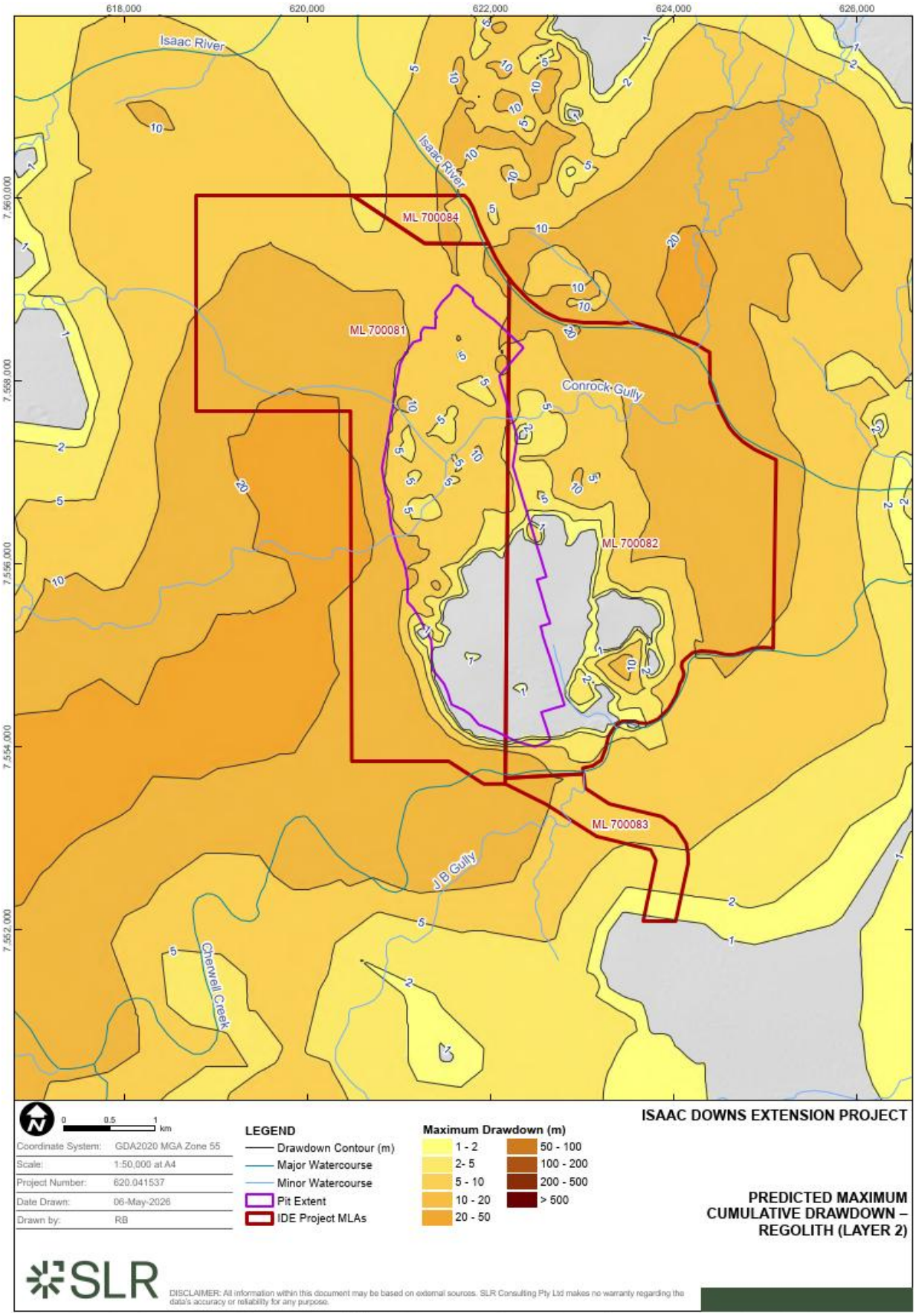


Figure 24-83 Predicted Maximum Drawdown (Cumulative) – Regolith

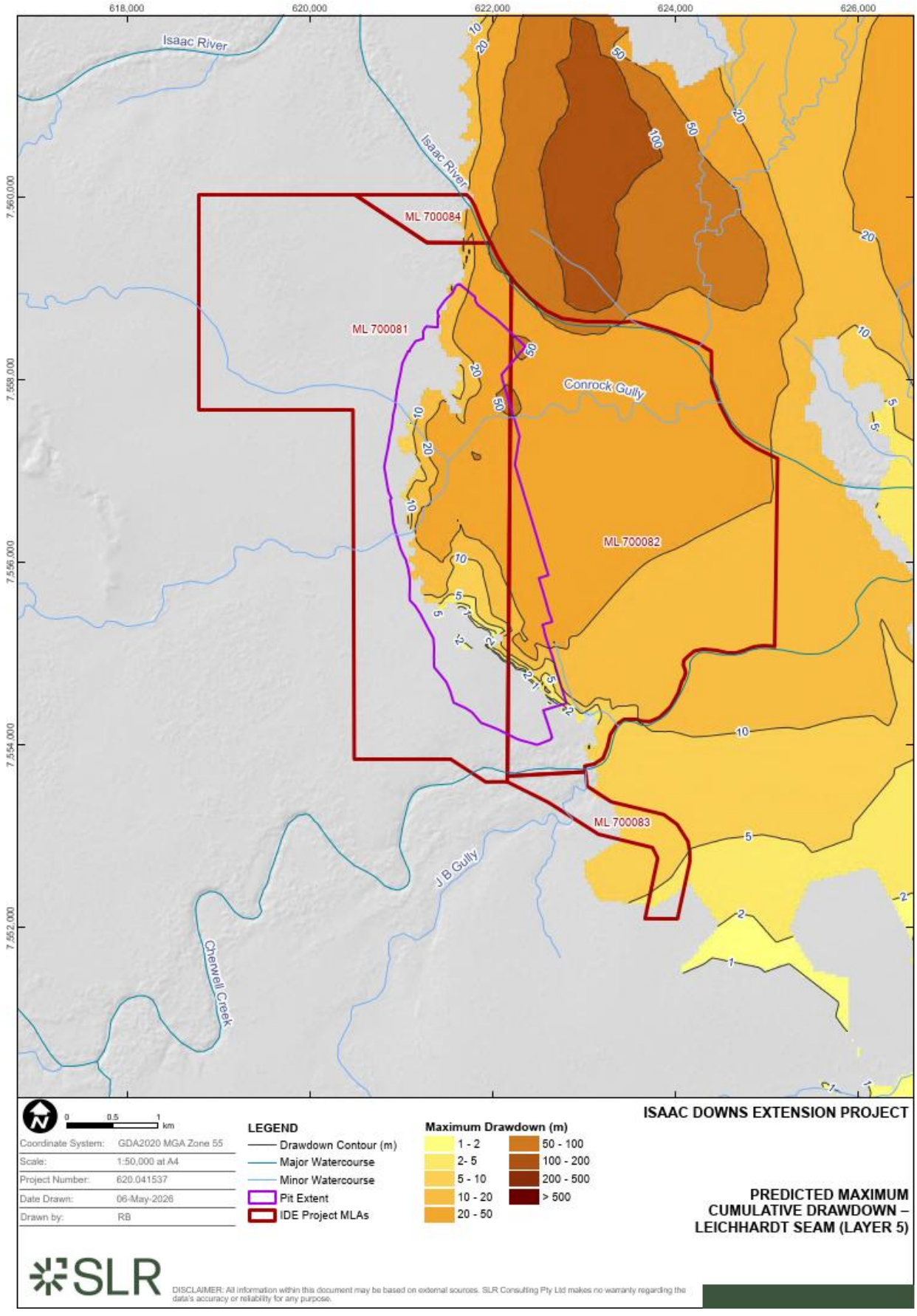


Figure 24-84 Predicted Maximum Drawdown (Cumulative) – Leichardt Seam

24.11.4.4 Residual Incremental Drawdown

The residual incremental drawdown is the drawdown at the end of the recovery period, due to the Project only. It is calculated for the last stress period of the simulation (i.e. at post mining equilibrium).

The residual incremental drawdown figures (Figure 24-85 and Figure 8-11 to Figure 8-15 of **Appendix K**) show where maximum drawdown impacts are predicted to exceed 1 m.

As shown in Figure 24-85, no incremental drawdown impacts exceeding 1 m are predicted for the alluvium as a result of the Project (as shown by the absence of drawdown contours).

Figure 8-13 of **Appendix K** shows that residual drawdown within the regolith (Layer 2) is limited in extent and confined to areas immediately to the south of the Project mining footprint at post-recovery, indicating minimal long-term impacts to the regolith following recovery.

Figure 8-14 and Figure 8-15 show that impacts are strongly concentrated around the Project mining area, with the largest magnitudes occurring in the Leichhardt and Vermont seams.

Comparison of the maximum incremental drawdown (Section 24.11.4.2) and residual incremental drawdown results indicates that drawdown magnitudes are substantially reduced by the end of the recovery period. Maximum drawdown occurs during active mining and represents the peak Project-related response across the model period, whereas residual drawdown represents the remaining incremental change at post-mining equilibrium and is lower in magnitude and more spatially confined.

For the Project, residual incremental drawdown is largely confined to areas immediately surrounding the mining footprint, with no widespread drawdown persisting beyond the Project area at post-recovery. This indicates a high degree of groundwater recovery following cessation of mining, with only small residual drawdown remaining within the deeper mined seams.

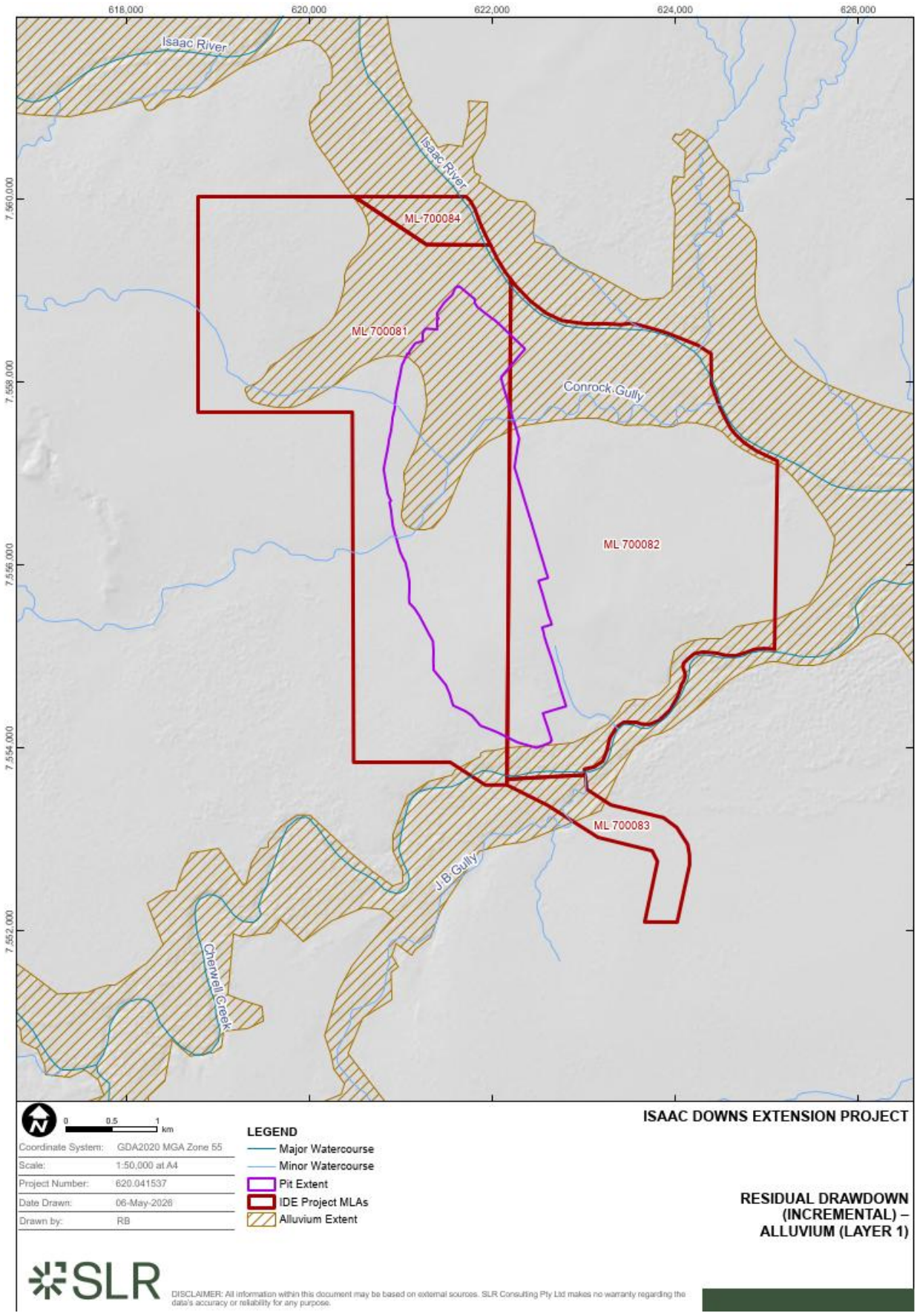


Figure 24-85 Residual Incremental Drawdown – Alluvium

24.11.4.5 Residual Cumulative Drawdown

The residual cumulative drawdown is calculated for the last stress period of the simulation, representing post-mining equilibrium conditions.

The residual cumulative drawdown figures (Figure 24-86 and Figure 8-16 to Figure 8-20 of **Appendix K**) show where cumulative drawdown impacts are predicted to exceed 1 m, for the last stress period of the simulation.

The residual cumulative drawdown for the alluvium (Figure 24-86) indicates that all drawdown within this layer arises from other existing and foreseeable mining operations rather than from the Project. This is consistent with the residual incremental drawdown results, which show no Project-only drawdown impacts exceeding 1 m in the alluvium. Accordingly, cumulative drawdown patterns within the alluvium predominantly reflect regional groundwater conditions and post-mining equilibrium responses associated with neighbouring mines, rather than Project-related effects.

A comparison of residual cumulative drawdown in the alluvium (Figure 24-86) and maximum cumulative drawdown in the alluvium (Figure 24-82) shows that cumulative drawdown is less for the post-mining equilibrium conditions.

Residual drawdown (cumulative) is shown across the water table, alluvium, regolith, and coal measures, with spatial patterns influenced by the location and extent of multiple mining operations. While drawdown magnitudes generally decrease with distance from the Project mining area, cumulative drawdown increases or persists in some areas further away, corresponding to the presence of other active or historical mines within the region.

In the deeper coal measures, particularly the Leichhardt and Vermont seams, cumulative drawdown reflects long-term groundwater responses to mining activities that extend beyond individual mine boundaries. These patterns indicate hydraulic interaction between mining areas and represent post-mining equilibrium conditions shaped by the combined influence of the Project and neighbouring operations.

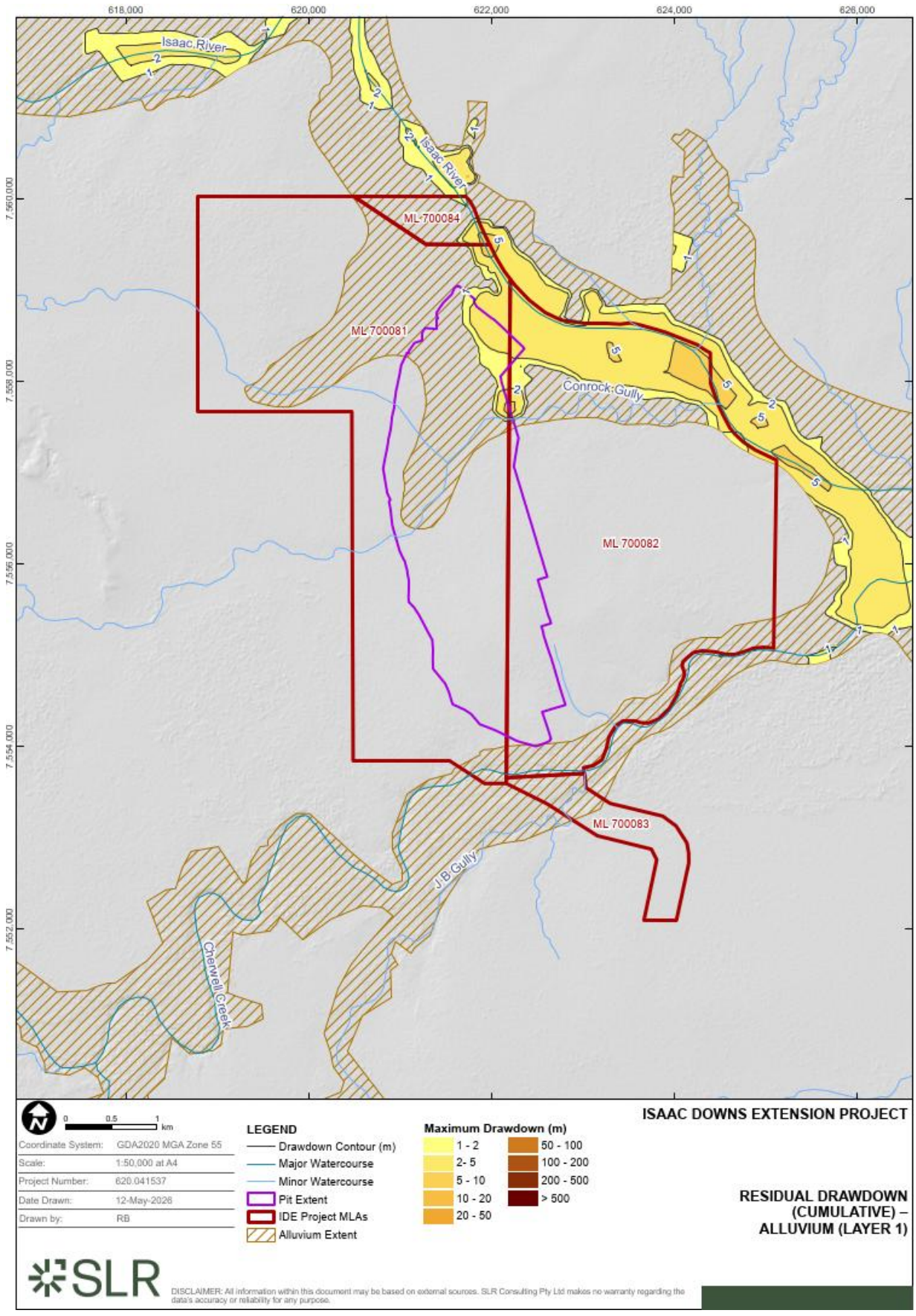


Figure 24-86 Residual Cumulative Drawdown – Alluvium

24.11.5 Model Predictions – Groundwater Interception

24.11.5.1 Operations

The predicted groundwater inflows to the Project's mine pit during operations (2029 – 2043) are presented in Figure 24-87.

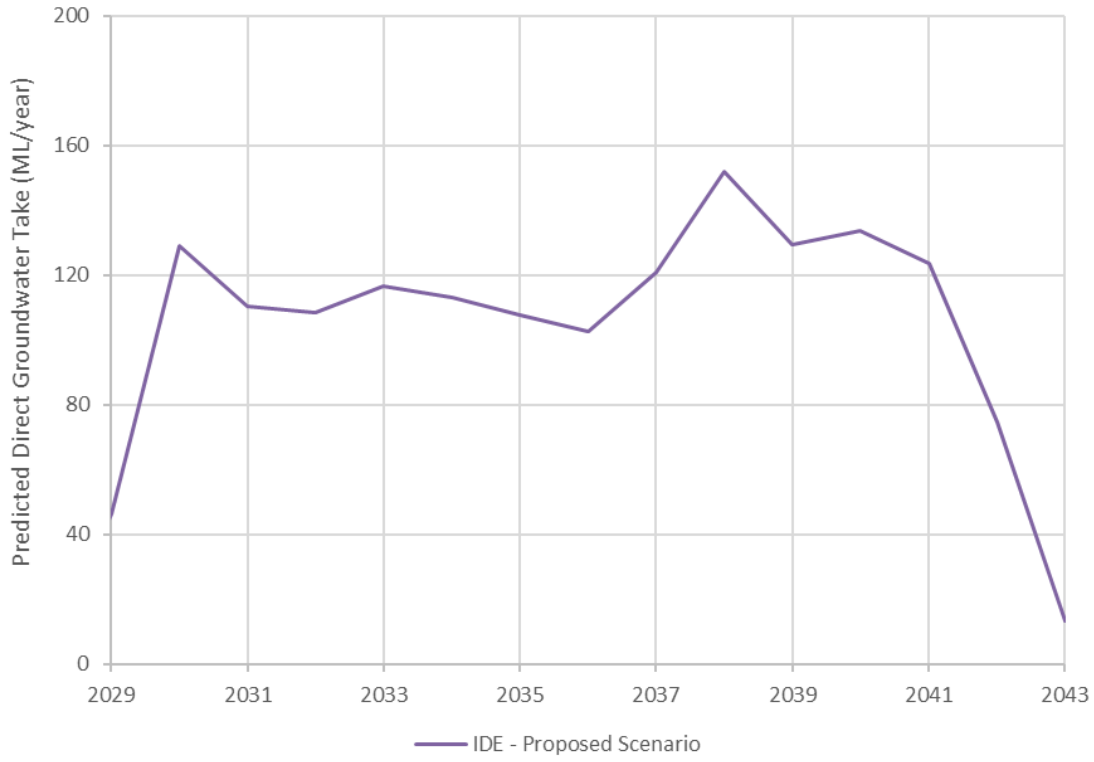


Figure 24-87 Mine Groundwater Inflows – Active Mining

24.11.5.2 Closure – Residual Void

The final predicted groundwater inflows to the residual void are shown on Figure 24-88, with inflows partitioned between those that flow into the residual void through spoil, and those that flow into the residual void through surrounding natural geological formations. This shows that almost all inflows are through spoil. Spoil materials are significantly more permeable and loosely compacted than the natural geological formations, providing preferential pathways for groundwater movement. As a result, groundwater is expected to enter the void predominantly through spoil.

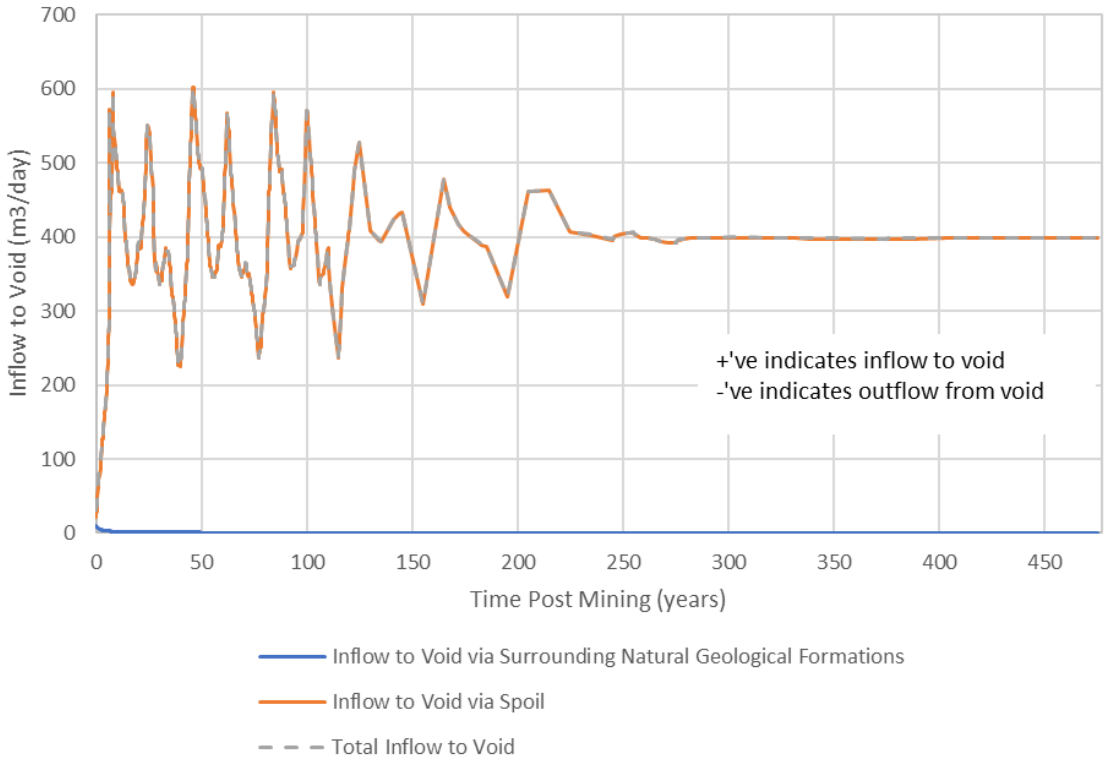


Figure 24-88 Predicted Residual Void Groundwater Inflows – Project Void

24.11.6 Model Predictions - Incidental Water Impacts

24.11.6.1 Influence on Alluvial Aquifer - Operations

The predicted incremental change in groundwater take from the alluvial aquifer due to the Project was calculated by comparing the net alluvium fluxes in the 'Proposed scenario' against the 'Approved scenario', with results shown in Figure 24-89. This shows that between the commencement of Project mining in 2029 and the end of mining in 2043, there is a predicted overall loss of water from the alluvial aquifer that is attributable to the Project of between approximately 0 and 34.5 ML/year. This represents a negligible reduction in the context of regional surface water flows; for example, compared to the mean daily flow of 430 ML/d in the Isaac River at Deverill, this equates to approximately 0.02% of annual flow.

The predicted cumulative alluvium net flux, is shown in Figure 8-24 of **Appendix K**. This shows that between 2029 and the end of Project mining in 2043, there is a predicted overall cumulative loss of water from the alluvial aquifer of between approximately 470 and 700 ML/year. This represents the net water flux associated with the alluvium across the entire regional-scale numerical model extent. As this is a cumulative prediction, the general trends in increasing and decreasing rates of loss of water from the alluvium cannot be attributed to the Project but to all mining operations represented in the model.

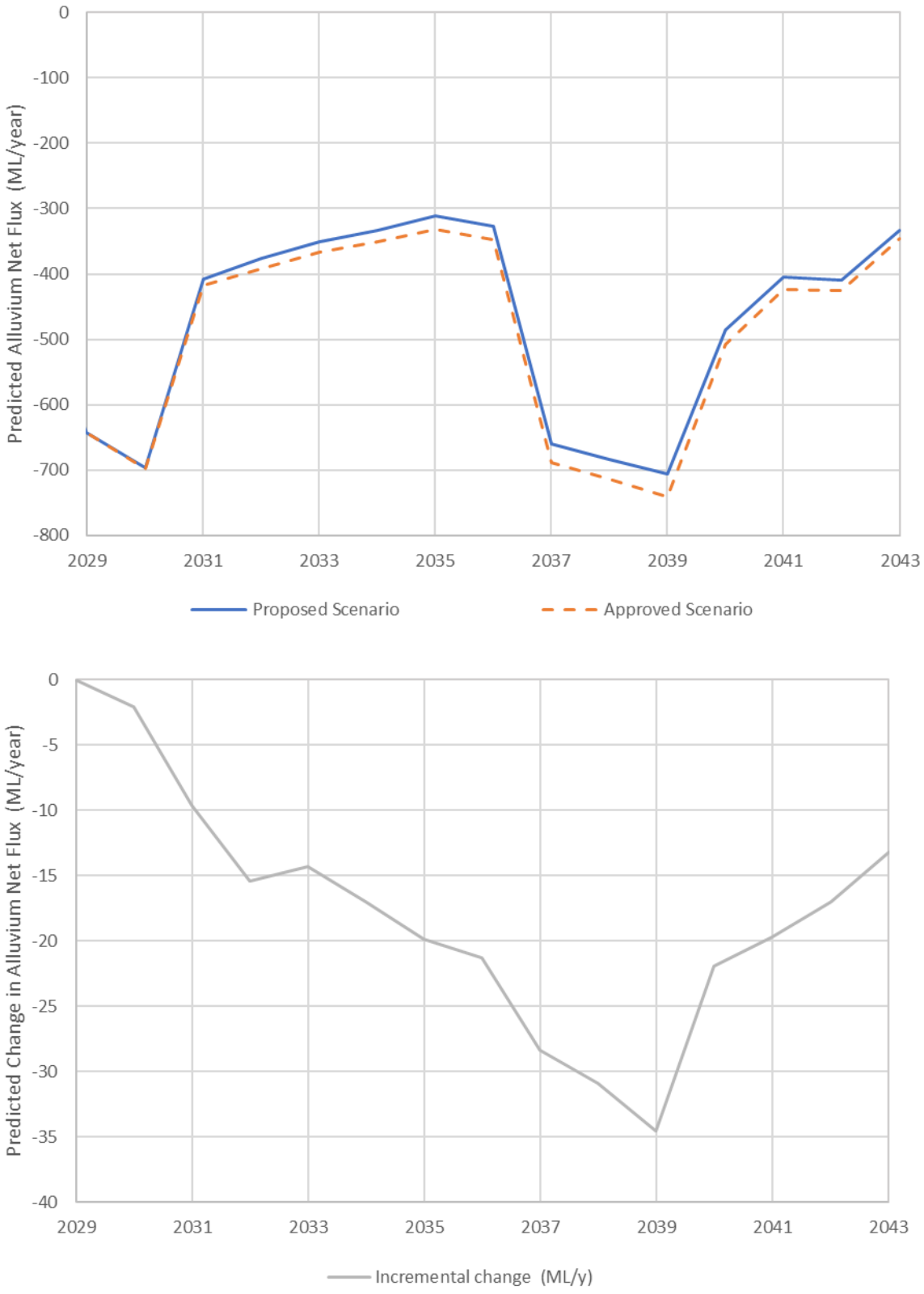


Figure 24-89 Incremental (Project) Predicted Alluvium Net Flux (top) and Change in Alluvium Net Flux (bottom)

24.11.6.2 Influence on Alluvial Aquifer – Post Mining

The predicted change in incremental (i.e. Project) alluvium net flux is shown on Figure 24-90.

The incremental net flux time series shows that post-mining variations are minor and do not exhibit any sustained increase in alluvium water loss attributable to the Project. Overall, the post-mining results demonstrate that Project-related impacts on alluvium water take are short-term, with no ongoing Project-specific increase in alluvium loss following mine closure.

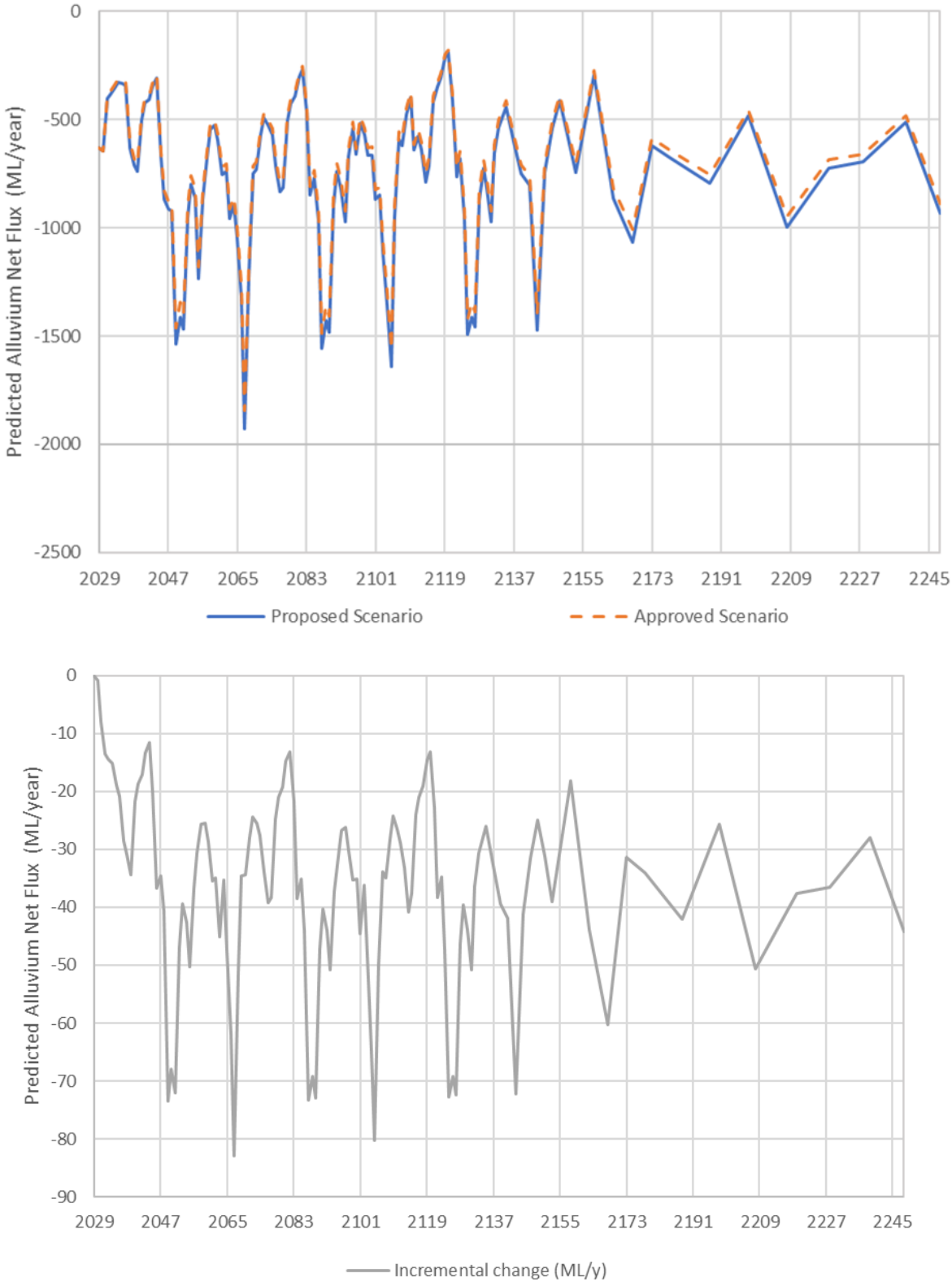


Figure 24-90 Predicted Alluvium Net Flux (top) and Change in Alluvium Net Flux (bottom) – Post Mining

24.11.6.3 Loss of Flow in Stream - Operations

Mining activities can result in a change in gradient from the aquifer into the watercourse, thereby reducing the rate at which baseflow occurs. The predicted change in net flux to the Isaac River, under both incremental and cumulative conditions, is shown in Figure 24-91.

This shows that between 2029 and the end of Project mining in 2043, there is no net flux in water moving in or out of the Isaac River that is attributable to the Project. The maximum cumulative net loss of water from the river is approximately 84 ML/year under a simulated future flow condition in 2030. This represents the net water flux associated with the River across the entire regional scale numerical model extent. As the Project does not result in a net flux of water to/from the River all fluxes are attributed all other mining operations represented in the model.

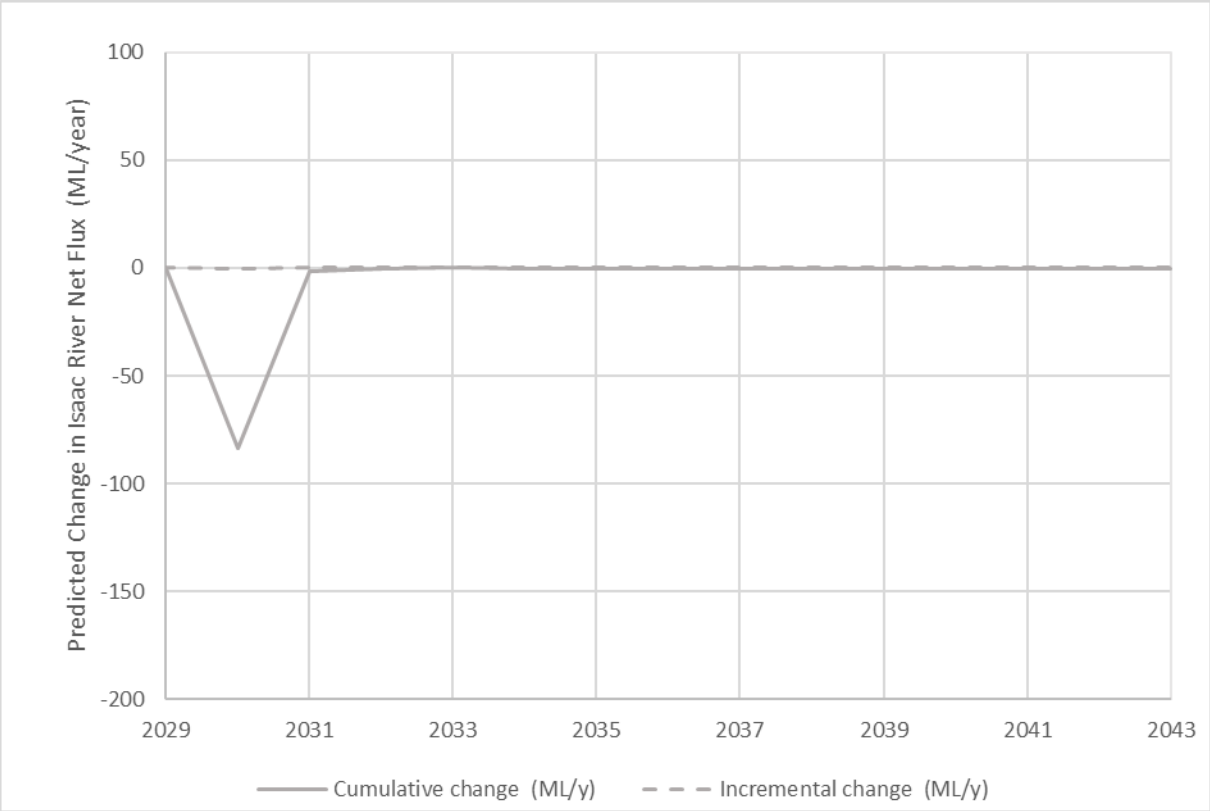


Figure 24-91 Predicted Reduction in River Baseflow (Incremental and Cumulative)

24.11.6.4 Loss of Flow in Stream – Post Mining

The predicted incremental (Project only) change in net flux and the predicted cumulative net flux of water moving in or out of the Isaac River for the post mining period are shown in Figure 24-92. This shows that both incremental and cumulative net fluxes to the Isaac River stabilise, with no ongoing Project-specific loss of river baseflow predicted during the post-mining period. The incremental net flux demonstrates that the Project has no impact on River flux.

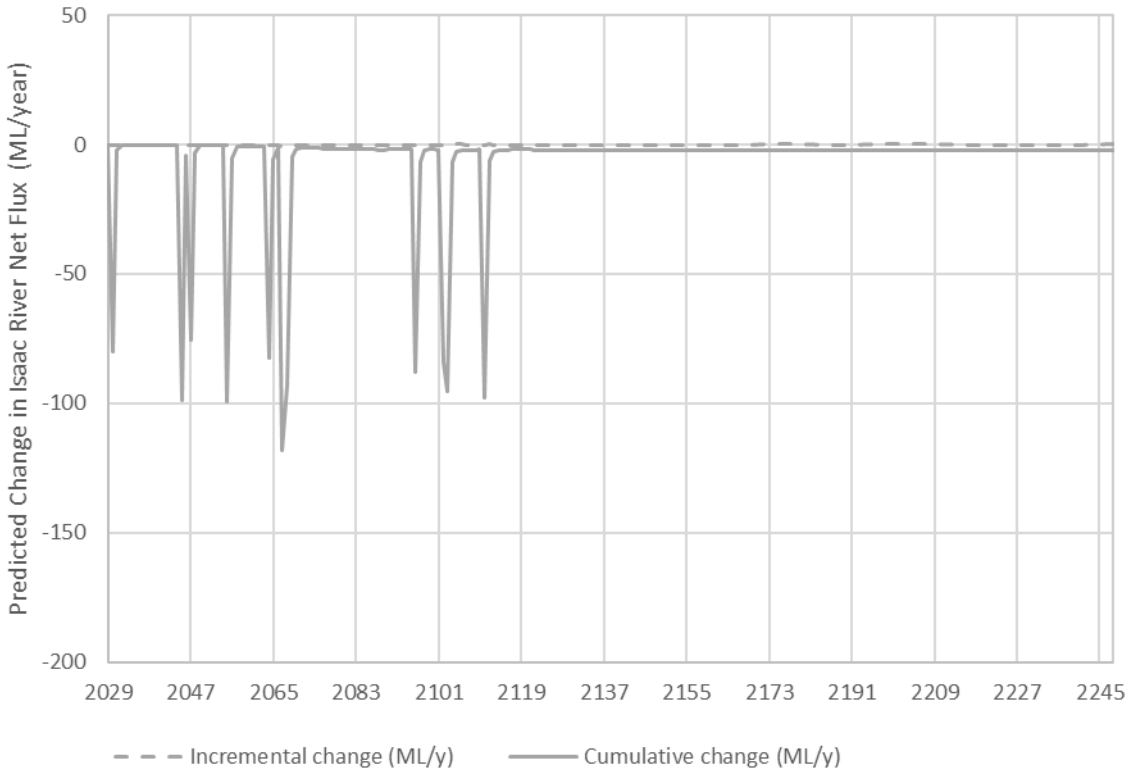


Figure 24-92 Predicted Reduction in River Baseflow (Incremental and Cumulative) – Post Mining

24.11.7 Model Predictions – Landholder Bores

Landholder bore locations are shown in Figure 24-15. The groundwater model was used to predict incremental and cumulative drawdown at landholder bores, with results discussed in Section 24.14.1

24.11.8 Model Predictions - Flow Path Simulation

An analysis of the water movement within the final landform was undertaken to simulate and assess the movement and fate of water particles through the groundwater system post mining. A number of particles were placed on the final landform and within the residual void in the recovery groundwater model and the model was used to simulate particle pathways along the groundwater flow field during recovery (i.e. 475 years).

The particles were placed at the surface of the model and released at the start of the post-mining simulation, with the movement of the particles then recorded during the post-mining simulation. Figure 24-93 shows the predicted movement of water particles in the 475-year recovery simulation of the final landform. The colours along the predicted particle flow paths provides the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallow to deep model layers.

The colour changes along the paths indicate that particles situated within the shallower saturated layers at the beginning of the post-mining simulation generally move progressively toward deeper layers over the post-mining period. The flow path analysis indicates the particles generally move toward the void lake, with many of the particles terminating in the void lake. Particles that move into the void during the post-mining simulation remain within the void for the duration of the simulation. Particles starting in the void themselves remain within the void for the duration of the simulation.

A series of particles starting outside the of the void are noted to travel outside the Project area, to the northeast in the direction of IDM. Particle tracking results indicate that migration is confined to the Rangal Coal Measures, and the flux direction is likely attributable to nearby mining operations (i.e. IDM) controlling drawdown and flow direction within the Rangal Coal Measures and terminates in the adjacent IDM void. The migration terminates in the adjacent void with no loss to regional groundwater.

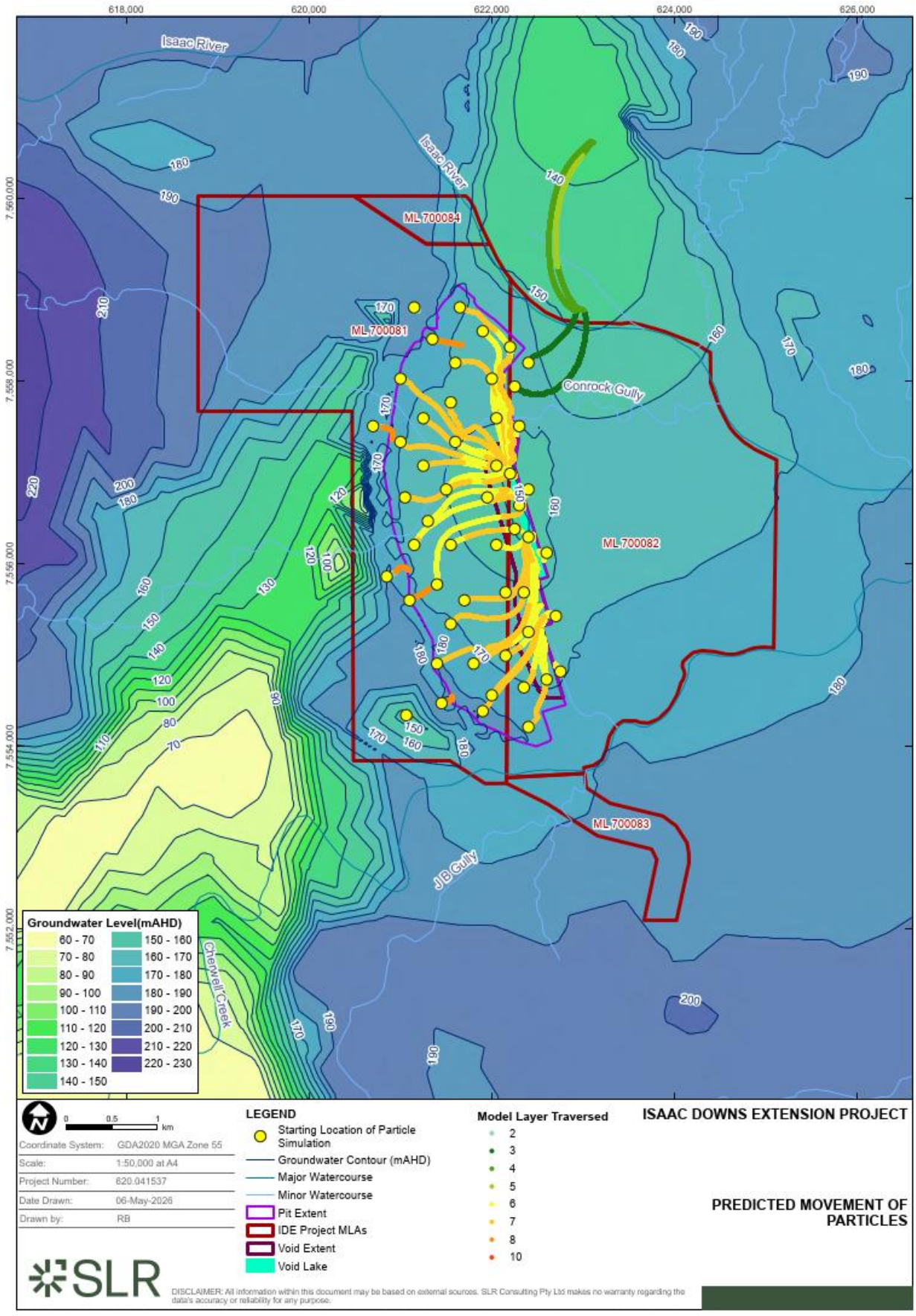


Figure 24-93 Predicted Movement of Particles

24.11.9 Sensitivity Analysis

Sensitivity analysis was undertaken to quantify how model calibration performance and model predictions respond to variations in input parameters, providing insight into model behaviour and uncertainty. Comparing calibration and prediction sensitivity allows for distinguishing between parameters that are constrained during calibration, and parameters that drive predictive uncertainty, which may or may not overlap. Such insights support decision-making in model refinement, data collection prioritisation, and risk-based scenario analysis. Details are presented in Appendix H of **Appendix K**. The sensitivity analysis identified that majority of the parameters are 'Type I - Type III' parameters. Types I-III parameters have an insignificant impact on model predictions or conditioned by calibration. Sensitivity analysis identified a limited amount of 'Type IV' parameters, which are parameters that are sensitive for the prediction but not the calibration. The uncertainty analysis covers the associated uncertainty from those parameters. The sensitivity analysis also highlighted several parameters that contribute to predictive uncertainty. A distinction was made between 'weak' and 'strong' Type IV parameters, with strong Type IV likely to be key contributors of prediction uncertainty. Prediction uncertainty was quantified for the quantities of interest.

24.11.10 Uncertainty Analysis

24.11.10.1 Overview

A Type 3 Monte Carlo uncertainty analysis was undertaken to estimate the uncertainty in the future impacts predicted by the model. Details are presented in Appendix H of **Appendix K**. This method operates by using the calibrated model realisations, executing the model independently for each realisation, and then aggregating the results for statistical analysis.

Calibrated realisations have been assigned a likelihood value as part of the sequential Monte Carlo calibration. As such, the quantities of interest (i.e. drawdown, mine groundwater inflow (active mining), alluvium take and river baseflow loss) are weighted for each realisation based on the normalised likelihood for this realisation. The statistical analysis is therefore performed on weighted predictions where realisations with a greater likelihood are given a higher weight. Results are presented as weighted percentiles for each quantity of interest.

The 109 calibrated realisations with the highest likelihood were selected for the uncertainty analysis. The predictions included in the uncertainty analysis were:

- Maximum Drawdown – the base case of the drawdown curve is plotting between the 67th and 95th percentile, meaning being at the upper end of the ensembles.
- Mine inflows (active mining) – the base case prediction mostly follows the 33-66th percentile interval, with inflows at later times being in the higher percentiles.
- Alluvium water take – the base case is conservative, following the 95th percentile of the ensemble. This gives certainty that the prediction for this quantity of interest is covering 95th percentile of cases, and the take might be lower than predicted.
- Loss of stream flow – very small range of the ensemble results, meaning the predictions have a high level of certainty.

Due to the long model run times and the number of realisations required for the uncertainty analysis, the assessment was limited to 200 years of post-mining conditions, by which time the final void lake level is expected to have reached equilibrium.

24.11.10.2 Uncertainty of Drawdown

To illustrate the level of uncertainty in the extent of predicted mine induced drawdown (1 m contours), the calibrated prediction model maximum drawdown (incremental and cumulative) and the 50th percentile maximum drawdown extent were compared to the maximum drawdown extent for the 5th

and 95th percentiles. In addition, residual drawdown (incremental and cumulative) was assessed. Overall, the results indicate that the most likely estimate (MLE) (i.e. the parameter set that results in the highest likelihood, also otherwise known as the best calibrated model realisation) 1 m contour fits in between the median and the 95th percentile of the ensemble for the Regolith (Layer 2), the Leichhardt seam (Layer 5) and the Vermont seam (Layer 7). As mentioned in Section 8.1, no incremental drawdown exceeding 1 m is predicted for the MLE in the alluvium (Layer 1) as a result of the Project. This means that the MLE results presented in Section 24.11.4 are thus unlikely to underestimate drawdown.

24.11.10.3 Uncertainty of Mine Groundwater Inflows

The uncertainty of mine groundwater inflow (active mining) into the Project pit (active take) from the start of Project mining (2029) to the end of mining (2043), is shown for the incremental (Project only) scenario in Figure 9-1 of **Appendix K.** The figures show the predicted mine groundwater inflows (active mining) for the MLE model and different weighted percentiles prediction ranges.

The predicted uncertainty in mine groundwater inflows (active mining) is up to 0.45 ML/d deviation from the median for the incremental scenario. Overall, the results indicate that the MLE model is representative of the 33rd – 67th percentile range from 2029 to 2036 and the 67th – 95th percentile range from 2036 to 2043 for the estimated mine groundwater inflows (active mining). The MLE results presented in Section 24.11.5 are thus unlikely to underestimate mine inflows.

24.11.10.4 Uncertainty in Alluvium Water Take

The uncertainty in alluvium water take from the start of the predictive model (2029) to post mining equilibrium (2249), is shown for the incremental (Project only) scenario (Figure 9-2 of **Appendix K**) and the cumulative scenario (Figure 9-3 of **Appendix K**). The figures show the predicted alluvium take for the MLE model and different weighted percentiles prediction ranges.

Negative values indicate a reduction in alluvium take, while positive values indicate an increase in alluvium take. The MLE model is representative of the 5th percentile to 33rd percentile for the incremental and cumulative alluvium take. The MLE results presented in Section 24.11.6 are thus unlikely to underestimate alluvium take.

24.11.10.5 Uncertainty in River Baseflow Loss

The uncertainty of stream baseflow loss from the start of the predictive model (2029) to post mining equilibrium (2249), is shown for the incremental (Project only) scenario (Figure 9-4 of **Appendix K**) and the cumulative scenario (Figure 9-5 of **Appendix K**). The figures show the predicted stream baseflow loss for the MLE model and different weighted percentiles prediction ranges. Overall, the MLE model is representative of the median for the active mining period and of the 5th percentile to 33rd percentile for the post-mining period. The MLE results presented in Section 24.11.6 are thus unlikely to underestimate river baseflow loss.

24.11.11 Climate Change

Consideration has been given to the potential influence of long-term climate change on groundwater recharge process and associated impacts. Climate change projections for the Project area indicate a modest reduction in annual rainfall and an increase in evapotranspiration. Under the SSP3-7.0 high-emissions scenario, annual rainfall is projected to reduce by approximately 10% by 2090, while potential evapotranspiration is projected to increase by approximately 12% (Queensland Government, 2024). These changes are expected to reduce effective recharge non-linearly, because recharge is controlled by rainfall intensity, event frequency, soil moisture conditions and evapotranspiration losses. The predictive uncertainty assessment includes varying recharge rates by up to an order of magnitude. As a result, potential future climate change to rainfall is covered within the range of recharge rates as modelled for uncertainty analysis for the impact assessment.

24.12 Assessment of Impacts and Management Measures – Surface Water

24.12.1 Overview of Potential Impacts

The section describes the potential impacts on surface waters from the Project, based on the assessments of the WMS. The WMS has been designed as the primary management measures to protect the EVs and WQOs for surface waters. **Appendix I** provides the content requirements and basis for a water management plan for the Project. The proposed management measures align with industry best practice for water management and are predicted to be effective in managing impacts to surface waters.

Section 24.13 provides an assessment of the potential impacts on surface waters Project related changes to hydrology, flood regimes and geomorphology (e.g. from levees and bridges).

This section assesses the potential Project impacts on surface waters from:

- controlled and uncontrolled releases from the mine-affected water management system
- stormwater runoff and sediment water releases during both construction and operation
- changes in stream flows due to loss of catchment area draining to local drainage paths due to capture of runoff within onsite storages and the open cut pit, as well as for the final landform
- changes in TSS or DIN, in accordance with the GBR Guideline, from relevant Project releases
- changes to regional water demand due to the potential need to obtain water from external sources to meet operational water requirements of mining operations
- releases of contaminants other than mine-affected water
- cumulative impacts of projects in the region on the EVs of the receiving waters.

Any impacts on surface waters could have an impact on the relevant EVs for the Isaac River sub basin (see Section 24.3.1), namely aquatic ecosystems (see **Chapter 25** for an assessment of potential impacts to aquatic ecology), visual recreation or cultural and spiritual values (see **Chapter 20** for an assessment of potential impacts to these values).

24.12.2 Changes to Water Quality

24.12.2.1 Mine-affected Water Management – Uncontrolled Releases

The water balance modelling results presented in Section 24.7.4.7 demonstrate that there is no risk of uncontrolled discharges of mine-affected water.

In addition, as described in Section 24.7.1.3.2, controls such as isolation valves, pressure release valves and flow meters, will be included in the design and construction of mine water transfer pipeline to prevent or minimise any accidental releases of water during transfer between IDM and the Project.

24.12.2.2 Mine-affected Water Management – Controlled Releases

The design of mine-affected water management system to allow for controlled releases in a manner that protects downstream EVs and WQOs, is described in Sections 24.7.1.3.2, 24.7.3.7 and 24.7.4.6.

The controlled release strategy is based on the EA releases conditions approved for IDM and the Model Mining Conditions. Due to the sequence of operations at IDM and the Project (i.e. IDM ramps down before the Project commences operations), concurrent releases of mine-affected water from IDM and the Project will not occur. The Project's proposed release strategy is effectively an extension of the approved release strategy at IDM. The latest REMP for IDM from January 2025 concludes that "The REMP is considered suitably designed to effectively address all potential concerns associated with current activities and historical releases at Isaac Downs, with the environmental management techniques adopted by Isaac Downs appropriately mitigating any significant impacts to the receiving environment. Furthermore, there are no indications that the current discharge limits are unsuitable to protect downstream environmental values." This demonstrates that the IDM release strategy protects

downstream environmental values, and therefore, is suitable as a basis for the Project's proposed controlled release conditions.

Controlled releases will only be required during wet or very wet climatic conditions (10% AEP and higher), and the predicted releases volumes are relatively low (a maximum annual volume of 131 ML/a) (see Section 24.7.4.6). During controlled release events, the release volumes are less than 0.25% of the Isaac River flows (typically less than 0.1%).

Figure 24-94 shows a ranked plot of modelled EC in the Isaac River downstream of the controlled release point on days when there is a controlled release opportunity of mine-affected water (i.e. when the Isaac River flow exceeds the minimum flow criteria and there is water available for release). The plot shows the modelled EC in Isaac River both with and without controlled releases.

The results demonstrate that the impact of the proposed controlled release strategy on the Isaac River salinity is insignificant (i.e. barely discernible difference between the 'including releases' and 'excluding releases' lines on Figure 24-94), with a potential increase in EC in the vicinity of the Project of less than 8 µS/cm. This insignificant increase is considered within the error margin of detectable change. The predicted Isaac River EC during controlled releases is below the high flow regional WQO of 250 µS/cm, and well below the proposed receiving water contaminant trigger level of 1,000 µS/cm (see Table 24-10).

The model predicts that controlled releases would only occur on less than 0.1% of all Isaac River flow days over the simulation period.

On this basis, the modelling demonstrates that the implementation and design of the mine-affected WMS and proposed release conditions would mitigate impacts of the Project from mine water releases on the salinity of downstream water quality.

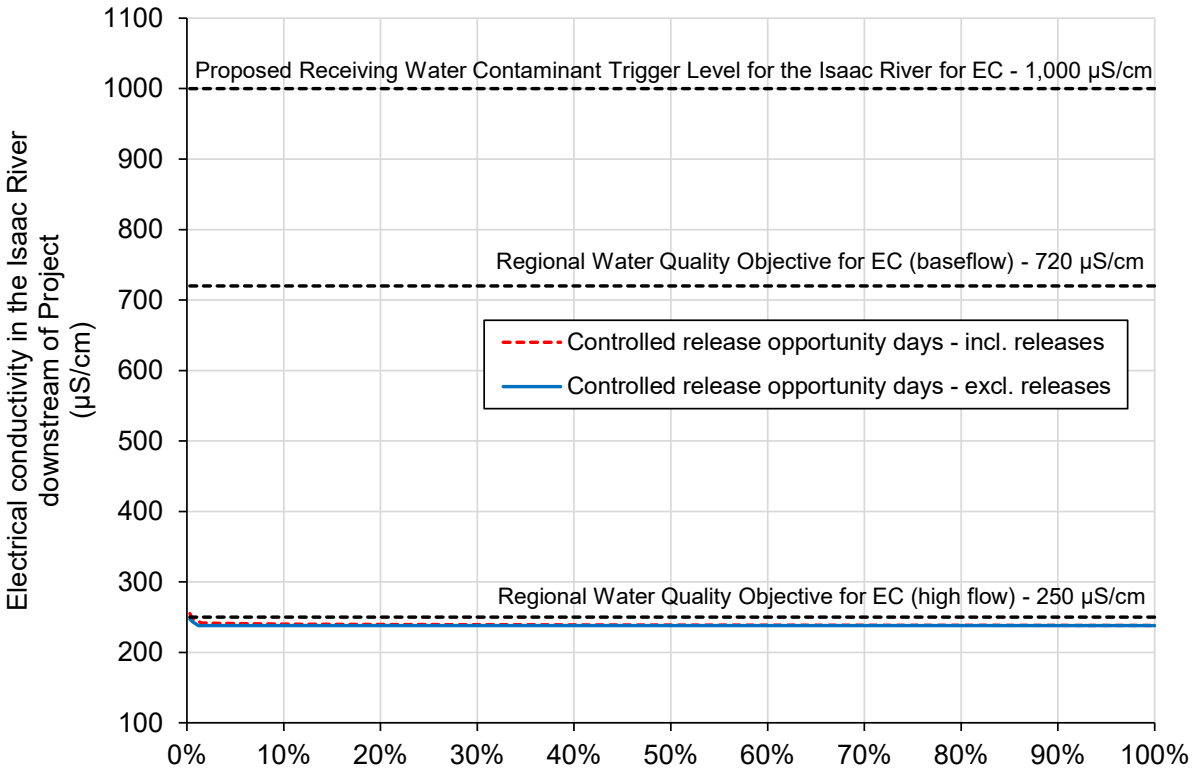


Figure 24-94 Electrical Conductivity in the Isaac River - Controlled Release of Mine-affected Water

24.12.2.3 Sediment Water Management

An assessment of the sediment affected water management system is provided in Section 24.7.4.8. The model results show that some overflow of water from sediment dams may occur during wet periods that exceed the design standard of the sediment control system (Section 24.7.1.3.3).

The geochemical characterisation of overburden / spoil material (see Section 23.8.5 of **Chapter 23**) indicates that the runoff draining to the sediment dams would have low salinity. Overflows would only occur during significant rainfall events which would also generate runoff from surrounding undisturbed catchments at background salinity. The water balance modelling indicates that the salinity of receiving water will be between 240 to 480 µs/cm, subsequent to any overflows from the sediment dams (typically during wet or very wet climatic conditions), which is well below the proposed EA receiving waters contaminant trigger level for EC of 1,000 µs/cm (the current EA receiving waters contaminant trigger level for IPM and IDM).

Figure 24-95 shows a ranked plot of modelled EC in the Isaac River downstream of the Project on days when there is a sediment dam overflows to the receiving environment. The plot shows the modelled EC in Isaac River both with and without sediment dam releases. The predicted increase in Isaac River EC is less than 24 µs/cm (i.e. barely discernible difference between the 'including releases' and 'excluding releases' lines on Figure 24-95). For the majority of release days (greater than 98%), the impact of sediment dam releases on Isaac River EC is less than 10 µs/cm. This insignificant increase is considered within the error margin of detectable change.

On this basis, the modelling demonstrates that the implementation and design of the sediment water management system would mitigate potential impacts of the Project from sediment dam overflows on the salinity of downstream water quality.

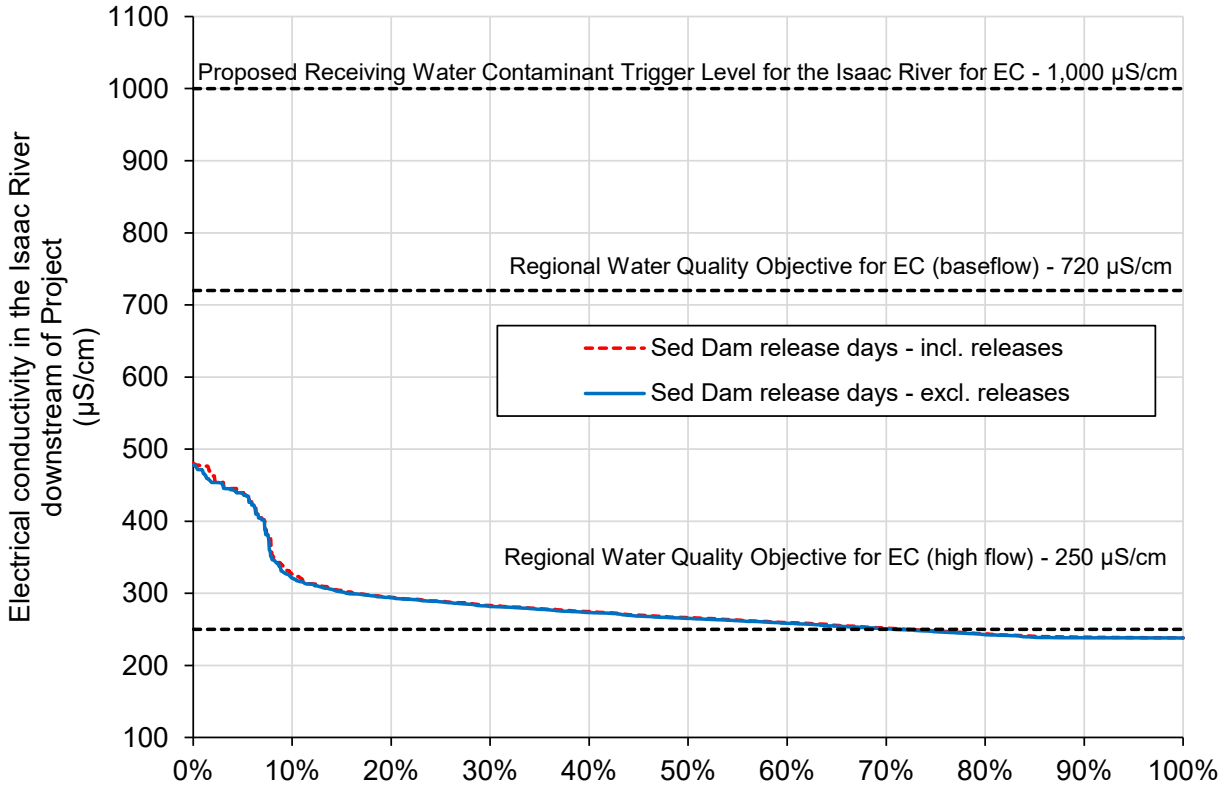


Figure 24-95 Electrical Conductivity in the Isaac River - Sediment Dam Releases

24.12.2.4 Management Measures

Section 24.7.1.1 describes the objectives and principles of the water management system, which have been developed to protect water quality and the EVs of the waterways potentially affected by the Project.

The general principles of the water management system, are as follows:

- A catchment runoff water management system that separates clean water from mine affected water and sediment water wherever possible.
- A mine affected water management system that contains potentially saline runoff from the pit and coal catchments in mine affected water dams. Mine affected water will be used as a priority in meeting site demands. Water from the mine affected water management system may only be released to the downstream environment in compliance with the proposed release rules, which are designed to protect WQOs and EVs.
- An on-site stormwater management system that contains runoff that potentially has elevated sediment concentrations in sediment dams. Water collected in the sediment dams will be managed in accordance with the ESCP (see 24.12.9) and used for dust suppression or will overflow to receiving watercourses after a period of settling.

The mine and sediment water management systems have been effectively designed to mitigate potential downstream impacts on surface water quality and protect the EVs and WQOs.

24.12.3 Streamflow Changes

24.12.3.1 Operations

During active mining operations (approximately 15 years), the WMS will capture runoff from areas that would have previously flowed to the downstream sections of Conrock Gully, Cherwell Creek and the Isaac River. The captured catchment area will change as the mine develops. A breakdown of the maximum catchment areas captured by the WMS is provided in Table 24-15.

Table 24-15 Catchment Area Captured During Operations by the Project

Catchment	Total Catchment Area (km^2)	Maximum Captured Catchment Area (km^2)
Conrock Gully	71	9.5
Cherwell Creek	698	3.6
Isaac River to downstream Cherwell Creek (includes Conrock Gully and Cherwell Creek)	3,528	13.6

The maximum captured catchment areas represent:

- Up to 13.4% (9.5 km^2) of the Conrock Gully catchment to the downstream boundary of the mine, by the end of mining.
- Up to 0.5% (3.6 km^2) of the Cherwell Creek catchment to the downstream boundary of the mine, by the end of mining.
- Up to 0.4% (13.6 km^2) of the Isaac River catchment to downstream of the Cherwell Creek confluence, by the end of mining.

The potential impact on water quantity in Cherwell Creek and the Isaac River due to the Project is likely to be undetectable and is considered negligible.

For Conrock Gully, the majority of the catchment lies upstream of the Project and is unaffected by catchment excision. The only area within the Conrock Gully catchment that is affected by catchment

excision is the small zone immediately downstream (to the east) of the Project between the Isaac River levee and the Isaac River.

Due to the diversion of Conrock Gully around the Project and discharging into the Isaac River upstream of the Conrock Gully confluence, this small zone (approximately 103 ha in area) has the majority of its catchment excised. However, this area lies within the Isaac River floodplain and would regularly be inundated by Isaac River backwater during flood flows.

Information provided in Section 24.8 shows that this downstream 1,450 m of Conrock Gully would be inundated by Isaac River backwater flows for flood events greater than the 50% AEP (1 in 2 year). This means that the loss of catchment from catchment excision from the Conrock Gully diversion is largely mitigated by Isaac River backwater flows for flows greater than 50% AEP.

24.12.3.2 Final Landform

At the completion of mining, the majority of the final landform impacted by mining will be rehabilitated with catchment runoff returned to the surrounding catchment. Rehabilitation and closure for the final landform is described in **Chapter 5**. Approximately 70% of the peak catchment area captured during mining operations will be returned to the receiving environment as part of the final landform design. Nevertheless, a final void remains in the final landform, which will continue to capture some runoff. A breakdown of the catchment areas captured by the final landform is provided in Table 24-16.

Table 24-16 Catchment Area Captured Within the Project's Final Landform

Catchment	Total Catchment Area (km^2)	Final Landform Captured Catchment Area (km^2)
Conrock Gully	71	2.9
Cherwell Creek	698	1.5
Isaac River to downstream Cherwell Creek (includes Conrock Gully and Cherwell Creek)	3,528	2.9

The final landform captured catchment areas represent:

- Around 4.1% (2.9 km^2) of the Conrock Gully catchment to the downstream boundary of the mine.
- Around 0.2% (1.5 km^2) of the Cherwell Creek catchment to the downstream boundary of the mine.
- Around 0.1% (2.9 km^2) of the Isaac River catchment to the downstream boundary of the mine.

The potential impact on streamflows in Cherwell Creek and the Isaac River for the final landform is negligible and would likely be undetectable.

Similar to the operational period, the majority of the Conrock Gully catchment lies upstream of the Project and is unaffected by catchment excision. The only area within the Conrock Gully catchment that is affected by catchment excision is the small zone immediately downstream (to the east) of the Project's final landform and the Isaac River.

Due to the diversion of Conrock Gully around the Project and discharging into the Isaac River upstream of the Conrock Gully confluence, this small zone (approximately 525 ha in area) has the majority of its catchment excised. However, this area lies within the Isaac River floodplain and would regularly be inundated by Isaac River backwater during flood flows.

Information provided in Section 24.9 shows that this downstream 3,000 m of Conrock Gully would be inundated by Isaac River backwater flows for flood events greater than the 50% Annual AEP (1 in 2 year). This means that the loss of catchment from catchment excision from the Conrock Gully diversion is largely mitigated by Isaac River backwater flows for flows greater than 50% AEP.

24.12.4 Regional Water Availability

The assessment of demand for raw water in Section 24.7.4.12 demonstrates that the Project's raw water demands, as integrated into the IPC WMS, will not exceed that existing raw water allocations with Sunwater. As such, the Project will have no impact on regional water availability.

With the workforce transition from IDM to the Project, the Project will not result in a material change in the number of people residing locally, and hence there will be no material change in the annual demand for regional water resources.

24.12.5 Release of Contaminants

The system for managing potentially contaminated water is described in Section 24.7.1.3.6. The location of potential contaminants such as fuel, oil or chemical storage, is limited to the go-line / crib area. These areas will be protected from flooding by the Project levees with a 0.1% AEP (1:1,000 year) design. In summary, these systems will be designed in accordance with Australian Standards for the handling, storage (including bunded storages) and management of potential contaminants to prevent their release to the environment. Procedures will be implemented to manage any accidental releases.

24.12.6 Cumulative Impacts

24.12.6.1 Overview and Projects Assessed

An assessment was undertaken is to identify the potential for impacts from the Project to contribute similar impacts from other projects, including activities proposed, under development or already in operation within a suitable region of influence of the Project (see Section 9.9 of **Appendix I**). Information on over 25 existing and proposed resource operations and renewables projects in the vicinity of the Project is provided in tables and figures in Section 9.9 of **Appendix I**, including IDM and the Bowen Gas project. Cumulative impacts were assessed for the following areas:

- Localised cumulative impacts that may result from multiple existing or proposed mining operations in the immediate vicinity of the Project. Localised cumulative impacts include the effect from concurrent operations that are close enough to potentially cause additive effect on the receiving environment. All existing and proposed projects located within the Isaac River catchment were included in the assessment.
- Regional cumulative impacts from mining operations throughout the Bowen Basin region or at a catchment level. Each mining operations may not represent a substantial impact at a regional level. However, the cumulative effect on the receiving environment may warrant consideration.

24.12.6.2 Water Quality

The Project is located in the Isaac River catchment, which is a major tributary within the Fitzroy basin. The Fitzroy basin is the largest catchment in Queensland draining into the Pacific Ocean and also the largest catchment that drains to the GBR, although it does not contribute significant freshwater flows to the coastal environment when compared to river systems further north.

In 2008, the Queensland Government undertook an investigation into the cumulative effects of coal mining in the Fitzroy River basin on water quality. The investigation found that:

- There were inconsistencies in discharge quality limits and operating requirements for coal mine water discharges as imposed through environmental authorities.
- In some cases, discharge limits and operating conditions of coal mines were not adequately protecting downstream EVs.

These conclusions led to a number of inter-related actions by Queensland Government and other stakeholders:

- WQOs were developed for the Fitzroy Basin and added to Schedule 1 the EPP Water in October 2011.
- Model Mining Conditions were developed for coal mines in the Fitzroy basin. These are designed to manage water discharges to meet the WQOs set out in the EPP Water and to provide consistency between mining operations in the Fitzroy basin.
- EAs for a number of mining operations were amended to introduce conditions consistent with the Model Mining Conditions.
- A number of mining operations entered into transitional environmental programs under the EP Act, which focussed on actions that would allow mines to achieve compliance with new EA conditions and upgrade operating conditions.

With these measures in place, a strong strategic and policy framework has been in place for over a decade for management of cumulative water quality impacts from mining activities in the Fitzroy Basin. This framework allows for management of individual mining activities in such a way that overarching WQOs can be achieved.

Mine-affected water from the Project will be managed through a mine water management system which is designed to operate in accordance with proposed EA conditions that are based on the Model Mining Conditions, and incorporated into the release criteria used in modelling the mine water management system. This mine-affected and sediment water management systems are demonstrated to have negligible impacts on water quality, specifically in relation to controlled releases of mine-affected water and sediment dams overflows. The potential impacts are considered within the error margin of detectable change. Therefore, the Project is expected to make a negligible contribution to cumulative impacts on surface water quality and associated EVs, especially as these are managed within the existing overarching strategic framework for cumulative impacts in the Fitzroy Basin.

24.12.6.3 Loss of Catchment and Stream Flows in the Isaac River

Section 24.12.3 describes the reduction in catchment of the Isaac River as a result of the Project final landform, which is around 0.1% of the catchment area of Isaac River to the confluence of Cherwell Creek

The cumulative impact assessment includes mining operations within the Isaac River catchment that are upstream, adjacent or downstream of the Project. The catchment of the Isaac River to the Stephens Creek confluence is around 7,782 km^2. This location has been selected as it is located downstream of existing projects included in the cumulative impact assessment.

There are approximately 20 existing coal mines that also capture runoff from the Isaac River catchment. The total estimated captured area of all these projects (including the Project) represents around 9.5% of the Isaac River catchment to the Isaac River and Stephens Creek confluence (encompassing all projects in the cumulative impact assessment including those downstream of the Project), of which the Project represents less than 0.2% of this value.

Areas captured within ESCP systems typically accounts for around 70% of the total captured area for a mine site. If this is applied to all sites, then the estimated captured catchment area within mine-affected water systems reduces to around 2.7% of the Isaac River catchment to the Stephens Creek confluence.

In addition, these mines have discharge licences which return captured surface water, as well as groundwater collected in underground workings, to the Isaac River catchment. Site discharges would reduce the impact on surface water volumes. There is limited information available on actual discharge volumes from the mines to the Isaac River.

The Project's contribution to the overall loss of catchment is minor. When taking into account potential discharges from the operating mines in accordance with their current approved release rules, the overall loss of catchment area and associated stream flow is relatively small. In practical terms, impacts on the volume of water flow in the Isaac River would be undetectable.

24.12.7 Downstream Water Users

Section 24.3.7 identifies existing water use entitlements downstream of the Project, which indicates that there is currently minimal use of surface water from the Isaac River downstream of the Project, and water use is limited to irrigation and stock watering. In combination with the negligible changes expected from the Project on surface water quality and flows, downstream users are unlikely to be impacted by the Project.

24.12.8 Water Management System Monitoring and Maintenance

The Project site's WMS will be monitored to ensure that they are operating as designed, including the following:

- Continual monitoring of water quality and storage volumes in the mine affected storages and sediment dams will be undertaken.
- The pit and dam pumps will be inspected and operated regularly to ensure they will operate when required.
- Sediment dams will be cleaned out on a regular basis to maintain the available sediment storage volume.
- Clean water drains will be monitored regularly to ensure they are operating as designed and do not allow mixing of clean and dirty water.
- Contaminated water sumps and interceptors will be inspected and cleaned out regularly.

24.12.9 Erosion and Sediment Control Plan

24.12.9.1 Overview

The Project's ESCP was developed to ensure the principles and objectives for the management of erosion and disturbed area runoff were properly addressed to meet the statutory requirements of the Model Mining Conditions. Section 24.7.1.3.3 details how sediment water will be managed by the Project. Sections 1.2 and 1.3 of **Appendix AD** provide further details on the purpose of the ESCP.

The ESCP may be endorsed or approved by DETSI as part of the approval for the Project under the EP Act.

As demonstrated in **Chapter 7** through landform evolution modelling, the design of the rehabilitated landform will achieve the erosional stability in accordance with the rehabilitation milestone criteria proposed in the PRCP schedule (**Appendix AC**).

This erosion and sediment control will be implemented for the following phases of Project work:

- planning and design (non-operational)
- construction and operation.

Project workers and contractors involved in earthworks and civil construction will be provided access to the ESCP. All works involving disturbance will be required to adhere to all aspects of the ESCP unless abnormal circumstances prohibit their use.

The management and implementation of the ESCP will be administered through the following key personnel:

- The Site General Manager is accountable for the application of the ESCP.
- The Site Environmental Superintendent is responsible for documentation and revisions of the ESCP.
- Contractors engaged to undertake work at the Project are responsible for implementation of the ESCP.

24.12.9.2 Erosion and Sediment Control

The ESCP is designed to assist in the management, reduction and mitigation of erosion and its associated sediment transport within and from the Project. The three cornerstones of the ESCP are as follows:

- Erosion control – prevention or minimisation of soil erosion (from dispersive, non-dispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
- Drainage control – prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of clean and dirty water through the area of concern.
- Sediment control – trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion) or from windborne particles.

Catchments that drain internally to the mine water management system into MAW dams or pits do not require erosion and sediment control management measures.

To be function efficiently, the ESCP will operate under the following principles:

- Ensure erosion and sediment control measures are designed and constructed effectively.
- Minimise the duration and extent of soil exposure.
- Promptly stabilise disturbed areas.
- Maximise sediment retention on the site.
- Control water movement through the site.
- Utilise existing topography and adopt construction practices that minimise soil erosion and sediment discharge from operational areas.
- Integrate erosion and sediment control issues / measures into the planning phases of construction and operations.
- Choose the erosion and sediment control techniques to account for site conditions such as soil, weather and construction conditions.
- Maintain all erosion and sediment control measures in proper working order at all times.
- Monitor the site and adjust erosion and sediment control practices to maintain the required performance standard.

Five main categories were taken into consideration to determine the appropriate erosion and sediment control technique to apply, all of which influence the erosion potential and the type of control measure(s) applicable:

- soil/spoil classification (e.g. dispersiveness)
- average slope of disturbance area
- extent and duration of soil disturbance
- location within the catchment and whether run-off from upslope can be controlled
- proximity to waterways.

Further details in relation to erosion and sediment control are provided in Section 4 of **Appendix AD**.

24.12.9.3 Erosion Control Measures

Water erosion was identified as the most likely cause of erosion within the Project's operational areas and commonly occurs as one or more of the following forms:

- Splash erosion is the spattering of soil particles cause by the impact of raindrops on soil.
- Sheet erosion is the uniform removal of soil in thin layers from sloping land.
- Rill erosion is the removal of soil by water concentrated in small but well-defined channels.
- Gully erosion produces channels deeper and larger than rills, generally greater than 300 mm deep).

Section 5.2 of **Appendix AD** summarises general erosion control techniques that are commonly used, such as gravelling, mulching and revegetation, with their applicability to flat, mild and steep slopes. Management methods proposed for dispersive soils include avoidance (e.g. stripping of non-dispersive topsoil rather dispersive subsoil for use in rehabilitation), reducing period of exposure, treatment with gypsum and covering with non-dispersive topsoil).

24.12.9.4 Drainage Control Measures

Operational drainage is considered temporary and will only be used during the Project's operational period. Once no longer required, all operational drainage will be decommissioned and rehabilitated.

The key drainage controls to be applied at the Project are as follows:

- Upslope catchment diversion drains, which divert the natural catchment around the site.
- Plateau drains, which convey runoff from the top of dumps towards the chutes and runoff collection drains.
- Overburden dump rock chutes, which collect runoff from the top and sides of dumps and convey the flow to the collection drains.
- Collection drains, which convey flow from dumps and infrastructure areas to the sediment dams.

The conceptual arrangement and location of proposed sediment drains for the mid stage of the Project are shown in Figure 6.1 of **Appendix AD**, based on reporting to the sediment dams shown in Figure 24-23. Final design and sizing of the proposed sediment drains over the life of the Project will be a dynamic process and will be undertaken by the proponent's mining contractor. Erosion and sediment controls will also be developed for the construction phase of the Project.

Section 6.2 of **Appendix AD** describes designs for drainage controls including:

- design life, where operational drainage controls that are anticipated to last longer than 24 months will be designed to cater for a 20-year Average Recurrence Interval (5% AEP) design storm to provide effective separation of diverted and sediment water
- check dam velocity control structures and velocity limits depending on material types for drains
- appropriate channel and chute linings (e.g. grass, rock, etc) to provide effective scour protection
- design of outlet structures to provide effective scour protection, including to sediment dams
- controls for unsealed roads such as shedding at regular intervals to sediment traps
- controls for waterway crossings (culverts and bed level crossings)
- drain configurations based on drains with low flows or high flows..

24.12.9.5 Sediment Control Measures

Due to the design of the Project's mining area and natural topography, only a limited proportion of the total mine disturbance area drains towards the receiving environment. The majority of the catchments drain internally and will be managed by the Project's WMS (Section 24.7.1). Notwithstanding this, internally draining spoil dumps and other erosion and sediment control catchments will be managed by the ESCP.

Section 24.7.1.3.1 overviews the Project's planned water management structure, which includes 11 sediment dams that will be used over the life of mining. The location of the proposed sediment dams is shown in Figure 24-21 to Figure 24-25. Additional minor sediment control structures will be constructed as part of the out of pit dump development. The final design and sizing of the planned sediment dams will include details of erosion and sediment controls required for the construction phase of the Project.

The design of the proposed sediment dams (see Section 7.2 of **Appendix AD**) has been based on maximum catchment area, settling volume, solid storage volume and total capacity.

Other primary and secondary supplementary sediment control techniques likely to be applied for the Project for localised sediment controls include rock filter dams, sediment traps, vegetated buffer strips and sediment fences.

The correct implementation of the Project's sediment controls will be guided by technical information derived from the IECA (2008).

24.12.9.6 Erosion and Sediment Control - Construction

The Project's disturbance activities will be conducted in accordance with site systems for the implementation of erosion and sediment control, including:

- a Permit to Disturb procedure
- internal projects standards
- Project-specific approval requirements
- an inspection regime.

Erosion and sediment control measures will be constructed prior to disturbance to reduce sediment laden stormwater discharging to the receiving environment. The scheduling and timing of works is an important element of any construction activity, with higher erosion risk in the wets season than the dry season. Erosion and sediment control measures will be designed and constructed by suitably qualified and experienced persons. Construction records and the management of change will be implemented for the Project's erosion and sediment control measures.

24.12.9.7 Erosion and Sediment Control Planning

The main areas of erosion and sediment control planning for the Project is associated with the overburden dumps, haul roads and topsoil stockpiles. As the Project progresses, it is possible that any changes to the proposed layout during the detailed design and construction phase may require a review of the planned erosion and sediment control measures.

Section 9 of **Appendix AD** details the steps required to determine the applicable erosion and sediment control techniques for a catchment and outlines the sequence for the installation of erosion and sediment control measures.

Decommissioning of erosion and sediment control measures will be part of returning the Project site to a natural landform which is safe, stable, non-polluting and able to support the proposed post mining land uses sustainably. The objective of decommissioning erosion and sediment control measures is to remove the operational structures and establish revegetation..

The decision as to which combination of erosion and sediment control measures will be adopted will be based on the following factors:

- site topography
- material / soil / surface / strata type – to determine where the control measure will be implemented and downstream of the control measure
- current disturbance category
- site specific constraints (e.g. proximity of local watercourse)
- length of time that area will remain at this disturbance category
- overall purpose of implementing erosion and sediment control measures at a particular location
- applicability of erosion and sediment control measures as per the erosion and sediment control measures matrix.

The erosion and sediment control matrix in Section 9.5 of **Appendix AD** shows a matrix of land uses and erosion and sediment control measures developed to assist in determining which erosion and sediment control measure(s) may be applicable. Not all erosion and sediment control measures will be applicable

to the relevant land use type. This tool for selecting appropriate erosion and sediment control measures is based on:

- the phase of the site (operational, non-operational or construction)
- land use type, adjacent land usage / classification and proximity to watercourses
- level of priority in providing erosion and sediment control measures.

An asset register database will be prepared for all erosion and sediment control structures at the Project site.

24.12.9.8 Monitoring and Maintenance

An effective monitoring and maintenance program will be established to assess the effectiveness of the Project's erosion and sediment control measures, and where required, conduct the appropriate repairs for identified issues. Section 10.1 of **Appendix AD** details how the monitoring and maintenance program for the Project's erosion and sediment control measures will function.

Any failure of effectiveness of an erosion and sediment control structure will be reported to the Site Environmental Superintendent. Incident reporting procedures will be established to report the ineffectiveness of an erosion and sediment control structure. The incident reporting will be managed in accordance with the Project's environmental management system. Corrective actions will be developed as soon as practicable for ineffective erosion and sediment control measures and may require advice from an appropriately qualified person. All corrective actions will be captured in the Project's environmental management system.

To ensure continuous improvement, the ESCP will be reviewed by an appropriately qualified person annually and regularly updated to ensure it remains current in relation to applicable reference documents, and erosion and sediment control techniques and application.

24.12.10 Surface Water Monitoring

24.12.10.1 Overview

Monitoring of surface water quality within and surrounding to the Project area in waterways and Project water storages will form a key component of the surface water management system. Monitoring of upstream, onsite and downstream water quality will assist in demonstrating that the Project's water management system is effective in meeting its objective of minimal impacts on receiving water quality and will allow for early detection of any impacts and appropriate corrective action.

The surface water monitoring protocols will:

- ensure compliance with the Project's EA and PRCP schedule
- provide valuable information on the performance of the water management system
- facilitate adaptive management of water resources on the site.

The surface water monitoring program will be implemented in accordance with the Monitoring and Sampling Manual (DES, 2018).

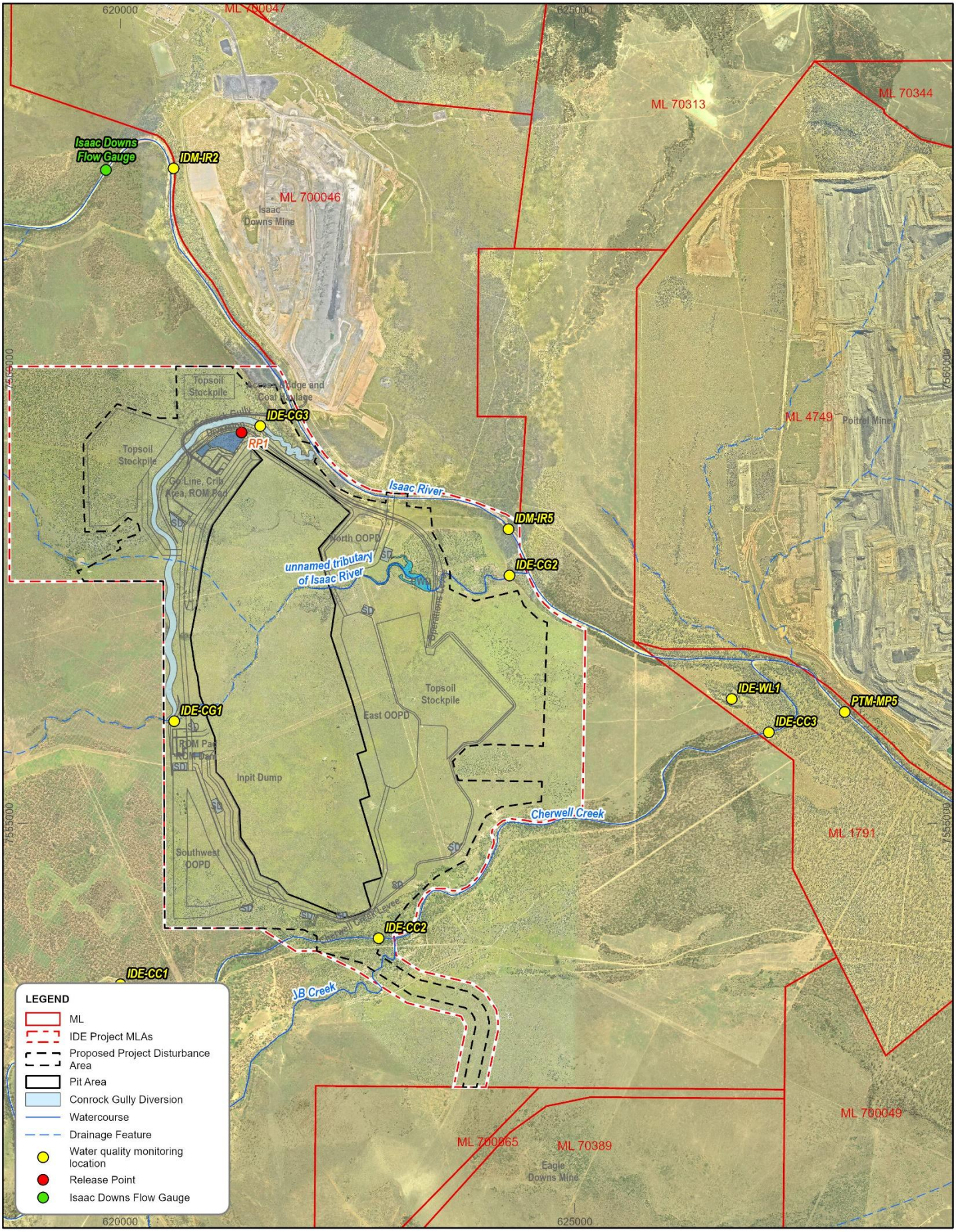
24.12.10.2 Water Quality Monitoring Locations

Surface water has been monitored a number of surface water locations in the Project vicinity (see Section 24.3.6). The surface water monitoring program will include continued monitoring at a number of these sites to monitor water quality upstream and downstream of the Project. The proposed surface water monitoring locations are shown in Figure 24-96 and summarised in Table 24-17. Figure 24-96 also shows the proposed release point (RP1) from the MAW2 into Conrock Gully diversion near the confluence with the Isaac River.

Table 24-17 Proposed Surface Water Monitoring Program

Site name	Waterway	Location	
		Longitude (GDA2020)	**Latitude (GDA2020)**
Upstream monitoring points			
ID-IR2*	Isaac River – upstream of IDM and IDE Project	148.168197	-22.040876
IDE-CG1	Conrock Gully – upstream of IDE Project	148.169025	-22.095638
IDE-CC1	Cherwell Creek – upstream of IDE Project	148.163531	-22.121846
Downstream monitoring points			
ID-IR5	Isaac River – downstream of Conrock Gully diversion	148.205483	-22.077632
IDE-CG2	Conrock Gully – downstream of IDE Project	148.204658	-22.080908
IDE-CG3	Conrock Gully diversion – downstream before confluence with Isaac River	148.177970	-22.066234
IDE-CC2	Cherwell Creek – upstream of JB Gully	148.191014	-22.117059
IDE-CC3	Cherwell Creek – downstream of IDE Project	148.232452	-22.096283
IDE-WL1	Unnamed wetland	148.228449	-22.092989
PTM-MP5*	Isaac River – downstream of IDE Project	148.240546	-22.094180

* = Primary upstream and downstream locations within the Isaac River.



Datum:	GDA2020 Zone 55
Scale:	See Scale Bar
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Drawn:	Minserve
Source:	Minserve/Stanmore
File:	20260414 Surface Water Monitoring.aprx

DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.

stanmore

ISAAC DOWNS EXTENSION

Surface Water Monitoring Locations

Figure | **24-96**

24.12.10.3 Mine-affected Water Quality Monitoring

The proposed mine-affected water release limits and monitoring frequency to be sampled at the proposed release point are provided in Table 24-8 and Table 24-9, based on variable flow criteria. These are the criteria that are proposed in the draft EA for the Project (see **Appendix AA**).

The proposed release contaminant trigger investigations levels for mine-affected water are provided in Table 24-18. Monitoring will commence within two hours of a release and thereafter weekly during release. In accordance with the draft EA (see **Appendix AA**) these are the trigger levels, where if they are exceeded, would require:

- a comparison of upstream and downstream monitoring results
- a comparison of downstream results with the trigger values
- where downstream results exceed upstream results and the trigger values, then undertake an investigation into potential for environmental harm and report to DETSI within a specified timeframe on the investigations and actions taken to prevent environmental harm.

Release contaminant trigger investigations levels were derived from the following sources as indicated in Table 24-18:

- WQOs/DGVs (typically for aquatic ecosystem EVs) presented in Section 24.3.2
- Site specific trigger values where this was supported by regional or local water quality data (see Section 24.3.6), and where these are greater than WQOs/DGVs
- Model Mining Conditions, where these are not available as WQOs/DGVs or site specific trigger values
- Limit of reporting, where this represents the lowest detectable limit in a sample.

Event-based sampling of mine-affected water releases will enable quantification of release water quality and their potential impact on the water quality of receiving waters.

Table 24-18 Release Contaminant Trigger Investigations Levels

Quality Characteristics	Trigger Level µg/L	Source of Trigger Level
Aluminium	212	Site-specific trigger value – see Table 24-3
Antimony	9	Aquatic ecosystem EV
Arsenic	13	Aquatic ecosystem EV
Cadmium	0.2	Aquatic ecosystem EV
Chromium	1.0	Aquatic ecosystem EV
Copper	3.0	Site-specific trigger value – see Table 24-3
Iron	280	Aquatic ecosystem EV
Lead	3.4	Aquatic ecosystem EV
Mercury	0.2	Aquatic ecosystem EV
Nickel	11	Aquatic ecosystem EV
Zinc	8.0	Aquatic ecosystem EV
Boron	940	Aquatic ecosystem EV
Cobalt	1.4	Aquatic ecosystem EV
Manganese	1,900	Aquatic ecosystem EV
Molybdenum	34	Aquatic ecosystem EV

Quality Characteristics	Trigger Level µg/L	Source of Trigger Level
Selenium	10	Limit of Reporting
Silver	1.0	Aquatic ecosystem EV
Uranium	1.0	Aquatic ecosystem EV
Vanadium	10	Aquatic ecosystem EV
Ammonia	720	Aquatic ecosystem EV
Nitrate	1,100	Aquatic ecosystem EV
Petroleum hydrocarbons (C6-C9)	20	Model Mining Conditions
Petroleum hydrocarbons (C10-C36)	100	Model Mining Conditions
Fluoride	320	80th %ile for Isaac River at Goonyella gauge (see Table 3.2 of **Appendix I**)
Sodium	188,000	80th %ile for Isaac River at Goonyella gauge (see Table 3.2 of **Appendix I**)

24.12.10.4 Receiving Water Contaminant Trigger Levels

Table 24-10 provides the proposed receiving water contaminant trigger levels, which are the criteria proposed in the draft EA (**Appendix AA**). In accordance with the draft EA, if receiving waters at a downstream monitoring point exceed the trigger levels during a mine-affected water release event then:

- downstream results are compared to upstream results
- where the downstream results exceed the upstream results, then undertake an investigation into potential for environmental harm and report to DETSI within a specified timeframe on the investigations and actions taken to prevent environmental harm.

24.12.10.5 Water Storage Monitoring

The water quality monitoring program will also include dam monitoring of all mine-affected water dams and sediment dams, as described in Section 24.7.1.3.2 and 24.7.1.3.3, respectively.

These water storages will be monitored on a quarterly basis for the parameters listed in Table 24-8, Table 24-9 and Table 24-18. Sampling from the water storages allows for an understanding of trends in water quality parameters prior to release and hence enables appropriate remedial actions to be undertaken if required prior to release (e.g. transfer to another storage or void at IPC).

24.12.11 Fitzroy Regional Receiving Environment Monitoring Program

The proposed adoption of the FRREMP for the Project is described in **Chapter 25**.

24.13 Assessment of Impacts and Management Measures – Hydrology and Geomorphology

24.13.1 Potential Impacts

The potential impacts from the Project on surface water resources include:

- Alterations to the flooding regime of the Isaac River, Cherwell Creek, JB Gully and Conrock Gully, due to the Project's infrastructure (operational phase) and final landform (post-closure phase).

- Impact on stream flows due to ingress of floodwater into the final void, which is not modelled to occur.
- Changes to creek and floodplain geomorphology, due to the construction of the Conrock Gully diversion and Project levees and levee plugs.
- Cumulative impacts of all projects in the region on the environmental values of the receiving waters.

The assessment of surface water impacts was undertaken based on commonly applied methodologies for the simulation of hydrologic and hydraulic processes using currently available data. The adopted approach was considered suitable for quantifying impacts to a level of accuracy consistent with current industry best practice. Certain aspects of the Project, such as changes to landforms due to construction of overburden dumps, will create permanent changes. However, these topographical changes will be designed and managed to protect the environmental values of receiving waters through rehabilitation stable landforms in accordance with PRCP schedule requirements.

24.13.2 Flood Impacts

Potential impacts of the Project on flood levels and velocities of the Isaac River, Cherwell Creek, JB Gully and Conrock Gully were assessed using a two-dimensional TUFLOW hydraulic model. The modelling included a range of design flood events from 50% AEP to the PMF, and considered for the Project's existing, developed and final landform conditions. Potential impacts of the Project on flood levels and velocities are fully described in Section 24.8 and Section 5 of **Appendix J**.

24.13.2.1 Mining Operations – Flood Regime Summary

The modelled potential impacts to the flood regimes of the Isaac River, Cherwell Creek, JB Gully and Conrock Gully during the Project's mining phase are summarised for potential water level impacts and potential water velocity impacts in Table 24-19 and Table 24-20, respectively.

Table 24-19 Summary of Modelled Potential Water Level Impacts – Project's Mining Operations

Location	Water Level Impacts
Isaac River	The flood levels in the Isaac River channel and floodplain increase up to 1 m (generally less than 0.5 m) along a 4 km reach for the 1% AEP flood event and up to 1.2 m (generally less than 1 m) along a 5.4 km reach for a 0.1% AEP flood event. The magnitude of changes in flood levels reduces for more frequent flood events. The flood level impacts do not extend downstream beyond the Project area. In the context of the regional landscape setting for the Project, flood level impacts are considered to be minor. Reducing the extent of the floodplain behind the Project's proposed Isaac River levee has negligible to minor impact on the expansion of the floodplain into areas that were previously not flooded. The proposed Isaac River bridge and the temporary dragline crossing have negligible impacts on the 1% and 0.1% AEP flood events, as the structures are inundated by these flood flows. Minor water level changes of up to 0.5 m at the Isaac River bridge and 0.25 m at the temporary dragline crossing can be observed for smaller events (e.g. the 10% AEP). The minor water level increases at the temporary dragline crossing are primarily a result of the bed level crossing. The bed level crossing will be removed and stabilised once the dragline walk is completed, which is proposed for the dry season. Therefore, the water level impacts in this area are highly unlikely to occur. A floodplain residence time impact assessment found negligible change to the duration of Isaac River flood events for all flood events. There are no material water level impacts to upstream and downstream flood management infrastructure at other mines, or at the Peak Downs Highway bridge or the Goonyella Railway bridge for any of the modelled events.
Cherwell Creek and JB Gully	The proposed Cherwell Creek bridge may increase water levels upstream of the bridge by up to 0.1 m for the 1% AEP flood event and 0.2 m for the 0.1% AEP flood event. During the 0.1% AEP flood event, flows are pushed towards the proposed Cherwell Creek levee plug by the bridge, causing a localised increase of up to 0.6 m at the proposed levee plug. The 0.1% AEP flows do not overtop the Cherwell Creek levee plug. Flows do not interact with the Cherwell Creek levee plug for any events more frequent than a 0.1% AEP flood event. The Cherwell Creek bridge and levee plug have negligible to localised minor impact on flood levels. The JB Gully bed-level crossing has a negligible impact on all modelled flood events, as the structure is inundated by flood flows.

Location	Water Level Impacts
Conrock Gully (other than diversion)	The flood levels immediately upstream of the diversion will be increased by up to 1.2 m for the 1% AEP flood event and 2.2 m for the 0.1% AEP flood event. Water level increases up to 0.1 m would propagate 800 m upstream for the 1% AEP flood event and 1,200 m upstream for the 0.1% AEP flood event. The magnitude of changes in flood levels reduces for more frequent flood events. Changes in flood levels are considered to be minor and localised. The remainder of the existing Conrock Gully channel will be excised by the Project. However, downstream of the Project area, in the remnant Conrock Gully channel, there is no change in flood levels for the 1% AEP and 0.1% AEP flood events, and up to the 10% AEP flood event, because these areas continue to be flooded by backwater flow from the Isaac River.

Table 24-20 Summary of Modelled Potential Velocity Impacts – Project's Mining Operations

Location	Velocity Impacts
Isaac River	The flood velocities are generally decreased upstream of the Project. The greatest decreases are located around the proposed Isaac River bridge, with modelled decreases reaching up to 0.9 m/s for the 1% AEP flood event and 1.1 m/s for the 0.1% AEP flood event. Velocity decreases also occur in the Isaac River floodplain adjacent to the Conrock Gully diversion, due to reduced conveyance in this location. The flood velocities in the eastern floodplain adjacent to the Project and the floodplain downstream of IDM would be increased. This increase occurs due to the increased conveyance through this section and the upstream reduction of the floodplain width due to the proposed Isaac River levee. The velocity increases in these sections may reach up to 0.7 m/s for the 1% AEP flood event and 1.0 m/s for the 0.1% AEP flood event. Rock protection is propsoed along a 2.5 km section of the Isaac River levee to mitigate potential scour risk. There are decreases in flood velocities on the downstream face of the Isaac River levee, due to reduced conveyance past this location. The velocity reduction in this location is up to 1.0 m/s for the 1% AEP flood event and 1.2 m/s for the 0.1% AEP flood event. The magnitude of change in velocity reduces for more frequent flood events. There are negligible changes in velocity at the Isaac River bridge and temporary dragline crossing for more frequent flood events. The flood velocity changes do not extend downstream beyond the Isaac River levee. There are no material velocity impacts upstream and downstream flood management infrastructure at other mines, or to the Peak Downs Highway bridge or the Goonyella Railway bridge for any of the modelled events. In the context of the regional landscape setting for the Project, flood velocity changes are considered negligible to minor.

Location	Velocity Impacts
Cherwell Creek and JB Gully	There are minor localised changes in velocities for the 1% AEP and 0.1% AEP flood events downstream of the proposed Cherwell Creek bridge and JB Gully bed-level crossing. The velocity impacts do not propagate downstream.
Conrock Gully (other than diversion)	The flood velocities upstream of the diversion would be decreased by up to 0.4 m/s for the 1% AEP flood event and 0.5 m/s for the 0.1% AEP flood event. The velocity reduction would propagate 700 m upstream for the 1% AEP flood event and 900 m upstream for the 0.1% AEP flood event. The magnitude of change would reduce for more frequent flood events. The remainder of the existing Conrock Gully channel will be excised by the Project. However, the remnant Conrock Gully channel will continue to be flooded by the Isaac River backwaters, with lower velocities than pre-mining.

24.13.2.2 Final Landform – Flood Regime Summary

The modelled impacts of the Project's final landform flood regime in the Isaac River, Cherwell Creek, JB Gully and Conrock Gully are summarised as follows:

- In relation to water levels:
  - The final landform results in negligible change to flood levels in the Isaac River. There are minor increases in water levels, up to 0.2 m, in the reach where the Conrock Gully diversion meets the floodplain.
  - The flood levels upstream of the Conrock Gully diversion are impacted to a similar level as the operational conditions scenario (Table 24-19).
  - There are no water level changes in Cherwell Creek in the vicinity of the final landform.
  - The magnitude of change in flood level is reduced compared to during mining operations, as the final landform allows for the expansion of the floodplain into areas previously protected by the Isaac River levee.
  - There are no changes in flood levels in the downstream remnant section of Conrock Gully as this area is subject to backwater flooding from the Isaac River
- In relation to velocities:
  - The final landform results in negligible change to velocity in the Isaac River channel.
  - There are decreased velocities in the existing Conrock Gully channel downstream of the mine, noting that these areas will continue to receive flood flows from Isaac River backwater flooding, but at reduced velocities.
  - The flood velocities upstream of the Conrock Gully diversion are impacted to a similar level as the operational conditions scenario (Table 24-20).
  - There are no flood velocity changes in Cherwell Creek in the vicinity of the final landform.
  - The magnitude of velocity change is generally reduced compared to during mining operations.

Overall the final landform, which incorporates the hydraulically stable diversion of Conrock Gully, and decommissioning and rehabilitation of the Isaac River levee, Cherwell Creek levee plug, the bridge crossings, and the dragline crossing, results in negligible changes to water levels and velocities.

24.13.3 Final Void – Flood Ingress Summary

The Project's flood modelling assessment in Section 24.8 shows that the final void lies outside of the 0.1% AEP flood extent for the Isaac River. Therefore, the Project will have no impact on Isaac River flows as there will be no ingress of water into the final void up to a 0.1% AEP flood event.

24.13.4 Geomorphic Impacts

24.13.4.1 Isaac River Channel Geomorphology

The Project's geomorphic impact assessment indicated that the Project's infrastructure and final landform are likely to have negligible to minor impacts on velocity, bed shear stress and stream power, and therefore, are unlikely to have a material impact on the geomorphology of the Isaac River channel in the vicinity of the Project.

24.13.4.2 Isaac River Floodplain Geomorphology

The Project's geomorphic impact assessment indicated that the Project's infrastructure and final landform are likely to have negligible to minor impacts on velocity, bed shear stress and stream power, and therefore, are unlikely to have a material impact on the geomorphology of the Isaac River floodplain in the vicinity of the Project.

During operations and for extremely rare 0.1% AEP flood events it is possible that some localised impacts to the Isaac River floodplain's geomorphology may occur in the sections downstream of IDM and the Isaac River levee. However, it is considered unlikely that these changes would occur within the Project's relatively short 15-year mine life. The proposed Isaac River levee will be decommissioned and rehabilitated prior to closure.

As part of the final landform preparation, floodplain surfaces will be stabilised and rehabilitated to achieve a self-sustaining vegetation cover. This vegetation cover will increase erosion resistance and stability. The hydraulic characteristics of flow within the Project's backfilled pit area are similar to or lower than under existing conditions, and therefore, the Project's backfilled pit area is expected to remain a stable landform with revegetation of the floodplain surface.

24.13.4.3 Chewrell Creek and JB Gully Geomorphology

The geomorphological impacts on the Cherwell Creek and JB Gully main channels and floodplains due to the Project are negligible, as evidenced by negligible changes in velocity, bed shears trees and stream power for all modelled flood events (see, for example, Figure 24-49and Figure 24-50).

24.13.4.4 Conrock Gully Diversion Geomorphology

As described in Section 24.10.8, Conrock Gully diversion's functional design was developed to address the objectives, design criteria and required outcomes of the DNRME guideline. Table 24-13 demonstrates that the diversion design reasonably matches the existing Conrock Gully geometry. Table 24-14 demonstrates that within the Conrock Gully diversion, the design hydraulic conditions are similar, and generally improved, to those in the existing Conrock Gully channel, and are consistent with the ACARP guideline for channel-averaged shear stress, stream power and velocity.

Under close to bank-full conditions, there are small reductions in shear stress, stream power and velocity predicted for the Conrock Gully diversion channel itself compared to the existing Conrock Gully channel. In the downstream diversion reaches shear stress, stream power and velocity will increase, compared to the rest of the diversion, as flows enter Isaac River, but they will be similar to or lower than those occurring in the existing Conrock Gully.

Revegetation of the Conrock Gully diversion will occur to achieve the ACARP guideline criteria. Rehabilitation of the Conrock Gully diversion will be scheduled to align with the Project's PRCP schedule requirements for the Conrock Gully diversion and to achieve a long term stable landform.

The Conrock Gully diversion will be monitored regularly to collect data for use in evaluating the performance of the diversion during construction and operation. Collection of monitoring data will help identify any issues with the construction of the diversion and assist with achieving rehabilitation milestones for a stable landform in accordance with the Project's PRCP schedule.

24.13.5 Cumulative Impact Assessment

The Project's flood assessment includes flood infrastructure from existing and proposed neighbouring mines, including IDM, Poitrel Mine and the Winchester South project. As a result, there is potential for cumulative hydrological impacts.

The Project flood model assesses the Isaac River flood regime with the existing and proposed flood infrastructure, including levees and final landforms, with and without the Project's proposed infrastructure in place.

The Project flood model considers the impact of the existing and proposed infrastructure on the flooding in the vicinity on the Project and determines the potential flood impact to the neighbouring mines. The potential flood impacts to the neighbouring mines due to the Project, as determined through the flood modelling, is summarised as follows:

- In relation to IDM:
    - Isaac River flood water levels adjacent to IDM increase by up to 0.6 m to 0.9 m for 1% AEP and 0.1% AEP flood events due to the Project. The IDM final landform will not be overtopped by the 0.1% AEP Isaac River flood, with the Project's proposed infrastructure in place.
    - Isaac River flood velocities decrease adjacent to the western face of IDM final landform by 0.1 m/s to 0.2 m/s for 1% AEP and 0.1% AEP flood events, with the Project's proposed infrastructure in place.
    - Isaac River flood velocities increase immediately downstream of the southern face of IDM final landform by 0.1 m/s to 0.3 m/s for 1% AEP and 0.1% AEP flood events, with the Project's proposed infrastructure in place. However, velocities were low in this location during existing conditions, and generally less than 1.5 m/s during a 0.1% AEP flood event, as the southern face of the IDM landform is located in a low-conveyance area of the Isaac River floodplain. Therefore, the change in velocity will not alter the proposed final landform design.
- In relation to Poitrel Mine:
    - There are no material water level or velocity impacts to the Poitrel Mine levee due to the Project's proposed infrastructure.
- In relation to the Winchester South project:
    - There are no material water level or velocity impacts to the approved Winchester South project's planned levee due to the Project's proposed infrastructure.

24.13.6 Proposed Mitigation and Management Measures - Operations

24.13.6.1 Levee and Levee Plugs

The following mitigation and management measures will be applied to the Project's levees:

- As required by the Dams Manual, a detailed CCA will be conducted by a suitably qualified person prior to the Project's construction phase, which will ensure flood immunity up to and including a 0.1% AEP flood event to Protect the Project's mining operations, including dams.
- Prior to the Project's construction phase, detailed designs of the Project's planned levee and levee plugs will be developed by a suitably qualified person to ensure compliance with the Dams Manual.
- Construction of the Project's levee and levee plugs will be supervised and certified by a suitably qualified person to ensure compliance with the Dams Manual.
- The Project's levee and levee plugs will be constructed prior to the Project's operational phase where activities occur in a floodplain.

- Rock protection is proposed on approximately 2.5 km of the central section of the levee between chainages 1700 m and 4200 m to prevent scour during the 0.1% AEP flood conditions.
- The non-armoured sections of the Project's levee and levee plugs will be revegetated with suitable grass species to increase erosion resistance and stability.
- Detailed designs of the levee and levee plugs may include cut-off trenches beneath the levee, and clay cut-off and capping of the levee crest.
- The Project's levee and levee plugs have been aligned to minimise impacts to riparian vegetation.
- The construction footprint of the Project's levee and levee plugs will be kept to a minimum that allows safe and efficient construction techniques.
- During the Project's mining phase, the levee and levee plugs will be monitored following regional flood events, and if required, flood damage will be rectified in a timely manner to ensure operational efficiency is reinstated.
- As regulated structures, the Project's levee and levee plugs will be subject to an annual inspection and reporting regime under the EP Act.
- The levee's and levee plugs' construction and operation will be in accordance with the DNRME guideline and the Dam Manual.
- During the Project's life of operations, the Project's levee and levee plugs will be managed under the Isaac Plains Complex (IPC) Safety and Health Management System (SHMS) and in accordance with the Project's EA.

24.13.6.2 Conrock Gully Diversion

The following mitigation and management measures will be applied to the Conrock Gully diversion:

- Prior to the commencement of mining in the Conrock Gully floodplain, the Conrock Gully diversion will be constructed as specified by its Functional Design Report to achieve a hydraulically and geomorphically stable structure.
- Construction of the Conrock Gully diversion will be supervised and certified by a suitably qualified person to ensure it complies with the Functional Design Report.
- If possible, the Conrock Gully diversion will be constructed during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the construction of the Conrock Gully diversion.
- The Conrock Gully diversion will be monitored as specified by its Functional Design Report, and if identified by monitoring, damaged areas will receive appropriate remedial actions in a timely manner to restore functional efficiency.
- During the Project's life of operations, the Conrock Gully diversion will be managed under the IPC SHMS and in accordance with the Project's EA.

24.13.6.3 Isaac River Bridge and Cherwell Creek Bridge

The following mitigation and management measures will be applied to the Isaac River and Cherwell Creek bridges:

- Prior to the Project's construction phase, a detailed design of the Project's planned bridges will be developed by a suitably qualified person.
- Construction of the bridges will be supervised and certified by a suitably qualified person to ensure it complies with its detailed design plans.
- The bridges' construction and operation will be designed to prevent permanent barriers to the flow of water
- If construction will not occur in accordance with the riverine protection exemption requirements (DRDMW, 2023), a riverine protection permit will be obtained.
- If possible, the bridges will be constructed during the dry season.

- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the construction of the bridges.
- During the Project's life of operations, the bridges will be managed under the IPC SHMS and in accordance with the Project's EA.

24.13.6.4 Temporary Isaac River Dragline Crossing

The following mitigation and management measures will be applied to the temporary Isaac River dragline crossing, which apply to both during construction phase walk and the closure / rehabilitation period walk (see **Chapter 4**):

- Prior to the Project's construction phase, a detailed design of the Project's planned temporary Isaac River dragline crossing will be developed by a suitably qualified person.
- Construction of the temporary Isaac River dragline crossing will be supervised and certified by a suitably qualified person to ensure it complies with its detailed design plans.
- The proposed location for the dragline walk route crossing of the Isaac River has been selected based on relatively shallow and low river banks and minimising areas of remnant vegetation clearing.
- The walk route construction, use and removal of material on the bed of the river would occur for less than 180 days (i.e. 6 months). The dragline walk route would not result in a permanent barrier to the flow of waters.
- The dragline walk route will be preferentially constructed and utilised in the dry season when flows in the Isaac River are unlikely.
- Following utilisation of the crossing, and within 180 days of construction commencement, the temporary gravel base will be removed, and any sand that has been removed will be replaced to restore the natural bed of the Isaac River.
- Bank cuttings and the walk route itself will be stabilised and rehabilitated through topsoiling, seeding and vegetation establishment. Rock protection installed during construction will remain in place. These rehabilitation and stabilisation activities will remain in place during the life of operations between the period when the initial dragline walk during construction and the later dragline walk during closure.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the construction of the temporary Isaac River dragline crossing.
- The temporary Isaac River dragline crossing will be constructed, operate and rehabilitated in accordance with the Waterway Barrier Works guideline for temporary waterway crossings.
- If construction will not occur in accordance with the riverine protection exemption requirements (DRDMW, 2023), a permit will be obtained.
- During its period of operation, the temporary Isaac River dragline crossing will be managed under the IPC SHMS and in accordance with the Project's EA.

24.13.6.5 JB Gully Bed-level Crossing and Conrock Gully Diversion Crossing

The following mitigation and management measures will be applied to the JB Gully bed-level crossing and the access / haul road crossing of Conrock Gully diversion:

- Following Project approval and prior to the Project's construction phase, a detailed design of the Project's planned crossings will be developed by a suitably qualified person.
- Construction of the crossings will be supervised and certified by a suitably qualified person to ensure it complies with its detailed design plans.
- The crossings' construction and operation will be based on the principles of the Waterway Barrier Works guideline.
- If construction will not occur in accordance with the riverine protection exemption requirements (DRDMW (2023)), a permit will be obtained.

- If possible, the crossings will be constructed during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the construction of the crossings.
- During the Project's mining phase, the crossings will be monitored following regional and local flood events, and if required, flood damage will be rectified in a timely manner to ensure operational efficiency is reinstated.
- During the Project's life of operations, the crossings will be managed under the IPC SHMS and in accordance with the Project's EA.

24.13.7 Proposed Mitigation and Management Measures – Final Landform

24.13.7.1 Levee and Levee Plugs

The following mitigation and management measures will be applied to the Project's levees:

- At the completion of mining and all other major rehabilitation works, the Project's levee and levee plugs will be decommissioned and rehabilitated as specified by the Project's PRCP schedule.
- If possible, the Project's levee and levee plugs will be decommissioned and rehabilitated during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the decommissioning and rehabilitation of the Project's levee and levee plugs.
- Monitoring of the rehabilitated area of the levee and levee plugs will continue as specified by the Project's PRCP schedule to demonstrate rehabilitation success for surrender of the Project's MLs and EA.

24.13.7.2 Conrock Gully Diversion

The following mitigation and management measures will be applied to the Conrock Gully diversion:

- Monitoring of the rehabilitated levee area will continue as specified by the Project's PRCP schedule to demonstrate long term establishment success of a hydraulically and geomorphically stable structure for surrender of the Project's MLs and EA.

24.13.7.3 Isaac River Bridge and Cherwell Creek Bridge

The following mitigation and management measures will be applied to the Isaac River and Cherwell Creek bridge:

- At the completion of mining and all other major rehabilitation and post-mining land use works, the bridges will be decommissioned and rehabilitated as specified by the Project's PRCP schedule (unless a third party agreement is reached for its retention).
- The proposed post mining land use for the rehabilitation bridge area is riparian vegetation.
- If possible, the bridges will be decommissioned and rehabilitated during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the decommissioning and rehabilitation of the bridges.
- Monitoring of the rehabilitated bridge areas will continue as specified by the Project's PRCP schedule to demonstrate rehabilitation success for surrender of the Project's MLs and EA.

24.13.7.4 Temporary Isaac River Dragline Crossing

The following mitigation and management measures will be applied to the temporary Isaac River dragline crossing following the return of the dragline to IDM:

- Once the dragline has returned to IDM, the crossing will be fully rehabilitated with the gravel base removed, sandy bed reestablished, bank cuttings filled to resemble pre-mining topography and

landforms rehabilitated through topsoiling, seeding and revegetation in accordance with the PRCP schedule requirements.
- The proposed post mining land use for the rehabilitation bridge area is riparian vegetation.
- Monitoring of the rehabilitated temporary Isaac River dragline crossing area will continue as specified by the Project's PRCP schedule to demonstrate rehabilitation success for surrender of the Project's MLs and EA.

24.13.7.5 JB Gully Bed-level Crossing and Conrock Gully Diversion Crossing

The following mitigation and management measures will be applied to the JB Gully bed-level crossing and the access / haul road crossing of Conrock Gully diversion:

- At the completion of mining, the crossings will be decommissioned and rehabilitated as specified by the Project's PRCP schedule.
- If possible, the crossings will be decommissioned and rehabilitated during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the decommissioning and rehabilitation of the crossings.
- Monitoring of the rehabilitated crossing areas will continue as specified by the Project's PRCP schedule to demonstrate rehabilitation success for surrender of the Project's MLs and EA.

24.14 Assessment of Impacts – Groundwater

24.14.1 Landholder Bores

Landholder bores are described and shown in Section 24.6.2.

Chapter 3 of the Water Act provides bore drawdown threshold triggers of 2 m for unconsolidated aquifers, and 5 m for consolidated aquifers, to aid in the assessment of impacts to third party bore users. These criteria have been adopted for the assessment.

Table 24-21 presents the MLE maximum predicted incremental drawdown at each bore, along with the approximate timeframes in which these peaks are expected to occur. In addition, Table 24-21 includes the 95th percentile drawdown from the uncertainty analysis, representing a conservative, high-end estimate of groundwater decline that exceeds most modelled outcomes. The periods during which 95th percent drawdown is predicted to exceed the relevant Water Act thresholds is also presented.

Model results indicate that the MLE maximum incremental drawdown does not exceed the 2 m or 5 m Water Act thresholds at any landholder bore. The uncertainty analysis shows that, for most bores, predicted drawdown remains within the 2 m and 5 m envelopes, except at 5 Mile Bore and 5 Mile Windmill Bore. At these bores, the 95th percentile drawdown marginally exceeds 5 m, suggesting exceedance is possible at these locations under conservative assumptions.

Mining is scheduled to commence in 2028 and conclude in 2043, followed by a modelled recovery period from 2044 to 2519. For the majority of landholder bores, maximum incremental drawdown occurs after mining has ceased, typically during the recovery period.

Overall, groundwater impacts are predicted to be limited, with drawdown remaining below regulatory thresholds for the MLE maximum drawdown prediction. The likelihood of widespread exceedances of drawdown thresholds at landholder bores due to the Project is low.

Table 24-21 Drawdown Impact on Landholder Bores

Year	Assumed Formation[1]	Longitude (GDA2020)	Latitude (GDA2020)	Bore Depth (m)[2]	Incremental			
					MLE Maximum Drawdown (m)	95th Percentile Drawdown (m)	Timing of Maximum Incremental Drawdown	Timing of Threshold Exceedance (2 m / 5 m)[2,3]
5 Mile Bore	Regolith	148.191184	-22.073753	36.3	<0.1	5.22	2050-2059	2044
5 Mile Windmill	Regolith	148.191223	-22.073762	36.3	<0.1	5.22	2050-2059	2044
Horse Paddock	Vermont Underburden	148.148627	-22.101058	85	0.59	2.33	2050-2059	NA
RN100254	Fort Cooper Underburden	148.135004	-22.073990	>150	0.35	4.23	2050-2059	NA
RN103210	Fort Cooper Overburden	148.136002	-22.073983	65.53	0.36	1.42	2050-2059	NA
RN162815	Fort Cooper Seams	148.200391	-22.131091	59	1.04	2.5	2170-2179	NA
RN162816	Fort Cooper Seams	148.137663	-22.063565	45	0.23	1.39	2120-2129	NA
RN162824	Regolith	148.159903	-22.086046	15	0.91	1.28	2280-2289	NA
RN162825	Fort Cooper Seams	148.182672	-22.124599	40.83	1.43	2.37	2160-2169	NA
RN182871	Fort Cooper Overburden	148.153633	-22.130199	60	0.29	1.44	2040-2049	NA
RN182872	Fort Cooper Overburden	148.182634	-22.124725	50	1.27	1.44	2040-2049	NA

1 Bores assigned to definitive geological unit and model layers based on known geology bore depth

2. Chapter 3 of the Water Act 2000 specified drawdown threshold triggers of 2 m for unconsolidated aquifers and 5 m for consolidated aquifers

3. NA=No exceedance to the Chapter 3 of the Water Act 2000 specified drawdown threshold triggers

24.14.2 Surface Drainage

The Isaac River is the major drainage feature of the region. It forms the northern boundary of the Project area and flows from west-northwest to southeast.

A natural hydraulic gradient exists between the Isaac River and the associated alluvium that results in seepage from the Isaac River to the alluvium (i.e. a losing system). The change in alluvial aquifer groundwater levels induced by mining does not have the potential to increase the hydraulic gradient between the Isaac River and associated alluvium. Consequently, the model does not predict that the average rate of seepage from the Isaac River to the alluvium will increase over the life of the Project, and therefore, the Project does not result in any loss of baseflow to the Isaac River and there are no other predicted groundwater-related impacts to surface drainage as a result of the Project.

24.14.3 Groundwater Quality

This section describes the potential sources and pathways for groundwater quality changes associated with the Project.

24.14.3.1 Spoil

Spoil emplacement at the Project will occur both within the mined void (in-pit backfill) and at designated out-of-pit spoil dump landforms, including the southwest and east out-of-pit dumps. The geochemical properties and environmental risk associated with spoil across all dump areas has been assessed in **Appendix F**, with results summarised in **Chapter 23**.

The spoil geochemical assessment demonstrated that spoil materials proposed for both in-pit and out-of-pit dumps are overwhelmingly non-acid forming, with low total sulphur concentrations and a strong excess of acid neutralising capacity. Leach testing showed that seepage from spoil is expected to be neutral to alkaline, with low salinity and very low dissolved metal concentrations, typically at or near laboratory detection limits.

For out-of-pit spoil dumps, it was concluded that the low contaminant source strength of spoil, combined with landform design and internal attenuation within the spoil mass, results in a low risk of groundwater quality impacts. No sustained acid generation or metalliferous drainage is expected from these landforms post-closure.

For in-pit spoil dump, interaction between groundwater and backfilled spoil is similarly characterised by neutral to alkaline seepage chemistry. Minor quantities of waste coal that are potentially incorporated within the in-pit spoil dump will be diluted and encapsulated by large volumes of non-acid forming spoil, ensuring groundwater quality is not adversely affected.

Based on the geochemical characteristics and assessed seepage behaviour of both in-pit and out-of-pit spoil, **Appendix F** concluded that spoil emplacements present a low risk to groundwater quality during operations and post-closure.

24.14.3.2 Final Void

The final predicted groundwater inflows to the residual void from the groundwater model is shown in Figure 24-88. The results show that over time all flow is inwards towards the void and there is no outwards flux from the void. This means that the residual void functions as a long-term groundwater sink, limiting the potential for off-site groundwater quality impacts.

Water within the final void would evaporate from the final void water body surface and draw in groundwater from the surrounding strata and runoff from the final void catchment areas. A final void water balance has been prepared for the Project (see **Appendix I** and **Chapter 5**). This shows that the water level remains well below the surface of void, there is no risk of the lake spilling to surface waters, and water quality in the void remains suitable for a range of post mining land uses, including livestock

watering and algae production. Irrespective of the water quality in the void, the final void water body would not pose a risk to the surrounding groundwater regime as the final void would remain as a groundwater sink.

The geochemical risks associated with the post-mining residual void, including groundwater interaction with exposed highwall and floor materials has been assessed in **Appendix F**, with results summarised in **Chapter 23**. The assessment concluded that water quality within the residual void will be influenced by neutral to alkaline groundwater inflows and spoil interaction, with limited potential for metal mobilisation. Therefore, the residual void was assessed as posing a low risk to surrounding groundwater resources.

24.14.3.3 Workshops and Storage – Leaks or Spills

All workshop and fuel/chemical storage areas (i.e. at the go-line area) at the Project will be developed and managed in accordance with current Australian Standards, as described in Section 24.15.2. This includes refuelling areas and chemical storage areas designed with adequate bunding and equipped for spill clean-up. These controls represent standard practice and are a legislated requirement at mining operations for preventing the contamination of groundwater. Therefore, there is low risk for groundwater contamination to occur as a result of fuel/chemical storage and handling.

24.14.3.4 Blasting

Blasting activities have the potential to release metals, metalloids and ammonia associated with chemical reactions during the blasting process. During mining, the inward hydraulic flow gradients to the open cut voids would inhibit the potential for any outflow of potential contaminants. Post-mining, model results indicate that the residual void continues to form a hydraulic sink such that there is no discharge offsite to the surrounding groundwater environment.

24.14.4 Aquifer Physical Integrity and Hydraulic Properties

The process of open pit mining proposed at the Project will result in the removal of the aquifer and aquitard units within the mine pit footprints.

Given the diversion will be less than 2m deep, the diversion will not interact with groundwater aquifers which are typically 10 – 20 mBGL.

It is considered that there is no potential for any other impacts to the physical integrity of any of the identified aquifer and aquitard units, since there is no mechanism for physical impacts to the geology to propagate away from the open pits (for example, as might occur associated with underground mining subsidence). As a result, there would in turn be no potential for impacts to the hydraulic properties of the identified aquifer and aquitard units outside of the open pit footprints.

24.14.5 Groundwater Dependent Ecosystems

24.14.5.1 Overview of Potential Impacts

The following potential impacts on GDEs have been assessed, as per the methodology from Richardson et al. (2011):

- Clearing of GDEs (Section 24.14.5.2)
- Partial or total loss or reduction in pressure of the aquifer being utilised by GDEs (Section 24.14.5.3).
- Changes to the interaction between surface flows and aquifers being utilised by a GDE (Section 24.14.5.4).
- Change in chemical composition or quality of an aquifer detrimentally impacting the health of a GDE (Section 24.14.5.5).

- Sedimentation of surface flows responsible for aquifer recharge (Section 24.14.5.5).
- Cumulative impacts (Section 24.14.5.6).

While there is no prediction of Project related groundwater drawdown in the alluvial aquifer, cumulative impacts may affect alluvial groundwater levels. However, the partitioning of groundwater in the alluvium between the perched groundwater unit and the alluvial aquifer limits the potential for propagation of drawdown impacts into the perched groundwater unit that supports GDEs. Figure 24-97 shows a pre-mining (all mining activity) GDE function in the Isaac River adjacent to the north section of the proposed mining pit (Figure 7-2 of **Appendix N** provides the indicative cross-section location). There is a separation through an unsaturated connection between the perched groundwater unit on which GDEs rely, and the alluvial aquifer on which drawdown impacts may occur. The mining operations model (Figure 24-98) shows cumulative drawdown impacts on the alluvial aquifer, which have not influenced groundwater levels in the perched groundwater unit due to partitioning and hydraulic separation. Cumulative drawdown on the regolith groundwater unit is also evident, though it has no impact on GDEs. In the operations model, groundwater in the coal seams drains into the mine pit for management within the mine water management system (refer to Section 24.7).

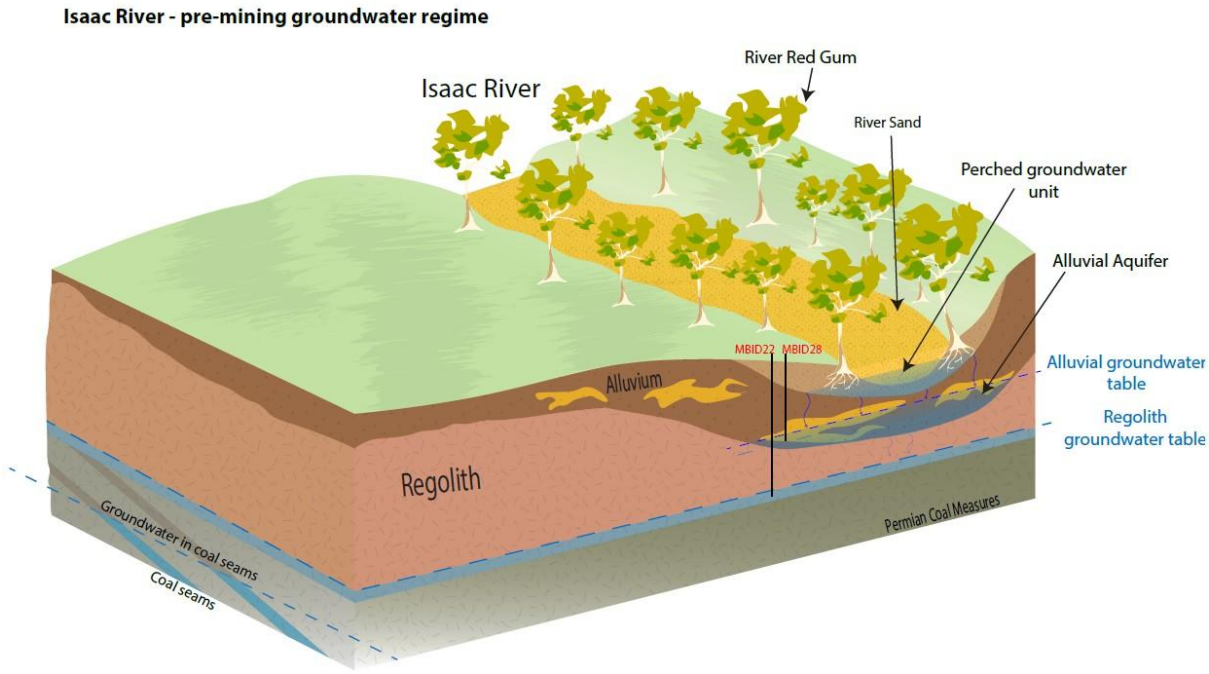


Figure 24-97 Pre-Mining Groundwater Regime

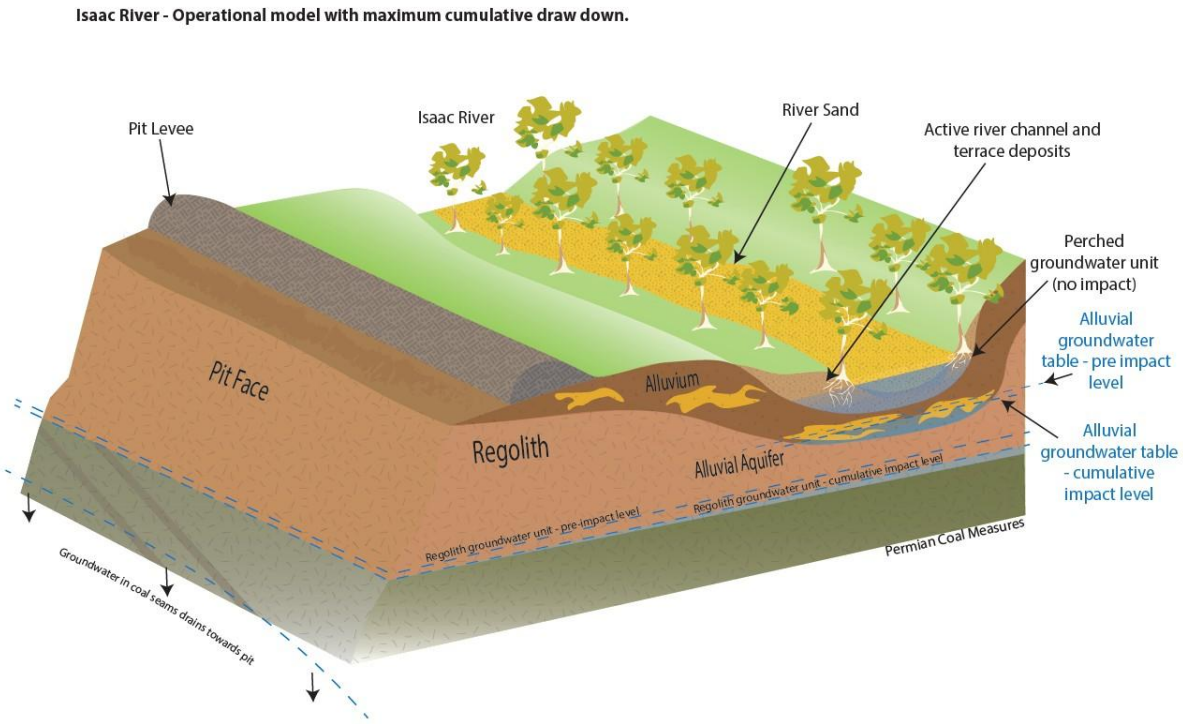


Figure 24-98 Mining Operations – Maximum Cumulative Drawdown

24.14.5.2 Clearing of GDEs

The proposed disturbance area for the Project intersects approximately 6.8 ha of localised parts of mapped GDE areas (see Figure 7-1 of **Appendix N**). These areas are mapped as RE 11.3.25 and are included in the assessment of impacts to terrestrial ecology (see **Chapter 25**), including identification of significant residual impacts to areas that require biodiversity offsets:

- The proposed Isaac River bridge crossing has a nominated 200 m wide construction corridor which, if it were all to be cleared, would impact 2.47 ha of groundwater dependent riparian vegetation fringing the Isaac River. However, this construction corridor width has been nominated to allow some flexibility in detailed design and it is likely that the disturbance in this area will be reduced.
- The proposed clearing for the dragline walk route to cross the Isaac River has a nominal 250 m wide construction corridor which, if it were all to be cleared, would impact 2.78 ha of groundwater dependent vegetation. However, this construction corridor has been nominated to allow some flexibility in detailed design and it is likely that the disturbance in this area will be reduced.
- Clearing of a maximum of 1.58 ha of groundwater dependent vegetation may be associated with the tie in point of the diversion of Conrock Gully and the Isaac River. However, this disturbance area allows for some flexibility in the construction of this tie in point, and is likely that the disturbance in this area will be reduced.

The nominated post mining land use for these locations in the PRCP (see **Appendix AB**) is riparian vegetation which would ultimately aim to achieve a similar ecosystem to that which existed pre-mining. Mapped GDEs, as shown in Figure 24-20, do not intersect with potential vegetation clearance associated with the bridge crossing of Cherwell Creek.

24.14.5.3 Aquifer Depressurisation

As per Section 24.11.4.2, there is no drawdown greater than 1 m attributable to the Project (i.e. the 'incremental drawdown') in the alluvial aquifer. The perched groundwater system is reliant on water from surface flows and hence is not subject to drawdown associated with mining projects.

While modelling predicts minor areas of groundwater drawdown within the Regolith layer, the GDE assessment found that groundwater in the Regolith is unlikely to support GDEs within and surrounding the Project area, and the predicted drawdown is outside the mapped GDE area.

24.14.5.4 Surface Flow Changes

The perched groundwater unit, which supports GDEs along the Isaac River and lower Cherwell Creek is hosted in active river channel and terrace deposits that interact directly with channel and overbank flows. Compared to the alluvial aquifer, the perched groundwater unit is also subject to much more rapid recharge and discharge. Project-related changes to surface flow volume and duration could influence recharge of the perched groundwater unit and affect the integrity of GDEs reliant on it.

The hydrology assessment (refer to Sections 24.8 to 24.10) provides comprehensive descriptions of potential changes to the surface flow regimes of the Isaac River and Cherwell Creek, including from the Isaac River levee (and to a much lesser extent a levee plug along Cherwell Creek), the diversion of Conrock Gully, and infrastructure crossings of watercourses.

Detailed hydraulic and hydrology modelling for a range of annual exceedance probability (AEP) events has been completed for the Project for the operational and closure periods, inclusive of all Project structures and landforms with the potential to alter hydrology and geomorphology (Sections 24.8 to 24.10). The design of infrastructure with the potential to alter hydrology and geomorphology has been undertaken to minimise impacts (e.g. locating the Isaac River levee approximately 100–400 m from the high bank; bridge designs with minimal interference with flows; and a temporary dragline crossing). In addition, hydraulic and hydrology modelling has been completed for five cross sections through the Isaac River and adjoining floodplain upstream, adjacent and downstream of the Project, with the five cross sections representing areas of potential ecological value, containing REs, TECs, and GDEs. This modelling has identified:

- The Project will have negligible impact on hydrology and geomorphology (e.g. flood levels, velocity, bed shear stress and stream power) for more frequent flood events (e.g. 10% AEP or 1:10 year flood event)
- The Project will have negligible to minor impact on hydrology and geomorphology for less frequent flood events (e.g. 1% AEP or 1:100-year flood event) during operations.
- Post mining, with the decommissioning and rehabilitation of the crossing infrastructure and the Isaac River levee, and restoration of the associated floodplain, the Project will have negligible impact on hydrology and geomorphology.
- The Project will result in almost no change in the duration for which flood events will occur (less than 1 hour change in duration for all AEP events), as measured at the nominated cross section locations.

Based on these findings, it is expected that the Project will have a negligible impact on the landforms that host GDEs and the surface water flows that recharge the groundwater resources upon which the GDEs rely, and therefore, impacts to floodplain vegetation, riparian habitat, and vegetation condition from changes to hydrology, hydraulics, or geomorphology are expected to be negligible.

24.14.5.5 Water Quality Changes or Sedimentation

Groundwater predictive modelling identifies a permanent cone of depression around the mining void into which potentially saline groundwater flows from coal seams and regolith will be directed during and post mining (see Section 24.11.8). This will facilitate the direct drainage of groundwater into the mining void,

where discharge capture will be controlled via the mine water management system during operations; and post mining the void will act as a groundwater sink.

Mine affected water will be captured within one of three proposed containment storages (see Section 24.7). The controlled release of mine affected water will occur under approved release conditions, based on flows and water quality, which are designed to protect downstream environmental values (see Section 24.7.4). There will be no predicted uncontrolled releases of mine affected from the Project (see Section 24.7.4).

Recharge to the perched groundwater unit that supports GDEs occurs during river channel flows associated with high-volume flood events with a substantial dilution factor and is unlikely that controlled releases of mine affected water would impact water quality within the perched groundwater unit to a degree that would compromise GDE health.

Surface water runoff from disturbed mining areas will carry sediment, requiring capture and management to prevent environmental harm. Section 24.7 describes the design of sediment management systems for the Project. The Project's erosion and sediment control plan (ESCP) (see Section 24.12.9 and **Appendix AD**) will manage sediment captured in runoff, adopting the three cornerstones of erosion and sediment control:

- Drainage control – prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of clean and sediment water through the area of concern.
- Erosion control – prevention or minimisation of soil erosion (from dispersive, nondispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
- Sediment control – trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion), or from windborne particles.

The Project will implement a combination of these control measures to effectively manage sediment and erosion at the site. When managed under the ESCP, there is an extremely low risk that excess sediment from disturbed mining areas will impact groundwater dependent vegetation.

24.14.5.6 Cumulative Impacts

Cumulative groundwater impacts are described in Section 24.11.4.3. Figure 24-82 shows the cumulative groundwater drawdown modelling for the alluvial layer (layer 1), indicating drawdown of 1 to 5 m directly adjacent to Project. As described in Section 24.14.5.3, the Project does not contribute to drawdown in the alluvial layer and hence drawdown in this layer is attributable to other mines in the local and regional area. While cumulative drawdown in the regolith is more extensive, based on the assessment that vegetation does not demonstrate dependence on the regolith (see Section 24.6.3), drawdown of the regolith is not expected to affect water availability to GDEs.

While other mining operations have the potential to impact GDEs on the Isaac River and associated local catchments, there are no reports of GDE impacts from existing mining operations. IDM implemented a GDEMMP in 2020 (3d Environmental, 2020b), specifically to monitor the impact of mining operations on GDEs fringing the Isaac River. To date, the monitoring at IDM has not identified any impacts to the health or function of GDEs associated with the Isaac River from operations. The outcomes of the IDM GDE monitoring support the findings of the Project's GDE assessment. In addition, the GDE assessment completed for the Winchester South project (3d Environmental 2023c) concluded a similar GDE function to areas assessed for the IDM and the Project, with groundwater-dependence restricted to the immediate riparian fringe of Isaac River and an associated floodplain wetland, and a GDE risk assessment for the Poitrel mine predicted no adverse impacts to GDEs.

Based on groundwater modelling (see Section 24.11), the Project does not further contribute to the cumulative impact of groundwater drawdown in the alluvial aquifer. Other local and regional mines or

future projects will be subject to their own approval requirements for the management of GDEs, which will complement the proposed management of GDEs for the Project, as described in Section 24.15.3.4.

24.14.6 Stygofauna

24.14.6.1 Overview of Potential Impacts

Potential impacts to stygofauna could occur through:

- changes in groundwater quality associated with:
  - accidental leaks or spills of hydrocarbons and other chemicals from infrastructure areas or mining equipment.
  - seepage from spoil dumps or the void lake to groundwater.
- drawdown in aquifers associated with stygofauna.

24.14.6.2 Leaks or Spills

Any leaks or spills would be highly localised (e.g. at the Project's go-line area), and controls will be implemented to prevent or remediate any spills or leaks (see Section 24.15.2). Whilst hydrocarbons and chemicals can impact aquatic fauna at relatively low concentrations, it is unlikely that localised spills or leaks in active mining areas would interact with aquifers in which stygofauna may be present.

24.14.6.3 Seepage – Spoil and Void

As described in Section 24.14.3, the risk to groundwater quality from seepage from spoil or the void is low. As a result, the risk to the aquifers and stygofauna communities from changes to groundwater quality from seepage is low. The implementation of the groundwater monitoring and management plan (GMMP) (see Section 24.15.3) will identify if there are changes to groundwater quality that exceed trigger levels for investigation.

24.14.6.4 Changes in Groundwater Levels

Stygofauna within and surrounding the Project area have been identified in the alluvial aquifer in the alluvium adjacent the Isaac River. Modelled maximum groundwater drawdown in the alluvium as a result of the Project (i.e. incremental drawdown) and cumulatively with all other existing and proposed resource project, is described in Section 24.11.4.2 and Section 24.11.4.3, respectively. There are no incremental (i.e. Project only) drawdown impacts exceeding 1 m predicted for the alluvium. Cumulative drawdown in the alluvium ranges from 1 to 10 m, with this almost entirely due to the influence of other projects.

Therefore, the Project has a negligible contribution to drawdown in the alluvium, and as a result, has a negligible contribution to any potential impacts on stygofauna in the alluvium.

At the taxonomic level available for other studies across the region, the stygofauna assemblages identified in the Project's assessment are not unique. Localised cumulative impacts to the alluvium represent a relatively small portion of the available habitat. Therefore, the Project is considered unlikely to impact the long term survival and persistence of these communities.

As a result of the findings of a low risk of impacts to stygofauna from drawdown from the Project, no stygofauna specific management measures are proposed. However, the GMMP (see Section 24.15.3) will be implemented and will identify if there are changes to groundwater levels that are not within the predictions of the Project's groundwater modelling.

24.15 Management and Mitigation Measures - Groundwater

24.15.1 Landholder Bores

In accordance with Chapter 3 of the Water Act, mining proponents are required to identify, monitor and review impacts on underground water resulting from the exercise of underground water rights. This includes the preparation and ongoing review of groundwater impact predictions and affected area mapping to confirm whether actual groundwater behaviour is consistent with that predicted. Groundwater monitoring undertaken for the Project provides the primary mechanism to identify any divergence between predicted and observed drawdown, including the potential for impacts to occur beyond those anticipated at groundwater users (landholder bores). Where groundwater drawdown attributable to mining activities is predicted or observed to exceed relevant bore trigger thresholds at a landholder bore, the Water Act requires the proponent to assess the bore and, where applicable, enter into a make good agreement with the bore owner to mitigate the impact on water supply.

Based on the potential impacts on landholder bores described in Section 24.14.1, the incremental drawdown is not predicted to exceed the Water Act trigger for unconsolidated aquifers at any bores, with a low likelihood of exceedance at only two bores (5 Mile Bore and 5 Mile Windmill Bore), reflecting their close proximity to the Project and shallow screened intervals. The proponent will enter a make good agreement with the landholder as required.

Possible landholder bore impact mitigation measures that may be applied as part of a make good agreement include:

- refurbishment of an existing groundwater bore
- installation of a new groundwater bore
- establishment of an alternative water supply arrangement
- use of another mutually agreed form of mitigation.

24.15.2 Management of Leaks or Spills

Facilities at the go line for the storage of fuels and minor maintenance requirements will be constructed and bunded in accordance with the relevant Australian Standard specifications, including but not limited to the provisions of AS 3780:2008 – The storage and handling of corrosive substances, AS 1940:2004 – The storage and handling of flammable and combustible liquids (AS 1940), AS 3833:2007 – Storage and handling of mixed classes of dangerous goods in packaged and intermediate bulk containers.

Under the IPC Safety Health Management System, hazardous substances Safe Operating Procedures (SOP) will be in place at these operations. A register will be maintained on site for all chemicals. Where appropriate, material safety data sheets will be kept in storage areas or available for on-line access, as required.

Fuel storage areas are a potential source of hydrocarbons, and fuel storage areas will be constructed and bunded in accordance with the relevant specifications of AS1940. Fuel storage areas will be inspected regularly, with repair and maintenance work completed as required. Bunds filled with stormwater will be drained or pumped out by a licensed contractor as soon as practicable to maintain the bund volume.

A waste oil system will collect all waste oils for transfer offsite or recycling onsite, so that waste oils are not released to the environment. Lubricants will be stored in a bunded concrete area with a sump to collect any spills.

All runoff from areas with potential contaminants will pass through water management controls such as an oily water separator or sediment trap before entering the mine affected water management system.

Incident reporting and the management of spills will be undertaken in accordance with the site operational incident reporting forms and procedures. A spill response protocol will be developed and

implemented. Spills management procedures will be designed to contain and remediate any spills of fuels or chemicals to prevent impacts to surface waters. Spill kits will be available close to areas where fuel, oils and/or chemicals are being regularly used or stored.

Specific waste bins and bunding will be used to isolate waste liquids, chemicals and hazardous wastes.

Hazardous liquid wastes awaiting disposal, such as hydrocarbons and oils, will be stored appropriately in accordance with AS1940:2004 'The storage and handling of flammable and combustible liquids'.

All areas containing potential contaminants or hazardous wastes will be protected from flooding by levees with flood protection for a 0.1% AEP (1:1,000 year) flood event. Hence, they will have a negligible risk of releasing contaminants during flood events.

With the implementation of these mitigation and management measures, the risk to the groundwater quality from leaks or spills is very low.

24.15.3 Groundwater Monitoring and Management Plan

24.15.3.1 Overview

A GMMP has been prepared for the Project (see **Appendix AE**). The GMMP describes the groundwater monitoring regime for the Project and associated groundwater impact limits and triggers for further assessment and groundwater impact management during the life of the Project. This section describes, based on the GMMP, the proposed groundwater monitoring network, including proposed water-level drawdown triggers and groundwater-quality limits for the defined compliance bores.

The GMMP may be endorsed or approved by DETSI and / or DCCEEW as part of the approval for the Project under the EP Act or EPBC Act, respectively.

24.15.3.2 Groundwater Monitoring Network

A groundwater monitoring network has been established for the Project, as described in Section 24.5.2. This monitoring contains sufficient monitoring points in terms of spatial coverage of monitoring across all formations of interest to describe pre-mining groundwater conditions and monitor potential changes in the groundwater environment during the Project's construction, operations and rehabilitation phases.

The groundwater monitoring network includes defined compliance and interpretation bores as shown in Table 24-22. Compliance bores are bores that have impact criteria thresholds established in the GMMP, whereas interpretation bores are bores primarily intended to provide for background monitoring data outside of the potential mining impact area, that would support the assessment of an exceedance of a limit or trigger at a compliance bore. Bores 205S, 205DR 593, 594, 592s, 592D, which are currently being monitored, are located within the footprint of the pit and will be mined out, and therefore, are not included in the Project's GMMP monitoring network, but will be monitored for interpretation purposes until removed.

Figure 24-99 presents the proposed GMMP groundwater monitoring network for each aquifer, classifying bores as either compliance or interpretation for each relevant aquifer unit.

24.15.3.3 Monitoring Regime – Baseline and During Mining

Routine monitoring includes groundwater level and quality monitoring. Routine monitoring prior to the commencement of the mining operation (i.e. baseline period) which is ongoing, will provide for continued assessment and characterisation of the pre-mining groundwater system, including quantification of pre-mining variability. Continuing to capture data to quantify pre-mining variability is important on the context of allowing the Project to distinguish any future Project related impacts from inherent natural variability, or variability from other mining operations, later during the Project's operational and

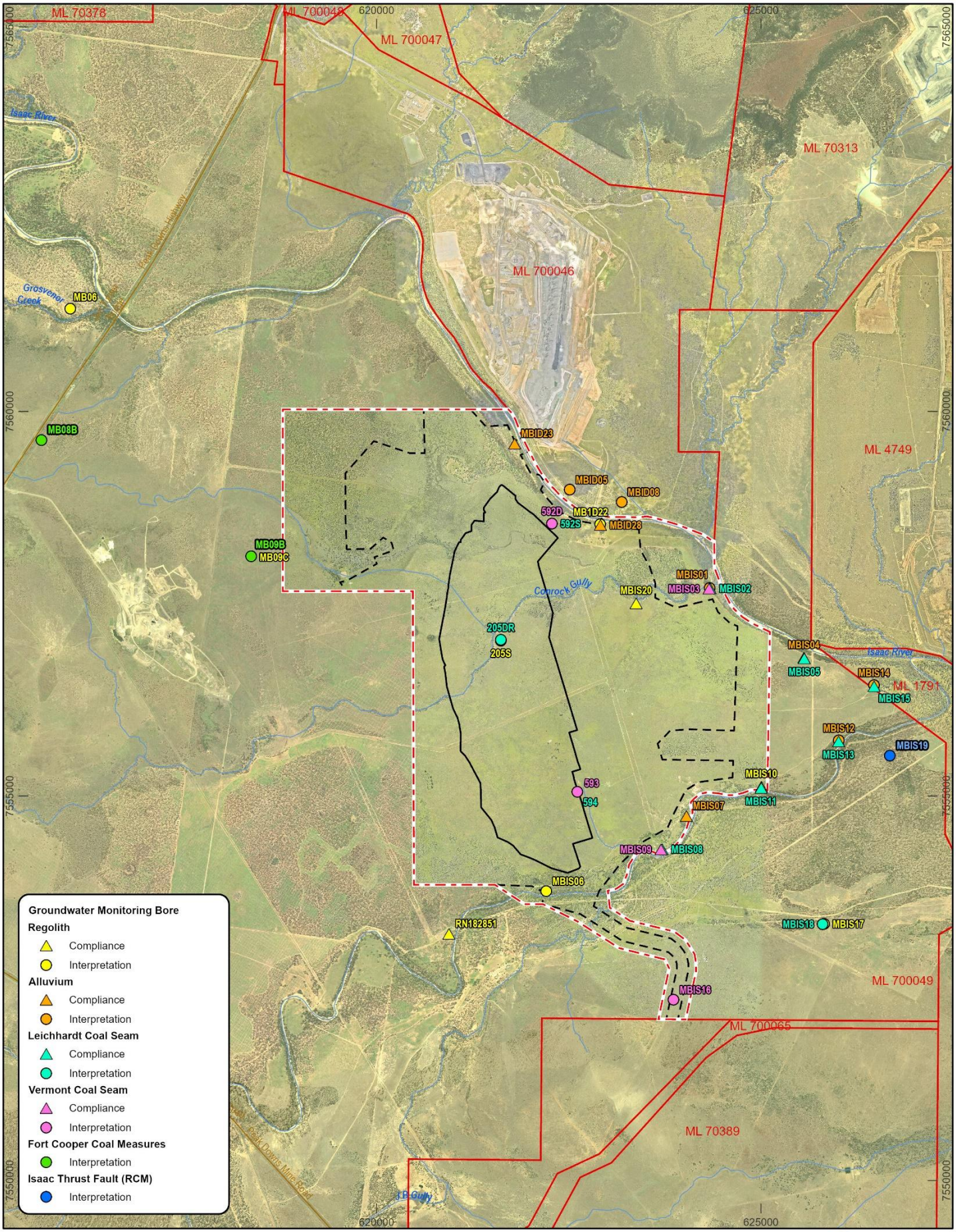
rehabilitation phases. The baseline monitoring program will continue until active mining commences, at which point the operational regime will be implemented.

Routine monitoring during the mining operation will provide early warning of any variation in the response of the groundwater system to that predicted by the groundwater modelling. This will enable the proponent to undertake mitigation measures, as required, to minimise any potential groundwater related impacts, such as to surrounding groundwater users and the environment (e.g. through the implementation of make-good measures).

Table 24-22 Project GMMP Monitoring Network

Bore	Total depth (mBGL)	Aquifer	Proposed GMMP Bore	Rationale
MBIS01	22	Alluvium	Interpretation	These bores are installed to the base of the alluvium. Recorded as dry since installation. Considered unsuitable as compliance bores but will continue to be monitored as interpretation bores.
MBIS14	11	Alluvium	Interpretation	
MBID23	14	Alluvium	Compliance	Shallow groundwater monitoring along Isaac River north of the pit.
MBID28	16	Alluvium	Compliance	Shallow groundwater monitoring along Isaac River northeast of the pit.
MBIS04	19	Alluvium	Compliance	Shallow groundwater monitoring along Isaac River.
MBIS07	19	Alluvium	Compliance	Shallow groundwater monitoring along Cherwell Creek southeast of the pit.
MBIS12	20	Alluvium	Interpretation	Shallow groundwater monitoring along Cherwell Creek.
MBID05	18	Alluvium	Interpretation	These form part of the IDM monitoring network and included as interpretation bores to provide shallow groundwater monitoring north of the Isaac River.
MBID08	17	Alluvium	Interpretation	
MBIS20	22	Regolith	Compliance	Shallow groundwater monitoring along Conrock Gully east of the pit.
MBIS06	12.4	Regolith	Interpretation	These bores are installed to regolith and are intermittently dry with a recent prolonged dry spell. As it is likely that there will be frequently no or insufficient water to sample (i.e. the regolith in this area is dry) they are considered unsuitable as compliance bores but will continue to be monitored as interpretation bores.
MBIS17	23	Regolith	Interpretation	
MB06	23	Regolith	Interpretation	Located more than 5 km to the northwest and upgradient of the pit shell. Not anticipated to be impacted by Project mining related drawdown .
MB09C	15	Regolith	Interpretation	Located over 1km to the east and upgradient of the pit shell. Not anticipated to be significantly impacted by Project mining related drawdown.
MBID22	37	Regolith	Interpretation	Shallow groundwater monitoring along Isaac River northeast of the pit. Groundwater levels are influenced by nearby actively pumping landholder bore. Bore is blocked and unsuitable for sampling.
RN182851	35	Regolith	Compliance	Mining impact south of the pit.

Bore	Total depth (mBGL)	Aquifer	Proposed GMMP Bore	Rationale
MBIS10	24.15	Regolith	Compliance	Located 2km to the southeast of the pit shell in a potential zone of Project drawdown.
MBIS02	138	Leichhardt coal seam	Compliance	Mining impacts northeast of the pit.
MBIS05	155	Leichhardt coal seam	Compliance	Mining Impacts east of the pit.
MBIS08	50	Leichhardt coal seam	Compliance	Mining impacts south of the pit.
MBIS11	94	Leichhardt coal seam	Compliance	Located 2km to the southeast of the pit shell in a potential zone of Project drawdown.
MBIS13	153	Leichhardt coal seam	Compliance	Located 2km to the east of the pit shell in a potential zone of Project drawdown.
MBIS15	52	Leichhardt coal seam	Compliance	Shallow groundwater monitoring along Isaac River and HSE Wetland. The bore is located more than 2 km to the east of the pit shell.
MBIS18	150	Leichhardt coal seam	Interpretation	Located over 2 km to the southeast of the pit shell outside of Project MLAs.
MBIS03	181	Vermont coal seam	Compliance	Mining impacts northeast of the pit
MBIS09	96.41	Vermont coal seam	Compliance	Mining impacts south of the pit.
MBIS16	69.19	Vermont coal seam	Interpretation	Located over 2 km to the south of the pit shell.
MBIS19	86	Isaac Thrust Fault core (RCM)	Interpretation	Monitoring on the Isaac Thrust Fault southeast of the pit outside of Project MLAs.
MB08b	84.2	Fort Cooper Coal Measures	Interpretation	Located more than 2 km to the northwest and upgradient of the pit shell. Not anticipated to be significantly impacted by Project mining related drawdown.
MB09B	36	Fort Cooper Coal Measures	Interpretation	Located over 1km to the east and upgradient of the pit shell. Not anticipated to be significantly impacted by Project mining related drawdown.



0 500 1000 1500 2000 2500

Metres

Datum:	GDA2020 Zone 55
Scale:	See Scale Bar
Date:	4/06/2026 1:05 PM
Drawn:	Minserve
Source:	SLR
File:	20260527 GMMP Monitoring Network.aprx

DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.

LEGEND

- Waterway
- Roads
- ML
- IDE Project MLAs
- Proposed Project Disturbance Area
- Project Pit Extent

stanmore

ISAAC DOWNS EXTENSION

Project GMMP Monitoring Network

Figure | **24-99**

24.15.3.4 Groundwater Level Triggers

The development of groundwater level triggers involves two key components, the calculation of 'reference level' values based on statistical analysis of the available groundwater level monitoring dataset and the derivation of 'groundwater level trigger thresholds' informed by numerical groundwater modelling. The groundwater level values for each bore are calculated as follows:

- Reference level is the bore specific groundwater level that all future groundwater level measurements will be compared to for the purpose of calculating actual groundwater drawdown. The reference level is derived on the basis of historic groundwater level monitoring data.
- Level trigger threshold is the derived from the predictive groundwater modelling at each bore location, such that an exceedance of the level trigger threshold represents greater groundwater level impact than predicted by modelling.
- Trigger level elevation is calculated by subtracting the level trigger thresholds from the reference levels at each bore.

The time series plots and analysis for each compliance bore reveals that groundwater levels are highly variable, primarily driven by natural causes (i.e. climate variability and response to rainfall). Furthermore, the relatively large range between the maximum and minimum groundwater levels highlights that groundwater level change compliance criteria need to appropriately recognise the significant variability in groundwater levels. Therefore, it is proposed to adopt the 20th percentile of the baseline dataset summary statistics as the reference level values, similar to the approach proposed within DES (2021) for establishing statistically appropriate groundwater quality triggers. Adoption of the 20th percentile allows consideration of the historic variability in groundwater levels when proposing a bore specific groundwater level that will be compared to model predictions for compliance purposes.

Level trigger thresholds have been based on the following criteria:

- Based on the maximum predicted cumulative drawdown for each bore. Drawdown values are derived from the best-calibrated model realisation at each bore location, within the relevant model layer, over the life of the mine.
- Where the proposed level trigger threshold would result in a level trigger elevation below the base of the model layer, then the level trigger threshold has been limited to drawdown to the base of the model layer.

The proposed reference level values, level trigger threshold and trigger level elevation for the compliance bores are presented in Table 24-23.

Table 24-23 Groundwater Level Trigger Thresholds

Proposed Compliance Bore	Formation monitored	Designation	Reference level (mAHD)	Level Trigger Threshold (m)	Trigger Level Elevation (mAHD)
MBID23	Alluvium	Compliance	186.03	1.50[1]	184.5
MBID28	Alluvium	Compliance	187.27	3.47[1]	183.8
MBIS04	Alluvium	Compliance	184.89	4.28[1]	180.6
MBIS07	Alluvium	Compliance	na		
MBIS20	Regolith	Compliance	186.56	7.60[1]	179.0
RN182851	Regolith	Compliance	194.77	13.38	181.4
MBIS10	Regolith	Compliance	170.44	9.64	160.8
MBIS02	Leichhardt coal seam	Compliance	186.67	25.86	160.8

Proposed Compliance Bore	Formation monitored	Designation	Reference level (mAHD)	Level Trigger Threshold (m)	Trigger Level Elevation (mAHD)
MBIS05	Leichhardt coal seam	Compliance	184.74	15.50	169.2
MBIS08	Leichhardt coal seam	Compliance	190.35	10.31	180.0
MBIS11	Leichhardt coal seam	Compliance	185.54	13.08	172.5
MBIS13	Leichhardt coal seam	Compliance	182.93	12.82	170.1
MBIS15	Leichhardt coal seam	Compliance	183.02	3.05	180.0
MBIS03	Vermont coal seam	Compliance	187.18	28.03	159.2
MBIS09	Vermont coal seam	Compliance	188.73	13.74	175.0
1. Maximum drawdown limited to base of model layer. Note: MBIS07 has not been given a water level trigger as the water level trigger elevation falls below the screen of the bore. MBIS07 is used for groundwater quality compliance only					

24.15.3.5 Groundwater Quality Limits

Groundwater quality limits for compliance bores have been established in accordance with the DES (2021) guideline 'Using monitoring data to assess groundwater quality and potential environmental impacts'. The general approach detailed in DES (2021), to use or derive site specific groundwater quality limits, is as follows:

- Determine summary statistics (i.e. 20th, 50th, 80th and 95th percentiles) for each bore and each indicator using all available validated data.
- Identify relevant default guidelines and WQOs (see Section 24.5.6.3).
- Determine whether the site-specific groundwater guidelines are more appropriate than existing default guidelines and WQOs through the following:
    - Compare the 20th (for pH lower guideline) and 80th percentile of the dataset to the relevant guidelines. DES (2021) states that where multiple EVs (with associated water quality guidelines) have been identified for an area of interest, groundwater quality should be managed to comply with the most conservative water quality guideline so that the most sensitive EV is protected.
    - Where insufficient data is available to derive a trigger value (e.g. fewer than 8 samples or where more than 15% of results were reported at the limit of reporting), the relevant ANZG 2018 guideline value, or other available guideline value (where ANZG 2018 value is not available) has been adopted as an interim limit.
    - Determine appropriate site-specific limits. The limits are appropriate if they are sufficiently conservative to measure whether an environmental impact could occur, but do not result in false non-compliances.
    - If the 80th percentile aligns closely with the default guideline or WQO, the default guideline WQO value should be adopted.

- If the 80th percentile is substantially lower than the default guideline WQO, a site specific value may be adopted. However, for toxicants, the default guideline may still apply where it is more conservative.
- If no default guideline WQO exists, the 80th percentile may be used as a site specific guideline, subject to regulatory acceptance.
- If the 80th percentile exceeds the default guideline WQO, a site specific value may be adopted where it better reflects local hydrochemical conditions.

Groundwater monitoring data analysis for the Project has included all sampling events to the end of 2025, noting that some bores have less than 8 samples. Therefore, interim trigger values have been developed based on consideration of the available data and default guideline WQO values. Additionally, some bores with fewer than eight data points show two or more exceedances of the ANZG 2018 guideline values, which have been adopted as interim trigger criteria. In these cases, 'TBA' has been included in Table 24-25 as it is proposed that these trigger values be reassessed once additional data become available to ensure they are representative of meaningful hydrochemical conditions.

The monitoring bore network will continue to be monitored and final 'limits' will be developed when a sufficient number of representative samples have been obtained from each bore.

The analytes for which groundwater quality limits have been developed, were based on the potential impacts of the Project (noting that groundwater quality impacts are unlikely, as described in Section 24.14.3), and their relevance to protect identified EVs.

Table 24-24 provides the groundwater quality parameters proposed for monitoring, whether the parameters require limits or are for reference / interpretation purposes only, and justification for the parameter selection.

The following parameters will be monitored as part of the GDEMMP (Section 24.15.4) at bores relevant to the GDEMMP for the context of vegetation health.

- salinity
- dissolved oxygen
- pH
- nitrogen
- phosphorous
- organic carbon.

The proposed groundwater quality limits for each bore for each parameter, based on the methodology described above, are provided in Table 24-25. Based on this methodology and the statistical data analysis, site specific values have been proposed for some parameters for two bores, MBID23 and MBID28.

Table 24-24 Proposed Parameters for Groundwater Quality Limits

Parameter	Limit required	Justification
Physiochemical parameters		
pH	Yes	Standard parameter, identified in DEHP (2011) and ANZG (2018) for the relevant EVs
EC	Yes	Standard parameter, identified in DEHP (2011)
TDS	No	Standard parameter, identified in ANZG (2018) for the stock watering (cattle) EV.
Metal and metalloids (Dissolved)		
Aluminium	Yes	Identified in ANZG (2018) for the relevant EV's
Arsenic	Yes	Identified in ANZG (2018) for the relevant EV's

Parameter	Limit required	Justification
Boron	Yes	Identified in ANZG (2018) for the irrigation EV
Cadmium	Yes	Identified in ANZG (2018) for the relevant EVs
Chromium	Yes	Identified in ANZG (2018) for the relevant EVs
Cobalt	Yes	Identified in ANZG (2018) for the irrigation EV
Copper	Yes	Identified in DEHP (2011) and in ANZG (2018) for the relevant EVs
Iron	Yes	Identified in DEHP (2011)
Lead	Yes	Identified in ANZG (2018) for the relevant EVs
Manganese	Yes	Identified in DEHP (2011) and in ANZG (2018) for the relevant EVs
Mercury	Yes	Identified in ANZG (2018) for the relevant EVs
Molybdenum	Yes	Identified in ANZG (2018) for irrigation EV
Nickel	Yes	Identified in ANZG (2018) for the relevant EVs
Uranium	Yes	Identified in ANZG (2018) for the relevant EVs
Silver	Yes	Identified in ANZG (2018) for the relevant EVs
Zinc	Yes	Identified in DEHP (2011) and in ANZG (2018) for the relevant EVs
Major Ions		
Sulphate	Yes	Identified in DEHP (2011) and in ANZG (2018) for stock watering (cattle) EV
Calcium	No	Identified in DEHP (2011) and in ANZG (2018) for stock watering (cattle) EV
Magnesium	No	Identified in DEHP (2011) and in ANZG (2018) for stock watering (cattle) EV
Potassium	No	To be monitored for interpretative purposes only, not identified in any relevant guideline for the relevant EVs
Carbonate	No	To be monitored for interpretative purposes only, not identified in any relevant guideline for the relevant EVs
Bicarbonate	No	To be monitored for interpretative purposes only, not identified in any relevant guideline for the relevant EVs
Sodium	No	Identified in DEHP (2011) and in ANZG (2018) for stock watering (cattle) EV
Chloride	No	Identified in DEHP (2011) and in ANZG (2018) for stock watering (cattle) EV
Non-Metallic Elements		
Nitrate	Yes	Identified in DEHP (2011)

Table 24-25 Interim Groundwater Quality Limits for Compliance Bores

Analyte	pH (Field)	EC (Lab)	SO4	[1]NO_3 as N	Ag	Al	As	B	Cd	Co	Cu	Cr	Fe	Hg	Mo	Mn	Ni	Pb	U	Zn
Unit	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MBID23	6.5 to 8.5[a]	8910[d]	318[d]	3.26[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	0.784[e]	0.0006[a]	0.1[b]	1.788[e]	0.014[a]	0.0034[a]	0.0158[e]	0.06[d]
MBID28	6.38 to 6.85[e]	8910[d]	318[d]	3.26[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0062[a]	0.001[a]	0.784[e]	0.0006[a]	0.1[b]	1.83[e]	0.011[a]	0.0034[a]	0.004[b]	0.3214[e]
MBIS04	6.5 to 8.5[a]	8910[d]	318[d]	3.26[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	TBA	0.0006[a]	0.1[b]	TBA	0.011[a]	0.0034[a]	0.002[b]	TBA
MBIS07	6.5 to 8.5[a]	8910[d]	318[d]	3.26[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	0.14[d]	0.0006[a]	0.1[b]	TBA	0.011[a]	0.0034[a]	0.002[b]	0.008[c]
MBIS20	6.5 to 8.5[a]	8910[d]	TBA	3.26[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	TBA	TBA	TBA	TBA	0.14[d]	0.0006[a]	0.1[b]	TBA	0.011[a]	0.0034[a]	0.002[b]	TBA
RN182851	6.5 to 8.5[a]	16000[d]	TBA	1.12[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	TBA	0.0006[a]	0.1[b]	TBA	0.011[a]	0.0034[a]	0.002[b]	TBA
MBIS10	6.5 to 8.5[a]	16000[d]	398[d]	1.12[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	0.246[d]	0.0006[a]	0.1[b]	0.291[d]	0.011[a]	0.0034[a]	0.002[b]	TBA
MBIS02	6.5 to 8.5[a]	16000[d]	398[d]	1.12[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	0.246[d]	0.0006[a]	0.1[b]	TBA	0.011[a]	0.0034[a]	0.002[b]	TBA
MBIS05	6.5 to 8.5[a]	16000[d]	398[d]	1.12[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	0.246[d]	0.0006[a]	0.1[b]	0.291[d]	0.011[a]	0.0034[a]	TBA	TBA
MBIS08	6.5 to 8.5[a]	16000[d]	398[d]	1.12[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	TBA	0.0006[a]	0.1[b]	0.291[d]	0.011[a]	0.0034[a]	0.002[b]	0.008[c]
MBIS11	6.5 to 8.5[a]	16000[d]	398[d]	1.12[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	0.246[d]	0.0006[a]	0.1[b]	0.291[d]	TBA	0.0034[a]	0.002[b]	TBA
MBIS13	6.5 to 8.5[a]	16000[d]	398[d]	1.12[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	0.246[d]	0.0006[a]	0.1[b]	0.291[d]	0.011[a]	0.0034[a]	0.002[b]	TBA
MBIS15	6.5 to 8.5[a]	TBA	TBA	1.12[d]	0.05[a]	0.055[a]	0.024[a]	TBA	0.0002[a]	0.1[b]	TBA	TBA	TBA	0.0006[a]	0.1[b]	0.291[d]	0.011[a]	0.0034[a]	TBA	TBA
MBIS03	6.5 to 8.5[a]	16000[d]	398[d]	1.12[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	0.246[d]	0.0006[a]	0.1[b]	0.291[d]	0.011[a]	0.0034[a]	0.002[b]	0.008[c]
MBIS09	6.5 to 8.5[a]	16000[d]	398[d]	1.12[d]	0.05[a]	0.055[a]	0.024[a]	0.5[b]	0.0002[a]	0.1[b]	0.0014[a]	0.001[a]	TBA	0.0006[a]	0.1[b]	0.291[d]	0.011[a]	0.0034[a]	0.002[b]	TBA

1. Guideline values reported as NO3 values have been converted to NO_3 as N to align with the sampling results.
a. Aquatic Ecosystem (95% Protection) (ANZG, 2018)
b. Irrigation (Fitzroy Basin WQO)
c. Stock (Fitzroy basin WQO)
d. Lower Isaac River (zone 34) (DEHP, 2011)
e. Site specific 80th percentile values.

24.15.3.6 Exceedance Investigations

The level trigger threshold is used to establish a level of drawdown in the draft EA (**Appendix AA**) and draft PRCP schedule (**Appendix AC**) that, if exceeded, would require an investigation.

A groundwater quality limit exceedance is identified where a bore-specific groundwater quality limit is exceeded on three consecutive sampling occasions. A groundwater level trigger exceedance is identified where measured groundwater levels at a bore indicate drawdown greater than the level trigger threshold.

An investigation into exceedances of groundwater level triggers or groundwater quality limits will involve determination of whether the exceedance is a result of:

- mining activities authorised under this environmental authority
- seasonal/natural variation
- neighbouring land use resulting in groundwater impacts
- any other potential cause.

Investigations will consider relevant monitoring data, groundwater flow conditions, baseline information, site activities, natural conditions and bore integrity.

Where an exceedance is determined to be caused by the Project's mining activities, then a further investigation will be undertaken to determine whether environmental harm has occurred or may occur, and the extent thereof. If the investigation determines that environmental harm has occurred, or may occur, the following actions will be taken after completing the investigation:

- implementation of measures as soon as reasonably practicable to reduce environmental harm including potential environmental harm
- development of long-term mitigation measures to address any existing groundwater contamination and prevent recurrence of groundwater contamination which is implemented in a reasonable time period
- if environmental harm has occurred as a result of groundwater drawdown exceedances:
    - determine any actions required to reduce the potential for environmental harm
    - determine any mitigation measures required to limit the drawdown in the affected groundwater resource.

24.15.3.7 Monitoring Regime – Post-Mining

The GMMP will continue during the post mining period until relinquishment of Project's MLs, except where additional requirements are identified through implementation of the PRCP schedule. As part of the post mining phase, the monitoring program will also include additional monitoring for the void lake as follows:

- Void water level - quarterly survey consistent with the frequency of groundwater level monitoring at groundwater bores.
- Void water quality – quarterly sampling consistent with the frequency and parameter suite for groundwater quality monitoring at groundwater bores.

24.15.3.8 Quality Assurance / Quality Control

The quality assurance and quality control procedures that will be adopted for the Project's GMMP are described in Section 6 of **Appendix AE**.

24.15.3.9 Reporting, Review and Improvement Process

During the life of Project operations, data collected through the GMMP will be used to assess the Project's impact on groundwater resources, and if deemed necessary update and refine the numerical groundwater model and its predictions of future impacts. These outcomes will in turn be used to review

and improve the GMMP through a continual reporting, review and improvement process as described in Section 8 of **Appendix AE**. In summary this includes:

- An annual groundwater monitoring report, assessing the results of monitoring and a review of the conceptual and numerical groundwater models.
- Periodic review of the GMMP, with the GMMP modified to reflect updated conditions or improved knowledge.
- Maintenance of the monitoring bores, with installation of new or replacement bores as required.

24.15.4 Groundwater Dependent Ecosystems

24.15.4.1 Disturbance Area Management

As identified in Section 24.14.5.2, there are approximately 6.8 ha of mapped GDEs within the proposed disturbance area, associated with the bridge crossing of the Isaac River, dragline walk route crossing of the Isaac River and tie in point of the Conrock Gully diversion with the Isaac River. The proposed design, construction and rehabilitation methodologies for this infrastructure are described in Section 4.12 and Section 4.14 of **Chapter 4**. In all instances the actual disturbance width needed for construction is likely to be less than the nominated disturbance area, which has been done to allow some flexibility in location during the detailed design phase. Nevertheless, all disturbance within the proposed disturbance area has been considered a direct impact in the terrestrial ecology assessment (see **Chapter 25**), with all GDE areas also mapped as habitat for listed threatened species, and as a result, have been assessed as likely to be significantly impacted. Hence all GDEs in the proposed disturbance area are included in the areas requiring biodiversity offsets (see **Chapter 25**).

Furthermore, all impacted GDE areas will be subject to rehabilitation with a post mining land use of riparian vegetation, as per the PRCP (see **Appendix AB**). In the case of the Isaac River bridge, rehabilitation will occur following completion of operations, with localised rehabilitation around construction areas that are not part of the operational area. For the temporary dragline crossing, rehabilitation will be staged with an interim rehabilitation stage between the pre-mining and post-mining dragline walks, and a final rehabilitation stage following operations. For the diversion tie-in point, rehabilitation will commence following diversion construction, which is early in the mine life.

24.15.4.2 Water Management

The Projects water management systems are described in detail in Section 24.7. These systems are design to protect downstream environmental values, including GDEs with dependence of surface water flows.

The water management strategy involves separating mine affected water, sediment water, and clean water, and applying appropriate management to each water type. Mine affected water (MAW) will be collected in the pit and transferred to the primary MAW dam. Two smaller MAW dams will collect runoff from the ROM pads, which will then be pumped to the primary MAW dam. MAW will be used for either dust suppression or piped to IDM or IPM if in excess. Alternatively, MAW will be released in a controlled manner to the Isaac River based on flows and water quality in the receiving environment to protect downstream water quality. MAW releases to the Isaac River will be specified and controlled by the Project's EA.

Sediment water, which is primarily runoff from overburden dumps before and during the rehabilitation stages, will be captured in sediment dams, which will be designed in accordance with relevant engineering standards to allow sediment settlement before water release. Water from sediment water storages will be used preferentially for dust suppression. In contrast, clean water from upgradient of the mining activities will be diverted around the mining activities into the Isaac River, Cherwell Creek and Conrock Gully diversion.

As demonstrated in Section 24.13, the design of levee and diversion infrastructure will have a negligible to minor impact on hydrology and geomorphology and hence this serves to mitigate potential impacts on GDEs with dependence of surface water flows.

24.15.4.3 Groundwater Monitoring and Management

A GMMP has been prepared for the Project and is described in Section 24.15.3. The GMMP demonstrates that a comprehensive groundwater monitoring network will be maintained throughout the Project life. Monitoring covers all the major groundwater units, including the alluvial aquifer, regolith, and coal seams. The primary purpose of the groundwater monitoring network will be to enable the detection and distinction of natural groundwater fluctuations from groundwater-level impacts associated with the de-watering of aquifers impacted by the Project.

24.15.4.4 Groundwater Dependent Ecosystem Monitoring and Management

24.15.4.4.1 Overview

A GDEMMP has been prepared for the Project (**Appendix AF**). This section summarises the key aspects of the GDEMMP, with details provided in **Appendix AF**. The GDEMMP presents a monitoring and management measures that are specific, measurable, achievable, reasonable / relevant and time specific.

The GDEMMP may be endorsed or approved by DETSI and / or DCCEEW as part of the approval for the Project under the EP Act or EPBC Act, respectively.

The GDEMMP addresses and manages any uncertainties associated with the potential impacts of the Project on GDEs, through the development of consistently applied monitoring actions, analysis and reporting of data trends, and development of 'early warning' triggers to identify if a decline in GDE health occurs. Corrective actions are described and will be implemented when statistically significant impacts on GDE function caused by Project activities are detected.

The IDM GDEMMP (3d Environmental, 2020b), and subsequent monitoring and assessments for IDM provide the basis for the methods proposed within the Project's GDEMMP. It is intended that IDM and Project GDEMMPs be complementary, monitoring the potential cumulative impacts associated with proposed and existing mining operations.

This GDEMMP provides a framework for the management and monitoring of GDEs associated with the Isaac River, Cherwell Creek and HES wetland including areas both within the area of predicted groundwater drawdown, and more broadly throughout the watercourse frontage, upstream and downstream from the Project area. A sequential approach to monitoring and management has been applied which allows for adaptive implementation of monitoring and management protocols reliant on results of prior assessment activities. The major components of the GDEMMP are:

- Apply monitoring and assessment techniques that support development of an environmental baseline for GDE function commencing prior to operations, including upstream and downstream control sites for GDE monitoring.
- Produce a statistically robust multi-parameter dataset that can be used to validate perturbations in GDE function that fall beyond thresholds of natural seasonal variation.
- Allow a flexible approach to monitoring which is subject to ongoing review and allows methods to be adapted based on results of lead-up monitoring and data analysis.
- Utilise biophysical and ecological parameters to establish an appropriate ecological trigger threshold, applied to indicate requirement for further investigation or corrective action.
- Develop a suite of management actions and corrective measures which can be applied if a breach of trigger threshold is identified.

The GDEMMP has been separated into two stages:

1. Two years of intensive data collection during which investigative thresholds will be defined.

2. The period after 2 years, comprising the remainder of operations and the post mining period, which will utilise data collected in the initial two years to re-assess the thresholds.

The thresholds for impact are linked to vegetation health and provide a comparison between the control and impact sites. Should the established thresholds be exceeded, this will trigger an investigation that will make use of other monitoring data on the bio-physical function of vegetation, groundwater, and surface water to determine the cause of a threshold exceedance. If drawdown of the groundwater table is found to be the cause of the threshold exceedance, then mitigation measures will be implemented, and the effect of mitigation measures monitored. If mitigation measures are not effective, habitat quality data from the GDE Habitat Quality Monitoring Program (Section 24.15.4.6) will be used to assess whether there is a significant residual impact to habitat for listed species requiring biodiversity offsets.

24.15.4.4.2 Monitoring and Analysis Techniques

Section 8 of **Appendix AF** provides a detailed description of the following monitoring methods, which were also used for the Project's GDE field surveys (see Sections 24.4.2 and 24.6.3):

- leaf area index (LAI)
- LWP
- SMP
- normalised difference vegetation index (NDVI) image capture
- stable isotope assessment of twig xylem, soil, surface water, and groundwater.

These methods will complement ongoing groundwater and surface water monitoring.

Statistical analysis will need to consider interactions between multiple datasets to establish baseline conditions and allow identification of statistically significant deviations from these conditions that may be associated with Project mining activities. The most critical interactions will be between biotic health (typically measured in LAI, LWP, and NDVI) and abiotic factors such as groundwater levels and salinity. Statistical tests applied to analysis of data will depend on whether datasets are normally distributed and may include bivariate analysis of two datasets (e.g. NDVI and LAI) applying a Pearson or Spearman Correlation. 'T-tests' will be applied to identify significant differences in mean values between sampling localities. More complex statistical analysis may be applied if investigative actions are required including multivariate analysis of variance (PERMANOVA) to interacting datasets.

The overriding purpose of the data collection and subsequent statistical analysis is to provide representation of natural variation in the system applied to both biotic factors and abiotic controls and allow appropriate trigger thresholds to be proposed.

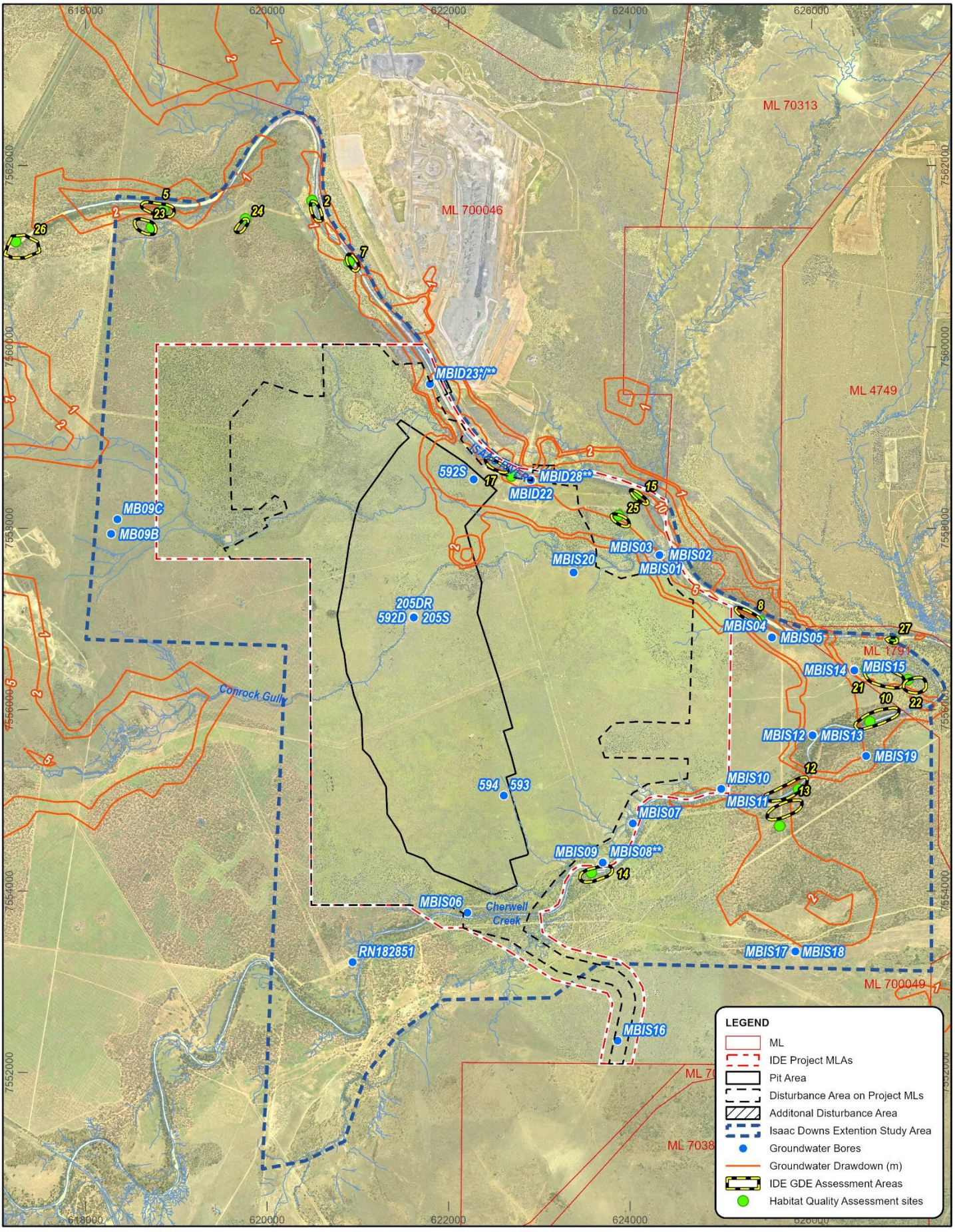
24.15.4.4.3 GDE Assessment Sites

The proposed GDEMMP assessment sites are shown in Figure 24-100. The assessment sites cover:

- Isaac River alluvium and riparian fringe (RE 11.3.25) (8 sites including an upstream and downstream control site)
- Cherwell Creek alluvium and riparian fringe (RE 11.3.25) (3 sites)
- HES Wetland (RE 11.3.27b) (1 site)
- Poplar Box TEC (RE 11.5.3), noting that this is not an identified GDE (2 sites)
- Brigalow TEC (RE 11.3.1 and RE 11.4.9), noting that this is not an identified GDE (3 sites).

Data collection will occur across all assessment sites, including the riverine and wetland GDEs, with upstream and downstream control sites positioned outside the modelled cumulative drawdown extent of the alluvial aquifer, as far as practical. Sites have been selected with consideration of related/nearby groundwater monitoring bores and terrestrial habitat quality sites, as shown in Figure 24-100. Where possible, sample points for base the GDE assessment (Figure 24-7) and GDEMMP utilise the same assessment sites, particularly trees, to maintain dataset continuity. Table 8-2 of **Appendix AF** provides a

detailed analysis of the GDE assessment sites, and nearby groundwater monitoring bores and habitat quality monitoring locations, demonstrating the integration of these monitoring programs.



0 250 500 750 1000 1250
Metres

Datum:	GDA2020 Zone 55
Scale:	See Scale Bar
Date:	5/06/2026 2:10 PM
Drawn:	Minserve
Source:	Watermark Ecohydrology
File:	20260511 GDEMMP Assessment Sites.aprx

DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.

stanmore

ISAAC DOWNS EXTENSION

GDEMMP Assessment Sites

Figure | **24-100**

24.15.4.4.4 Monitoring Phases, Reporting and Review

Reporting will be prepared at the completion of each monitoring event describing the findings of monitoring.

Bi-annual baseline monitoring (four events covering two wet seasons and two dry seasons) will be undertaken for a two-year period, commencing November 2025 (dry season), and then planned for early / mid 2026 (wet season), late 2026 (dry season) and early / mid 2027 (wet season). At the completion of four baseline monitoring events, a consolidated report will be prepared which provides a synopsis of the data collected, including correlations between parameters and statistical analysis (where possible) of seasonal ecological function.

The aim of the four-event intensive data collection period is to determine the range of natural seasonal variation in the measured parameters, particularly LWP and LAI which are fundamental indicators of plant stress. These parameters can be correlated to the NDVI signature, which will allow future monitoring to be undertaken remotely at an 'on demand' basis, supplemented with field assessment.

Following completion of the baseline monitoring program, NDVI will be captured on an annual basis during the height of dry season (nominally October/November) to support ongoing monitoring of GDE health. NDVI threshold values will be calculated from correlations to LAI established during the baseline assessment and annually checked for statistically significant threshold exceedance events that affect the impact site, in the absence of similar affects at the control site. The NDVI capture will be supplemented with field assessment measuring LAI and LWP at dedicated monitoring localities including control and impact sites on a two-yearly basis, at the peak of the dry season (typically October to November).

A monitoring event that includes field assessment of monitoring parameters will be undertaken to coincide with completion of mining at the Project. Follow up field survey periods will occur two, four and six years after operations. Capture of NDVI datasets will be completed on an annual basis for the approximate six-year period. Considering the impact of groundwater drawdown on vegetation health can take several years to manifest, a period of six years, or until rehabilitation is successfully completed, should be a sufficient to capture any trend for declining vegetative health that is the result of Project mining activity.

24.15.4.4.5 Triggers for Investigative Action

LAI is proposed as the primary monitoring parameter. A decrease in LAI is an initial indicator of vegetative stress. LAI is a precursor to more intensive impacts to habitat values. LAI varies on a seasonal basis dependent on water availability.

Following the outcomes of the IDM Baseline Assessment Review (3d Environmental, 2023), a preliminary threshold of the 20th percentile of the relevant LAI values is proposed as a preliminary threshold indicator of vegetative stress for the GDEMMP, to be confirmed during the two year baseline monitoring period. NDVI is to be used as a supplementary measure to support investigative actions.

Figure 24-101 details the process and decision framework from initial data collection through to corrective actions in the case that a threshold breach can be linked to Project activity. The initial two years of the assessment covers wet and dry season surveys, to provide a baseline against which future vegetation condition trends can be assessed. At each stage, decision pathways are provided when threshold breaches are identified, including requirements for investigative action and corrective measures where causal factors can be linked to mining activity. Corrective actions, including potential requirement for biodiversity offsets, are discussed in Section 24.15.4.5.

Following the two-year baseline assessment, statistical correlation between various assessment parameters will be drawn, particularly the relationship between LAI and NDVI to allow ongoing monitoring to be completed remotely on an annual basis, and trigger thresholds to be adapted. The full suite of parameters collected during the baseline assessment period, with their relevance, intended application

in both the baseline assessment and longer-term monitoring program is provided in Table 10-1 of **Appendix AF**. However, NDVI may be proposed as the primary method for detecting changes in vegetation condition if the correlation between LAI and NDVI is robust. Following the two-year baseline assessment period, subsequent field data collection will be completed in the dry season to determine if the condition threshold is exceeded and, if exceeded, trigger the flow chart process in Figure 24-101 for investigation, mitigation (corrective action) and / or offsets.

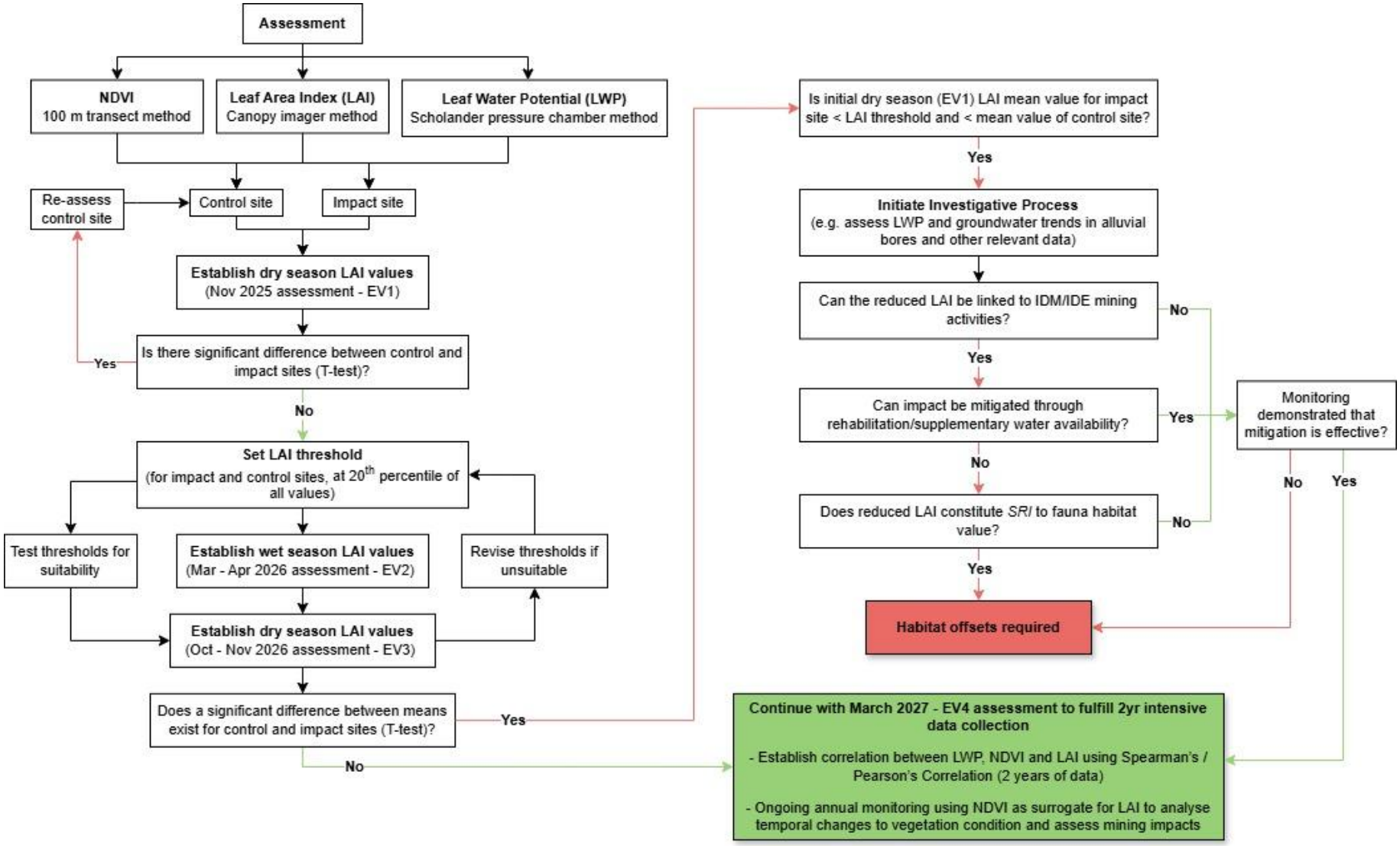


Figure 24-101 GDE Monitoring, Assessment and Decision Process

24.15.4.5 Potential Corrective Actions and Adaptative Management Measures

Section 11 of **Appendix AF** describes the potential corrective actions should GDE monitoring and data analysis detect a statistically defined decline in GDE health. These actions are:

- Restoration of tree water supply through direct injection or infiltration of surface waters.
- Infill planting.

Direct injection is likely to be practical for localised areas where impacts are detected in scattered trees or scattered groups of trees rather than application in broader scale impact mitigation. This method may be particularly suitable for any unexpected impacts to the HES Wetland habitat, where the deep sand layer below the wetland habitat provides a suitable substrate to capture, hold and attenuate any injected water.

It may be possible to restore water supply in critical portions of the tree root zone through enhancing natural infiltration involving flooding a shallow trench with suitable water.

Infill planting is recommended using River red gum (*Eucalyptus camaldulensis*) and forest red gum (*Eucalyptus tereticornis*), which are ecologically adaptable. Small scale trials may commence in areas subject to initial Project disturbance of GDEs (e.g. Isaac River crossings), through planting of forest red gum seedlings into existing canopy gaps. This will require some maintenance through drier periods until seedlings have established. Trials do not need to be extensive and should focus on the capacity of the species to survive, through planting of scattered trees into existing canopy gaps.

Corrective actions, should they be required, will be monitored using the monitoring methods described in the GDEMMP. Infill planting will be monitored on a regular basis during establishment (e.g. monthly then annually).

24.15.4.6 Groundwater Dependent Ecosystem Habitat Quality Monitoring Program

24.15.4.6.1 Overview

The GDE Habitat Quality Monitoring Program (GDEHQMP) (**Appendix AG**) has been prepared to complement the GDEMMP (Section 24.15.4.4). The GDEHQMP utilises information from the terrestrial ecology assessment (**Appendix P**, **Chapter 25**) to determine the habitat types for matters of national environmental significance (MNES) and matters of state environmental significance (MSES) that may be linked to GDEs.

The purpose of the GDEHQMP is to identify if potential changes to GDE health (as determined by the GDEMMP) result in a decline in habitat quality that are likely to result in a significant impact on MNES and MSES associated with GDEs. The GDEHQMP describes the following:

- A monitoring methodology to assess habitat quality within identified GDEs and, as a precautionary measure, surrounding vegetation types that are not identified as GDEs.
- The establishment of baseline ecological condition within these vegetation communities prior to Project activities impacting groundwater (e.g. overburden removal).
- Procedures for ongoing monitoring of habitat quality within these vegetation communities during the Project to detect changes over time and assess the effectiveness of management measures, as described in the GDEMMP.
- A definition of trigger thresholds for habitat quality changes, and indicators of vegetation stress, which will trigger further assessment of the likelihood of significant impacts to MNES and MSES.

The GDEHQMP may be endorsed or approved by DETSI and / or DCCEEW as part of the approval for the Project under the EP Act or EPBC Act, respectively.

24.15.4.6.2 GDEs and Associated MNES and MSES

Based on the mapping of GDEs (see Figure 24-20) and terrestrial ecology mapping (see **Chapter 25**), the REs associated with GDEs are:

- RE11.3.25 (wet eucalypt woodlands on alluvial plains and drainage lines), found along the riparian fringe of the Isaac River and Cherwell Creek
- RE11.3.27b (ephemeral wetlands), found at the HES wetland.

Based on the terrestrial ecology assessment (**Chapter 25**), the MNES and MSES that are associated with these REs are described in Table 24-26, and shown in Map 3 and Map 4 of **Appendix AG**, respectively.

In addition to the MNES and MSES shown to be associated with GDEs, monitoring will also occur in other vegetation types and habitats that formed part of the GDE assessment, namely:

- Brigalow TEC (also Prescribed REs that are an endangered or of concern RE)
- Poplar Box TEC (also Prescribed REs that are an endangered or of concern RE)
- Ornamental Snake habitat.

Table 24-26 GDEs, REs and Associated MNES and MSES

RE	Vegetation Community	Associated MNES Values (Map 3 Appendix AG)	Associated MSES Values (Map 4 Appendix AG)
11.3.25	Wet eucalypt woodlands on alluvial plains and drainage lines	Squatter Pigeon habitat, Koala habitat, Greater Glider habitat	Prescribed RE within the defined distance from the defining banks of a relevant management watercourse map, Essential Habitat and Protected Wildlife Habitat (the same as MNES species)
11.3.27b	Ephemeral wetlands	Squatter Pigeon habitat, Koala habitat, Greater Glider habitat, Australian Painted Snipe habitat, Common Greenshank habitat, and Sharp-tailed Sandpiper habitat	Prescribed RE that intersects with an area shown as a wetland on the vegetation management wetlands map, HES wetland, Essential Habitat and Protected Wildlife Habitat (the same as MNES species)

24.15.4.6.3 Monitoring Program

The GDEHQMP comprises the baseline assessment period prior to Project activities impacting groundwater, and ongoing monitoring to assess changes in GDE health and habitat quality during operations and closure.

The monitoring methodology will utilise the same habitat quality scoring methodologies that informed terrestrial and offset assessments for the Project, undertaken in accordance with Commonwealth and State guidelines (see Section 2.1.1 and Section 2.3.1 of **Appendix AG**). The methodology will include assessment of site-based attributes, site-context attributes and species stocking rates. These components will be used to calculate habitat quality scores for relevant MNES and MSES habitat values and to provide a consistent basis for assessing changes in habitat quality over time. This habitat quality scoring methodology has been selected as it provides quantitative measures of vegetation composition, structure and ecological function, while also incorporating species-specific habitat characteristics. This enables an assessment of the capacity of GDE habitats to support MNES and MSES values.

The habitat quality scoring methodology supports consistency with the approach used to inform determinations of whether impacts to MNES and MSES associated with GDEs are determined to be

significant. As such, the habitat quality scores derived through the GDEHQMP may be used to support future assessment of Project-related impacts and, where required, subsequent biodiversity offset calculations.

The proposed GDEHQMP monitoring sites are shown in Figure 24-100, and were selected for consistency with the GDEMMP monitoring sites. This allows for the results from the two monitoring programs to be used in conjunction for interpretation of findings. There are 17 permanent habitat quality monitoring sites, comprising impact and control sites, to enable the detection of changes in habitat quality and to distinguish potential Project-related impacts from broader regional changes (e.g. drought) not attributable to the Project. The monitoring sites are located in all vegetation communities and habitat types identified in Section 24.15.4.6.2.

The baseline assessment will occur biannually (wet season and dry season) for at least 2 years, and will derive average habitat quality scores for each monitoring site and relevant MNES and MSES values. These scores will establish the baseline condition against which future ongoing monitoring results can be compared. The ongoing monitoring program will occur biennially (every two years), during the dry and wet seasons.

24.15.4.6.4 Thresholds and Actions

The nominated threshold criteria for GDEs linked to MNES and MSES values represents a substantial reduction in habitat quality and serves as a trigger for assessment of the likelihood of significant impacts and potential offset requirements.

The threshold criteria is linked to habitat quality scoring (out of 10), where a decline in score of more than two points relative to the site's baseline score represents a material change in ecological condition beyond expected short-term seasonal variation. This decline is considered to represent a potentially significant decline in vegetation community or habitat condition. When the threshold is exceeded, this will trigger additional investigation into whether the decline in score is a result of Project activities, the likelihood of significant impacts to MNES and MSES (where the decline in score is Project related) and whether offsets are required to compensate for significant impacts.

Where threshold criteria are exceeded, a staged response will be implemented to verify the monitoring result, determine the likely cause of the change, and identify the appropriate management response, including:

- Verification of monitoring results.
- Assessment of the likely cause (i.e. whether related to Project impacts to groundwater) and correlation with results on GDE health from the GDEMMP. Additional field verification may be undertaken to confirm the observed change and determine any changes in species stocking rates.
- Implementation of management and mitigation measures, as per the GDEMMP.
- Assessment of whether there are residual significant impacts to MNES and MSES, in accordance with Commonwealth and State Guidelines, following the implementation of mitigation measures.
- Determination of offset requirements, utilising habitat quality scoring data collected during monitoring.

24.15.4.6.5 Adaptive Management, Reporting and Reviews

The threshold criteria for the GDEHQMP may be refined during baseline surveys or through ongoing management in response to monitoring outcomes and the identification of any additional information needs. Where changes are required to the methodology and threshold criteria, the GDEHQMP will be reviewed and updated as required.

Upon completion of the baseline monitoring surveys, a baseline GDE habitat quality assessment report will be prepared. This report will document the baseline habitat quality condition, summarise seasonal variation during the baseline period, and present the habitat quality scores assigned to each monitoring

site. This report will also identify any relevant trends, limitations or data gaps and confirm the baseline condition against which future monitoring results will be compared. The findings will be used to support the refinement of habitat quality thresholds.

The findings from ongoing monitoring will be compiled and reported, with monitoring outcomes assessed against the baseline scores and established threshold criteria. Where there are threshold exceedances this will trigger the actions described above.

The GDEHQMP will be reviewed every five years, or sooner if there are changes to the GDEMMP, approval conditions, reporting obligations or Project activities.

24.15.4.7 Assessment of Residual Risk to GDEs

Section 7.5 of **Appendix N** provides an assessment of the risk of Project impacts to GDEs (as per Section 24.14.2) before and after monitoring and management measures (as per Section 24.15.3.4). The risk assessment combines the likelihood of the potential impact event with the magnitude (or consequence) the impact event. The significance of risks is described as:

- High significance: Complete destruction of a GDE in terms of complete loss of keystone species and conversion to an alternate degraded ecological state. Impacts are irreversible and the only feasible option for mitigation is an environmental offset under relevant environmental policy and legislation.
- Moderate significance: Degradation of a GDE to an extent such that 25% or more keystone species are affected by the action. Impacts will be reversible only with mitigation.
- Low significance: Impacts are short in duration and reversible without mitigation required.
- Insignificant: Impacts are undetectable when assessed against a relevant ecological baseline.

Based on the risk assessment outcomes the residual or mitigated risk ranking is low for direct clearing and low to insignificant for other impact mechanisms. This is a function of the small area of direct impact, the low likelihood of other potential impacts from the Project and the implementation of proposed management measures should impacts be detected.

24.16 Assessment of Significance of Impacts

24.16.1 Methodology

Potential impacts of the Project in relation to water resources were assessed with reference to 'Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources' (DCCEEW, 2022) (the Guidelines).

A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the water resource which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

The impacts on surface water from the Project, and proposed management measures, including monitoring programs, are summarised in Section 24.12 and Section 24.13.

The impacts on groundwater from the Project have been summarised in Section 24.14, with proposed mitigation measures, including groundwater monitoring program, summarised in Section 24.15.

These outputs have been assessed against the criteria for significant residual impacts in the Guidelines using a consequence and likelihood matrix to rate each impact's significance. Those impacts with a rating of high or extreme are considered to constitute a significant residual impact. Those impacts with a rating of low or moderate are considered to be unlikely to have a significant residual impact. This assessment considered the sensitivity of the environment, and the Guidelines.

24.16.2 Sensitivity

The sensitivity of an environmental value is determined from its susceptibility or vulnerability to threatening processes, and as a consequence of its intrinsic value. The attributes of sensitivity that were considered are:

- conservation status
- intactness
- uniqueness or rarity
- resilience to change
- replacement potential.

Applying these attributes enables the sensitivity of an environmental value to be ranked as high, moderate or low, as per Table 24-27. The sensitivity of an environmental value, once determined, does not change unless proposed actions or activities reduce the sensitivity of the value to adverse effects.

Table 24-27 Criteria for Sensitivity

Sensitivity	Description
High	• The environmental value is listed on a recognised or statutory state, national or international register as being of conservation significance. • The environmental value is intact and retains its intrinsic value. • The environmental value is unique to the environment in which it occurs. It is isolated to the affected system/area which is poorly represented in the region, territory, country or the world. • It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the environmental value.
Moderate	• The environmental value is recorded as being important at a regional level, and may have been nominated for listing on recognised or statutory registers. • The environmental value is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements. • It is relatively well represented in the systems/areas in which it occurs, but its abundance and distribution are limited by threatening processes. • Threatening processes have reduced its resilience to change. • Replacement of unavoidable losses is possible due to its abundance and distribution.
Low	• The environmental value is not listed on any recognised or statutory register. It might be recognised locally by relevant suitably qualified experts or organisations. • It is in a poor to moderate condition as a result of threatening processes which have degraded its intrinsic value. • It is not unique or rare and numerous representative examples exist throughout the system/area. • It is abundant and widely distributed throughout the host systems/areas. • There is no detectable response to change, or change does not result in further degradation of the environmental value. • The abundance and wide distribution of the environmental value ensures replacement of unavoidable losses is achievable.

24.16.3 Impact Assessment Ranking

The qualitative impact analysis was conducted in accordance with *AS ISO 31000:2018 – Risk Management Standard* and *HB 203:2012 Environmental Risk Management Principals and Processes*. It involves consideration of impact consequences and the likelihood to determine an impact significance rating.

Specific consequence ratings have been developed, as described in Table 24-28, which considers sensitivity and the consequence criteria, including intensity, duration, magnitude and geographic extent of impacts.

Consequence is defined as the outcome of an event which may have the potential to change the existing environmental values.

As an event can have one or more occurrences and can have several causes and several consequences, the most probable worst-case consequences are defined after the application of mitigation and management measures. This was determined from the assessment of impacts predicted through modelling in the surface water and groundwater impact assessments, and professional judgement from specialists. 'Moderate', 'major' and 'catastrophic' consequences are considered as potential to be a 'significant impact' for changes to the hydrology or water quality of a water resource, once combined with the likelihood of occurrence.

Table 24-28 Consequence Definitions

Descriptor	Environmental Impact
Insignificant	- Negligible environmental impact. Minor transient release within the WQOs and environmental approval limits. - No impact to water users. - Negligible change in flows or hydrology. No users or 3rd party infrastructure affected. - Negligible changes to geomorphology and associated ecosystems. - No change to surface and groundwater interactions.
Minor	- Controlled or planned release in accordance within the WQOs and environmental approval limits. - Onsite unplanned contaminant spill immediately contained without outside assistance. - No ongoing or repeat exceedances of water quality release limits or persistent or increasing exceedances of the WQOs detected in receiving waters. - Reduces utility of 1 to 2 water users, which can be compensated through make good arrangements. - Minor changes in flows or hydrology with potential for localised or short-term impacts on downstream or upstream users or 3rd party infrastructure. - Minor changes to geomorphology with negligible to minor changes in associated ecosystems. - Minor / localised impact to GDEs and localised impact to aquatic ecosystems. - Possible minor interactions with surface and groundwater with very minor impacts.
Moderate (potentially significant)	- Short term unplanned release that exceeds the WQOs or release limits but does not have lasting impacts to aquatic ecosystems. - Onsite contaminant spill contained with outside assistance. - Long term discharge of pollutant, non-persistent, but possible widespread water quality impacts above the WQOs however the receiving environment remains within 80% of the ecosystem protection guideline. - Impact can be remediated without long term loss or very localised long persistent damage. - Surface and groundwater interaction caused by mining activities with no risk of contaminant transfer or mobilization. - Moderate changes in flows or hydrology, with potential for -sub-catchment scale or medium-term impacts on downstream or upstream users or 3rd party infrastructure.

Descriptor	Environmental Impact
	- Moderate changes in geomorphology with potential for moderate localised impacts to associated ecosystems. - Significantly reduces utility of less than 5 downstream water users. - Changes to groundwater levels and / or baseline surface flows with potential to impact GDEs or aquatic ecosystems. - Alterations to floodplains, with no major change in flood behaviour and no loss of riparian vegetation causing destabilisation of waterways.
Major (potentially significant)	- Short to medium term off-site or long-term release that exceeds exposure limits known for downstream aquatic ecosystems. - Long term change in water quality is greater than that required for 'slightly to moderately disturbed' systems. - Significantly reduces current utility of more than 10 downstream water users with minor future impacts. - Surface and groundwater interaction cause contaminant mobilization or hydrological flow changes that have regional impacts 10 to 50 years beyond the life of the Project. - Major changes in flows or hydrology, with potential for regional or long term downstream or upstream impacts on users or 3rd party infrastructure. - Major changes in geomorphology with potential for high downstream or upstream impacts on associated ecosystems. - Major impacts to regulating services by material alterations to the watercourse flows or floodplains, loss of riparian vegetation causing destabilisation of waterways, changes to groundwater levels and baseline surface flows, causing impacts to aquatic ecosystems or GDEs.
Catastrophic (potentially significant)	- Significant extensive detrimental long-term impacts on the local environment, with moderate impacts in the regional catchment. - Catastrophic and/or extensive chronic discharge or persistent hazardous pollutant that frequently or continuously exceed water quality trigger levels for aquatic ecosystem protection causing impacts to downstream ecosystem health and resilience. - Catastrophic changes in flows or hydrology, with potential for permanent regional scale downstream or upstream impacts on users or 3rd party infrastructure. - Catastrophic changes in geomorphology with widespread, long term impacts on associated ecosystems. - Damage to an extensive portion of aquatic ecosystem or GDEs through major combined impacts to surface water and groundwater resources. - Current and long-term future impact on water resource utility.

Table 24-29 sets out the frequency categories for the risk assessment. The Guidelines state that to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on a water resource is a real or not remote chance or possibility. Thus, 'likely' has been considered to include possible (3) to almost certain (5) likelihood events in this impact assessment, which when combined with consequence have the potential to be a significant residual impact.

The likelihood considers the frequency of the consequence severity occurring from a casual event or activity and not the frequency of the event or activity. Where the impact or risk exposure is limited in duration or carries long-term potential consequences, then probability scores have been adopted; and where the impacts or risks are generated from ongoing activities over the life of the Project then frequency of occurrence has been applied.

Table 24-29 Frequency Categories for Likelihood

Category	Frequency
5	Almost Certain Event – certain impact will occur
4	Likely Event – occurs frequently (e.g. once in a year)
3	Possible Event – sometimes occurs (e.g. less than once in 5 years)
2	Unlikely Event – rarely occurs (e.g. less than once per 10 or 20 years)
1	Rare Event – will almost never occur (e.g. less than once per 50 years and highly unlikely to occur during Project life)

The impact significance is ranked by combining consequence and likelihood and applying the risk analysis matrix in Table 24-30. Those risks which are considered likely to have a significant impact, in accordance with the Guidelines, are those ranked as either high or extreme risks.

Table 24-30 Risk Analysis Matrix

		CONSEQUENCE				
		Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
LIKLIHOOD	Almost Certain (5)	Moderate (10)	High (16)	High (18)	Extreme (23)	Extreme (25)
	Likely (4)	Moderate (7)	Moderate (11)	High (17)	High (21)	Extreme (24)
	Possible (3)	Low (4)	Moderate (8)	Moderate (12)	High (19)	High (22)
	Unlikely (2)	Low (2)	Low (5)	Moderate (9)	Moderate (14)	High (20)
	Rare (1)	Low (1)	Low (3)	Low (6)	Moderate (13)	Moderate (15)

24.16.4 Sensitivity of the Receiving Environment

A summary of the key surface water and groundwater values and qualities at the Project and surrounds, which determine and influence the sensitivity of the receiving environment are provided in Table 24-31. These were compared to sensitivity criteria to determine the level of sensitivity.

Table 24-31 Sensitivity of Surface Water Resource Values

Aspect	Description of Sensitivity, Value and Quality	Sensitivity
Surface Water		
Surface water values	• Moderate value for provisioning services with limited use of Isaac River water and no use of local creeks due to ephemeral supply. • Moderate supporting value for local aquatic habitat, with GDEs utilising water in perched groundwater system (supplied by surface water flows) identified along the Isaac River, Cherwell Creek and a HES wetland. • Moderate local and regional supporting services with riparian vegetation health along watercourses dependent on flows. This provides a biodiversity corridor, connected with downstream regional watercourses supporting aquatic fauna which require environmental flows during dry conditions to maintain health and habitat. • Low regulating services for the downstream discharge to the Great Barrier Reef coastal environment due to the minimal impact on the very large Fitzroy Basin catchment, and with even larger rivers in the north (e.g. Burdekin River) provided greater volumes of fresh water. • No recreation or tourism provided by local creeks and limited use within in the Isaac River. Cultural heritage values associated with Isaac River and Cherwell Creek	Moderate
Catchment runoff and stream flow	• Local drainage channels / creeks are in a poor to moderate condition as a result of threatening processes which have degraded their intrinsic value. • Isaac River and Cherwell Creek in moderate condition as a result of threatening processes including agriculture and mining. • The ephemeral flows provide resilience to temporal flow changes.	Low - Moderate
Flood regime River - floodplain connectivity	• Riparian vegetation continues to receive flood flows. • Conrock Gully (a defined drainage feature) diversion will continue to provide flows • Land use is not sensitive to changes in flood regime with two local landholders, and limited infrastructure or assets within the Project area or surrounding area where changes in floodplain are predicted. • Levees designed to Q1000 flood event prevent flooding of the pits during operations. Isaac River levee decommissioned after operations to restore floodplain flows. • Sediment movement downstream has low sensitivity as Isaac River bed dominated by sands, with aquatic habitat and environments adapted to flow regime. • Some flood dependent wetlands present, with one HES wetland downstream of any Project related hydrological changes.	Low - Moderate

Aspect	Description of Sensitivity, Value and Quality	Sensitivity
Water quality	• Threatening processes (e.g. catchment wide resource activities) may have reduced resilience to change in regional or local watercourses. • Water quality in the vicinity of the Project area is considered to be slightly alkaline, with low to moderate variable EC and elevated nutrient levels in the upstream reaches. • No change in water quality in local watercourses from Project activities. Model mining water conditions were developed for coal mines in the Fitzroy basin. These model water conditions are designed to manage water discharges to meet the water quality objectives set out in the EPP (Water) and to provide consistency between mining operations in the Fitzroy basin. • Proposed mine affected water release criteria based on the Model water conditions to protect downstream environmental values and water quality objectives. • Cumulative impacts from resource companies managed through basin wide application of model mining water conditions.	Low to Moderate
Groundwater		
Groundwater resource values	• Low - moderate landholder provisioning services with limited use of the resource due to high salinity and limited yields. Groundwater in the region has limited use by local landholders. Two local landholder bores in use within 5 km of Project with potential drawdown marginally greater than 2m. • Groundwater within the alluvium (alluvial aquifer) unlikely to be providing water supply with ecological dependencies. • Surface water / groundwater interactions occur, although as a 'losing system' from surface water to groundwater aquifers. • Low to no cultural services (including recreation and tourism, science and education) • Moderate supporting services (e.g. maintenance of ecosystem function) with GDEs along Isaac River supported by perched groundwater system in river sands.	Low - Moderate
Groundwater regime	• Drawdown will change aquifer pressure and groundwater levels in the local area. Water from coal seams in the Permian coal measures is not a groundwater supply for landholders or ecosystems. • Two local landholder bores in use within 5 km of Project with potential drawdown marginally greater than 2m. • Unlikely for potential ecological dependencies on alluvium (alluvial aquifer).	Low
Groundwater quality	• Water quality is variable but can be suitable for stock watering. • Residual void acts as permanent groundwater sink, so no recharge of groundwater aquifers.	Low - Moderate
Interconnections between ground and surface regimes	• No perennial flows in the vicinity of the Project • Rivers 'lose' water to the groundwater system. • No loss of baseflow to the Isaac River.	Low

Aspect	Description of Sensitivity, Value and Quality	Sensitivity
Cumulative Impacts	• Groundwater in all aquifers has been, or will be, depressurized by surrounding resource projects. • Cumulative impacts on alluvium (alluvial aquifer) from other resource projects in the local area, with Project resulting in negligible contribution to existing cumulative impacts.	Low - Moderate

24.16.5 Residual Significant Impact Assessment

An assessment of the significance of the Project's residual impacts to surface water resources is provided in Table 24-32, which demonstrates that residual impacts of the Project on surface water resource values are either low or moderate, and do not result in significant impacts to surface water resources.

An assessment of the significance of the Project's residual impacts to groundwater is provided in Table 24-33, which demonstrates that residual impacts of the Project on groundwater values are either low or moderate and do not result in significant impacts to groundwater resources.

Table 24-32 Assessment of Significance of Residual Impacts to Surface Water Resources

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
Hydrology of Surface Water Resource							
Reduction in catchment size for local and regional watercourses during and post mining.	The Project results in a reduction of 0.4% to 0.5% of Isaac River and Cherwell Creek catchments. Impacts to flow will be negligible. Post mining the reduction in catchment due to the Project would reduce further to around 0.1% to 0.2% of the Isaac River catchment. There is negligible change in flows from the residual void catchment compared to total catchment area. Conrock Gully catchment downstream of the mine will continue to receive backwater flows from the Isaac River	- Mine water captured during operations and used onsite. - Post mining residual void captures direct rainfall.	- Minimise mine affected water catchments during operations. - Release sediment water in accordance with EA approved ESCP. - Release mine water in accordance with EA approved criteria linked to flows and water quality in the receiving environment. - Minimise the size of the residual void in accordance with the approved PRCP schedule.	**1**	**5**	Moderate (10)	**No Significant Residual Impact** - Negligible to minor impacts on flows, unlikely to be detectable in local and regional catchments. - No surface water users likely to be affected. - Not predicted to impact on water resource availability or cause significant impacts to hydrogeological regime locally or regionally. - Low / moderate sensitivity of local and regional watercourses subject to negligible changes in flows. - Minimal contribution of the Project to cumulative impacts from other resource projects in the region.
Changes in flood flows (depths, velocities and duration)	Negligible to minor change in flood depths, extent, velocity and duration of Isaac River and Cherwell Creek. Minor increases to extent and depth of	- New bridges across Isaac River and Cherwell Creek - Temporary bed level dragline	- Isaac River levee and crossing infrastructure decommissioned post mine life.	2	2	Low (5)	**No Significant Residual Impact** - Negligible to minor changes in flood depths, velocities and duration are

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
	flooding over agricultural lands, and does not pose risks to receptors or 3rd party infrastructure. Flood flows in Conrock Gully diversion similar to existing Conrock Gully.	crossing of Isaac River. - Levees designed for the 1:1,000 flood event. - Post mine life final landform marginally encroaches onto floodplain.	- Stable approved final landform design post mine life. - Bridge design have minimal influence on flows - Dragline crossing is temporary (< 6 months in dry season)				predicted as a result of Project infrastructure, with changes limited to localised area. - No users or 3rd party infrastructure affected.
Changes in geomorphology	Conrock Gully diversion geomorphology similar to existing Conrock Gully, Negligible to minor change in in stream power and bed shear stress in Isaac River and Cherwell Creek.	- Conrock Gully diversion - Infrastructure and levees	- Conrock Gully diversion designed in accordance with State guidelines to be geomorphically stable. - Infrastructure decommissioned post mine life	2	2	Low (5)	**No Significant Residual Impact** - Negligible to minor changes in flood bed shear stress and stream power are predicted as a result of Project infrastructure, with changes limited to localised area. - Conrock Gully diversion similar to pre-mining Conrock Gully - No users or 3rd party infrastructure affected.
Changes to flows – inundation of mine pit by floodwater during operations	Capture and / or release of additional surface waters that would become mine affected water if pit inundated, requiring release under approved release criteria. Cessation of mining in affected pits.	- Flood levels overtop 1:1,000 flood level required for levee designs.	- All levees will be designed to 1:1,000 flood level in accordance with the Manual. - Levee design and construction subject to strict EA conditions on	4	1	Moderate (13)	**No Significant Residual Impact** - Levees will be designed, constructed and operated to prevent overtopping by floods to the 1:1,000 flood event.

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
			standards and certification for regulated structures. - Annual inspections and certifications required under EA conditions for regulated structures (levees).				
Changes to flows – inundation of residual void by floodwater post mine life	Capture and / or release of additional surface waters that would become mine affected water and potentially inundate the residual void.	- Post mine life flood levels exceed the 1:1,000 flood level in the final landform.	- Safe, stable final landform designed so that residual void is outside the 1:1,000 flood level. - Bunding prevents ingress of PMF flood event. - Final landform designed in accordance with approved PRCP schedule.	4	1	Moderate (13)	**No Significant Residual Impact** - Final landform designed so that residual void is outside the 1:1,000 and PMF flood events.
Additional demand on the State's surface water resources for mine operations	Allocation of State water resources to mining operations results in less volume available to other State water users.	- External allocation of water (other than existing supply to IPC) for the Project is required.	- Maximise re-use of onsite water. - Modelling shows that water demand will not exceed the existing supply available to IPC.	2	1	Low (3)	**No Significant Residual Impact** - No additional external water supply required. - No impact on surface water resources available under State water resource plans.
Surface Water Quality							
Release of mine affected water and sediment affected water	Potential change in downstream water quality results in impacts on WQOs and environmental values.	- Uncontrolled releases of mine affected water during very wet climatic conditions	- Controlled releases of mine affected water undertaken in accordance with EA flow and quality criteria designed to	2	2	Low (5)	**No Significant Residual Impact** - Low to moderate sensitivity of receiving environment.

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
		- Releases of sediment affected water that is not in accordance with ESCP.	protect environmental values and WQOs. - Modelling demonstrates no predicted uncontrolled releases of mine affected water. - Sediment dams designed in accordance with recognised engineering standards. - Releases from sediment dams in accordance with ESCP. - Annual FRREMP to monitor potential impacts on aquatic environment. - Regular water quality monitoring at established monitoring points, and investigations if there are exceedances of relevant criteria.				- No predicted uncontrolled mine affected water releases - Sediment affected water releases modelled to be within receiving water quality background values. - Cumulative impacts managed under State EA release criteria for all mine sites in the Fitzroy Basin, developed in accordance with the Model Mining Conditions.
Changes in water quality – residual void lake water overtops to surface drainages post mine life	Release of mine affected water post mine life. Additional flows to local drainages, which would partially restore minor catchment losses.	- Residual void water balance stabilises at a level that results in overtopping to surface drainages.	- Modelling for residual void water levels demonstrates that residual void water levels will stabilise well below the surface overtopping level.	3	1	Low (6)	**No Significant Residual Impact** - No predicted overtopping of residual void water to surface water post mine life.
Construction of Isaac River bridge, Cherwell Creek bridge,	Increased sedimentation of downstream watercourses.	- Construction of haul road crossings.	- Construction in dry season where possible (i.e. no flows).	2	3	Moderate (8)	**No Significant Residual Impact**

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
temporary dragline crossing of Isaac River, bed level crossing of JB Gully	Potential barriers to fish passage.	- Design of crossings.	- Scour protection to minimize obstruction of waterway flow and control erosion. - Construction in accordance with recognised standards and guidelines to minimise potential for sedimentation. - Bridge design does not prevent fish passage. - Bed level crossing allows low flows and fish passage.				- Control measures established. - Low sensitivity of watercourses to sedimentation. - Moderate sensitivity of watercourses as fish habitat (see **Chapter 25**). - No MNES aquatic species (see **Chapter 25**).
Spills of hydrocarbons or chemicals	Localised water quality changes	- Accidental spills or releases	- Spill control procedures will be implemented. - Locations of fuel and chemical storages designed in accordance with relevant Australian Standards, bunded and with runoff control structures. - Reduced fuel and chemical storage requirements on-site due to the Project's integration with the IPC's MIA.	2	2	Low (5)	**No Significant Residual Impact** - Low to moderate sensitivity of receiving environment. - Controls in place. - Any accidental release likely to be localised and easily contained and remediated. - Reduced on-site storage requirements.

Table 24-33 Assessment of Significance of Residual Impacts to Groundwater

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
Hydrology of Groundwater Resources							
Aquifer depressurisation – landholder water supply bores	Reduction in water levels in landholder groundwater supply bores.	- Mining results in drawdown of groundwater within aquifers used by landholders. - Decline in groundwater level / pressure at water bores, reducing water supplies.	- Numerical groundwater modelling predicts that there will be less than 2m drawdown in water levels at all landholder supply bores. - A make good agreement will be implemented with local landholders for the provision of water if there are impacted bores. - The groundwater monitoring program will be ongoing. - EA trigger level thresholds and quality limits apply to monitoring bores, with investigations required is trigger or limit thresholds are exceeded.	2	3	Moderate (8)	**No Significant Residual Impact** - Modelling demonstrates minor localised drawdown at 2 landholder bores. - Make good agreement if required. - EA conditions regulate groundwater impacts on landholder bores. - Groundwater bore monitoring to detect if changes in levels or quality in monitoring bores.
Aquifer depressurization – change to surface water base flows	Drawdown of aquifers resulting in a change to surface water base flows.	- Aquifer depressurisation	- A natural hydraulic gradient exists between the watercourses and the alluvium that results in seepage from the watercourses to the alluvium (i.e. a losing system). - There are no predicted groundwater-related	2	1	Low (3)	**No Significant Residual Impact** - Groundwater does not contribute to surface water base flows.

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
			impacts to surface drainage as a result of the Project.				
Aquifer depressurisation – GDEs	Drawdown of aquifers resulting in a reduction of groundwater availability, potentially impacting GDEs.	Aquifer depressurisation where there may be GDEs.	- The perched groundwater system supports GDEs on the Isaac River, but is disconnected from the alluvial aquifer. - GDEs not reliant on alluvial aquifer, hence no impact from drawdown in alluvial aquifer. - Perched groundwater system recharged by seasonal surface flows. - Dominant riparian species are adaptable to ecological change. - No GDEs within Conrock Gully or other non-riparian areas - GDEMMP, GDE habitat quality monitoring program, FRREMP and GMMP.	2	2	Low (5)	**No Significant Residual Impact** - GDE reliance on perched groundwater system rather than alluvial aquifer. - GDEMMP, GDE habitat quality monitoring program, FRREMP. - GMMP
Change in hydrology of surface waters that provide water to the perched groundwater system utilised by GDEs	Changes in river surface flows, resulting in altered hydrology of perched groundwater system that supports GDEs.	Infrastructure or mining within Isaac River catchment. Infrastructure or mining within floodplain, thereby altering flood depths and velocities.	- Negligible to minor changes to hydrology and geomorphology predicted. - Negligible change in Isaac River catchment size during and post mining.	2	2	Low (5)	**No Significant Residual Impact** - GDEMMP - Minimal changes hydrology and geomorphology.

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
			- River crossings have minimal impact on flood levels and velocities. - Temporary dragline crossing will be rehabilitated.				
Aquifer drawdown – stygofauna.	Drawdown of aquifers resulting in a reduction of groundwater availability, potentially impacting stygofauna.	Mining and aquifer drawdown. .	- Project does not result in drawdown in alluvial aquifer where stygofauna found. - Groundwater monitoring	1	3	Low (4)	**No Significant Residual Impact** - Stygofauna taxa are common in Project area. - Low sensitivity of stygofauna. - Project impacts on alluvial aquifer negligible.
Additional demand on the State's groundwater resources for mine operations	Allocation of State groundwater resources to mining operations results in less volume available to other State water users.	- Groundwater allocation, other than associated water sought.	- Maximise re-use of onsite water, including use of mine affected water and sediment affected water for dust suppression. - Modelling shows that no external water supplies are required for the Project. - All groundwater inflows as a result of mining are 'associated water' for which take is authorised under an EA. No additional groundwater supplies are required.	2	1	Low (3)	**No Significant Residual Impact** - No additional external water supply required. - No impact on groundwater resources available under State water resource plans. - Associated water take approved under EA. - No requirement for additional groundwater supplies.

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
Cumulative impacts on groundwater levels	Cumulative drawdown of groundwater aquifers.	- Other resource projects with cumulative impacts	- Cumulative impacts on alluvium predicted as a result of other resource projects, with those projects subject to their own management controls. - Cumulative impacts on the coal seams is predicted although these have limited, if any, use for landholders or GDEs. - Ongoing water level and quality monitoring across the monitoring network at the Project and at other resource projects.	3	3	Moderate (12)	**No Significant Residual Impact** - Project has negligible contribution to cumulative impacts in alluvium - Cumulative impacts on coal seams unlikely to affect landholder bores or GDEs. - GMMP
Groundwater Quality							
Spills of hydrocarbons or chemicals	Localised groundwater quality changes	- Accidental spills or releases	- Spill control procedures will be implemented for the Project. - Locations of fuel and chemical storages designed in accordance with relevant Australian Standards, bunded and with runoff control structures. - Reduced fuel and chemical storage requirements on-site due to the Project's integration with the IPC's MIA.	2	2	Low (5)	**No Significant Residual Impact** - Low sensitivity of receiving environment. - Controls in place. - Any accidental release likely to be localised, and easily contained and remediated. - Reduced on-site storage requirements.

Event	Potential Impact	Causes	Controls	Residual Impact			Significance of Residual Impacts
				C	L	Score	
Seepage from spoil dumps	Localised groundwater quality changes	- Seepage from in-pit or out of pit spoil dumps	- Low geochemical risk associated with spoil - Geochemistry SPR study identified low risk of impacts from seepage from spoil. - Inward hydraulic gradient to mine pit during operations and residual void post closure.	2	2	Low (5)	**No Significant Residual Impact** - Low geochemical risks. - Majority of soils dumped in-pit. - Groundwater monitoring
Changes in water quality – mine affected water during operations or residual void lake water enters groundwater system and migrates to other water resources (e.g. landholder bores, GDE water sources)	Groundwater quality changes associated with mine affected water or residual void water during or post mine life.	- Mine affected water enters groundwater system - Residual void water balance stabilises at a level that results in recharging of groundwater.	- During mining, the inward hydraulic flow gradients to the open cut voids would inhibit any migration of water outwards to the regional groundwater system. - Mine water management system. - Modelling for the residual void water levels demonstrates that water levels will stabilise below the groundwater source /sink level – i.e. voids will remain a sink post mining.	2	1	Low (3)	**No Significant Residual Impact** - No mechanism for contaminants in mine water or residual void water to enter the groundwater system. - No predicted recharge of residual void water to groundwater post mine life, as void water level below source / sink level.

24.17 Conclusion

A comprehensive surface water assessment was undertaken for the Project, including identification of environmental values and the development of a water management system to protect surface water values.

A comprehensive groundwater assessment was undertaken for the Project, including identifying groundwater environmental values of the Project area and surrounds, undertaking groundwater fieldwork investigations, developing conceptual groundwater and ecohydrological models, assessing impacts on groundwater values through the development of a numerical groundwater model, and determining management measures and mitigation strategies to protect groundwater values.

The environmental values of surface waters within and surrounding the Project area, including catchments, watercourses, drainage features, regional and local water quality and streamflows, were identified through field based monitoring and studies and desktop information. The Project is located in the Isaac River catchment of the Fitzroy Basin and is bounded by the Isaac River and Cherwell Creek. Water quality objectives for these surface waters were developed through published guidelines, and regional and local water quality sampling.

Groundwater values were determined through a comprehensive fieldwork program, supported by geological and desktop data from other local and regional resource projects. The field program comprised:

- installation of a Project bore network comprising 34 bores in all potential aquifer units
- collection and utilisation of data from surrounding bore networks at nearby resource projects, including historical data from an additional 26 bores
- a bore census of all landholder bores with potential to be impacted by the Project
- routine groundwater level and quality monitoring at bores in the monitoring network, including the use of loggers
- hydraulic testing of bores
- drilling to identify the Isaac Thrust Fault, with associated geophysical testing and bore installation to assess hydraulic conductivity across the fault
- electrical resistivity imaging along the Isaac River and Cherwell Creek to determine the extent and thickness of the alluvium.

Based on the understanding of the fieldwork, desktop data and geological setting, the hydrogeological regime of the Project area comprises the following key hydrogeological units:

- Cenozoic sediments:
    - Quaternary alluvium – forms the unconfined alluvial aquifer localised to major ephemeral drainage lines (i.e. Isaac River and Cherwell Creek).
    - Perched groundwater systems are likely to occur within the alluvium. These are discrete groundwater units sitting above the Quaternary alluvial aquifer / water table, and are separated by an unsaturated zone.
    - Quaternary to Tertiary non-alluvial sediments and weathered units (collectively termed ‘regolith’) – unconfined unit with variable but limited saturation and generally present at the surface within the Project area.
- Triassic Rewan Group – considered a regional scale aquitard.
- Permian coal measures with:
    - low permeability interburden and overburden units with aquitard properties.
    - coal seam aquifers, identified as the main aquifers for the Project and surrounding area.

Groundwater data allowed for the characterisation of hydraulic properties, recharge, flow, discharge and quality. Water quality in the Cenozoic sediments (including alluvium) ranges from brackish to highly saline and is likely to be unsuitable for aquatic ecosystem protection. However, the water quality is considered

suitable for stock watering and irrigation in some areas. Water quality in the Permian units ranges from brackish to highly saline and is generally unsuitable to be used for stock watering, irrigation, and aquatic ecosystem protection. Water quality objectives were defined for the various groundwater units based on State and Commonwealth guidelines.

The potential groundwater receptors in the vicinity of the Project are landholder bores, GDEs and stygofauna.

Multiple lines of evidence, including measurements of LWP and SMP, stable isotopes, radon, and physical observations, were applied to assess the groundwater dependence of vegetation across multiple assessment areas within and surrounding the Project area. This data was complemented by data on site-specific geology, geomorphology, soil physical properties, and groundwater.

The surface water management system was developed for all water types for the Project, and is the primary management measure to mitigate potential impacts to surface waters. The water management system involves separation of mine-affected water, sediment water and clean water. Raw water will be imported to site under existing allocations from Sunwater for IPC. The Project's water management system has been integrated into IPC's water management system which allows for balancing of mine-affected water flows, transfers of raw water, and hence a reduction in storage and water discharge requirements at the Project.

Mine-affected water dams and sediment dams have been designed to achieve the objective of the water management system to protect downstream environmental values. A preliminary consequence category assessment has been completed for all water storages, which based on the low consequence of failure, were not assessed as regulated structures.

A comprehensive numerical water balance model was developed to test the performance of the water management system. The model simulated water inflows and outflows through the various stages of mine development with different climatic sequences. The model maximises the recycling of water from water storages to meet Project water demands. The system assessment found the following:

- There would be no uncontrolled releases of mine-affected water.
- Controlled releases of mine-affected water would be undertaken in accordance with flow and water quality criteria designed to protect downstream environmental values and water quality objectives, including negligible change in the salinity of receiving waters.
- Sediment dam overflows would occur in accordance with their engineered design standard during wet or very wet climatic conditions, but these overflows would result in a negligible change in salinity of receiving waters.
- The Project's mine pit would continue to operate in all but very wet climatic conditions.
- The Project would be a net importer of water from the rest of IPC.
- Void water storages at IPC would remain well below their capacity, including storage of any excess water from the Project.
- The whole of IPC, inclusive of the Project would not require an external raw water supply in excess of the existing allocations with Sunwater.
- During the period of operations, changes in climate would lower the risk of pit inundation, controlled release volumes and sediment dam overflow volumes.

During operations the water management system will capture runoff that would otherwise report to the watercourses. The final landform, which includes a residual void, will capture runoff that would otherwise report to the watercourses, but to a lesser extent than during operations. This loss of streamflow is expected to be negligible for the Isaac River and Cherwell Creek. There will be a loss of flows to the downstream reach of Conrock Gully. However, this area will continue to be flooded by backwater flood flows from the Isaac River for flood events greater than 1 in 2 years.

In accordance with GBR Guideline requirements, the Project will not result in a net decline in water quality to surface water basins that feed into the GBR.

In areas with potential contaminants such as hydrocarbons or chemicals (e.g. go-line area), additional controls will be implemented to prevent the release of contaminants, capture any contaminants in management systems and remediate spills if they occur. In addition, the Project's integration with IPC has reduced on-site hydrocarbon and chemical storage requirements.

An erosion and sediment control plan has been developed to manage sediment releases during construction and operations, through the design and installation of erosion and sediment control structures including strategically located sediment dams.

To understand the potential impacts to the hydrologic and geomorphic environments within the Project area and in the vicinity of the Project, a detailed flood modelling assessment was conducted using a hydraulic model for a range of design flood events from 50% AEP to the PMF for the Project's existing, developed (mining), and final landform (post closure) conditions.

The hydraulic model results were used to assess the potential impacts of the Project's mining and post-closure phases on flood levels and velocities, and the geomorphic behaviour of the Isaac River, including the potential to increase erosion and/or sedimentation, and impact on the morphology of the adjacent floodplains.

Infrastructure interacting with waterways during operations has been designed to minimise hydrological impacts, including minimising barriers to flows during all flood events. Following operations, infrastructure will be decommissioned and rehabilitated, further reducing any hydrological impacts.

The Project's flood modelling identified the following outcomes during mining operations in relation to water levels and velocities:

- The flood level changes do not extend downstream beyond the Project area and are considered to be minor in the context of the regional landscape of the Project.
- Reducing the extent of the floodplain behind the proposed Isaac River levee has negligible to minor impact on the expansion of the floodplain into areas that were previously not flooded.
- The proposed Isaac River bridge and the temporary dragline crossing have negligible to localised minor impacts on flood events.
- The dragline crossing will be temporary and occur during the dry season, hence any modelled changes water levels or velocities are highly unlikely to occur.
- A floodplain residence time impact assessment found negligible change to the duration of Isaac River flood events.
- In the context of the regional landscape setting for the Project, flood velocity changes (decreases and increases) are considered negligible to minor. Rock protection is proposed along a 2.5 km section of the Isaac River levee to mitigate potential scour risk.
- There are no material water level or velocity impacts to upstream and downstream flood management infrastructure at other mines, or at the Peak Downs Highway bridge or the Goonyella Railway bridge, for any of the modelled events.
- Flows do not interact with the Cherwell Creek levee plug for any events more frequent than a 0.1% AEP flood event.
- The JB Gully bed-level crossing has a negligible impact on all modelled flood levels.
- There are minor localised changes in velocities for the 1% AEP and 0.1% AEP flood events downstream of the proposed Cherwell Creek bridge and JB Gully bed-level crossing. The velocity impacts do not propagate downstream.
- For the Conrock Gully diversion, changes in flood levels are considered to be minor and localised. The magnitude of change would reduce for more frequent flood events.

- The remainder of the existing Conrock Gully channel will be excised by the Project. However, the remnant Conrock Gully channel will continue to be flooded by the Isaac River backwaters, with lower velocities than pre-mining.

The Project's flood modelling identified the following outcomes for post closure in relation to water levels and velocities:

- The final landform results in negligible change to flood levels and velocities in the Isaac River and Cherwell Creek. The magnitude of change in flood level and velocities is reduced compared to during mining operations, as the final landform allows for the expansion of the floodplain into areas previously protected by the Isaac River levee.
- Conrock Gully diversion results in localised minor changes to flood levels and velocities in the closure landform, in accordance with the acceptable functional design for the diversion. There are no changes in flood levels in the downstream remnant section of Conrock Gully as this area is subject to backwater flooding from the Isaac River.

In summary, the modelled potential impacts to the flood regimes (flood levels and velocities) of the Isaac River, Cherwell Creek, JB Gully and Conrock Gully, during the Project's mining phase and post closure from the final landform, were both determined to be negligible to minor.

The Project's geomorphic impact assessment identified during mining operations that peak velocities, bed shear stresses and stream power levels along the floodplain adjacent to Isaac River are generally similar to the peak levels under existing conditions and are appropriate compared to the ACARP guideline values.

The Project's geomorphic impact assessment identified in relation to final landform conditions that there are negligible to minor changes in the hydraulic characteristics within the floodplain of the Isaac River as a result of the proposed final landform. As part of final landform preparation required under the Project's PRCP, floodplain surfaces will be stabilised and rehabilitated to achieve a self-sustaining vegetation cover. This vegetation cover will increase erosion resistance and enhance landform stability.

In summary, the Project's geomorphic impact assessment indicates that the Project's operational infrastructure and final landform are likely to have negligible to minor impacts on velocity, bed shear stress and stream power, and therefore, are unlikely to have a material impact on the geomorphology of the Isaac River's channel and floodplain in the vicinity of the Project. The Project will have negligible impact on the geomorphology or Cherwell Creek and JB Gully.

A functional design report was developed for the Conrock Gully diversion to address the objectives, design criteria and required outcomes of the DNRME guideline. A hydraulic assessment of the Conrock Gully diversion demonstrates that the diversion design reasonably matches the existing Conrock Gully geometry and the design hydraulic conditions are similar, and generally improved, to those in the existing Conrock Gully channel, and are consistent with the ACARP guideline for channel-averaged shear stress, stream power and velocity.

The Project's flood modelling assessment shows that the final void lies outside of the 0.1% AEP flood extent for the Isaac River and other watercourses. Therefore, the Project will have no impact on Isaac River or other watercourse flows as there will be no ingress of water into the final void up to a 0.1% AEP flood event.

A climate change flood assessment was undertaken and demonstrated that the proposed flood protection levee and levee plugs for the Project's developed conditions adequately protects the mining operations from flooding during the 0.1% AEP climate change flood event, even under conservative assumptions about changes in climate during the operational life of the Project. The climate change assessment also determined that the Project's final void will not be inundated following mine closure during a year 2100 0.1% AEP climate change flood event.

A preliminary consequence category assessment of the Project's flood protection infrastructure was completed, which included the Isaac River flood protection levee, Cherwell Creek levee plug and Conrock

Gully levee plug. All the Project's flood protection infrastructure were classified as 'regulated structures' in accordance with the Dams Manual. The Project's flood modelling results for mining with the levee and levee plugs in place demonstrate that the levee and levee plug designs protect the Project's mining operations from a 0.1% AEP flood event (plus freeboard), and therefore, are compliant with the hydraulic performance requirements for regulated levees outlined in the Dams Manual.

A cumulative impact assessment was completed using the flood model to incorporate all infrastructure from surrounding existing and proposed mines The cumulative impact assessment demonstrated that there were no material water level or velocity on surrounding mines or projects.

A conceptual hydrogeological model of the groundwater regime was developed based on hydrogeological information obtained for the Project area and surrounds.

Where present, the alluvial aquifer is disconnected from the riverbed elevation. Spatially, the alluvial aquifer is locally variably saturated and is dry and/or comprised only of clay in several locations. Shallow perched groundwater systems occur locally within recent channel sands and bank deposits, typically within 1–2 m of the ground surface. These perched systems are transient, seasonally recharged during flow and flood events, and are hydraulically disconnected from the deeper alluvial aquifer.

In the Permian coal measures, groundwater is encountered mainly in the coal seams and are the main aquifer units in the Project area. The Permian coal measures at and surrounding the Project have undergone extensive deformation. The main northwest-southeast trending fault is the Isaac Thrust Fault, with testing confirming that the fault does not provide a higher permeability pathway for groundwater flow in the Permian coal measures.

An ecohydrological model was developed based on fieldwork and an understanding of groundwater and surface water environments, which resulted in the identification of GDEs along the Isaac River, lower portions of Cherwell Creek near confluence with the Isaac River, and the HES wetland. Riparian vegetation fringing the Isaac River and lower reaches of Cherwell Creek utilises a discontinuous and seasonally variable perched groundwater system that is associated with active alluvial deposits, including fluvial sands, riverbanks, and river terraces, extending laterally from the main river channel underneath the riverbanks in some locations to support riparian terrestrial GDEs. Field data indicates that GDEs rely on this perched groundwater system rather than deeper alluvial aquifer. Recharge of the perched groundwater unit occurs through surface flows fed by seasonal rainfall events, which leak into the alluvial aquifer via a weak unsaturated hydraulic connection. The HES wetland is maintained by infiltration of seasonally ponded wetland surface water, with perched groundwater discharge driven by transpiration. The HES wetland is not connected with the deeper alluvial aquifer.

A stygofauna pilot survey was completed across bores in all aquifer units in accordance with relevant State and Commonwealth guidelines. The alluvial aquifer in the vicinity of the Isaac River is considered to be the primary location for stygofauna assemblages within and surrounding the Project area. At a taxonomic level, comparable with historical reporting and studies across the region, the identified stygofauna are same taxonomic groups that are the most commonly recorded across Queensland.

During mining, excavation of open-cut pits and depressurisation of the coal seams will create localised hydraulic sinks, resulting in a change of natural hydraulic gradients in the vicinity of mining area. Groundwater flow will be directed toward the pit from the surrounding coal seams, and regolith. This inward flow regime causes localised drawdown and depressurisation. However, the extent of these changes is constrained by the low permeability interburden. The discontinuous nature of the alluvial aquifer, combined with its weak hydraulic connectivity to deeper units, means that regional flow directions (aligned to drainage) will be largely maintained.

A numerical groundwater model was developed for the Project. An existing regional scale groundwater model informs and underpins the Project's numerical groundwater model, with the core model architecture remaining consistent, with targeted refinements and scenario applications for the Project.

Groundwater modelling included model calibration, model predictions, and sensitivity and uncertainty analysis.

An independent technical peer review of the numerical groundwater modelling was undertaken. This review determined that the model is fit for purpose, which is to produce a calibrated groundwater model and predict groundwater inflows, drawdown, and flow changes, with models suitable for predicting impacts from the Project.

Numerical modelling was used to predict Project only (incremental) impacts and cumulative impacts with other resource projects during and post mining.

No incremental drawdown impacts exceeding 1 m are predicted for the alluvium as a result of the Project. The predicted maximum incremental drawdown is less than 2 m within the regolith, and is confined to a small area directly south of the Project area. The coal seams of the Rangal Coal Measures experience drawdowns as a result of mining at the Project, with these occurring along the western margin of the pit area in both seams.

Cumulative drawdown increases with depth, with the most pronounced depressurisation occurring within the mined coal seams. Shallower units exhibit broader but lower-magnitude cumulative drawdown patterns. The spatial extent of cumulative drawdown reflects the combined influence of long-term mining activities within the Project area and nearby resource operations.

Post mining drawdown magnitudes are substantially reduced compared to maximum drawdown, typically during mining. For the Project, residual incremental drawdown is largely confined to areas immediately surrounding the pit area, with no widespread drawdown persisting beyond the Project area. This indicates a high degree of groundwater recovery following cessation of mining.

The perched groundwater system is not subject to drawdown from the Project or other resource projects. As GDEs demonstrate a reliance on the perched groundwater system rather than the deeper alluvial aquifer, groundwater drawdown associated with the Project or other resource projects (i.e. cumulative drawdown) is unlikely to impacts GDEs. This is borne out by GDE monitoring results for IDM since 2020 along the Isaac River, where there has been no decline in GDE health.

The Project has a negligible contribution to drawdown in the alluvium, and as a result, has a negligible contribution to any potential impacts on stygofauna in the alluvium. At the taxonomic level available for other studies across the region, the stygofauna assemblages identified in the Project's assessment are not unique. Localised cumulative impacts to the alluvium represent a relatively small portion of the available habitat. Therefore, the Project is considered unlikely to impact the long term survival and persistence of stygofauna communities.

Modelling identified that the Project would result in a negligible loss of water from the alluvial aquifer during and post mining. A natural hydraulic gradient exists between the Isaac River and the associated alluvium that results in seepage from the Isaac River to the alluvium (i.e. a losing system). The change in alluvial aquifer groundwater levels induced by mining does not have the potential to increase the hydraulic gradient between the Isaac River and associated alluvium. Consequently, the model does not predict that the average rate of seepage from the Isaac River to the alluvium will increase over the life of the Project, and therefore, the Project does not result in any loss of baseflow to the Isaac River and there are no other predicted groundwater-related impacts to surface drainage as a result of the Project.

Model results demonstrate that the residual void remains a long-term groundwater sink, limiting the potential for off-site groundwater quality impacts.

Groundwater modelling at each landholder bore demonstrates that drawdown at all bores for the most likely model predictions will not exceed a 2 m drawdown threshold. Monitoring will be undertaken at landholder bores, and the proponent will enter a make good agreement if drawdown at these bores exceeds the relevant threshold.

Based on the geochemical characteristics and assessed seepage behaviour of in-pit and out-of-pit spoil, seepage from spoil emplacements presents a low risk to groundwater quality during operations and post-closure. Further groundwater quality is unlikely to be impacted by the Project due to the inward hydraulic flow towards the pit area during mining and residual void post mining. Controls will be implemented to manage any localised spills of hydrocarbons or chemicals.

The design of the Project's surface water management systems will protect downstream environmental values and hence minimise any impact on GDEs. Changes to hydrology and geomorphology from the Project are expected to have negligible impact on GDEs. Approximately 6.8 ha of GDEs occur in the Project disturbance area. However, the actual extent of clearing in these areas is likely to be less; and all impacts to GDEs in the disturbance area will be subject to biodiversity offsets and will be rehabilitated to a riparian ecosystem.

The assessments of the hydrologic and geomorphic environments within the Project area and in the vicinity of the Project, during the Project's mining and post closure phases, have demonstrated that there will be no negligible to minor impacts.

A surface water monitoring program has been developed to monitor releases from the Project, including the development of release limits based on variable flows and water quality, release contaminant trigger investigation levels, and receiving water contaminant trigger levels for mine-affected water. The proponent proposes to join the FRREMP (as supported by DETSI), as a regional industry participant, to monitor any changes to the receiving environment. The surface water monitoring program and FRREMP will be implemented to monitor potential environmental impacts and ensure that the site water management system is meeting its objectives.

A GMMP has been developed to detect changes in groundwater levels and quality, and establish groundwater quality limits, groundwater level triggers and investigation procedures should limits or triggers be exceeded. The GMMP comprises a comprehensive bore network within and surrounding the Project area in all aquifer units, with bores for monitoring compliance and bores for interpretation of background conditions.

Despite the findings of low potential for impacts to GDEs, the proponent has developed a comprehensive GDEMMP, which is designed to monitor and detect changes in GDE health that may be attributable to Project activities. Should the Project impact GDE health than corrective actions are proposed, and if there is still a significant impact to GDEs, as measured by changes in habitat quality to listed species that utilise the identified GDEs, then biodiversity offsets will be provided. The GDE assessment determined that the residual (post mitigation) risk of the Project's potential impacts on GDEs was insignificant to low.

The surface water and groundwater assessments, including design of the water management system, field water quality, flow and level data, water quality objectives, and data from surface water and groundwater modelling, form the basis for the proposed EA and PRCP schedule conditions for the Project.

Potential impacts of the Project on surface water and groundwater resources were assessed with reference to *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (DCCEEW, 2022). The assessment demonstrates that residual impacts of the Project on surface water and groundwater resource values are either low or moderate; and hence are unlikely to result in a significant impact to water resources.

24.18 References

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