Appendix B.6 - 1

EIS Stage 6 Extension to the Tailings Storage Facility

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

Boliden Tara Mines Limited

Environmental Impacts Statement

For inspection purposes only.
Consent of copyright owner required for any other use.

Tailings Storage Facility Extension, Stage 6, Integrated Constructed Wetland and Associated works.

April, 2016

EPA Export 06-01-2017:02:02:07

Declaration

Document Title: Environmental Impact Statement (EIS), Tailing Storage Facility Extension, Stage 6, Integrated Constructed Wetland and Associated Works.

I, Paschal Walsh on behalf of the company (BTMD) certify that the information contained in the following document is truthful, accurate and complete.

Paschal Walsh.

Paschal Walsh
EHS Manager

For inspection purposes only.
Consent of copyright owner required for any other use.

Date: 12/12/2016

EPA Export 06-01-2017:02:02:07

Contents

Section 1 Introduction ..... - 1 -

1.1 Background ..... - 1 -

1.2 Necessity for the proposed development – TSF extension 4

1.2.1 Present Situation 4

1.2.2 Necessity for the proposed development – ICW Construction 5

1.3 E.I.A. Regulations 6

1.4 Role of Government and Statutory Bodies 6

1.5 Content of the EIS 7

1.6 Terminology 7

1.7 Project Team 9

Section 2 Scoping and Consultation 10

2.1 Introduction 10

2.2 Site History 11

2.3Existing capacity 11

2.4 Future Requirements 12

2.5 Necessity for the proposed development – ICW Construction 13

2.6 Tailings Storage Facility - Options 13

2.6.1 Conceptual options 13

2.6.2 Engineering and operational considerations 17

2.6.3 Environmental considerations 20

2.6.4 The "Do-nothing" Option 23

2.6.5 Preferred Option- TSF 23

2.6.6 Options for Passive Treatment – Integrated Constructed wetland 25

2.7 Environmental scoping study 27

2.7.1 The Environmental Impact Assessment process 27

2.7.2 Content of the EIS 30

2.8 EIA Approach and Methodology 34

Section 3 Project Description ..... - 39 -

3.0 Proposal ..... - 39 -

3.1 Introduction 42

3.1.1 Tailings Facility Configuration 46

3.1.2 Construction methodology 47

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

3.2 Construction Materials 49
3.2.1 General 49
3.3 Site Preparation 52
3.3.1Composite Lining 57
3.4 Geotextile 59
3.4.2 General 59
3.4.3 500 g/m2 and 1000 g/m2 Non-Woven Geotextile 59
3.4.4 Terram 1000 60
3.5 Seepage 62
3.6 Perimeter Interceptor Channel 63
3.7 Embankment Stability Modelling 66
3.7.2 Model Geometry 66
3.7.3 Geotechnical Parameters 66
3.7.4 Stability Modelling 68
3.7.5 Results of Stability Modelling 68
3.8 Spillway 72
3.9 Operations 73
3.10 Piezometer and Groundwater Monitoring 77
3.11 Settlement Monitoring Points 77
3.12 Construction 80
3.12.1 General 80
3.12.2 Indicative project time scale 81
3.13 Tailings Characteristics 82
3.14 Closure and Decommissioning 84
Project Description Part B - Integrated Constructed Wetland (ICW) 85
3.15 Introduction 85
3.16 'Passive Treatment System' - Integrated Constructed Wetland 87
3.16.1 Key Benefits of an ICW 87
3.16.2 Integrated Constructed Wetland treatment 88
Processes of metal removal 89
3.17.1 Research - Meso-scale Integrated constructed wetland trial 91
Plate 3.1 Trial ICW site at the Randalstown TSF (Sept 2015) 92
3.17.2 Proposed PTS/ICW 93

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

3.18 Site assessment and suitability 96
3.19 Construction of ICW 97
3.20 ICW water levels 99
3.21 Discharge quality and flow rates 100
3.22 Hydraulic discharges 100
3.23 Discharge pipeline 100
3.23.1 Pipeline installation 102
Section 4 Ecology - Terrestrial 105
4.1 Introduction 105
4.1.3 Site description- ICW discharge pipeline 113
4.2 Existing Environment 117
4.2.1.2 Meath Development and National/Meath Biodiversity Action Plans 117
4.3 Field surveys 118
4.3.2 Habitat Mapping 121
4.3.3 Bird Surveys 121
4.3.3.1 General Bird Survey – summer bird surveys 121
4.3.3.2 Kingfisher Survey 122
4.3.3.3 (Breeding) Wader Survey (Lapwing, Curlew, Redshank, etc.) 123
4.3.3.4 Raptors 123
4.3.3.5 Winter bird surveys of species of conservation concern 123
4.3.4 Blackwater – Nevinstow townland 128
4.3.5 Mammal Surveys 130
4.3.5.1General Mammal Survey (including Badger) 130
4.3.5.2 Spring Badger survey at identified sett 131
4.3.5.3 Otter Survey 132
4.3.5.4 Bat surveys - summer 132
4.3.5.5 Bat surveys – winter 134
4.3.6 Selected Invertebrate Groups 136
Butterfly 136
Bees and Bumblebees 137
4.4 Results 139
River Boyne and River Blackwater SAC – site code 002299 142
River Boyne and River Blackwater SPA – site code 004232 147

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

4.4.1.2 County Development and Biodiversity Action Plans 148
4.4.2 Field Surveys 152
4.4.2.1 Botanical/Habitat surveys 152
4.4.2.2 Freshwater Habitats 152
4.4.2.3 Grassland Habitats 156
4.4.2.4 Disturbed Ground Habitats(ED) 158
4.4.2.5 Woodland and Scrub Habitats 163
4.4.3 European Communities (Birds and Natural Habitats) Regulations 2011 167
4.4.5 Bird Surveys 168
4.4.5.1 General bird surveys 168
Kingfisher Surveys 169
Wader Surveys 169
Raptors 170
Winter bird surveys of species of conservation concern 170
4.5 Mammal Surveys 172
4.5.1 General Mammal surveys (including badger) 172
4.5.2 Otter Survey 173
4.6 Bat Surveys - summer 174
4.6.1 Static monitor bat surveys 174
4.6.3 Bat Surveys – winter 186
4.7 Surveys of selected Invertebrate Groups 188
4.7.1 Butterfly surveys 188
4.7.2 Bee and Bumblebee Surveys 188
4.7.3 Surface water stream - Blake's Stream 189
4.8 Evaluation of results 194
4.8.2 Importance of habitats 194
4.8.2.1 Freshwater Habitats 194
Grassland and associated habitats 195
Disturbed Ground Habitats(ED) 196
4.8.3 Woodland and Scrub Habitats 197
4.9 Importance of ecological corridors and "stepping stones" 198
4.9.1 Blake's Stream 198
4.9.2 The Yellow River 198

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

4.9.3 The Navan – Kingscourt Rail-line 201
4.9.4 The Hedgerow/Treeline network 203
4.9.5 Woodland 203
4.9.6 Waterbodies 204
4.10 Protected species 205
4.10.1 Badgers 205
4.10.2 Bats 205
4.11 Invasive Alien Plant Species 206
Japanese Knotweed (Fallopia japonica) 206
Giant Hogweed (Heracleum mantegazzianum) 206
Himalayan Balsam (Impatiens glandulifera) 207
4.12 Mitigation Measures 208
4.12.1 Summary of key conservation priorities 208
Use of the Tailings facility by avifauna 211
4.12.2 Invasive Plant Species Control and Management Plan 212
4.12.3 Loss of Woodland Habitat - Mitigation 212
4.12.4 Loss of Pond Habitat – Mitigation 213
4.13 Decommissioning- Potential impacts on roosting birds - Mitigation 216
4.14 Pipeline installation 217
4.14.1 Potential Direct, Indirect or Secondary Impacts 217
4.14.2 Gauging of Impacts on Natura 2000 sites 222
4.14.3 Sources and significance of impacts 223
4.15 Mitigation – On-going and planned monitoring 224
4.15.1 Monitoring of bats 224
4.15.2 Winter Bird Monitoring 224
4.15.3 Monitoring of woodland for use by Badger 224
4.15.4 Monitoring of habitats/flora: environs of the TSF 225
4.15.5 Monitoring of Nocturnal Macro-moths 225
4.15.6 Mitigation/Preventative measures during the pipeline installation 226
Section 5 Ecology - Surface water 228
5.1 Introduction 228
5.1.1 Background 228
5.2 Methodology 235

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

5.2.1 Desktop Review 235
5.2.2 Field Surveys 235
5.2.3 Evaluation 236
5.3 Receiving Environment 242
5.3.1 Designated Sites 242
5.3.1.1 Overview of Designated Sites within the Wider Study Area 242
5.3.1.2 Designated Natura 2000 Sites 245
River Boyne and Blackwater (SAC): 245
River Boyne and River Blackwater (SPA) 247
River Boyne Estuary SPA 248
Boyne Coast and Estuary SAC 248
5.3.1.3 Designated Natural Heritage Sites 249
Jamestown Bog (NHA) 249
Girley Bog (NHA) 249
5.3.2 Aquatic Habitats and Flora 250
5.3.2.1 Aquatic Habitats 250
5.3.2.2 Invasive Species 252
5.3.3.2 Other species of conservation concern 254
White-clawed Crayfish 254
Common Frog and Smooth Newt 254
Common Lizard 254
Aquatic Macroinvertebrates 255
5.4 Potential Impacts 257
5.4.1 Designated Sites 257
5.4.1.1 Construction Phase 257
5.4.1.2 Operational Phase 258
5.4.1.3 Cumulative Impacts 261
5.4.2 Aquatic Habitats and Flora 262
5.4.2.1 Construction Phase 262
5.4.2.2 Operational Phase 265
5.4.2.3 Cumulative Impacts 267
5.4.3 Aquatic Fauna 268
5.4.3.1 Construction Phase 268

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

5.4.3.2 Operational Phase 268
5.4.3.3 Cumulative Impacts 268
5.5 Mitigation Measures 269
5.5.1 Designated Sites 269
5.5.1.1 Construction Phase 269
5.5.1.2 Operational Phase 270
5.5.2 Aquatic Habitats and Flora 271
5.5.2.1 Construction Phase 271
5.5.2.2 Operational Phase 272
5.5.3 Aquatic Fauna 272
5.5.3.1 Construction Phase 272
5.5.3.2 Operational Phase 273
5.6 Residual Impacts 273
5.6.1 Designated Sites 273
5.6.2 Aquatic Habitats and Flora 273
5.6.3 Aquatic Fauna 273
5.7 References 276
Appendix 5.1 278
Section 6 Air 282
6.1 Introduction 282
6.1.1 Study Methodology-Assessment Criteria 283
6.2 Receiving Environment - Air 288
6.2.1 General 288
6.2.2 Baseline Air Quality 288
6.2.2.1 Benzene and Toluene 292
6.2.2.2 Nitrogen Dioxides (NO2) 293
6.2.2.3 Sulphur Dioxide (SO2) 294
6.2.2.4 Carbon Monoxide (CO) 295
6.2.2.5 Particulate Matter (PM10 & PM2.5) 296
6.2.2.6 Dust Monitoring 298
6.4 POTENTIAL IMPACTS OF THE PROPOSAL 301
6.4.1 Construction Phase 301
6.4.1.1 Traffic Emissions 302

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

6.4.2 Operation Phase 304
6.4.2.1 Scheduled Emissions 304
6.4.2.2 Climate 304
6.4.3 "Do-nothing" Scenario 307
6.5 Remedial or Reductive Measures 308
6.5.1 Construction Phase 308
6.5.2 Operation Phase 309
6.5.3 Climate 310
6.6 Predicted residual impacts of the development 311
6.6.1 Construction Phase 311
6.6.2 Operation Phase 311
6.6.3 "Worst Case" Scenario 311
6.6.4 Decommissioning 312
6.7 Monitoring 314
6.7.1 Construction Phase 314
6.7.2 Operational Phase 314
Section 7 Roads and Traffic 315
7.1 Introduction 315
7.1.1 Objectives 315
7.1.2 Report Structure 316
Figure 7.1 Site location map 317
7.2 Proposed development 318
7.2.1 Site Location 318
7.2.2 Existing and Proposed development 319
7.3 Existing and proposed traffic conditions 320
7.3.1 Traffic Survey 320
7.3.2 Existing Road Network 321
7.3.2.1 Proposed network improvements 322
7.3.3 Trip generation and distribution 322
Table 7.2 - Details of Stage 6 Construction Phases 322
Table 7.3 Total Trips Generated 324
7.3.3.2 Trip Distribution 325
7.3.4 Seasonal Adjustment 331

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

7.3.5 Traffic growth 334
7.4 Road Impacts 366
7.4.1 Junction Analysis 366
7.4.1.1 Introduction and Methodology 366
7.4.1.2 Assessment Years 366
7.5 Analysis Results 367
7.6 Link Capacity 381
7.7 Impacts related to traffic 383
7.7.1 Road Safety 383
7.7.2 Pedestrians 383
7.7.3 Sensitive Locations 383
7.8 Conclusions and recommendations 384
Section 8 Water 385
8.1 Introduction 385
8.1Scope of the Assessment 386
8.1.2Policy and Legislative Context 386
8.1.3Assessment Methodology 386
8.2 Description of the Proposed Development 387
8.2.1 Stage 6 Design 387
8.3 Hydrology and Hydrogeology Baseline Assessment 389
8.3.1 Hydrology 389
Surface Watercourses 389
8.3.2 Geology and Hydrogeology 392
8.3.3 Water Use around Tara Mines and the TMF 402
8.3.3.1 Water Quality 402
8.3.3.2 Water Quality Standards 405
8.3.3.3 Surface Water Quality in the area of the TMF 409
8.4 Hydrological and Hydrogeological Impacts 413
8.4.1 Impact Assessment Methodology 413
8.4.2 Receptor Sensitivity 413
8.4.3 Magnitude of Impact 414
8.4.4 Significance of Effect 415
8.4.5 Potential Impacts 415

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

8.4.6 Receptors 417
8.4.6.1 During Construction of Stage 6 Extension 417
8.4.6.2 Impacts on Groundwater Hydrology 417
8.4.6.3 Impacts on Groundwater Quality 418
8.4.6.4 Impacts on Groundwater Vulnerability 418
8.4.6.5 Impacts on Surface Water Hydrology 418
8.4.6.6 Impacts on Surface Water Quality 419
8.5 During Operation of Stage 6 419
8.5.1 Impacts on Groundwater Hydrology and Quality 419
8.5.2 Impacts on Surface Water Hydrology and Quality 420
8.5.3 Closure of TMF 420
8.6 Impacts on Groundwater Hydrology and Quality 421
8.6.1 Impacts on Surface Water Flow and Quality 421
8.6.2 Summary of Impacts and Significance of Effects 424
8.7 Monitoring Recommendations 433
8.8 References 435
Section 9 Landscape and visual 436
9.1.1 Background 436
9.1.2 Scope of Work 436
9.1.3 Legislative Framework / Planning Policy 437
9.1.4 Views & Prospects 437
9.1.5 Protected Sites 438
9.1.6 Consultations 439
9.2 Receiving Environment 440
9.2.1 Baseline Study Methodology 440
9.2.1.1 Study Area 441
9.2.1.2 Sources of Information 441
9.2.1.3 Field Monitoring / Inspection 441
9.2.2 Landscape Baseline 441
9.2.2.1 Existing Landscape Appraisals 441
9.2.2.2 Outdoor Recreational Facilities within the Study Area 443
9.2.2.3 Site Specific Landscape Appraisal 444
9.2.2.4 Landscape Receptors 445

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

9.2.3 Visual Baseline 445
9.2.3.1 General Visibility 445
9.2.3.2 Visual Receptors 446
9.3 Impact Assessment 449
9.3.1 Evaluation Methodology 449
9.3.1.1 Landscape Sensitivity 449
9.3.1.2 Viewpoint Sensitivity 450
9.3.1.3 Magnitude of Landscape/Visual Effects 450
9.3.1.4 Significance of Effects 452
9.3.2 Landscape and Visual Impacts 453
9.3.2.1 Landscape Effects 453
9.3.2.2 Landscape Sensitivity 453
9.3.2.3 Magnitude of Change to Landscape 453
9.3.2.4 Significance of Landscape Impact 456
9.3.2.5 Visual Effects 456
9.3.2.6 Magnitude of Change to Viewpoints 457
9.3.2.7 Significance of Visual Impact 464
9.3.3 Impacts on Landscape/Planning Designations 465
9.3.3.1 Views & Prospects 465
9.3.3.2 Extractive Industry and Building Materials Production 465
9.3.3.3 Outdoor Recreational Facilities 465
9.3.3.4 Do-nothing Scenario 465
9.4 Mitigation Measures 466
9.5 Residual Impact Assessment 466
Section 10 Noise 471
10.1 Introduction 471
10.2 Aspects of the proposed development 471
10.3 Methodology 471
10.4 Acoustic terminology 471
10.5 Existing Environment 473
10.5.1 Baseline Noise Survey 473
10.5.2 Site Description 475
10.5.3 Results of Noise Survey 476

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

10.6 Characteristics of Proposal 476
10.6.1 Construction details 478
10.7 Noise Impact 481
10.7.1 Target Criterion and Noise Limits 481
10.7.2 Construction Impacts 483
10.8 Road Traffic Noise Generated by Development 486
10.8.1 Road Traffic 486
10.8.3 Road Traffic Noise 489
10.9 Ground Vibration 492
10.10 Mitigation measures 493
10.11 Commentary 493
10.12 Monitoring 494
10.13 Conclusion 495
10.14 References 495
Section 11 Human beings – Socio & Economic 496
11.1 Introduction 496
11.2 Methodology 496
11.3 Existing Environment 496
11.3.1 Land-Use 497
11.3.2 Population 497
11.3.3 Employment 498
11.3.4 Socio-Economic Profile of the Locality 499
11.3.5 Tourism and Amenities 500
11.3.6 Material Assets 502
Extractive Industry: 502
11.4 Significant Impacts 504
11.4.1 Effects on Population 504
11.4.2 Effects on Health and Safety 504
11.4.3 Effects on Employment and Economy 504
11.4.4 Effect on Land use 505
11.4.5 Effects on Amenities and Tourism 505
11.4.6 Effects on Material Assets 506
11.5 Mitigation Measures 506

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

11.5.2 Health and Safety 506
11.5.3 Employment and Economy 507
11.5.4 Amenities and Tourism 507
11.6 Conclusion 507
Section 12 Material Assets 508
12.0 Introduction 508
Part A Cultural and Heritage - Archaeology 508
12.1 Introduction 508
12.2.2 The Stage 6 Development Site 509
12.2.3 The Proposed ICW Site 510
12.2.4 Methodology 510
12.2.4.1 Archaeological and Historical Background 511
Medieval Period 512
12.2.4.2 Recorded Monuments 515
Recorded Monuments elsewhere in Randalstown Townland 516
Recorded Monuments in Adjacent Townlands 516
12.2.5 Field Survey 519
12.2.5.3 Land South of TSF (proposed ICW site) 524
Plate 12.1.2. Row No.1 looking SW 525
Plate 12.1.4 526
Row No.3 looking W 526
12.2.6 Potential Impact of the Proposed Development 527
12.2.7 Remedial and Mitigation Measures 529
12.2.8 Conclusions 530
Bibliography 530
Part B Soil, Vegetation and Land Use 532
12.3.1 Introduction 532
12.3.2 The Existing Environment 533
12.3.2.1 Sources of Information 533
12.3.2.2 Land Use 533
12.3.2.3 Trace Metal Concentrations in Soils 534
12.3.2.4 Trace Metal Concentrations in Vegetation 538
12.3.3 Impacts During Construction 540

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:07

12.3.4 Impacts During Operation 541
12.3.4 Decommissioning and Post Closure 542
12.3.6 Environmental Monitoring 542
12.3.7 Unexpected Circumstances 542
12.4.1 Introduction 543
12.4.2 Study Design 544
12.4.2.1 Study Farms 544
12.4.2.2 Sample Analysis 548
12.4.2.3 Statistical Methodology 549
12.4.3 Soil and Herbage Results 549
12.4.3.1 Soil and Herbage Heavy Metals 549
12.4.3.2 Soil Fertility and Major Elements 552
12.4.3.3 Soil Trace Elements 556
12.4.3.4 Herbage Major Elements 557
12.4.4 Animal Samples 564
12.4.5 Animal Fertility and Production 570
12.4.5.1 Heavy metal levels in milk and animal tissues 570
References 572

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

APPENDICES

Appendix 2	2.1 List of statutory consultees
	2.2 List of private consultees
	2.3 Attendees at meetings
Appendix 3 Integrated constructed wetland design	3.1 A - Drawings
	3.1 B - Site assessment form
	3.1 C - Flood Risk Assessment (ICW site and environs)
	3.1 D - Water Balance
	3.1 E - Assimilative capacity calculations
Appendix 4 Ecology	4.1 A NPWS Derogation DER-Bat 2016-15
	4.1 B NPWS Derogation DER-Badger 2016-23
	4.2 Complete List of Flora observed during surveys
	4.3 Results of winter bird surveys
	4.4 Results of Bats surveys
	4.5 Flight maps of Whooper Swan and Golden Plover observed during winter bird surveys
	4.6 Habitat Map of Stage 6 footprint
Appendix 7 Traffic	7.1 Traffic Survey Data
	7.2 Roads Structural evaluation
Appendix 8 Water	8.1 A Flood risk assessment (TSF Stage 6 site and environs)
	8.1B Water Framework Directive Assessment
Appendix 9 Landscape and Visual	9.1 Landscape Designations Map (including viewpoint locations)
	9.1 Two Zone of Theoretical Visibility (ZTV) Maps
	9.1 Six Viewpoint Sheets, refer to Figures 9-1 to 9-9. The viewpoint sheets include sketch photomontages of the proposed development for four of the chosen viewpoints.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:07

Section 1 Introduction

The EIS covers two distinct components of the Tailings facility operation and decommissioning

Project Part 1: **Lateral extension to the existing tailings storage facility**
Project Part 2: **Construction of Integrated Constructed Wetlands & pipeline.**

1.1 Background

Boliden Tara Mines Limited, the largest operating zinc and lead mine in Europe, is located at Knockumber, 2 km west of Navan in County Meath. Orebody development at this mine commenced in 1973, with production beginning in 1977.

Mining continues today at a rate of between 2.3 and 2.6 million tonnes of ore per year. Ore production encompasses the drilling, blasting and removal of the ore from underground deposits. Broken ore is delivered to one of five underground primary crushers and reduced in size to less than 150 millimeters before being hoisted to the surface. Ore is then fed to an autogenous grinding mill which grinds the ore to a fine powder which is then pumped as aqueous slurry to metallurgic flotation cells.

For inspection purposes only.
Consent of copyright owner required for any other use.

Within the flotation cells, galena (Lead sulphide) and sphalerite (Zinc sulphide) are differentially separated, while undesirable minerals such as pyrite are depressed. Differential flotation and selective depression of minerals are enhanced by chemical additives to the flotation chamber feed.

Once the target minerals have been extracted the tailings stream is cycloned to separate the coarse sand fraction from the finer slimes fraction. The coarse fraction of tailings is pumped, to the underground mined out areas. In so doing, approximately 50% of the tailings are used underground to backfill mined voids. The tailings used for backfilling is stabilised, chemically and physically, by mixing with Portland cement.

The remaining fines fraction tailings is pumped as an aqueous slime to the Tailings Storage Facility (TSF) located some 2.5 km north of the processing plant in the townland of Randalstown. On an annual basis approximately 1.1 million tonnes of tailings are deposited for permanent storage in the TSF.

Since its inception the tailings facility has been constructed and operated in seven stages, Stages 1, 2, 3 (lateral extensions) and the more recent Stage 4A, 4B, 5A and 5B (upstream vertical extensions), using combinations of temporary and permanent embankment walls.

The TSF is constructed as a ring-dike configuration, enclosed by earth-fill embankment walls. The embankment walls are constructed of low permeable glacial clay till and armoured with a layer of coarse material on the upstream slope.

EPA Export 06-01-2017:02:02:07

The existing TSF, enclosing a footprint area of approximately 171 ha, serves as containment for tailings to settle and consolidate, as well as a storage area for water that is circulated back to the processing plant at Knockumber for reuse in the processing plant or for eventual discharge to the *River Boyne*.

Proposal

- **It is proposed to extend the existing TSF laterally in a northerly direction.**
    - **Here after the proposed facility will be referred to as *TSF Stage 6*.**
    - **The proposal facility will cover a footprint area of c. 58 hectares, extend to a height of 22 m above ground level and will provide a potential a storage volume of approximately 9.6 million cubic metres [13.6 million tonnes].**

- **The second part of the proposed development is the construction of an Integrated Constructed wetland (ICW). The proposal facility will cover a footprint area of c. 12 hectares. The function of the wetland is to provide a passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle.**
    - **Treated water will discharge from the ICW to the river Blackwater via a buried HDPE pipeline.**

For inspection purposes only.
Consent of copyright owner required for any other use.

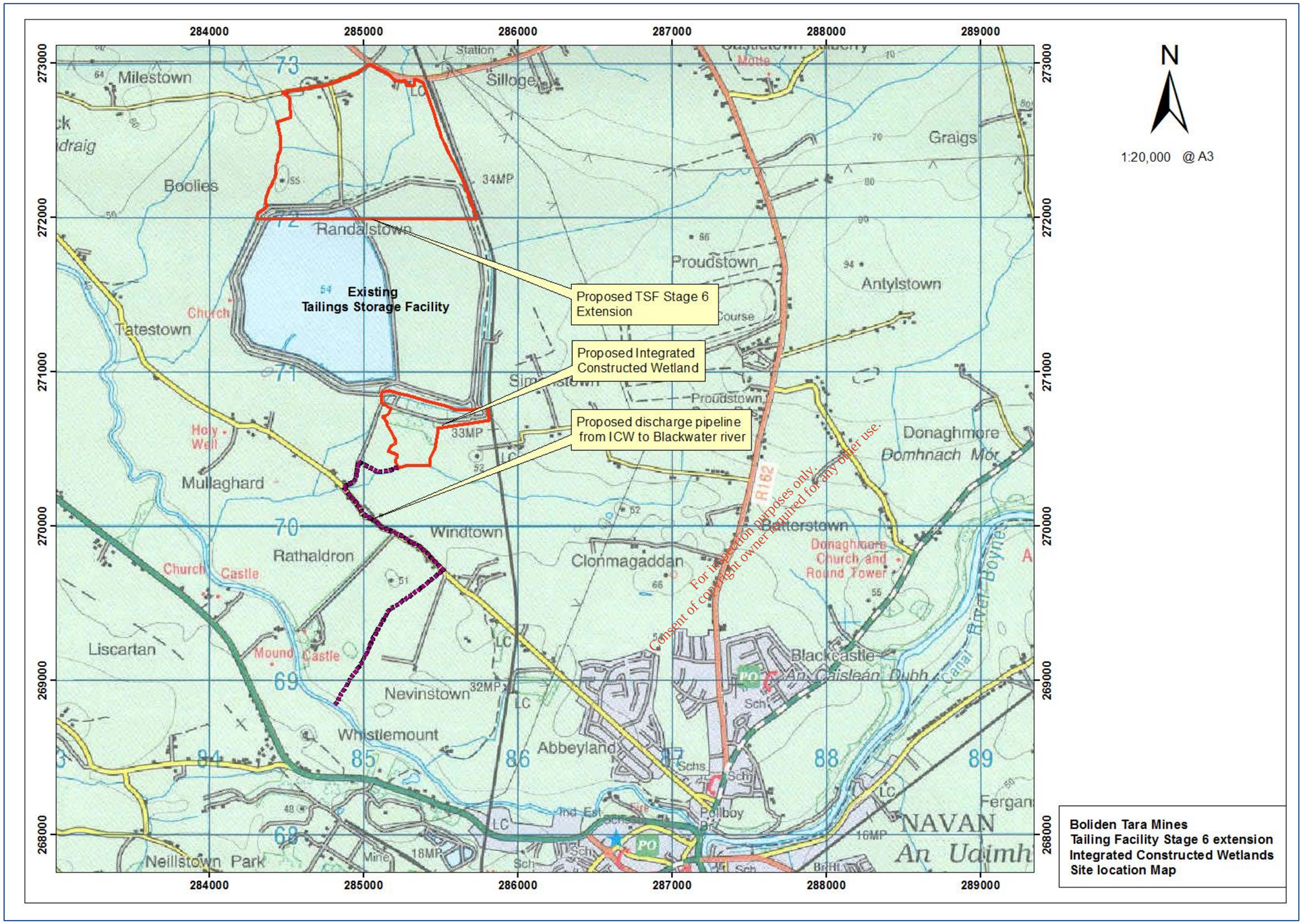
As with the development of the previous stages of the Randalstown Tailings Facility, the application for planning consent is supported by an Environmental Impact Statement.

Environmental Impact Assessment (EIA) is *a process for anticipating the effects on the environment caused by a development.* The document that is produced as the output of this process (and which is submitted to the planning authority and disclosed to a series of statutory consultees for comment) is known as an Environmental Impact Statement (EIS).

The EIS has been prepared in accordance with the current guidelines prepared by the Environmental Protection Agency (EPA), namely:

- *Guidelines on the information to be contained in Environmental Impact Statements* (2002).
- *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (2003).*

EPA Export 06-01-2017:02:02:07



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 1.1 Site location map

EPA Export 06-01-2017:02:02:07

1.2 Necessity for the proposed development – TSF extension

1.2.1 Present Situation

At the start of 2016 a total of 40.3 million tonnes (Mt) of tailings had been deposited in the TSF.

The void remaining in Stage 5 is (3.2 Mm^3) equivalent to 4.6 Mt of tailings.

Current mine production schedules show that Stage 5 will be at full capacity by the end of 2019. The Company therefore needs to increase the storage capacity of the existing tailings facility to allow the processing of ore beyond the year 2019.

1.2.1.2 Medium Term Plan

Based on end-2015 ore reserves and the life of mine plan to 2019 it is envisaged that a further 17Mt of ore will potentially be mined at Tara Mines. Processing 17Mt of ore will require storage for 9.35Mt or 6.8Mm^3 of tailings.

The present available storage capacity, 3.2 Mm^3 equivalent to 4.6Mt of tailings, will enable the processing of 7.13Mt of ore.
Provision must therefore be made to provide an additional 7Mm^3 of tailings storage capacity or 9.8Mt of ore reserves will remain un-mined.

The proposed Stage 6 development will provide a total of 9.9 Mm^3 of storage in two phases: 6.6 m^3 in Stage 6 Phase 1 and 3.3m^3 in Stage 6 Phase 2. The graph, figure 1.2, shows the long term tailings deposition plan.

Consent of copyright owner required for any other use. For inspection purposes only.

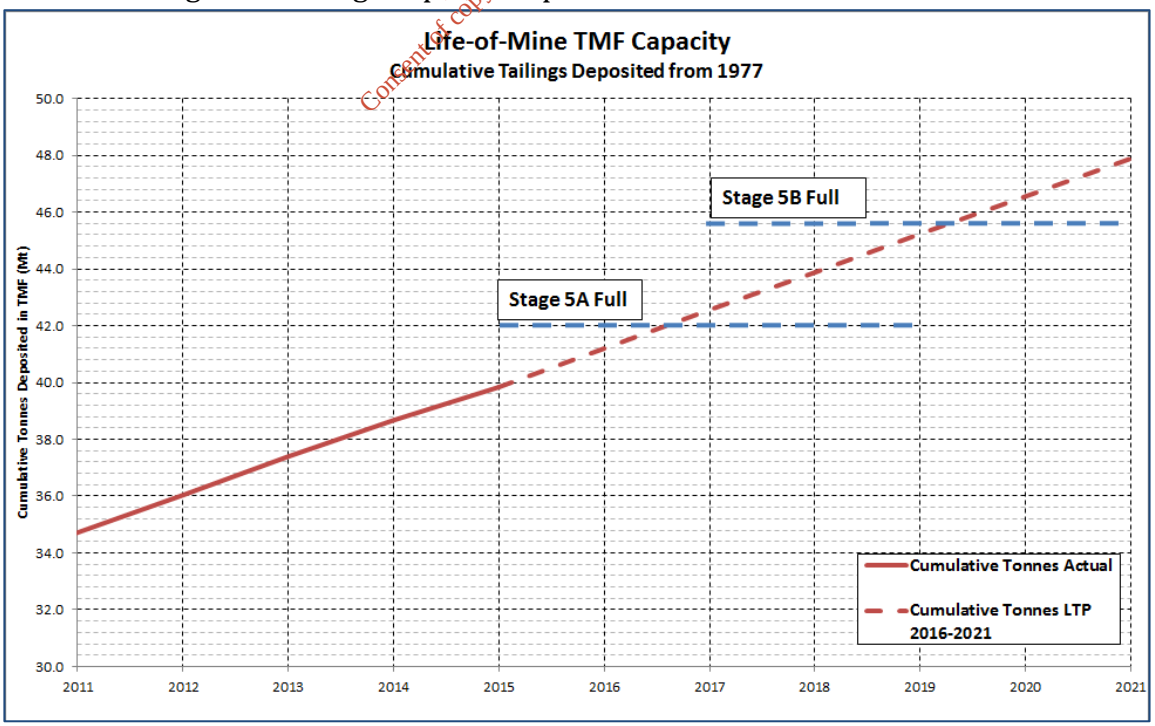


Figure 1.2 Long-term tailings deposition plan

EPA Export 06-01-2017:02:02:07

1.2.2 Necessity for the proposed development – ICW Construction

The Company's Closure Remediation and Aftercare Management Plan (CRAMP) detail the phased approach to success decommissioning from:

- The closure phase followed by
- The aftercare Phase
  - involving post-closure monitoring and maintenance which could last for five to ten years.
  - followed by the passive phase where monitoring and maintenance is reduced and this could also last for five to ten years.

After these phases the reclaimed area of tailings facility should be stable and is expected to be self-sustaining in the longer term. The time periods will be based on performance of the rehabilitation.

One essential component of the CRAMP is the management of surface water runoff from the site. Under normal operating condition at the TSF water is treated and stored before it is recycled to the processing plant at the main mine site. Excess water is discharged to the river Boyne under the company's Industrial Emissions Licence (ref. EPA, P0 516-03).

Post closure and remediation water recycling will cease and runoff from the TSF site will be treated in the intended ICW prior to eventual discharge to the River Blackwater.

Surface water flows will be by directed gravity to the ICW. Here water will be treated to the required levels prior to discharge to the Blackwater River, at a discharge point south east of the TSF and ICW sites.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:07

1.3 E.I.A. Regulations

Environmental Impact Assessment (EIA) is a procedure for systematic examination of the likely effects on the environment of a proposed development and is required for certain types and scales of development prescribed by Article 93 and Schedule 5 of the Planning and Development Regulations 2001-2006 and Article 23 of the European Communities (Environmental Impact Assessment Regulations) 1989-2006.

The European Communities (Environmental Impact Assessment) Regulations, 1989-2006 and the Planning and Development Regulations 2001-2006 bring EC Directive 85/337/EEC, as amended by Directives 97/11 and Article 3 of 2003/35/EC, (commonly known as the Environmental Impact Assessment Directive) into effect in Ireland.

Tailings impoundments (either new facilities or the expansion of existing facilities) are not referred to directly in the regulations however based on consultation with the planning authority and the president set by the TSF Stage 4 extension it was decided that an EIA would be undertaken.

1.4 Role of Government and Statutory Bodies

Consent of copyright owner required for any other use. For inspection purposes only.

Responsibility for the protection of the environment and the regulation of planning issues lies primarily with the Department of the Environment, Community and Local Government. Other Government departments, statutory bodies and special interest groups also exercise important control functions. The responsibility for further regulation in the natural resource sector, including mining, is currently administered by the Department of Communications, Energy and Natural Resources who also, though not directly, have responsibility for environmental control through the Central and Regional Fisheries Boards. Within the Department of the Environment, Community and Local Government, the Natural Heritage Service, plays a major role in relation to the protection, conservation and management of the natural and built as well as the historic environment.

Natural heritage

Of the statutory bodies, local authorities have a major role in relation to the enforcement of planning legislation especially at county and local level. The major environmental management responsibility for improving and protecting the environment lies with the Environmental Protection Agency (EPA). Another statutory body with immense regulatory power is the Planning Appeals Board, An Bord Pleanala, which determines first and third party appeals *inter alia* against planning decisions. Other bodies with responsibilities in relation to mining development are the Health Service Executive and the Health and Safety Authority; however, the extent of their involvement varies with the circumstances of individual proposed developments.

EPA Export 06-01-2017:02:02:07

Of the Special Interest Groups the most important is An Taisce, the National Trust for Ireland. It has prescribed body status under the planning acts and has the right of examination of planning applications. A lesser participatory role in planning decisions has been played by Fáilte Ireland.

1.5 Content of the EIS

The Environmental Protection Agency (EPA) has produced guidelines on the production of an EIS in line with the Environmental Impact Assessment Regulations, and these guidelines have been followed in the production of this report. The EIS has been structure in what the EPA term a Grouped Format Structure, which examines each topic as a separate section referring to the existing environment, the proposed development, impacts and mitigation measures.

Boliden Tara Mine Limited has developed an extensive environmental monitoring programme around the existing Randalstown tailings facility partly in response to conditions attached to Planning Conditions and latterly in response to requirements of the Company's IE Licence No. P0516-03. This information enables the environmental performance of the existing facility to be assessed over time and provides a sound basis to predict the magnitude and significance of potential / likely impacts from an expanded development.

For inspection purposes only.
Consent of copyright owner required for any other use.

The preparation of the EIS has also afforded due regard to the following Environmental Protection Agency Guidance documents:

- Guidance on the Information to be Contained in Environmental Impact Statements (March 2002)
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (March 2003)

The environmental topics included in this EIS are presented in Table 1.1.

1.6 Terminology

The following terms are used in this EIS to describe the proposed development site:

- "Perimeter embankment" refers only to the walls, constructed of clay fill, within which the tailings are deposited.
- "Tailings Storage Facility [TSF]" refers only to the total area of deposited tailings within the perimeter embankment.
- "Tailings Management Facility [TMF]" refers to the whole operational site, which, in addition to the tailings dam, includes the supporting infrastructure such as the interceptor channel, perimeter road, pump house, etc.

EPA Export 06-01-2017:02:02:07

Table 1.1 Subject Areas included in the EIA/EIS

Subject area[1]	Level of Detail Required	Comments
Human beings		
Economic activity/employment	Significant Minimal	Significance of Tara to the local economy
Land-use	Significant	Additional borrow areas
Health & safety	Significant	Public safety, nuisance
Traffic		Construction traffic
Geology and Soils	Significant	
Superficial and bedrock deposits	Modest Significant	Prediction of impacts of seepage Influence on seepage
Faulting	Modest	Attenuation of seepage
Geochemistry		Restoration of borrow areas
Agricultural capability of soils	Significant	
	Significant	Vulnerability to seepage
Hydrogeology and hydrology	Significant	Interaction with near-surface groundwaters
Hydrogeology	Significant	Existing quality and potential changes
Surface water hydrology		
Surface and groundwater quality	Modest	Local wells, stock-watering
Potential uses of water resources	Significant	Influence on air quality, noise
	Significant	
Climatic factors		
Weather		Fugitive dust
	Significant	Construction noise, traffic noise
Air quality		
Suspended particulates		
Noise	Modest	From residential properties and public sites
	Modest	
Landscape		
Visibility		
	Modest	Borrow areas; freshwater ecology (fisheries)
Fauna		
Habitats		Presence of some protected bird species on site
Protection status	Modest	
	Modest	
Flora		Borrow areas
Communities		
Material Assets		Borrow areas
Archaeology		Animal health, trace metal accumulation
Agriculture		

Note: [1] Adapted from *Guidelines on the information to be contained in Environmental Impact Statements* (2002).

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:07

1.7 Project Team

BTMLs Environmental Department staff has prepared this EIS with assistance of the following specialists:

- **Project Design/Description**
  Roger White. Golder Associates
- **Scoping**
  Dr. Mark Dodd-Smith, MDS Mining & Environmental Services, Suffolk, UK
- **Landscape**
  SLR Consulting
- **Soils, Vegetation & Land Use**
  Professor Michael Johnson, External Advisor, Liverpool University, UK
  Oliver Fitzsimons, MSc. Snr Environmental Engineer. BTML
- **Hydrology and Hydrogeology**
  Dr. Jane Sladen, AECOM
- **Ecology, Wildlife and Fisheries**
  Dr. Patrick Moran, Forest, Environmental Research Services Limited, Navan
  Daireann Mc Donlad, Tobin Consulting Engineers, Dublin
  Oliver Fitzsimons, MSc. Snr Environmental Engineer. BTML
- **Animal Health**
  James Crilly, Veterinary Surgeon, Cork
- **Air Quality**
  Dr. Brian Sheridan, Odour & Environmental Engineering Consultants, Trim, Co. Meath
- **Noise**
  Brendan O'Reilly MSc. Noise & Vibration Consultants
  Oliver Fitzsimons, MSc. Snr Environmental Engineer. BTML
- **Roads & Traffic**
  Tobin Consulting Engineers, Dublin
- **Human Beings**
  Ailish Mc Cabe, Snr Environmental Engineer. BTML
  Tobin Consulting Engineers, Dublin
- **Archaeology- Heritage and Cultural**
  David Sweetman

The following BTML personnel contributed significantly to the preparation of the EIS:

- Paschal Walsh B.Eng, (Hons) H Dip
- Oliver Fitzsimons MSc. B. Env.Sc. (Hons)
- Ailish Mc Cabe, B. Ag.Sc. (Hons)

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:07

Section 2 Scoping and Consultation

2.1 Introduction

The scoping stage of the Environmental Impact Statement (EIS) assists in identifying those issues and risks that are likely to be important during the Environmental Impact Assessment process and which, therefore, must be adequately addressed in the EIS.

MDS Mining & Environmental Services Ltd (MDS) undertook the scoping process on behalf of Boliden Tara Mines Limited.

The scoping process involved

- Consultation (both formal and informal) with the planning authority and statutory consultees to identify relevant issues and agree appropriate methodologies (see Appendix 2.1).
- Consultation with local communities to identify issues of potential concern (see Appendices 2.2 and 2.3).
- In addition, the scoping process afforded due regard to the information gained as a result of:
    - Consultations and meetings that took place during the planning of previous construction projects.
    - Technical studies undertaken as part of previous EIA/EIS for the TSF.
    - Monitoring records available during the construction and operation of the existing facility.
    - Comments and complaints received from local communities during the construction and operation of the existing facility.
    - Potential changes to the characteristics of the surrounding environment.
    - Potential changes in the regulatory requirements and policy.
    - Developments in good practice.

Consent of copyright owner required for any other use. For inspection purposes only.

<u>Proposal</u>

- **It is proposed to extend the existing TSF laterally in a northerly direction.**
    - **Here after the proposed facility will be referred to as *<u>TSF Stage 6</u>*.**
    - **The proposal facility will cover a footprint area of c. 58 hectares, extend to a height of 22 m above ground level and will provide a potential a storage volume of approximately 9.6 million cubic metres [13.6 million tonnes].**
- **The second part of the proposed development is the construction of an Integrated Constructed wetland (ICW). The proposal facility will cover a footprint area of c. 12 hectares. The function of the wetland is to provide a**

EPA Export 06-01-2017:02:02:07

passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle.

- **Treated water will discharge from the ICW to the river Blackwater via a buried HDPE pipeline.**

2.2 Site History

The Navan mine which is owned and operated by Boliden Tara Mines Limited (BTML) is the largest operating zinc-lead mine in Europe.

BTML currently processes c. 2.5 million tonnes of ore per annum, producing some 300,000 tonnes of zinc concentrate and 40,000 tonnes of lead concentrate annually.

Since 1977, when the mine began production, the residue from ore processing, known as tailings, has been utilised to back-fill the underground mine working with the remaining portion being pumped to the Randalstown Tailings Storage Facility (TF) some 3 km north of the mine site.

To date, there have been seven separate developments of the TSF resulting in the construction of seven operational stages:

- Stage 1, the initial Tailings Facility was commissioned in 1977.
- Stages 2 and 3 were constructed in the 1980s as lateral extensions to the original facility.
- Stages 4A and 4B were constructed in the late 1990s as vertical upstream raises to Stage 1/2 and Stage 3 respectively.
- Stage 5A was constructed in 2013 as a vertical upstream raise to Stage 4A.
- Stage 5B was constructed in 2015 as a vertical upstream raise to Stage 4B.

For inspection purposes only.
Consent of copyright owner required for any other use.

2.3Existing capacity

The combined tailings capacity of the existing facility is approximately 44.9 million tonnes (31.6 million m^3) (Golder Associates, January 2016).

Although the rate of processing has remained stable in recent years, at approximately 2.5 million tonnes per annum, the rate of tailings disposal varies depending on a number of factors, principally the requirements for backfill of tailings to stabilise worked-out areas of the mine underground.

Process tailings are separated using cyclones with the coarser sand fraction being used as backfill with the remaining slimes fractions pumped to the TSF.

The ability to use the sand fraction of the tailings in backfill depends on:

- The suitability of the coarse fraction of process tailings for backfill.
- The availability of the worked-out areas underground and the timing of backfill activities.
- The use of “waste” rock as backfill material in the underground mine. Waste rock is barren rock that is mined to access ore grade material and is also suitable for use as backfill.

EPA Export 06-01-2017:02:02:07

Historically, between 48% and 52% of tailings were recovered for backfill to the mine (Golder Associates, January 2016), although this can vary significantly in the short term and in recent years, the proportion has dropped to approximately 45%.

Consequently, the quantity of tailings deposited in the Randalstown Tailings Facility has ranged from between 1.0 million tonnes per annum (equivalent to approximately 720,000 m^3) in the early 1990s to 1.3 million tonnes per annum (equivalent to approximately 1,278,978m^3) in 2014.

Based on the current rates of tailings deposition, the capacity of Stage 5, which is currently operational, is sufficient to support mineral processing at BTML until end 2019(Golder Associates, January 2016).

This rate of utilisation of the existing storage capacity is broadly consistent with the prediction made in 2009 in the Environmental Impact Statement for the Stage 5 extension (Boliden BTML Mines Limited, 2009).

2.4 Future Requirements

BTML currently has "proven and probable" mineral reserves of some 17 million tonnes (2015 JORC data).

On-going exploration regularly modifies this estimate, with the reserves being increased in 2014, for example, by 17% (some 2.2 million tonnes) effectively replacing the entire ore production for that year.

At current rates of production, the known reserves extend the operating life of BTML well beyond 2020, when the existing capacity of the Randalstown Tailings Facility will be exhausted. With recent exploration findings regularly increasing (or at least maintaining) the known reserves, it would be prudent to plan for a mine life of at least an additional 10 years beyond 2020.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:07

2.5 Necessity for the proposed development – ICW Construction

The Company's Closure Remediation and Aftercare Management Plan (CRAMP) detail the phased approach to success decommissioning from:

- The closure phase followed by
- The aftercare Phase
  - involving post-closure monitoring and maintenance which could last for five to ten years.
  - followed by the passive phase where monitoring and maintenance is reduced and this could also last for five to ten years.

After these phases the reclaimed area of tailings facility should be stable and is expected to be self-sustaining in the longer term. The time periods will be based on performance of the rehabilitation.

One essential component of the CRAMP is the management of surface water runoff from the site. Under normal operating condition at the TSF water is treated and stored before it is recycled to the processing plant at the main mine site. Excess water is discharged to the river Boyne under the company's Industrial Emissions Licence (ref. EPA, P0 516-03).

Post closure and remediation water recycling will cease and runoff from the TSF site will be treated in the intended ICW prior to eventual discharge to the River Blackwater.

For inspection purposes only. Consent of copyright owner required for any other use.

Surface water flows will be by directed gravity to the ICW. Here water will be treated to the required levels prior to discharge to the Blackwater River, at a discharge point south east of the TMF and ICW sites.

2.6 Tailings Storage Facility - Options

2.6.1 Conceptual options

As part of the consideration of each stage in development of the Randalstown Tailings Facility, BTML and its consultants have undertaken a series of high level reviews of the alternative options available for provision of the required tailings capacity. The most recent of these reviews was undertaken in 2008 prior to the design and permitting of Stage 5. A similar exercise has been undertaken as part of the scope of works in support of the development of Stage 6.

As with previous reviews, the consideration of alternatives has included:

i) A review of the potential for reducing the quantity of tailings requiring disposal

The review of the potential for reducing the quantity of tailings requiring disposal has its roots in work undertaken by BTML in the 1970s that looked at the potential for

EPA Export 06-01-2017:02:02:07

inclusion of tailings in commercial products (for example, in cement production). These were discounted, primarily due to a range of technical constraints (for example, the high magnesium content of the tailings causes deterioration in cement after setting).

As there are no new factors to be taken into consideration in 2016, this option is not considered further at this time.

ii) A review of the method of tailings disposal

The review of the method of tailings disposal compared the existing method of "conventional" slurry disposal with paste tailings disposal. The application of paste technology in the mining industry has seen significant advances since the Randalstown Tailings Facility was first commissioned.

Paste tailings are tailings that have been dewatered to the point where they contain little or no "free" water (i.e. water does not separate from the paste after discharge). Paste tailings are normally deposited on a conical pile around a central discharge tower (although they can subsequently be redistributed by mobile plant). Some of the key advantages of paste disposal over conventional slurry disposal that were identified in 2008 (Boliden BTML Mines Limited, 2009) are:

- ***Reduced surface area:*** paste tailings disposal requires a significantly smaller footprint, which usually results in reduced impacts on, for example, soils and land-use, terrestrial ecology, hydrology and hydrogeology and archaeology.
- ***Reduced water storage:*** the need to store potentially contaminated tailings supernatant water at the disposal site can be much reduced, or even eliminated (depending on water treatment and discharge arrangements), which is usually associated with a perceived reduction in environmental risk.
- ***Reduced seepage:*** the quantity of seepage emanating from the base of a paste tailings disposal facility is significantly reduced, which usually results in reduced impacts on hydrology and hydrogeology, water quality and aquatic ecology.
- ***Reduced environmental risk:*** paste tailings disposal is normally associated with a much reduced risk of environmental damage in the event of an embankment breach, since the paste itself cannot flow significant distances (and little or no water is stored in the facility).
- Some of the key disadvantages commonly associated with paste tailings disposal that were also identified in 2008 include:
- ***Additional plant at the disposal site:*** the distance between the mine and the Randalstown tailings facility is too great for the paste to be produced at the mine and then pumped to the disposal site; consequently, a new paste plant would need to be constructed at the tailings facility and operated at times consistent with the hours of operation of the plant (potentially 24-hrs/day, 7-days/week), which would inevitably be a source of noise at a site where, apart from during construction activity, little or no noise is generated.
- ***Discharge tower:*** paste is normally discharged from one or more towers that increase in height as the paste accumulates around them; for paste that forms

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

a slope of angle 5%, the towers may need to be several 10s of metres high (depending on the number of towers) to ensure the paste was dispersed adequately or, alternatively, each tower could operate with 24-hour mobile plant to redistribute the tailings; each tower would also require 24-hour external lighting for routine observation of the disposal area and to provide safe access; these discharge towers would inevitably, therefore, be highly visible, a source of light pollution and, in the event that mobile plant is operating, a source of noise and dust.

- ***Emergency provisioning:*** it is common practice at operations that utilise paste disposal to construct an emergency facility capable of storing, for example, one week's tailings production to allow for uninterrupted ore processing during times of routine maintenance and repair to the paste plant.
- ***Water management:*** the existing tailings facility acts not only as a location for the deposition of tailings but also as a reservoir for storage of water. BTML has a positive water balance (i.e. a surplus of water pumped from underground workings that needs to be discharged, after treatment, to the environment). The rate of discharge is dependent upon the flow in the receiving water (the River Boyne) and at times of low flow significant volumes of water are stored temporarily in the tailings facility (where they also assist with dust suppression). Changing to paste technology, therefore, would probably entail construction of separate water storage facility at Randalstown.
- ***Operational constraints:*** the particle size distribution of the tailings comprising the paste must be consistent over time (to maintain the desired geotechnical properties of the paste); consequently, the current practice at BTML of the intermittent removal of the sand fraction for backfilling would need to be changed; many of the changes that could potentially be required would themselves be associated with adverse environmental implications (for example, increased road traffic generated by the need to truck unwanted sands to the disposal facility).
- The 2008 review concluded that, although technically feasible (subject to detailed study), the operational constraints, water management issues and additional environmental impacts associated with a paste plant (noise, lighting etc.) combined to render this option unattractive. The significant disadvantages with the application of paste technology at BTML remain essentially the same in 2016 and, as there are no new factors to be taken into consideration, this option is not considered further at this time.

Consent of copyright owner required for any other use. For inspection purposes only.

iii) A review of the location for tailings disposal

The reviews of alternative options for tailings disposal have usually considered six alternatives in principle:

- A lateral extension of the existing facility to the north, south, east or west.
- A vertical extension of the existing facility.
- Construction of a completely new facility at an unspecified location.

In 1996 and 2008, the option of developing a new facility at an unspecified greenfield location was essentially a theoretical exercise due to the low likelihood of a suitable

EPA Export 06-01-2017:02:02:07

location being identified and the inevitable high impact that would arise from such a development in the event that a location could be identified. This situation remains largely unchanged in 2016, although the development in the Navan area that has occurred since the 2008 review was undertaken suggests that the options for identifying a suitable greenfield location are, if anything, diminishing with time. The review of options undertaken in 2015, however, acknowledged that all options remained theoretically possible although the detailed focus remained on a lateral extension or further vertical raise to the existing facility.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

2.6.2 Engineering and operational considerations

To ensure that the assessment of options incorporates appropriate engineering and design considerations, each conceptual option has been reviewed based on the following:

- Timing of construction
- Operational constraints, including water management and closure considerations.
- As part of this review, the following assumptions were adopted:
- Suitable options should ideally be able to provide for a minimum ten years of operational life (i.e. a minimum storage capacity of some 8.5 million m^3).
- Suitable options should provide for a suitable capacity for temporary water storage
- The basic design of a lateral extension to the existing facility, or a facility at a new location, would be broadly consistent between options, irrespective of the direction of the extension or the location of the new facility.
- The basic design of a vertical extension would be consistent with the design of the existing raises and subject to the same level of engineering investigation.
- The necessary construction materials should be available on-site or within feasible transport distances.
- Suitable options must be amenable to construction and commissioning at a date that allows for uninterrupted operation of the process plant.
- Each option would require essentially the same support "infrastructure" (tailings pipeline, return water pipeline, power supply, pump station, interceptor channel, access, security fencing etc.).
- Landownership was not considered as part of the “theoretical” review of options, although it is acknowledged as a major practical consideration for some of the options.
- Specific locations for the construction of a new facility were not identified, although, for the purposes of this review, it has been assumed that a new site of 50 – 100 ha of suitable undeveloped land could be found.

The relative advantages and disadvantages of each option from an engineering and operational perspective are summarised in Table 2.1

Environmental considerations are addressed separately in the following section.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:07

Table 2.1 Engineering and Operational Considerations

	Vertical Raise	Lateral Extension				New location
		North	East	South	West	
Technically feasible (subject to detailed engineering studies)	Yes	Yes	Yes	Yes	Yes	Yes
Minimum 10 years tailings storage	No[1]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]
Adequate water storage	No[3]	Yes	Yes	Yes	Yes	Yes
Construction material requirements	Lowest	High[4]	Highest[4]	High[4]	Highest[4]	Highest[4]
Timing of construction and commissioning	Difficult[5]	Flexible	Flexible	Flexible	Flexible	Flexible
New tailings and return water pipelines, access and power supplies	No	No	No	No	No	Yes
Operational constraints	Yes[6]	No	No	No	No	No
Additional closure issues	Yes[7]	No	No	No	No	No
Land ownership issues	No	No	Yes	Yes	Yes	Yes

Consent of copyright owner required for any other use. For inspection purposes only.

Notes:

[1] The maximum storage capacity of a further vertical raise would be equivalent to some 7 years of operating life.
[2] Options could provide a minimum storage capacity of equivalent to some 10 years of operating life.
[3] The need to drain Stage 5a to allow construction work would limit the capacity to store water.
[4] A lateral extension or development of a new location would require a greater volume of construction material, the presence of the railway to the east and the stream to the west of the existing facility ensure that the construction of a lateral extension in these directions would require more material than those directly abutting the existing facility.
[5] The period of time between completion of filling of the existing Stage 5 and construction of a further raise is potentially problematic.
[6] The dimensions of Stage 6a would be sub-optimal for managing the tailings discharge since at the narrowest point, the stage would be only 330 metres wide; more intensive discharge management would be required to prevent formation of a ridge across the facility creating two separate "ponds".
[7] Slightly increased seepage from the facility on closure.

The review of engineering and operational considerations of the options indicates that, although technically feasible, a further vertical raise does not meet all the

EPA Export 06-01-2017:02:02:07

relevant criteria. In particular, the additional storage capacity that could be provided by a further raise does not meet the currently anticipated requirements. (This is largely an inevitable consequence of the situation where each additional vertical raise occupies a progressively smaller surface area and successive raises are, for engineering reasons, progressively less in height). There are also other constraints that, whilst not insurmountable, indicate that a further vertical raise is not the best option.

The review also indicates that, in principle, a lateral extension, in any of the four directions, or the development of a new location are all technically feasible. The development of a new location would also be contingent upon the availability (and acquisition and development) of a suitable corridor for the construction of a new tailings pipeline and return water pipeline between the process plant and the disposal site. A new location would also require suitable road access for construction (and operation) and a power supply.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

2.6.3 Environmental considerations

As part of the Environmental Impact Assessment for both the Stage 4 (1996) and the Stage 5 (2009) TSF extension projects, a theoretical analysis was undertaken of the potential environmental impacts associated with the alternative options. The potential impacts were assigned a rank from 1 to 6; the lowest ranking (i.e. 1) being indicative of the option likely to give rise to the least impact and the highest ranking (i.e. 6) being indicative of the option likely to give rise to the greatest impact. Assigning a rank in this way did not involve any attempt to assess the magnitude of the likely impact; thus a rank of 1 did not imply "no significant impact" and a rank of 6 did not imply "significant impact" - the rank was merely an indication that the impact of one option was likely to be greater or lesser than that of another.

The conclusions of the two exercises in 1996 and 2008 were quite similar, namely that:

- Construction of a new facility at an unspecified location would have given rise to the greater additional environmental impact.
- The construction of a vertical raise was the option that satisfied the requirements for additional tailings deposition whilst having the least impact on the environment.
- There was little apparent difference between possible lateral extensions.

A similar exercise has been repeated in for the Stage 6 Proposal (see Table 2.2).

Consent of copyright owner required for any other use.
For inspection purposes only.

The current exercise has been adapted to take account of the land-use changes to the north of the existing facility, where the land has been used as a source of construction material for the Stage 5 raise.

This work is on-going and, as a consequence, the area has not yet been restored. Accordingly, the analysis considers both the land in its current (i.e. “brownfield”) condition and the land in a condition where it has been restored in accordance with the existing planning conditions.

The consideration of a new location has again been included in this exercise as an option at a unspecified location.

EPA Export 06-01-2017:02:02:07

Table 2.2 Qualitative Appraisal of Potential Impacts Associated with Options for Tailings Disposal

	Lateral extension				Vertical raise	New location
	North	East	South	West		
Landscape	1 (2)	3 (3)	4 (4)	2 (1)	5= (5=)	5= (5=)
Soils and land-use	2 (2=)	3= (2=)	3= (2=)	5= (5=)	1 (1)	5= (5=)
Terrestrial ecology	2 (2=)	3= (2=)	3= (4)	5= (5=)	1 (1)	5= (5=)
Hydrology/hydrogeology	6 (6)	4 (4)	5 (5)	3 (3)	1 (1)	2 (2)
Water quality	2 (2)	3= (3=)	3= (3=)	3= (3=)	1 (1)	3= (3=)
Aquatic ecology	1= (1=)	1= (1=)	1= (1=)	1= (1=)	1= (1=)	1= (1=)
Air quality	1= (1=)	1= (1=)	1= (1=)	1= (1=)	6 (6)	1= (1=)
Noise & vibration	3 (3)	1= (1=)	4= (4=)	1= (1=)	4= (4=)	6 (6)
Traffic	4= (4=)	4= (4=)	1 (1=)	1 (1=)	1 (1=)	4= (4=)
Human beings	1= (1=)	1= (1=)	1= (1=)	1= (1=)	5 (5)	6 (6)
Material assets	1= (1=)	6 (6)	1= (1=)	1= (1=)	1= (1=)	1= (1=)
Average ranking	2.2 (2.3)	2.5 (2.5)	2.5 (2.5)	2.4 (2.4)	2.5 (2.5)	3.5 (3.5)
Total ranking	**24 (25)**	**27 (28)**	**27 (27)**	**26 (26)**	**27 (27)**	**39 (39)**

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

Note :

1. Ranking is based on the existing (2015) condition of the land to the north of the existing facility, which is still be worked for construction material for Stage 5; the ranking in brackets is an alternative analysis based on the condition of this land after it had been restored in accordance with the existing planning conditions.
2. The use of a ranking system is not intended as a means of quantifying the magnitude of different impacts. Thus a rank of 1 does not imply "no significant impact" and a rank of 6 does not imply "significant impact" - the rank is merely an indication that the likely impact of one option is to be greater or lesser than that of another.

The appraisal process is not particularly sensitive and, therefore, small differences in the overall ranking between options have limited value. Nevertheless, the results of this exercise differ somewhat from those undertaken in 1996 and 2008.

There would appear to be little difference between most of the options (with the exception of the option of developing a completely new location). In particular, unlike the previous exercises, the option of a further vertical raise does not stand out as prominently as the option likely to be associated with the least impact on the environment.

The change in the ranking of the option of a further vertical raise is primarily a consequence of its increased ranking for impacts associated with “human beings” (including nuisance), noise and air quality, which is related to the greater elevation and exposure of the area of construction and operational activity inherent in a further vertical raise.

For inspection purposes only.
Consent of copyright owner required for any other use.

There is little apparent difference in the possible lateral extensions. The ranking differences are unlikely to be significant given the “high level” nature of the analysis, although there is now a suggestion that a lateral extension to the north might be associated with a lesser impact than an extension in other possible directions. This is largely a consequence of the use of this land as a source of material for construction of the Stage 5 development.

The potential impacts of an extension on to land already disturbed are, unsurprisingly, somewhat different to those that would normally be associated with an extension on to land that is essentially a “greenfield site”. In most cases, the potential impacts might be expected to be less than for a greenfield site (as would normally be the case with potential impacts on soils & land-use and ecology, for example), or may be unaffected, i.e. the potential impacts are independent of the condition of the site (as could be the case with traffic related impacts, for example).

In some cases, however, the impacts might actually be greater (as, for example, might be the case with potential impacts on groundwater where the removal of clay material may increase the vulnerability of underlying groundwater). Varying the analysis of a northern extension dependent on whether the ranking is based on the current condition of the site or based on its “restored” condition appears to make only a marginal difference to the predicted potential impact.

EPA Export 06-01-2017:02:02:07

Construction of a new tailings facility on an alternative location away from Randalstown will create a fresh suite of impacts affecting other communities and environments particularly in terms of visual and landscape impacts, noise, dust and traffic. Local geology, land use, visibility, water resources and ecological status would be significant determinants of a suitable location.

As with the engineering and operational constraints, the qualitative appraisal of the environmental impacts of relocating the tailings facility away from Randalstown makes this the least attractive option.

2.6.4 The "Do-nothing" Option

An appraisal of the full range of options available to BTML must include consideration of the "do nothing" option. This option would entail constraining the life of the mine to a level which can be accommodated within the existing capacity of the Randalstown Tailings Facility.

In practice, the consequence of this would be the premature cessation of the mining operation in 2019 and the premature closure of the mining operation. Whilst some of the potential environmental impacts, associated primarily with construction activity, would be reduced under a "do-nothing" option, premature closure of the mine would also be associated with:

- An inefficient utilisation of natural resources (potentially viable zinc and lead resources would remain undeveloped).
- The loss of a significant economic benefit to the local and national economy.

For inspection purposes only.
Consent of copyright owner required for any other use.

2.6.5 Preferred Option- TSF

Unlike the review of options undertaken for Stage 4 in 1996 and Stage 5 in 2008, the review of the potential environmental impacts of the options for Stage 6 does not reveal one particular option to be obviously better than most of the alternatives.

Consequently, an attempt has been made to combine the environmental ranking with a ranking based on engineering and operational considerations (see Table 2.3).

This combined ranking reveals the preferred option to be an extension to the north of the existing facility. This option combines a low environmental ranking with good engineering and operational criteria.

Nevertheless, the analysis suggests that a lateral extension to the existing facility in any of three of the four directions (north, south and west but not east) could be an acceptable option for the provision of additional storage capacity.

Whilst the comparison of options does not identify any single option as clearly having a lesser potential impact, engineering and operational criteria tend to favour the construction of an extension to the north. The comparison itself, however, does not give an indication of either the "magnitude" or "acceptability" of the likely impact associated with an extension. These issues are addressed in a detailed EIA.

EPA Export 06-01-2017:02:02:07

Table 2.3 Combined Ranking of Environmental, Engineering and Operational Aspect

	Lateral extension				Vertical raise	New location
	North	East	South	West		
Environmental Impacts: Total ranking (from Table 2)	**24**	**27**	**27**	**26**	**27**	**39**
ENGINEERING AND OPERATIONAL CONSIDERATIONS:						
Technically feasible (subject to detailed engineering studies)	1=	1=	1=	1=	1=	1=
Minimum 10 years tailings storage	1=	5=	1=	1=	5=	1=
Adequate water storage	1=	1=	1=	1=	6	1=
Construction material requirements	2=	4=	2=	4=	1	4=
Timing of construction and commissioning	1=	1=	1=	1=	6	1=
Operational constraints	1=	1=	1=	1=	6	1=
Additional closure considerations	1=	1=	1=	1=	6	1=
Land ownership issues	1=	3	3	3	1=	3
Total ranking for engineering and operational considerations	9	17	11	13	32	13
Combined total ranking	**33**	**44**	**38**	**39**	**59**	**52**

For inspection purposes only. Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

2.6.6 Options for Passive Treatment – Integrated Constructed wetland

It is propose to establish a passive treatment system for the treatment of site runoff during the closure and aftercare phases of the tailing facilities life cycle.

At this stage the complete data set is not available to fully inform the process of developing the most appropriate strategy in meeting the discharge water quality standards.

The best case scenario is that runoff will not require any further treatment and can be discharged to the surface water network with risk to water quality.

It is however assumed that water will require treatment and that effluent emanating will not meet the discharge guidelines.

Options considered include

- Active Treatment;
- Passive Treatment;
- Dilution; and
- A combination of the above methods subject to comprehensive modelling, test work and field trials.

Consent of copyright owner required for any other use. For inspection purposes only.

The formally agreed definition of Passive in-situ (constructed) Remediation:

'**Passive in-situ** (constructed) remediation (PIR) signifies an engineering intervention which prevents, diminishes and / or treats contaminated waters at source, using only naturally available energy sources (such as topographical gradient, microbial metabolic energy, photosynthesis and chemical energy), and which requires only infrequent (albeit regular) maintenance to operate successfully over its design life.'

This in turn can be resolved into two subsidiary definitions:

'**Passive Treatment** is the improvement of water quality using only naturally-available energy sources, in gravity-flow treatment systems (such as wetlands or subsurface-flow bioreactors) which are designed to require only infrequent (albeit regular) maintenance to operate successfully over their design lives.'

'**Passive prevention** of contaminant release is achieved by the surface or subsurface installation of physical barriers (requiring little or no long-term maintenance) which inhibit pollution-generating chemical reactions (for instance, by permanently altering redox and / or moisture dynamics), and / or directly prevent the migration of existing contaminated waters.'

The '**Passive Treatment'** process indicated above is considered appropriate for the treatment of the TSF

EPA Export 06-01-2017:02:02:07

The main aims of the Integrated Constructed Wetland (ICW) system are;

- Sustainable water quality and management
- Reduce long-term treatment, operation and maintenance costs

In addition to the above aims, an ICW will provide a range of ecosystem services, including:

- Carbon sequestration (storage).
- Avoidance of quick discharge of intercepted water by releasing water slowly from intercepting ICW ponds.
- Retrieval (recycling) of water-vectored materials such as metals and organic matter.
- Develop new wetland-dependent resources.
- Facilitate biodiversity and reanimation of habitats.
- Facilitate awareness of the values of wetlands and act as a form of education.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

2.7 Environmental scoping study

2.7.1 The Environmental Impact Assessment process

The first phase in the EIA process is usually to seek confirmation as to whether or not a formal EIS is required to be submitted to the planning authority (the "screening" phase).

However, the requirement for an EIS was established during the previous stages in the development of the Randalstown Tailings Facility and this precedent makes a repeat of the screening phase unnecessary.

The second phase in the EIA process is the scoping phase. The scoping phase assists in identifying those issues and risks that are likely to be important during the EIA and which, therefore, must be adequately addressed in the EIS.

The scoping process would normally involve the following:

- Consultation (either formal or informal) with the planning authority and statutory consultees to identify relevant issues and agree appropriate methodologies.
- Meeting with local communities and Non-Governmental Organisations (NGOs) to identify issues of potential concern.
- The scoping of the EIA for Stage 6 is facilitated by the information gained as a result of:
  - Public consultation meetings
  - Meetings with the local authority
  - Consultations and meetings that took place during the planning of the Stage 4 and Stage 5 raises. The issues raised during the planning for the Stage 5 raise as summarised below (see Table X).
  - Technical studies undertaken as part of the EIA for Stages 4 and 5.
  - Monitoring records available during the construction and operation of Stages 4 and 5.
  - Comments and complaints received from local communities during the construction of Stages 4 and 5.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:07

Table 2.4 Summary of Issues Raised during Planning for Stage 5

Issue	Source
Animal health	Local residents
Archaeology	Dept Environment Heritage and Local Govt
Consideration of alternatives	Local residents
Consultation	Local residents
Dam stability and risk of failure	Local residents, Meath CC
Flora and fauna	Dept Environment Heritage and Local Govt
Groundwater quality and usage of local water resources, surface water quality and management	Local residents, Meath CC
Health impacts of dust	Local residents, National Roads Authority
Landscape, visual impact, amenity	Local residents
Noise	Local residents, National Roads Authority
Nuisance, including working hours	Local residents
Traffic	Local residents, National Roads Authority

For inspection purposes only.
Consent of copyright owner required for any other use.

As a result of this information, a degree of confidence can be placed on the validity of the scoping exercise. Nevertheless, scoping cannot be based solely on a review of historical documents and opinions; others factors that also require consideration include:

- Changes to the engineering design associated with transition from a vertical raise to a lateral extension
- Changes to the sources of construction materials.
- Potential changes to the characteristics of the surrounding environment.
- Potential changes in attitudes and priorities amongst consultees.
- Potential changes in the regulatory requirements and policy.
- Developments in good practice.

Of fundamental importance is the need to import significant quantities of construction materials due to the non-availability of useable sources of material on adjacent lands. This change has implications not just for the road infrastructure and its current users but also for communities and sensitive environmental receptors living along the transport route(s). As a consequence there is a potential step-change

EPA Export 06-01-2017:02:02:07

in the number of potential receptors for the impact assessment when compared with previous expansion projects.

The proposed site for the ICW is located to the south of the TSF and comprises 12ha of agricultural grassland and woodland. The natural ground varies from 45m to 40.0m (OD) with undulations.

The main features of the proposed project will include a series of wetland ponds that are densely planted with marsh plant species. The wetland will be constructed so that its structure will not be any greater than 1.5-2m above existing ground level. The wetlands will generally be below the level of the existing ground, except for the embankments and roadways. Roadways around the ICW will have a hardcore/gravel surface. Roadways to the site from the north entrance will be retained.

At the proposed Integrated Constructed Wetland, landscaping will be carried out along the site boundary with suitable trees and shrubs ensuring that the works integrate with the surrounding area. This will have the effect of reducing the visibility of the wetlands from all directions. Existing hedgerows and tress/shrubs will be retained where possible.

Most of the proposed works will be at or below ground level. The exceptions will include features such as handrails at discharge points to the surface waters and monitoring locations, fencing around the ICW and landfill, control panels and kiosks (1m) and some lighting at monitoring points.

Treated water will discharge from the ICW to the river Blackwater through a buried pipeline.

The nearest designated site is the Blackwater River SAC located south of the proposed ICW site. Further details are provided in the Environmental Impact Statement and Natura Impact Statement.

Maps highlight that the site is prone to flooding, while local knowledge is that there has been no flooding on the site. However a Flood Risk Assessment has been undertaken.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:07

2.7.2 Content of the EIS

In accordance with the current guidelines published by the Environmental Protection Agency, the EIS should include:

- A non-technical summary
- A description of the proposed development
- An analysis of alternative designs, locations and processes
- A description of the existing (baseline) environment
- A statement of the predicted impacts of the proposed development
- A statement of the measures that will be applied to mitigate predicted negative impacts.

The description of the existing environment and the prediction of the proposed development should be considered with reference to a range of subject areas. The guidelines advise against omitting completely a consideration of any of the specified subject areas whilst acknowledging that the level of detail that should be assigned to each subject area may differ, depending on the likelihood of impacts associated with the development; in some instances, the level of detail applied to certain topics may be minimal provided that an appropriate justification is provided.

A review of relevant subject areas has been undertaken based on the available information, and, in particular, has been used to identify subject areas that have attracted detailed attention in the past, particularly those associated with the construction and operation of the Stage 5 raise.

Nevertheless, it is acknowledged that a lateral extension to the north constructed largely with material imported to site is likely to require a somewhat different focus from that adopted in the vertical raises of Stages 4 and 5.

For inspection purposes only.
Consent of copyright owner required for any other use.

The scoping exercise has been used to present an overall outline of the recommended focus of the EIA/EIS for a northern extension (see Table 2.5). This initial recommendation is subject to modification based on on-going consultations and the findings of the specialist EIA studies.

EPA Export 06-01-2017:02:02:07

Table 2.5 Subject areas requiring consideration

Subject area[1]	Rating of potential significance (Positive and negative)	Comments
Human beings		
Economic activity/employment	Significant	Significance of Tara to the local economy
Land-use	Minimal	Removal of restoration obligation for northern borrow area
	Modest	Removal of grazing land in siting of ICW
Health & safety	Significant	Public safety, nuisance
Traffic/road infrastructure	Significant	Importing of construction material, construction traffic
Geology and Soils		
Superficial and bedrock deposits	Significant	Significance of removal of material for Stage 5 construction
Faulting	Minimal	Presence/impact of any faults
Geochemistry	Minimal	Attenuation of seepage
Agricultural capability of soils	Minimal	Loss of restored borrow areas
Hydrogeology and hydrology		
Hydrogeology	Significant	Risk of seepage
Surface water hydrology	Significant	Vulnerability of surface waters
Surface and groundwater quality	Significant	Existing quality and potential changes
Potential uses of water resources	Modest	Local wells, stock-watering
Flooding	Modest	Overflow rom ICW
Climatic factors		
Weather	Modest	Influence on site water balance, air quality, noise
Climate change	Minimal	Macro and micro scale
Air quality		
Suspended particulates	Significant	Fugitive dust
Odour	Minimal	Tailings carrying water
Landscape		

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:07

Subject area[1]	Rating of potential significance (Positive and negative)	Comments
Visual impact and amenity	Moderate	Residential properties and public sites
Amenity	Significant	The conservation of wetland-dependent wildlife and can function as a significant educational and amenity resource. The layout, structure and composition of the wetlands is landscaped to be compatible with all aspects of its surroundings, even taking into account the site's own visual impact and wildlife habitats
Fauna and fauna		
Habitats	Modest	Disturbance to areas not used for excavation and disturbance to adjacent sites
Protection status/protected species	Modest	Presence of some protected species on site
ICW Habitat enhancement/Biodiversity	Significant	Wetlands provide a much diminished important suite of habitats for invertebrates, marginal and aquatic vegetation, amphibians, fish and a range of breeding and wintering wildfowl
Material assets		
Road infrastructure	Significant	Road capacity, bridge weights, crossings, junctions and access
Archaeology	Minimal	Disturbance to areas not used for excavation
Agriculture	Modest	Loss of grazing land
	Modest	Animal health, trace metal accumulation

For inspection purposes only.
Consent of copyright owner required for any other use.

Note: [1] Adapted from *Guidelines on the information to be contained in Environmental impact Statements* (2002).

EPA Export 06-01-2017:02:02:07

The EIA should address the issues identified above within the context of:

- **Both positive and negative impacts.**
- Direct impacts arising from the construction, operation and eventual closure of the facility.
- Alternatives within the framework of preferred option (i.e. alternative access routes, sources of material, timing of construction activity etc.).
- Indirect impacts, including those arising as a consequence of planned mitigation measures.
- Cumulative impacts (additional to impacts arising from the existing facility).
- Short term and temporary impacts experienced during construction or during particular phases of operation.
- Long-term and permanent impacts.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

2.8 EIA Approach and Methodology

Table 2.6 Impact Assessment Methodology

Subject area	Baseline Data Collection	Impact Assessment	Mitigation measures
Human beings			
Economic activity/employment	In-house data on tax revenues, wages, employment, value of purchases, contractors	Prediction of potential loss of tax revenues, wages, employment, indirect benefits over predicted life of mine	Not applicable
Land-use	Land-use survey of adjacent lands and likely transport routes to identify potential sensitive receptors	Evaluation of significance of impacts on identified receptors Evaluation of alternative transport options	Routing of transport Scheduling of transport
Health & safety	In-house data documenting the levels of nuisance reported currently	Assessment of nuisance (see also air quality), traffic risks	Specify management practices to reduce predicted nuisance impacts/traffic risks.
Traffic	Traffic survey on route for transport of construction material Specialist opinion on feasibility of using the adjacent rail line either directly or indirectly (e.g. conveyors)	Prediction of increased traffic volumes Cross reference to other issues (public safety, noise, etc.)	Traffic control measures Optimum use of locally won construction materials Routing and scheduling of transport
Geology and Soils			
Superficial and bedrock deposits, faulting, geochemistry	Characterisation of underlying geology and influences on design	Not applicable	Not applicable

For inspection purposes only. Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

Subject area	Baseline Data Collection	Impact Assessment	Mitigation measures
	Relevance of removal of borrow material for Stage 5		
Agricultural capability of soils	Likely capability of a restored northern borrow area in accordance with existing planning permission	Evaluation of significance of loss of restored borrow areas	Not applicable
Hydrogeology and hydrology			
Hydrogeology	Extension of existing data presented for Stage 5 raise to include new footprint and adjacent areas	Prediction of any seepage rates, pathways etc.	Incorporation of liner Leak detection?
Surface water hydrology	Extension of existing data presented for Stage 5 raise to include new footprint and adjacent areas	Prediction of any changes in run-off patterns, stream diversions	Not applicable
Surface and groundwater quality	Historic and recent monitoring data (in-house) for surface and groundwater	Risks during construction (run-off, suspended solid loading) Prediction of any seepage Prediction of changes to surface water quality Cumulative impacts with existing stages Post-closure impacts	Measures adopted during construction phase (e.g. settlement ponds) Incorporation of liner Closure planning

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

Subject area	Baseline Data Collection	Impact Assessment	Mitigation measures
Potential uses of water resources	Survey of potential and actual users of water resources, including domestic wells, stock-watering, irrigation	Significance of predicted changes in water quality at location of usage Reference to historic data	Not applicable
Climatic factors			
Weather	Existing data presented for Stage 5 raise updated as appropriate	Not applicable	Not applicable
Climate change	Not applicable	Impact on GHG emissions	Not applicable
Air quality			
Suspended particulates	Existing in-house monitoring data Expansion of monitoring network to incorporate relevant sites adjacent to new footprint (if necessary)	Predictions of dust generated by construction activity Prediction of any fugitive dust from the tailings	Dust control measures during construction Dust control tailings deposition
Odour	Data on xanthate concentrations in tailings water	Qualitative assessment of odour	Not applicable
Noise	Survey of current noise levels at selected sensitive properties close to construction site and transport routes	Prediction of increased noise levels at selected sensitive properties Prediction of indirect impacts (including noise from construction of noise bunds)	Noise control, noise bunds, controls on working hours

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

Subject area	Baseline Data Collection	Impact Assessment	Mitigation measures
Landscape			
Visibility and amenity	Existing data presented for Stage 5 raise updated as appropriate; identification of additional residential properties or public places from which the facility area will be visible	Assessment of impacts arising from operation of the borrow areas Preparation of photomontages from the same (and any new locations identified) to illustrate the visibility of Stage V	Screening
Fauna and flora			
Habitats and protected species	Ecological survey of undisturbed areas of the site (especially birds, bats) Identification of any sensitive locations adjacent to transport routes In-house monitoring data for fisheries and aquatic ecology; recent in-house data on trace metal concentrations in fish	Qualitative assessment of impacts of loss of habitat arising Predicted changes in fisheries and aquatic ecology "Appropriate Assessment" required where impacts on a SAC are anticipated	Not applicable
Material assets			
Archaeology	Archaeological survey undisturbed areas of the site.	Qualitative assessment of the prediction of impacts on any identified sites of archaeological interest and risk assessment of impact on the possible presence of	Avoidance of any identified sites

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

Subject area	Baseline Data Collection	Impact Assessment	Mitigation measures
		unidentified sites	
Agriculture	Updated information on agricultural enterprises on adjacent lands; current in-house data on trace metal levels in soils, vegetation and data on current animal health status	Predicted changes in impacts on agriculture	Not applicable
Road infrastructure	Road condition Traffic counts Bridge restrictions Sensitive junctions, bends etc.	Impact on road infrastructure Impacts on existing traffic flows Accident risk	Road/bridge improvements Routing/scheduling

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:07

Section 3 Project Description

This section of the EIS is presented in two distinct parts:

- PROJECT DESCRIPTION PART A: Dealing with the proposed Tailings storage Facility (TSF) Stage 6 extension

- PROJECT DESCRIPTION PART B: Dealing with the proposed Integrated Constructed Wetland & discharge pipeline to the river Blackwater

3.0 Proposal

Boliden Tara Mines Limited operates one of Europe's largest zinc lead mines at Knockumber, 2 km west of Navan in County Meath.

Since its inception the tailings facility has been constructed and operated in seven stages, Stages 1, 2, 3 (lateral extensions) and the more recent Stage 4A, 4B, 5A and 5B (upstream vertical extensions), using combinations of temporary and permanent embankment walls.

The TSF is constructed as a ring-dike configuration, enclosed by earth-fill embankment walls. The embankment walls are constructed of low permeable glacial clay till and armoured with a layer of coarse material on the upstream slope.

Consent of copyright owner required for another use. For inspection purposes only.

After target minerals have been extracted in the processing plant the tailings stream is cycloned to separate the coarse sand fraction from the finer slimes fraction. The coarse fraction of tailings is pumped, to the underground mined out areas. In so doing, approximately 50% of the tailings are used underground to backfill mined voids. The tailings used for backfilling is stabilised, chemically and physically, by mixing with Portland cement.

The remaining fines fraction tailings is pumped as an aqueous slime to the Tailings Storage Facility (TSF) located some 2.5 km north of the processing plant in the townland of Randalstown. On an annual basis approximately 1.1 million tonnes of tailings are deposited for permanent storage in the TSF.

The TSF is constructed as a ring-dike configuration, enclosed by earth-fill embankment walls. The embankment walls are constructed of low permeable glacial clay till and armoured with a layer of coarse material on the upstream slope.

EPA Export 06-01-2017:02:02:07

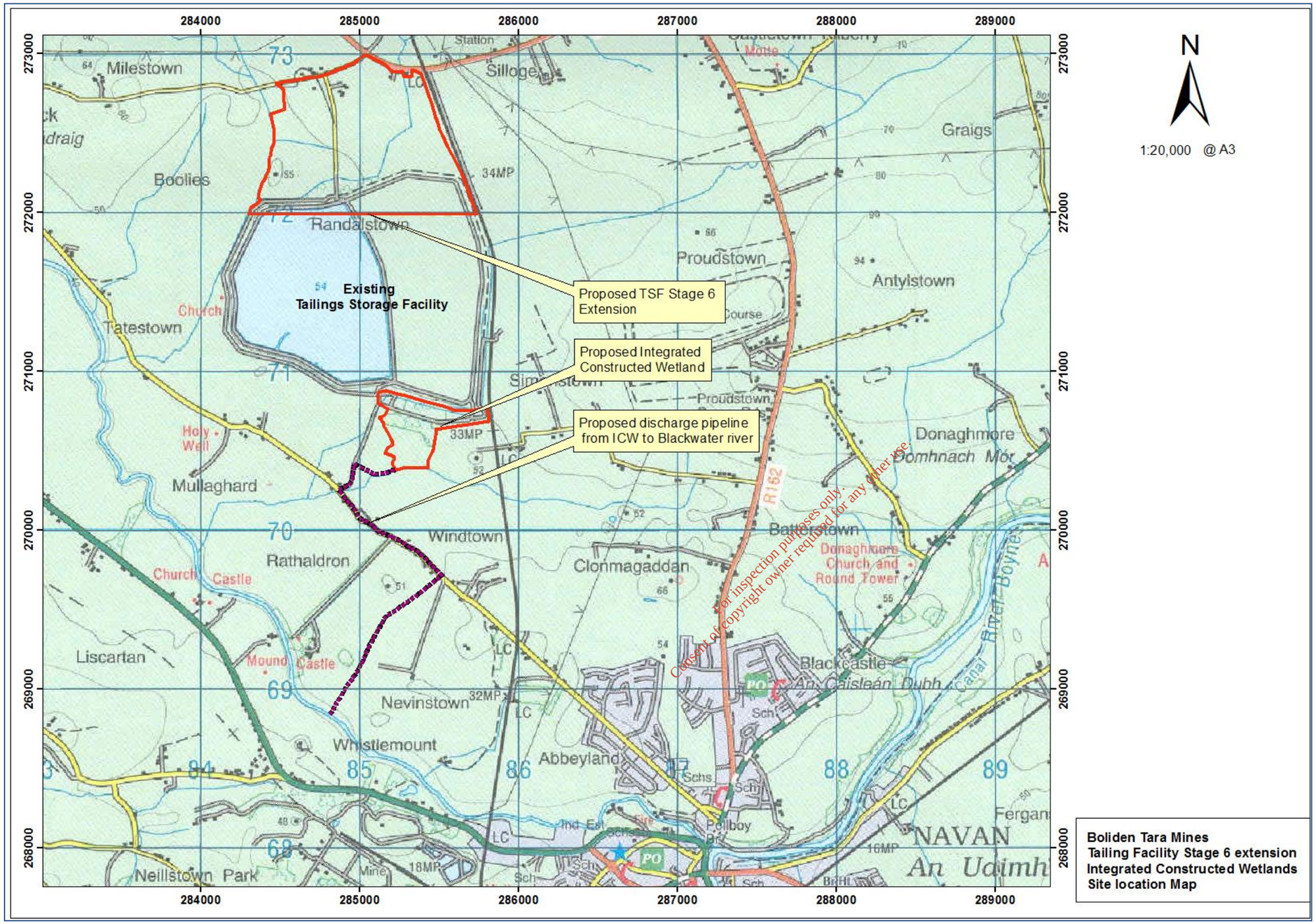
The TSF, enclosing a footprint area of approximately 171 ha, serves as containment for tailings to settle and consolidate, as well as a storage area for water that is circulated back to the processing plant at Knockumber for reuse in the processing plant or for eventual discharge to the *River Boyne*.

- **It is proposed to extend the existing TSF laterally in a northerly direction.**
    - **Here after the proposed facility will be referred to as *TSF Stage 6*.**
    - **The proposal facility will cover an area of c. 58 hectares, extend to a height of 22 m above ground level and will provide a potential a storage volume of approximately 9.6 million cubic metres [c.13.6 million tonnes].**

- **The second part of the proposed development is the construction of an Integrated Constructed wetland (ICW). The function of the wetland is to provide a passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle.**
    - **Treated water will discharge from the ICW to the river Blackwater via a buried HDPE pipeline.**

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.1 Site location map. Proposed Stage 6 extension north of the existing TSF and the proposed ICW south of the TSF site. Pipeline route to the river Blackwater.

EPA Export 06-01-2017:02:02:08

PROJECT DESCRIPTION PART A - Tailings Storage Facility Stage 6

3.1 Introduction

The proposed TSF Stage 6 extension will be located along the northern sector of the existing tailings facility (Figure 3.2 and 3.3) and will be confined within the worked out 'borrow areas' to the north.

It is proposed to construct the Stage 6 embankment in two phases

- The first phase, PHASE 1 to a crest elevation of 59.29m AOD[1] and
- The second phase, PHASE 2 to a crest elevation of 67.29m AOD.

External ramps will provide access from the main haul roads.

The total construction volumes and storage volumes for the two phase development are presented in table 3.1.

Table 3.1 Struck Storage and Construction Volumes at given Crest Elvs.

Phases	Crest Elevation m AOD	Tailings Struck Storage Acc. Vol. m³	Life in years
1	59.29	5,300,000	6.5
2	67.29	4,280,000	5.0

For inspection purposes only. Consent of copyright owner required for any other use.

***Note**

- The 'life in years' has been based on a tailings discharge into the TSF of 1.1Mt/y tailings to TMF, a 0.5% beach slope and an average dry density of 1.42 t/m³.
- Projected TSF operational life of 11.5 years

The main benefit of two phase development is that the maximum amount of fill can be sourced from the basin area of the site to use in construction.

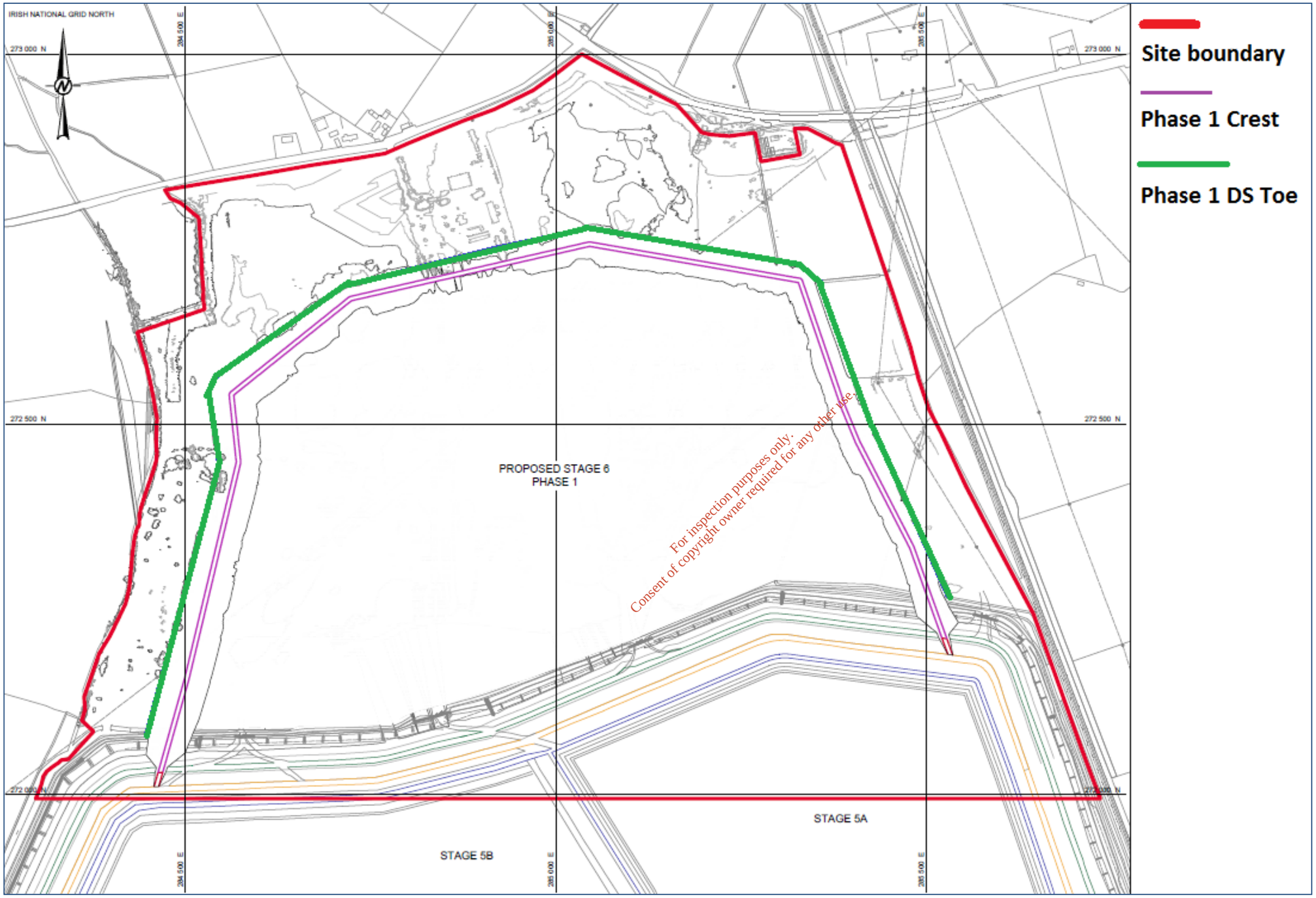
Once the first phase is complete, the basin area will be in accessible to any future borrowing by the placement of the lining system.

The floor plan area of the TSF basin is approximately 43 Ha.

Refer to Figures 3.2 & 3.3.

[1] AOD Elevation **A**bove **O**rdnance survey **D**atum

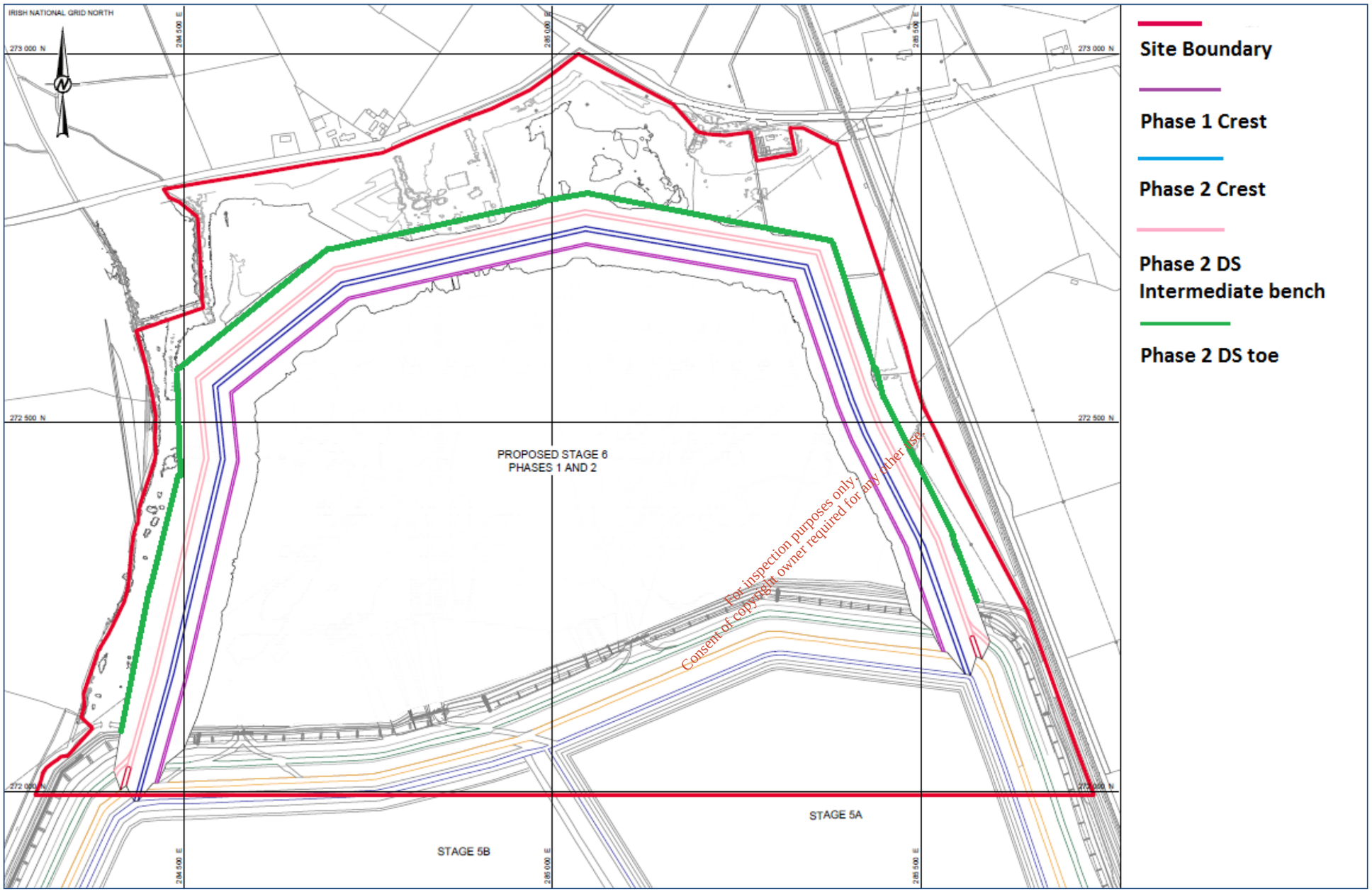
EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.2 Stage 6 Phase 1 Layout

EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.3 Stage 6 Phase 2 Layout

EPA Export 06-01-2017:02:02:08

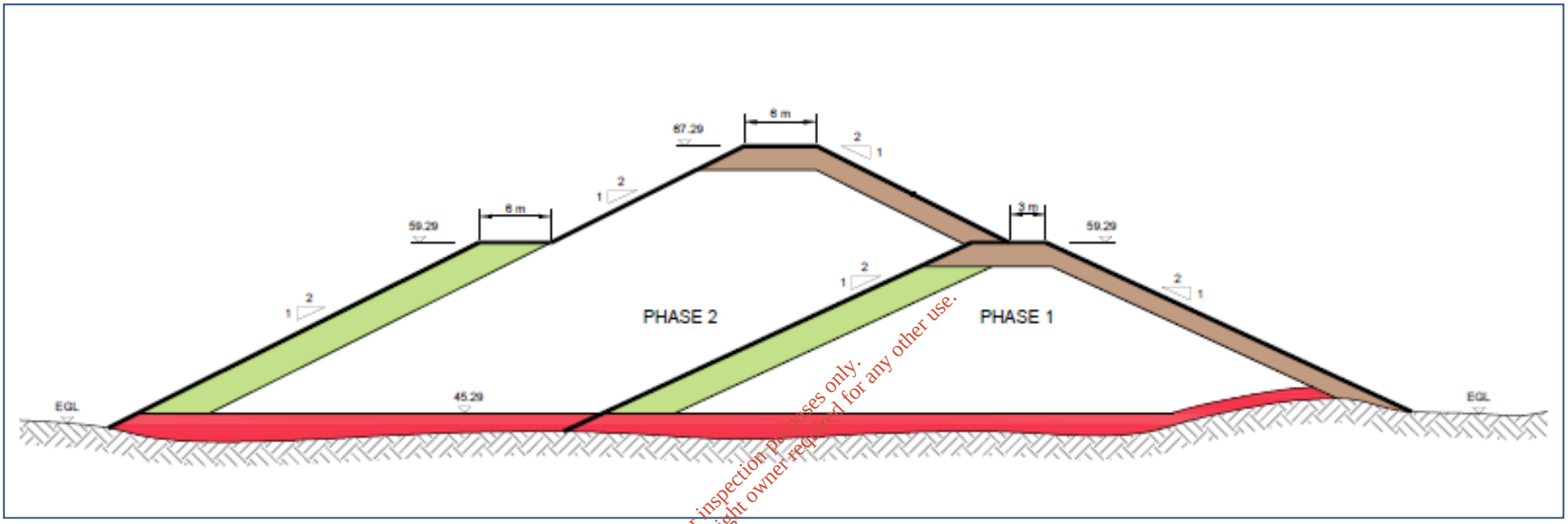


Figure 3.4 TSF cross section: Existing and Proposed Stage 6

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:08

3.1.1 Tailings Facility Configuration

The existing TSF is constructed as a ring-dike configuration, enclosed by earth-fill embankment walls. The embankment walls are constructed of low permeable glacial clay till and armoured with a layer of coarse material on the upstream slope.

Since its inception the tailings facility has been constructed and operated in seven stages.
Stages 1, 2, 3 were constructed to cover an area of approximately 171 hectares to a height above ground level of c. 12 metres.

The Stage 4 extension was constructed as an 'upstream raise'[2] in the 1990. This 6 meter vertical extension took the height of the facility to 18 metres

The Stage 5 extension was a further upstream extension. This 4 meter vertical raise too the overall height of the facility to C 22 metres.

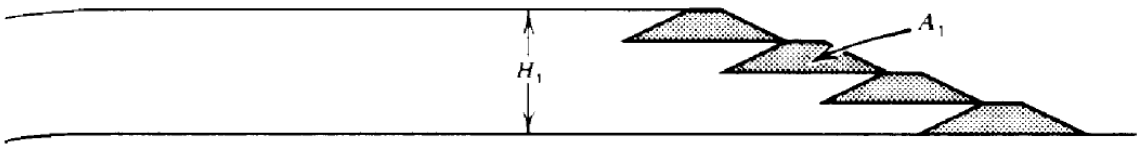
The proposed Stage 6 extension will be constructed in two phases.

- Phase 1 will be a later extension to the north of the existing facility and will extend to a height of 14 metres and will tie in to the northern wall of the existing dam.

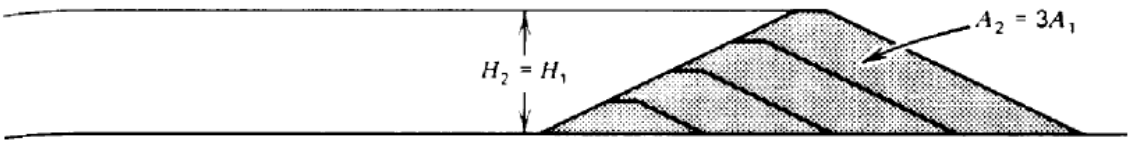
- Phase 2 will be a 'downstream raise'[3] extension to Phase 1. It will extend to a height of 22 metres and tie into the northern wall of the existing dam.

For inspection purposes only.
Consent of copyright owner required for any other use.

[2] Schematic: Typical upstream embankment raise: Construction inward and upward.



[3] Schematic: Typical downstream embankment raise: Construction outward and upward.



EPA Export 06-01-2017:02:02:08

3.1.2 Construction methodology

The construction of the embankment walls will be different from all previous TSF embankment walls forming the existing facility because of the inclusion of a composite lining on the upstream face of the embankment walls and basin area.

The upstream slope of phase 1 will be constructed with a slope of 2H:1V and will be keyed into the northern embankment wall of the existing facility. The crest elevation will be 59.29 m AOD (14 metres above ground level[4]).

The upstream slope of phase 2 will be constructed with a slope of 2H:1V and will be keyed into the northern embankment wall of the existing facility. The crest elevation will be 67.29 m AOD (22 metres above ground level).

The overall downstream slope will be approximately 2.25H:1V consisting of two 2H:1V slopes with a 6m bench at 59.29 m AOD for the second phase.

The crest width of the dam walls for all phases is 6 m and the maximum wall height will be approximately 22 m.

Sections through the dam wall are presented in Drawing 6.5 and the section locations are shown in Drawing 6.6. Much of the dam wall footprint is within the existing areas which have been previously borrowed for Stage 5.

Consent of copyright owner required for any other use.
For inspection purposes only.

The upstream sector of the proposed dam, Figure 3.4, will consist of a 6m wide unit of clayey glacial till (Type A1 and/or Type A2). The footprint of the dam wall will be constructed with a 1m minimum thickness of Type D2 rock which acts as a drainage blanket.

This material will also be placed below an elevation of 44.29 m AOD across the dam wall footprint. To bring the dam wall up to an elevation of 44.29 m AOD will require approximately 2,500 m^3 of Type D2 material. On the lower parts of the downstream sector of the dam wall, a 6 m width of Type A2 glacial till will be placed. Between the upstream Type A1/A2 zone and the downstream Type A2 zone is a random fill zone which would include Type A2 and A3 as well as Type D2 material.

The northern embankment wall of the existing TSF, perimeter interceptor channel and finger drain channels will be stripped of topsoil and vegetation prior to receiving the protection material and lining system forming Stage 6.

A 100 mm layer of processed rock-fill Type C material would be placed over the Type A materials on the upstream side of the new Stage 6 dam walls and on the northern face of the existing embankment wall (Dwg.6.7) to provide protection for the lining

[4] The current ground level is variable and generally lies between elevations of 43.29m AOD and 53.29 m AOD.

EPA Export 06-01-2017:02:02:08

system. The maximum particle size of the Type C would be 20 mm and the material would be well graded.

A 1,000 g/m^2 non-woven geotextile will be placed on top of the Type C material prior to placement of the lining system. The adjoining wall would be cleaned of vegetation, trimmed to receive the 100 mm layer of Type C followed by the 1,000 g/m^2 non-woven geotextile. The Type C material on the dam walls would continue over the backfilled finger channels and backfilled perimeter interceptor channel.

The Type C will intercept any seepage at the downstream toe of the northern dam wall and into the perimeter interceptor channel. Where Type C is placed on the Type E material backfill it will be separated by *Terram 1000 geotextile* or equivalent. *Terram geotextile* may also be required in soft areas on the borrow area floor and downstream toe of the existing northern dam wall. Once the Type C material is placed, the composite lining would be formed along the base, up the slope and anchored on the crest.

A perimeter roadway will be constructed and merge with the roads around the existing TMF. A new security fence is required along the north perimeter access road, and tied into the existing fences on the eastern and western site boundaries; Figure 3.5.
A road surfacing material Type B, 200 mm thick would be required at the top of the dam crest and the lower perimeter road, intermediate bench at 59.29 m AOD and any permanent ramps.

Consent of copyright owner required for any other use. For inspection purposes only.

It is anticipated that at least 3 external ramps will be installed along the northern wall of Stage 6. The first ramp would be in a central location (Dwg.6.2) and be accessed via the main tarmac road from the site offices. Two other ramps would be located opposite the east and west sectors of the northern borrow area. These ramp would allow access to the remaining borrow materials and stockpiles to complete the second phase of Stage 6, the capping of Stage 5B and the eventual capping of Stage 6. Temporary internal ramps will also be required but these would be removed systematically as the lining system is installed.

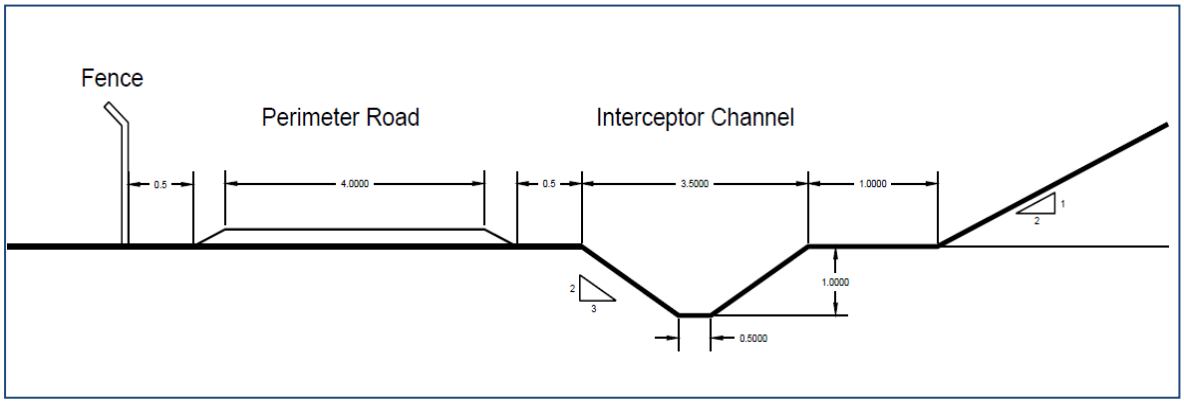


Figure 3.5 Perimeter roadway, fence and interceptor channel.

EPA Export 06-01-2017:02:02:08

3.2 Construction Materials

Construction materials will be sourced for a number of potential sources, including:

- On site 'borrow pits'
- Onsite stockpiles
- Third party licenced facilities
- The main mine site at Knockumber (surplus mine rock)

3.2.1 General

The dam wall raise is constructed from several materials which include cohesive glacial till, granular glacial material and processed rock fill.

It consists of the following material types:

- Type A1 and A2 Cohesive Glacial Till
- Type A3 Glacial Granular Material
- Type B Road Material
- Type C Protection Material
- Type D1 Backfilling Existing Borrow Area Drains
- Type D2 Dam Footprint Drainage Blanket Material
- Type E 75 mm Coarse Drainage Backfill For Perimeter Interceptor Channel and Concrete Chutes.

For inspection purposes only.
Consent of copyright owner required for any other use.

Type A Materials

3.2.2.1 Type A1

Type A1 will be suitable material complying with the following:

- Material Type A shall be glacial silty sands and gravels obtained from the borrow area with a Plasticity Index greater than 10%;
- The moisture content shall be between -2% and +4% of optimum as measured in the Standard Proctor method and the material shall be free of all unsuitable material and compacted to 95% of Standard Proctor in 300 mm lifts; and
- Maximum particle size is 200 mm in the minimum dimension.

3.2.2.2 Type A2 Material

Type A2 will be suitable material complying with the following:

- Material Type A2 shall be glacial silty sands and gravels obtained from the borrow area with a Plasticity Index less than 10% but greater than 4%;
- The moisture content shall be between -2% and +4% of optimum as measured in the Standard Proctor method and the material shall be free of all unsuitable material and compacted to 95% of Standard Proctor in 300 mm lifts; and
- Maximum particle size is 200 mm in the minimum dimension.

3.2.2.3 Type A3 Material

Type A3 will be suitable material complying with the following:

EPA Export 06-01-2017:02:02:08

- Material Type A3 shall be glacial silty sands and gravels obtained from the borrow area with a Plasticity Index less than 4%;
- The moisture content shall be between -2% and +4% of optimum as measured in the Standard Proctor method and the material shall be free of all unsuitable material and compacted to 95% of Standard Proctor in 300 mm lifts; and
- Maximum particle size is 200 mm in the minimum dimension.

Granular Rock Material

3.2.2.4 General

There is a requirement for a large quantity of granular rock material which will be either imported or derived from quarrying in the borrow area and these are discussed below.

3.2.2.5 Type B Road Surface Material

The specification for this material which conforms to the 804 specification is tabulated below.

Table 3.2: Type B Grading Envelope

Sieve Size (mm)	Coarse (% passing)	Fine (% passing)
63	100	
31.5	90	80
16	85	55
8	65	35
4	50	22
2	40	15
1	35	10
0.5	20	0
0.063	7	0

For inspection purposes only.
Consent of copyright owner required for any other use.

The material will be compacted with four passes of a 10 tonnes smooth vibratory roller.

EPA Export 06-01-2017:02:02:08

3.2.2.6 Type C Protection Material

The specification for this material is tabulated below.

Table 3.3: Type C Material

Sieve Size (mm)	% Passing
20	100
6.3	60-95
1.18	35-80
0.300	15-60
0.075	0-30

This will be nominally compacted with a smooth roller on the basin floor. The protection material placed on the dam wall side slopes will also be nominally compacted with a smooth roller winched down from the crest or by an alternative method agreed by the Engineer.

Consent of copyright owner required for any other use. For inspection purposes only.

3.2.2.7 Type D1 Backfilling Existing Borrow Area Drains

The specification for this material is tabulated below.

Table 3.4: Type D1 Grading Envelope

Sieve Size (mm)	Coarse (% passing)	Fine (% passing)
250	100	
100	100	30
75	60	10
50	40	0
20	15	0
10	10	0
1	6	0

This material will be placed and nominally compacted with the construction plant.

3.2.2.8 Type D2 Dam Footprint Drainage Blanket Material

The specification for Type D2 material is that it is granular and 100% passing 250 mm. The material will be placed in maximum lift size of 500mm and compacted with a 10 tonnes vibratory roller using 6 passes.

3.2.2.9 Type E Coarse Drainage Material

This material is uniformly graded at 50 mm diameter.

EPA Export 06-01-2017:02:02:08

Fill Material Quantities

The volumes of material for construction are tabulated as follows.

Table 3.5: Material Quantities

Description	Unit	1st Stage Qty	2nd Stage Qty	Total Qty
Total Dam Fill Volumes	**m3**	**529,683**	**1,173,586**	**1,703,269**
Type A1/A2 Upstream Wall Construction	m3	123,671	110,617	**234,288**
Type A 2 Downstream Wall Construction	m3	113,658	111,893	**225,550**
Type B Road Surfacing	m3	4,902	5,056	**9,958**
Type C Protection Material	m3	52,926	7,426	**60,352**
Type D1 Drainage	m3	5,000		**5,000**
Type D2 Dam Footprint Drainage	m3	110,064	98,918	**208,982**
Random Fill	m3	182,290	852,159	**1,034,449**
Type E Coarse Drainage	m3	5,000		**5,000**
Total Construction Volumes	**m3**	**597,511**	**1,186,067**	**1,783,578**

3.3 Site Preparation

There is a considerable amount of site preparation that is required to develop this site of which some could be undertaken pre-construction while other activities would be done during construction.

Consent of copyright owner required for any other use. For inspection purposes only.

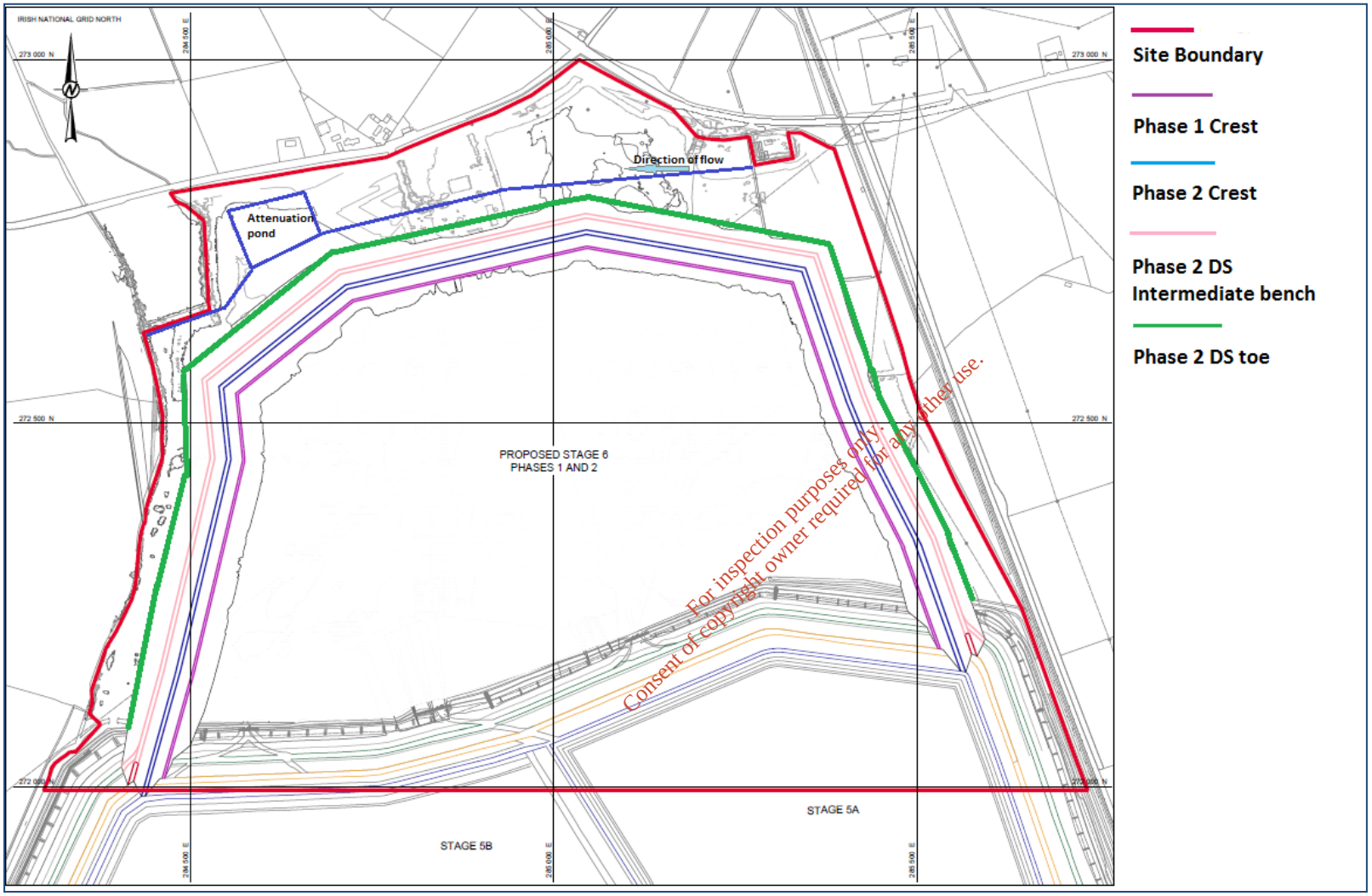
Blakes Stream cuts across the Northern borrow area and the Seven Fields borrow area and is located in the basin area of the proposed Stage 6 facility. It enters the site in the north east corner and exits the site in the south west corner via a settling pond complex before entering the Yellow River. It is proposed to reroute Blakes Stream from its natural south westerly flow path to a westerly flow path.

The stream will enter the Yellow river (as before) at a confluence c. 400 metres north of the current point Refer to Figure 3.6.

There are a number of trees that will require removal from the site. The majority are immediately north of the existing northern dam wall but also occur around the Contractors compound as well as the central site road and along established drainage ditches. All vegetation will be removed from the footprint of the proposed Stage 6 TMF.

There are several power lines that cross the site. These are shown on Drawing 6.10. A 10 KV power line runs along the downstream toe of the existing northern dam wall. This will require realignment. Another power line carrying 38 KV follows the eastern boundary of the seven fields borrow area and this will need to be realigned further to the east beyond the footprint of the TMF. A power line crosses diagonally from north east to south west of the seven fields and the northern borrow area. This is a 38 KV line and will need to be moved.

EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.6 Realignment of *Blakes Stream*

EPA Export 06-01-2017:02:02:08

The elevations within the existing borrow area forming the footprint Stage 6 is variable and the Figure 3.7 is a recent survey showing the cut and fill depths to an elevation of 45.29 m AOD. After removal of the materials from the borrow area some regarding of the surface will be required to receive the lining system. The existing drainage system will be backfilled with Type D1 material to prevent ponding during the placement of the lining system. Boulders from Types A1 and A2, and Type D2 material will be used to fill hollows.

Type D2 material will be used to bring the level of the subgrade to an approximate elevation of 44.29 m AOD within the footprint of the dam wall. On subgrade above 44.29 m AOD, a 1m layer of Type D2 will be placed. Any unsuitable materials in the basin area will be removed and stockpiled outside the TMF footprint and used for capping restoration.

Groundwater may be an issue and it may be difficult to remove all water from the excavation and some boulders and Type D2 material may have to be placed into water to raise the excavation level prior to installation of the lining system. Care is required as the lining system will be placed during the summer when the water table is at its lowest. However, as the water table rises during the approach of autumn and winter, it is important to surcharge the liner to prevent the lining lifting. The most practical method is to place the tailings into the facility soon after the lining is placed or mine water and at the end of summer.

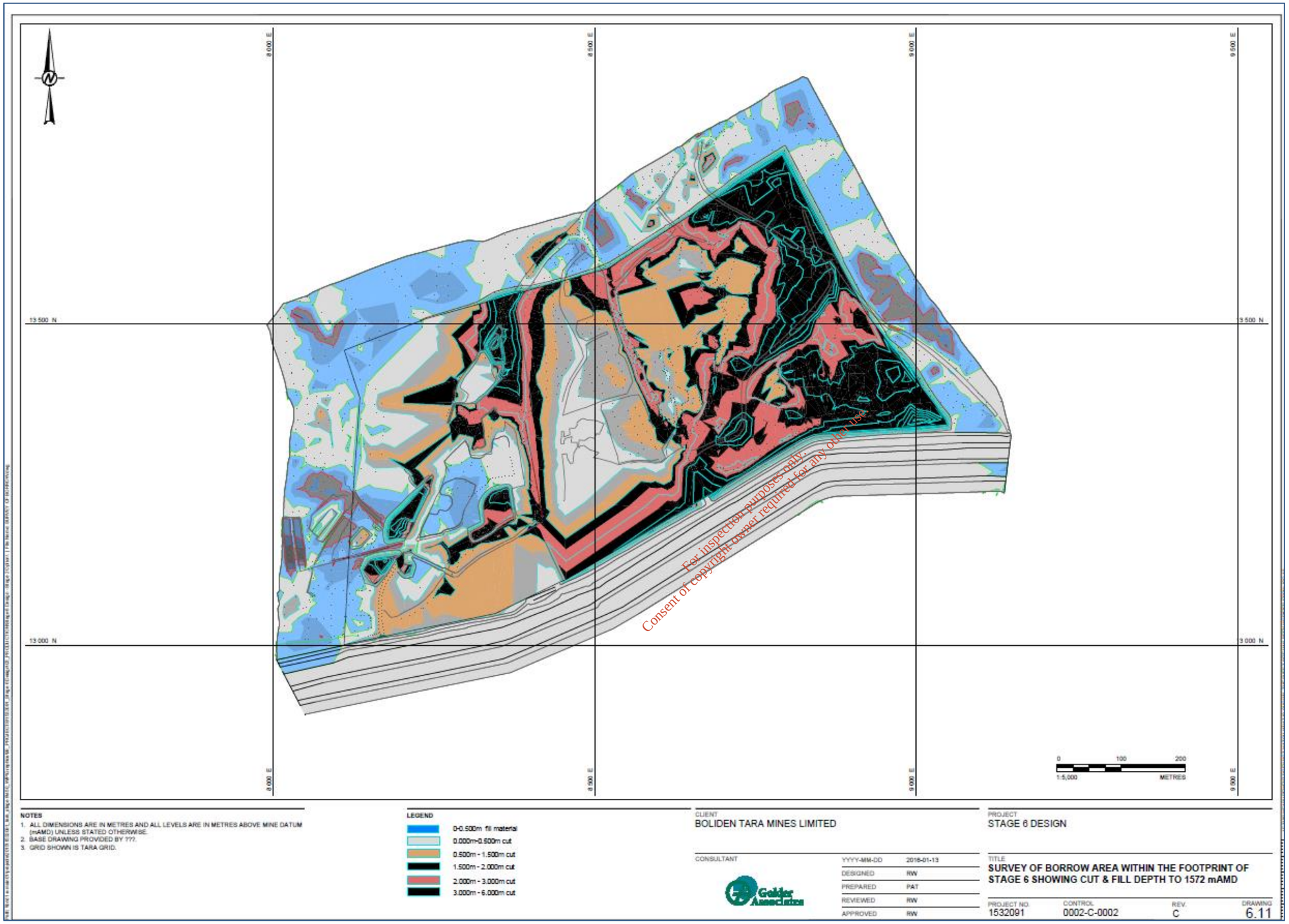
For inspection purposes only.
Consent of copyright owner required for any other use.

After regarding of the floor area, a 100 mm layer of Type C is placed on top of the floor where the lining system is to be placed in the basin area. In soft areas, Terram 1000 would be placed prior to Type C placement.

Generally, prior to the preparation of the foundations, a resistivity and microgravity survey would be undertaken to delineate the presence of any palaeokarstic features in the limestone bedrock (refer to Figure 3.8).

Some anomalies result from rapid changes in the thickness of the glacial till above the bedrock or highly weathered and fractured near surface bedrock. Any anomalies, if found, would be investigated by drilling. However, as discussed in Sections 2 and 3, the majority of the Stage 6 footprint is founded on Palaeozoic rocks which are non-calcareous rocks and it is only the south west corner of the Northern borrow area where limestone may be present as part of the Pale Beds. The geophysical work undertaken in the borrow area to determine the 'excavatability' of the bedrock indicated the possibility of palaeokarst in five locations as presented below.

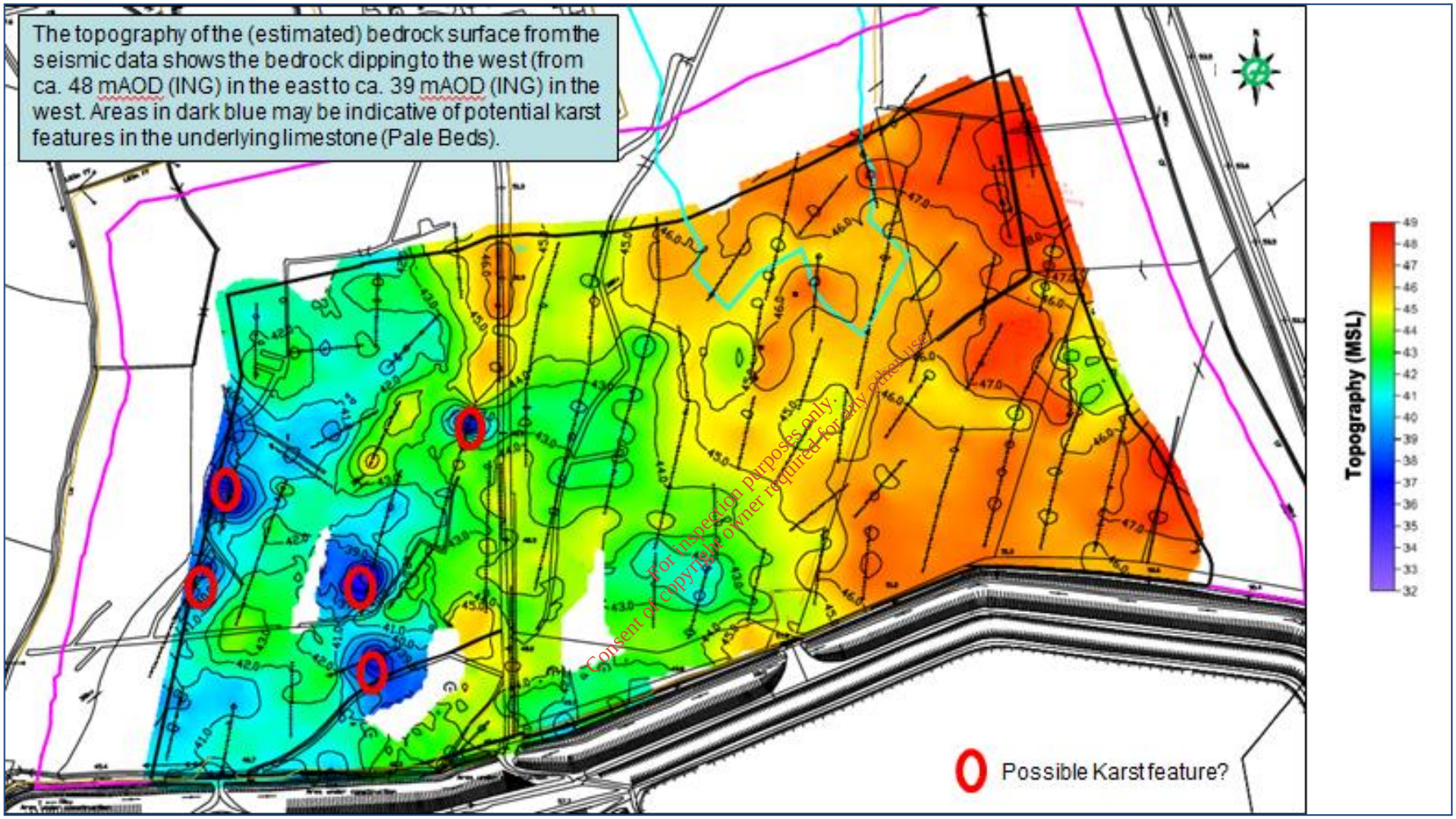
EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.7 Borrow area survey

EPA Export 06-01-2017:02:02:08



Consent of copyright owner required for any other use.
For inspection purposes only.

Figure 3.8 Possible Palaeokarstic Features (Ref.3.5)

EPA Export 06-01-2017:02:02:08

3.3.1Composite Lining

The proposed stage 6 extension will incorporates a composite lining system which consists of high density polyethylene (HDPE) geomembrane over a geosynthetic clay liner (GCL).

The composite lining will overlie a1000 g/m^2 geomembrane which in turn overlies 100 mm of Type C protection material as shown in figure 3.9.

High Density Polyethylene (HDPE)

The HDPE will be 2 mm thick, double textured and is placed directly over GCL on the 2H:1V upstream slopes of the dam wall. In the basin area the HDPE is 2 mm thick and smooth and is placed directly over the GCL. The HDPE and GCL are anchored along the dam crest at 59.29 m AOD and along the existing north wall of Stage 4 at an elevation of 63.29 m AOD for the first phase of Stage 6. Similarly, the lining system is anchored along the dam crest at 67.29 m AOD for the second phase of Stage 6.

The geomembrane materials shall consist of high density polyethylene, produced from new resins and containing no fillers, plasticisers or additives of any kind with the exception of carbon black.

For inspection purposes only.
Consent of copyright owner required for any other use.

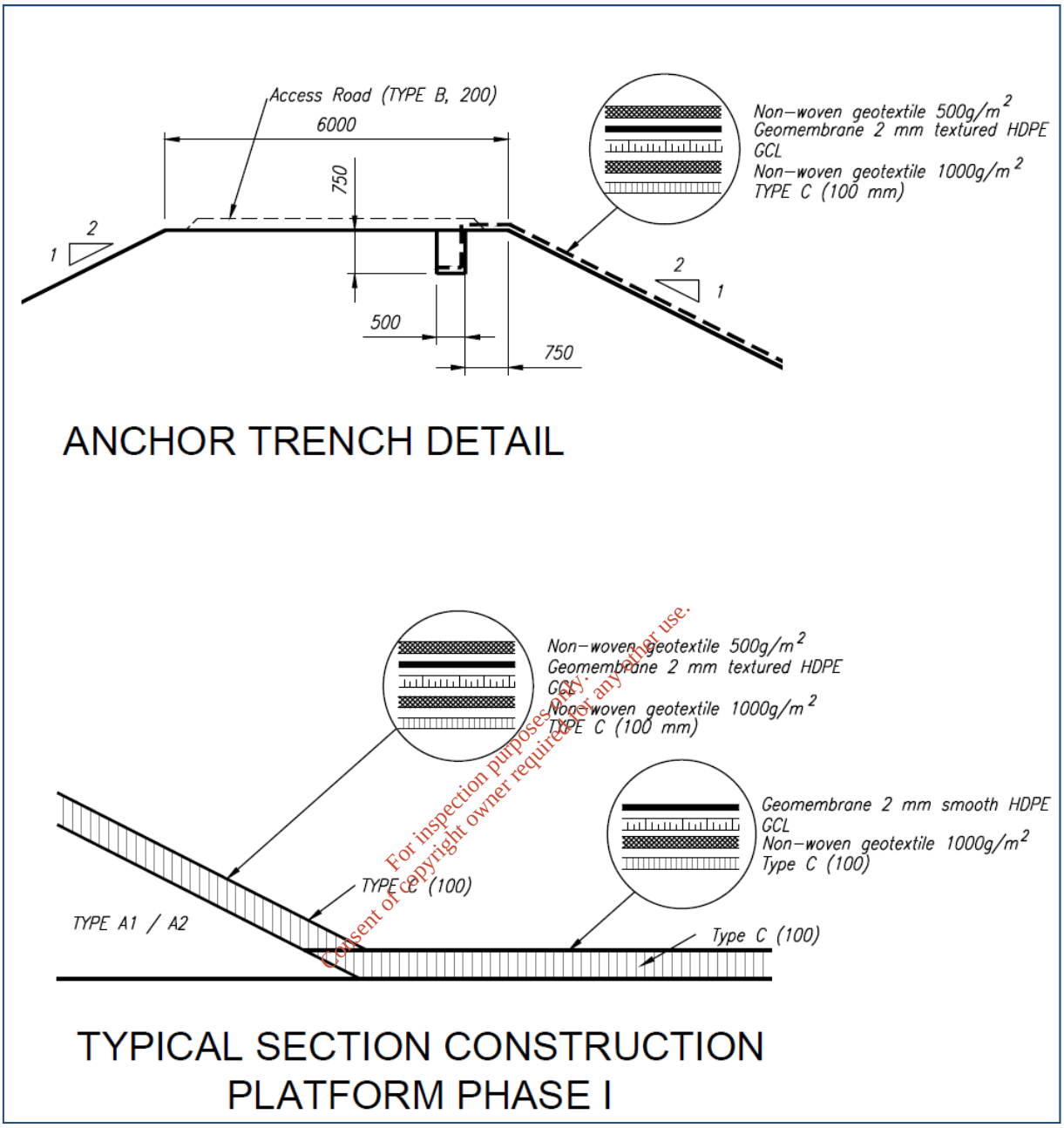
The geomembrane shall comply with the requirements set out in the table 3.6 below for 2.0 mm double textured and smooth geomembrane.

Table 3.6 HDPE Properties

Parameters	Properties	
Material	Double Textured 2 mm	Smooth 2 mm
Thickness (minimum average)	nom. (mil)	
• Lowest individual of 10 values	-10%	-10%
Density mg/l (minimum.)	0.940 g/cc	0.940 g/cc
Tensile Properties (minimum average)		
• Yield strength	29 kN/m	29 kN/m
• Break strength	21 kN/m	53 kN/m
• Yield elongation	>12%	>12%
• Break elongation	>100%	>700%
Tear Resistance (minimum average)	250 N	249 N
Puncture Resistance (minimum average)	500 N	640 N
Stress Crack Resistance	300 hr.	300 hr.
Carbon Black Content (range)	2.0 - 3.0%	2.0 - 3.0%

The geomembrane installation will be independently supervised and will be subjected to a strict CQA procedure.

EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.9 Composite lining system detail

Geosynthetic Clay Liner (GCL)

The GCL is placed beneath the HDPE geomembrane and over the Type C sub-base material on the upstream dam slopes and basin area of the facility.

The GCL shall be Bentofix or an approved equivalent and the grade shall be 3600 g/m^2 dry weight with a maximum permeability of 5E-11 m/s. The GCL shall consist of a layer of natural sodium bentonite clay encapsulated between two polypropylene textiles (geotextile), and have the following properties:

EPA Export 06-01-2017:02:02:08

Table 3.7: GCL Properties

Parameter			Properties
Bentonite Layer	Swell Index, Minimum		24 ml/2g
	Fluid Loss, Maximum		18 ml
	Sodium Bentonite, Minimum		3600 g/m^2
Geotextile Mass (Minimum Average Roll Value)	Slit-Film Woven		105 g/m^2
	Nonwoven Needle Punched		200 g/m^2
Index Flux (Maximum)			8x10^{-9} m^3/m^2/s
Hydraulic Conductivity (Maximum)			5x10^{-11} m/s
Peel Strength (Minimum)			240 N/m
Strip Tensile Strength (Minimum)	Machine Direction	Tensile Strength	8 kN/m
		Elongation	8%
	Across Machine Direction	Tensile Strength	8 kN/m
		Elongation	8%
Hydrated Internal Shear Strength (Minimum)			24 kPa

For purposes of strength, performance, and integrity, the GCL shall be manufactured by mechanically bonding the geotextile using a needle-punching process. Needle-punched GCLs are those which, by the use of a needling board, have fibres of the non-woven geotextile pushed through the bentonite clay layer and integrated into a woven or non-woven geotextile.

The bentonite sealing compound or bentonite granules used to seal penetrations and make repairs shall be made of the same natural sodium bentonite as the GCL and shall be as recommended by the GCL Manufacturer. All GCL shall be free of damage or defect.

The GCL installation will be independently supervised and will be subjected to a strict CQA procedure.

For inspection purposes only.
Consent of copyright owner required for any other use.

3.4 Geotextile

3.4.2 General

Three types of geotextile material are required, a 1000 g/m^2 non-woven needled punched geotextile to protect the lining system from underneath, a carbon rich 500 g/m^2 non-woven needled punched geotextile to protect the lining system from above on the slope and a Terram 1000 or equivalent as a separation medium.

3.4.3 500 g/m^2 and 1000 g/m^2 Non-Woven Geotextile

A 1000 g/m^2 non-woven needle punched geotextile is required to protect the GCL and HDPE geomembrane from the underlying Type C material which in turn is placed on top of the Type B material. A carbon rich 500 g/m^2 non-woven needle punched geotextile is required in the anchor trench and on the surface of the HDPE to protect this material from the surcharge and movement of pipe work.

EPA Export 06-01-2017:02:02:08

The physical and mechanical properties of the 1000 grm/m² and 500 grm/m² non-woven needle punched geotextile are given below.

Table 3.8: Non-Woven Geotextile Properties

Parameter	Specification 1000 g/m²	Specification 500 g/m²
CBR Puncture Resistance	Minimum 10,000 N	Minimum 5,000 N
Wide Width Tensile Strength	Minimum 75 kN/m	Minimum 40 kN/m
Elongation at break	Minimum 50%	Minimum 50%
Thickness	Minimum 8.0 mm	Minimum 5.0 mm
Mass per unit area	Minimum 1000 g/m²	Minimum 500 g/m²

3.4.4 Terram 1000

A separation geotextile will be required in some glacial foundation areas exposed, to prevent the Type C material punching into any soft and wet material. It will not always be possible to remove these materials or prevent water accumulating on the surface of the glacial till particularly in localised depressions. The geotextile would also be used to separate the coarse drainage material (Type D1 and Type E) and finer material. The separation textile would be Terram 1000 or equivalent.

For inspection purposes only.
Consent of copyright owner required for any other use.

Geo-textile Material Quantities

The areas of material for construction are tabulated as follows.

Table 3.9: Material Quantities

Description	Unit	Phase 1 Qty	Phase 2 Qty	Total Qty
1000 g/m² Geotextile	m²	529,262	74,255	**603,517**
500 g/m² Geotextile	m²	99,262	74,255	**173,517**
Terram 1000	m²	176,421	24,752	**201,172**
GCL	m²	529,262	74,255	**603,517**
HDPE (Smooth) 2 mm	m³	430,000		**430,000**
HDPE (Textured) 2 mm	m³	99,262	74,255	**173,517**

Anchor Trench

The geosynthetics will be fixed in an anchor trench excavated along the crest of the dam wall stages as shown in section in Figure 3.9. The trenches will be excavated with rounded shoulders where the geotextile and geomembrane lining will adjoin the trench in order to avoid sharp curvatures in the membrane material. The trench will be backfilled with screened Type C material and compacted in layers not exceeding 150 mm deep.

EPA Export 06-01-2017:02:02:08

Permanent Surcharge

A permanent surcharge is required on the exposed geomembrane to prevent the HDPE from being lifted and damaged by wind action and minimise damage from pipe movements. It also acts as a ladder if someone accidently falls into the facility. The surcharge will consist of car tyres in filled with Type C material and placed on the carbon rich 500 g/m^2 non-woven needle punched geotextile. Each line of surcharge shall be a maximum of 2 m centres longitudinally and anchored on the crest and the weights consisting of car tyres shall be a maximum of 1.5 m apart down slope and where applicable on the lining placed on the floor of the tailings and a minimum distance of 1 tyre width beyond the downstream toe. The two tyres at the toe of the slope and 1 tyre width beyond will be tied together (Dwg 6.13). The tyres will be attached by suitable rope with a minimum life of 10 years.

Leak Detection

A leak detection survey using DC electric current will be undertaken after the installation of the lining system. This geophysical method was previously used. An electric current is passed between two electrodes, one placed in either water ponded in the cell or by a water spray jetted onto the lining and the other in the peat outside the cell. With the geomembrane intact, the water in the cell will be electrically isolated from the external environment.

The resulting potential field, measured as a potential difference between two non-polarising electrodes, is small but uniformly distributed over the geomembrane.

If the geomembrane is defective, current will flow through the point of leakage and the measured potential will peak around the position of the defect.

Data acquisition is performed within the cell on a predetermined grid marked on the geomembrane at 2.0 m spacing. Two or more sets of data are obtained simultaneously, with information automatically stored on data loggers where possible. The results are processed and plotted on site, then overlaid on the plan of the cell to allow the immediate detection and location of the defect.

The voltage used is about 240 V and there is a strict safety protocol to follow to ensure no connection is made between the personnel, the ground and the water during the data gathering phase.

It is also anticipated that some difficulties will arise in physically walking on the flooded geomembrane. The surface of the geomembrane forming the basin area will be extremely slippery and to overcome this problem the operators use specialised waterproof clothing and footwear developed in the sailing industry.

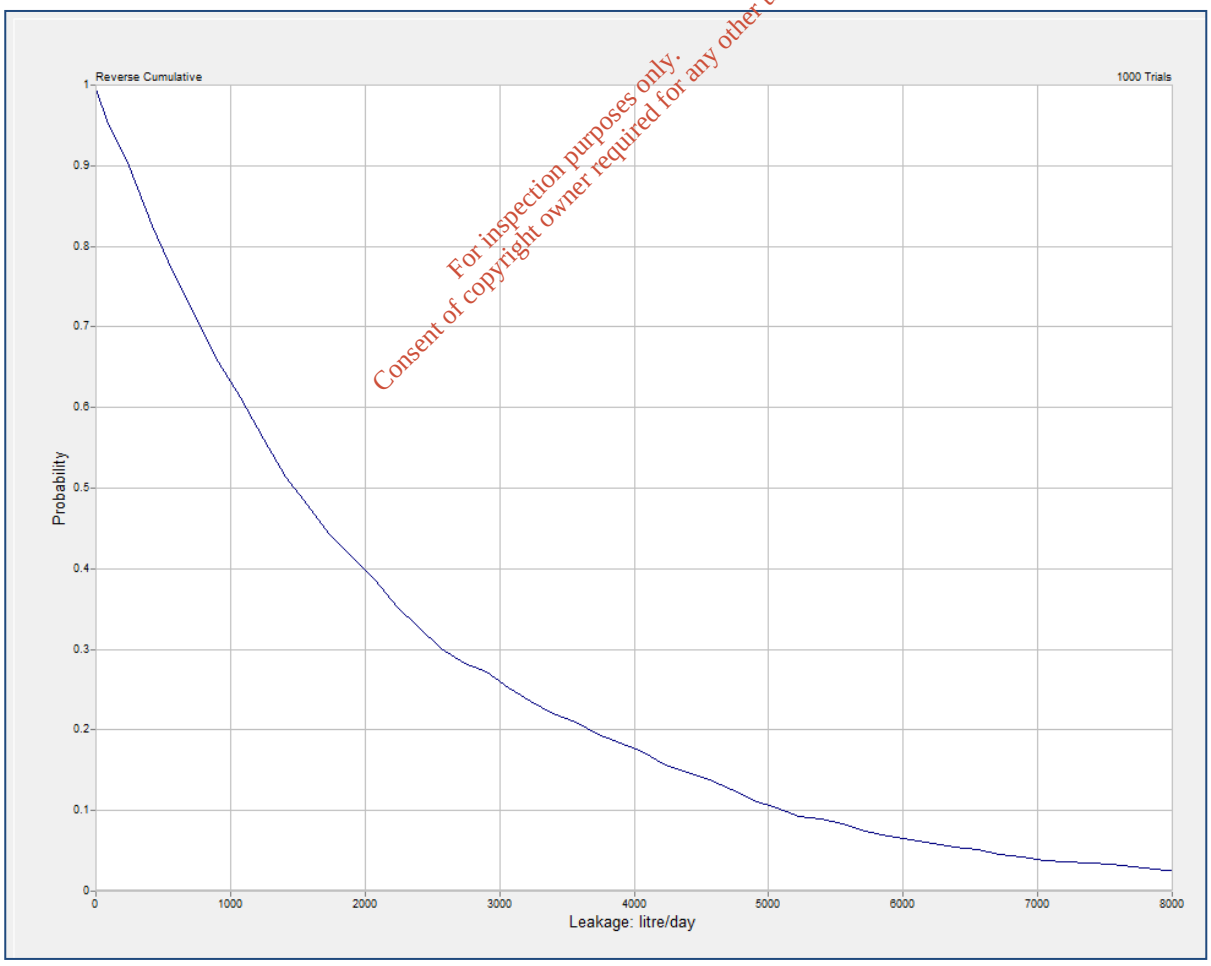
Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:08

3.5 Seepage

Seepage from the TMF will be controlled by the low permeability composite lining system, and the low permeability of the tailings retained by the facility. Experience of a large number of quality assured and controlled geomembrane installations indicates (Reference 6.1) the presence of between 2 and 5 leaks per hectare and these are generally less than 10 mm^2 in size.

Seepage calculations have been based on the design equations given in References 6.1 and 6.2 and for the worst case, when the facility is filled with tailings.
The volume of seepage flowing laterally through the dam wall via the GCL and some nominal defects in the lining system for a constant head of 20m (Phase 2) would be an average of about 1.5 m^3/day with a 10% probability of the seepage being less than 0.25 m^3/day and a 10% probability of greater than being 5 m^3/day. The range represented in the figure 3.10 below, is based on a number of variables including infiltration rate based on the range of vertical permeability values of the tailings, the range of defects in the lining per hectare, the effective permeability of the composite lining and head acting on the lining.



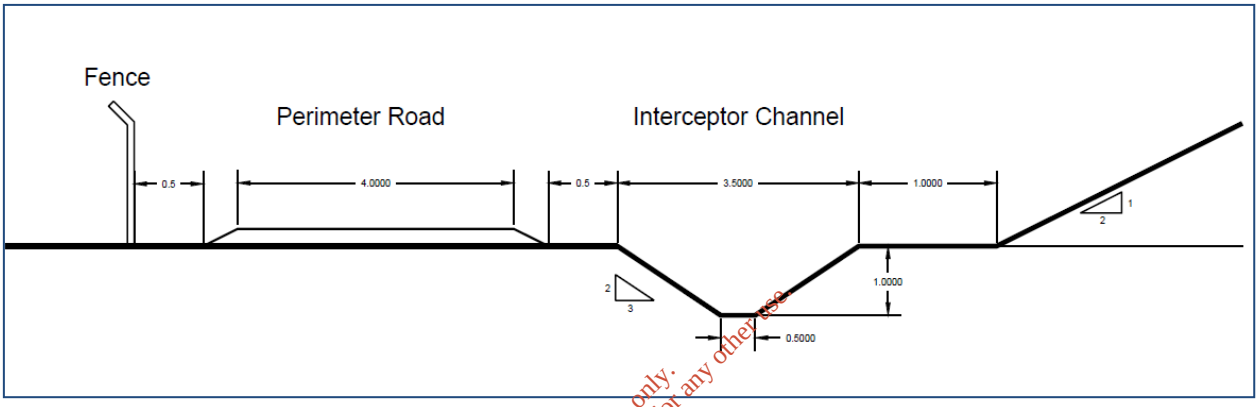
For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.10 Probability of Seepage from Composite Lining System

EPA Export 06-01-2017:02:02:08

3.6 Perimeter Interceptor Channel

The regional groundwater flow is from the north east to the south west and the minimal seepage passing through defects in the lining system will mix and be diluted with the ground water. The perimeter interceptor channel, figure 3.11,will collect surface water runoff from the dam walls, perimeter road and borrow areas. This seepage will be insignificant when compared with the clean surface water runoff from the dam walls and surrounding land.



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.11 Perimeter roadway, fence and interceptor channel.

During winter, sections of the perimeter interceptor channel will intercept the groundwater as it rises and this will be monitored for quality. It is expected that water quality will be suitable for discharge into the environment directly but initially it will be collected.

The final profile of the channel will be fixed during construction after the removal of unsuitable materials and also after borrowing suitable material. The perimeter interceptor channel will discharge into the existing east and west perimeter interceptor channel.

The longitudinal profile is considerably variable and generally between 42.29 m AOD and 53.29 m AOD as shown on figures 3.12A & 13.12B. The plan showing the chainage of the longitudinal profile is shown in Figure 13.13.

It is not anticipated that the channel in the glacial till or bedrock will be significantly deeper than 1 m and the side slopes would vary from 1H:2V to 1H:1V to 3H:2V depending on the material excavated.

EPA Export 06-01-2017:02:02:08

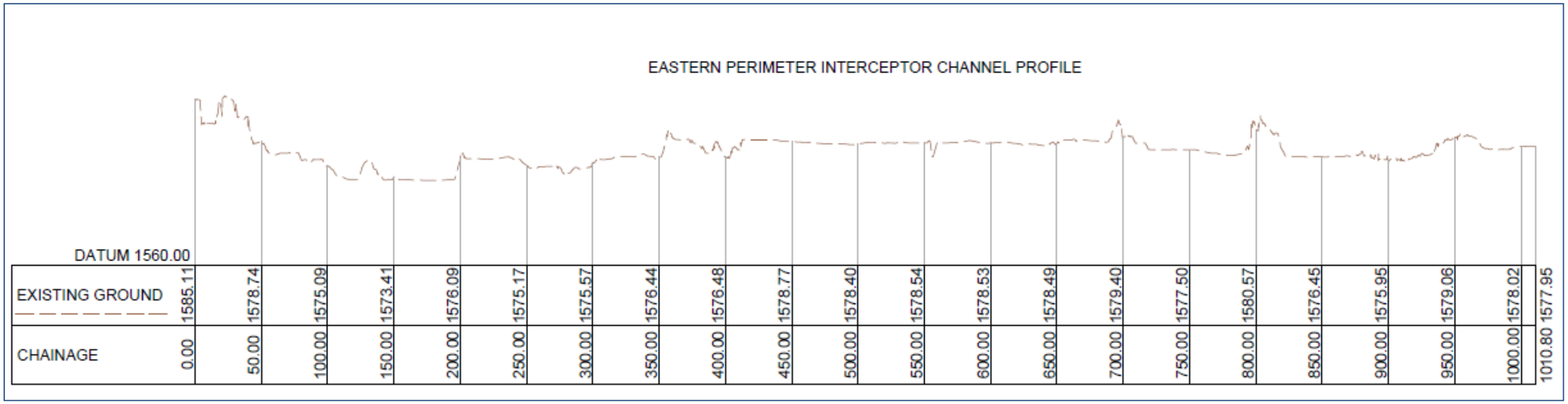


Figure 3.12 A Longitudinal profile along the eastern perimeter interceptor channel

For inspection purposes only.
Consent of copyright owner required for any other use.

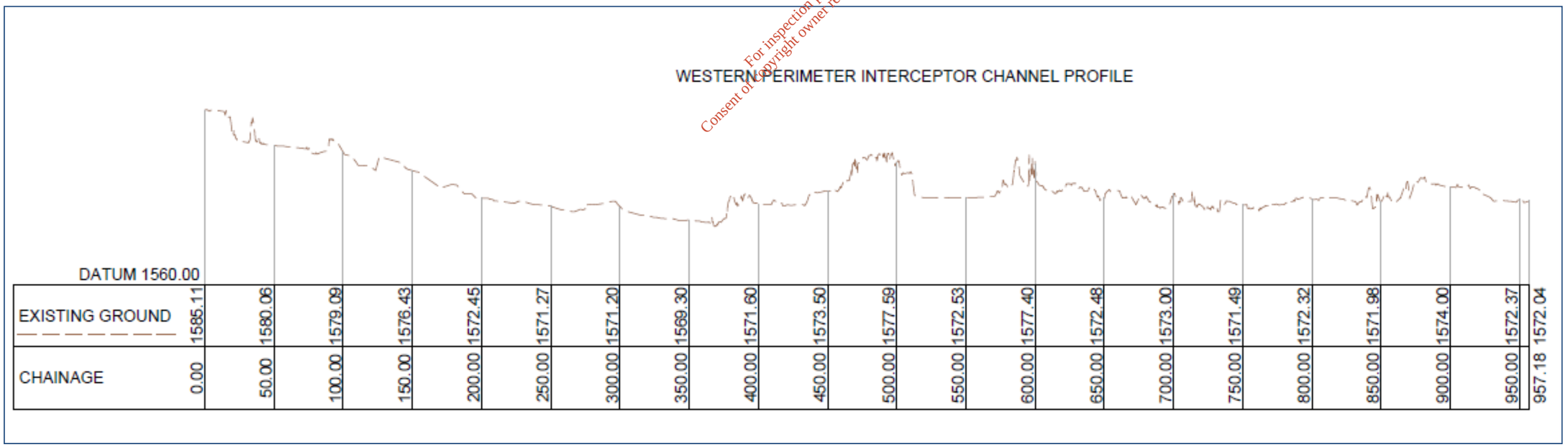


Figure 13.12 B Longitudinal profile along the western perimeter interceptor channel

EPA Export 06-01-2017:02:02:08

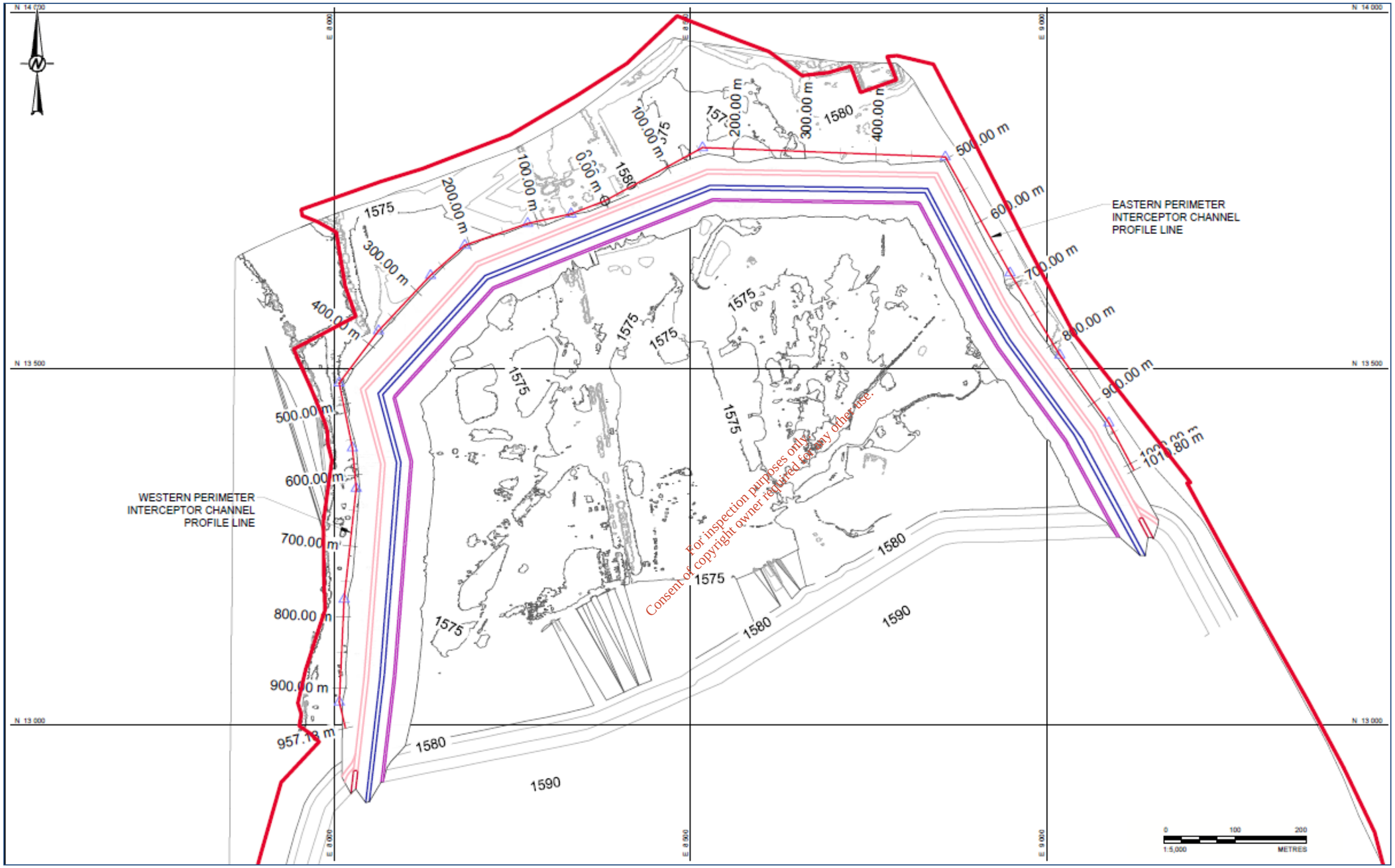


Figure 13.13 Chainage of the longitudinal profiles as illustrated in figs 3.12A & 3.12B.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:08

3.7 Embankment Stability Modelling

The stability analysis for the proposed cell was carried out using limit-equilibrium slope stability software, SLOPE/W version 7.15 (Reference 6.3).

The analytical method used was *Morgenstern and Price* method of slices, which satisfies both force and moment equilibrium.

The stability analysis indicates that the dam walls have adequate Factor of Safety (FoS) under the modelled conditions. Details of the modelling approach and the results are presented below.

3.7.2 Model Geometry

The model geometry is based on a typical cross-section of perimeter dam wall at full height (67.29 m AOD) including the bench at 59.29 m AOD.

The Stage 6 height is approximately 22 m above the glacial till/bedrock foundation level. The modelled sub-surface conditions are based on the geotechnical investigation information at the site of the existing TSF.

For inspection purposes only.
Consent of copyright owner required for any other use.

3.7.3 Geotechnical Parameters

The geotechnical strength parameters adopted in the stability modelling are presented in the table 3.10 and the geometric configuration presented in Figure 3.14.

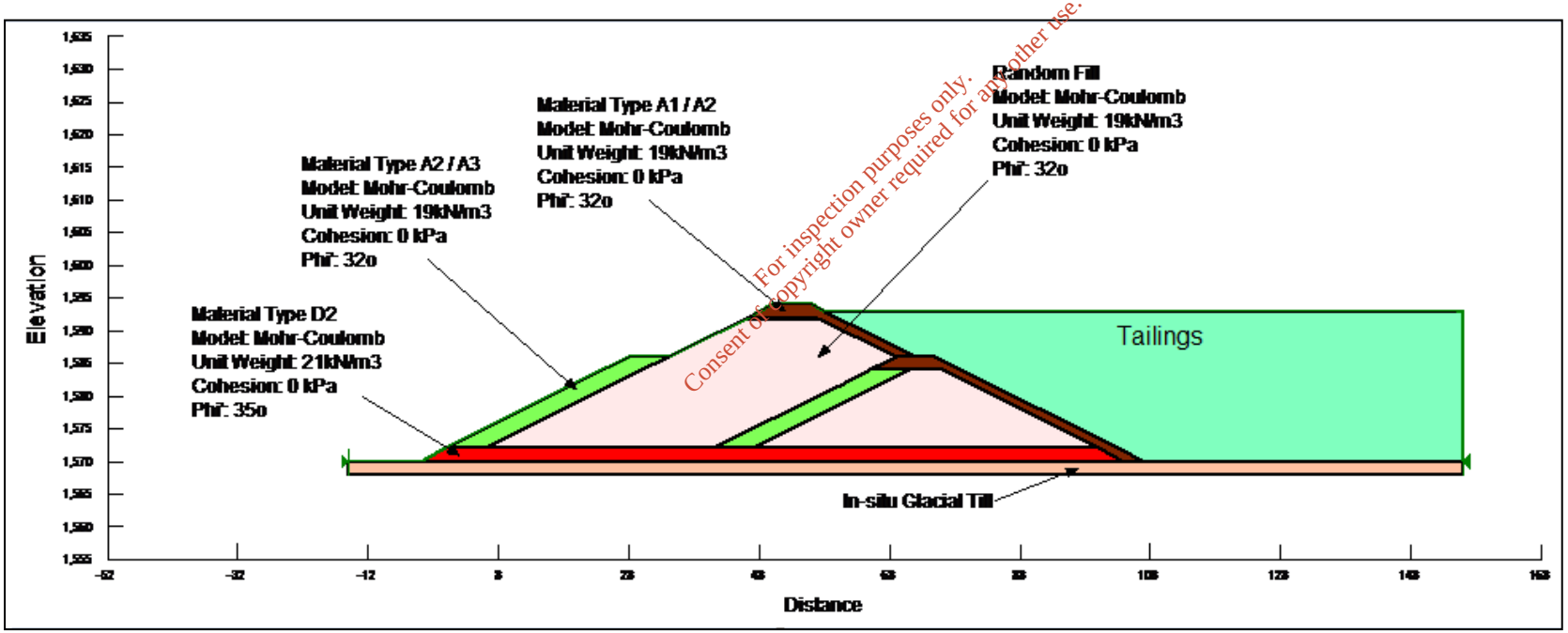
Effective strength parameters are typically used to assess long-term stability (after closure), whereby the excess pore pressures developed in any fine grained soils have dissipated.

EPA Export 06-01-2017:02:02:08

Table 3.10: Geotechnical Parameters for Stability Analysis

Material Type	Unit Weight (kN/m³)	Effective Strength	
		c' (kPa)	ø' (deg)
Type A	19	0	32
Type D1 and D2	21	0	37
Tailings	18	0	32
In-situ Glacial Till	20	5	32
Limestone Bedrock*	-	-	-

*Limestone bedrock was considered impenetrable by slope failure.



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.14 Model with material details

EPA Export 06-01-2017:02:02:08

3.7.4 Stability Modelling

The stability of the TMF wall for each option was considered under the following conditions:

- Long-term downstream embankment stability, with tailings level 1 m below the crest. The HDPE liner was assumed to be intact and an assumed phreatic surface was drawn down through the embankment by the downstream drainage blanket and the rock used in downstream construction.

- Long-term downstream embankment stability, with tailings level 1 m below the crest. The HDPE liner was considered to undergo complete failure and the drainage system was no longer free draining and the phreatic surface exits the dam wall in the slope at one third of its height. This is a very extreme scenario which is unlikely to develop.
- Further analyses were undertaken using pseudo-static conditions corresponding to a 0.06 g acceleration for the liner intact.

3.7.5 Results of Stability Modelling

The results of the stability analyses are presented in Table 3.11 below in the form of the FoS for the most critical slip surface and in Figures 3.15 to 3.18.

The required minimum FoS was exceeded under all conditions analysed.

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 3.11 Results of Stability Modelling

Case	Condition	Location	FOS
1	Long-term, tailings 1m below crest, phreatic surface at the toe of the dam. Static condition	Downstream	1.63
2	Long-term, tailings 1m below crest, phreatic surface at the toe of the dam. Ground Acceleration 0.06g. Pseudo static condition.	Downstream	1.38
3	Long-term, tailings 1m below crest, phreatic surface exists 1/3 dam height. Static condition.	Downstream	1.16
4	Long-term, tailings 1m below crest, phreatic surface exists 1/3 dam height. Ground Acceleration 0.06g. Pseudo static condition.	Downstream	0.99

EPA Export 06-01-2017:02:02:08

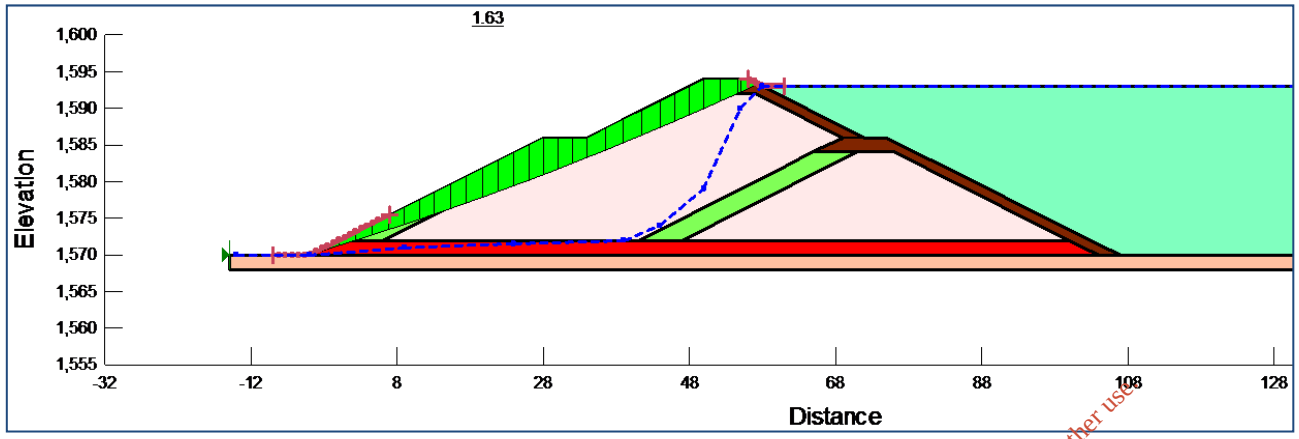


Figure 3.15 Static Analysis with Drainage Blanket operational (Phreatic Surface at the Dam toe)

For inspection purposes only.
Consent of copyright owner required for any other use.

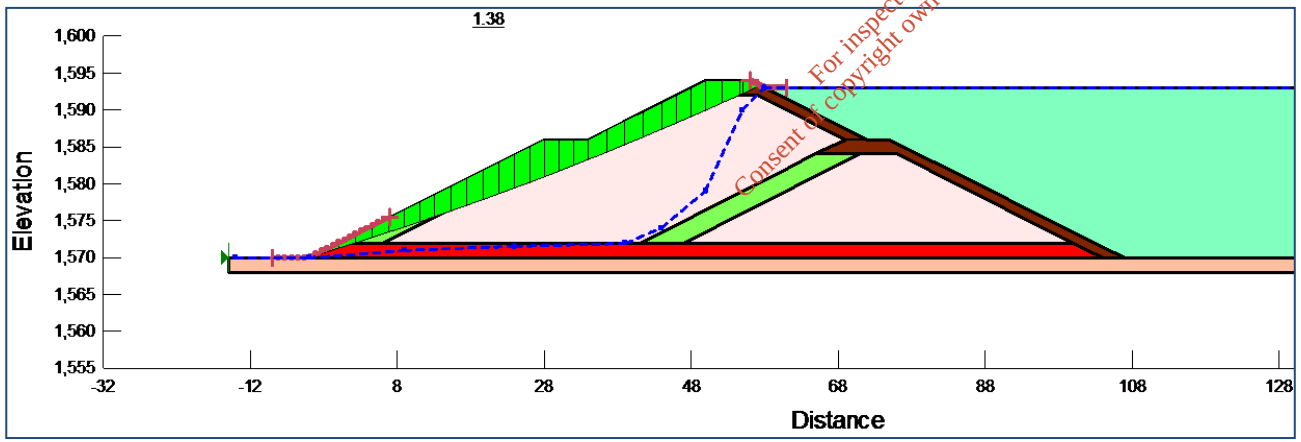


Figure 3.16 Pseudo – Static analysis with Drainage Blanket operational (Phreatic Surface at the Dam toe)

EPA Export 06-01-2017:02:02:08

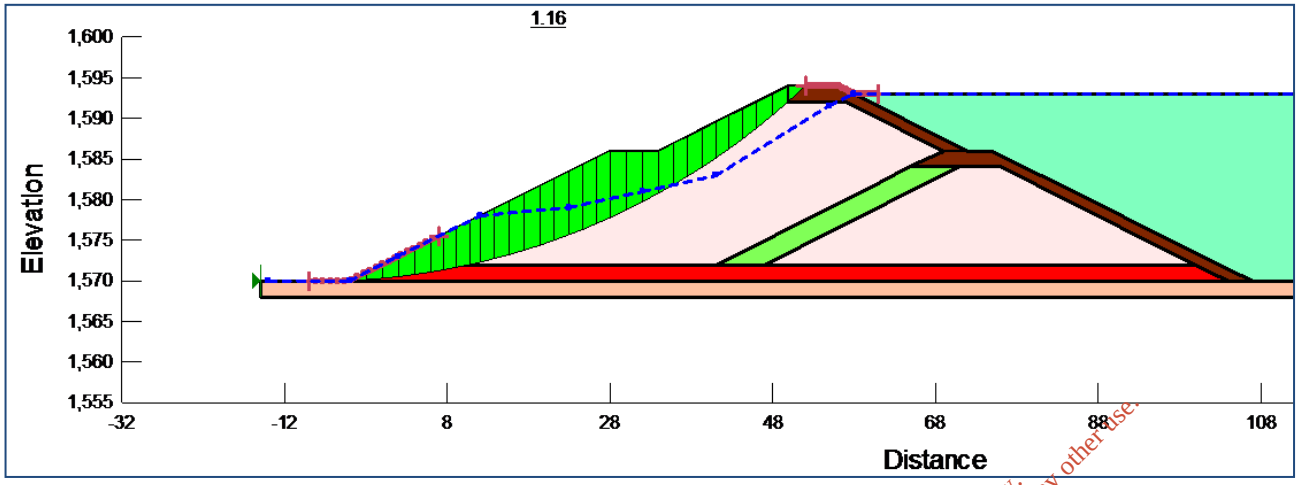


Figure 3.17 Static Analysis with Drainage Blanket blocked (Phreatic Surface at 1/3 Dam height)

For inspection purposes only.
Consent of copyright owner required for any other use.

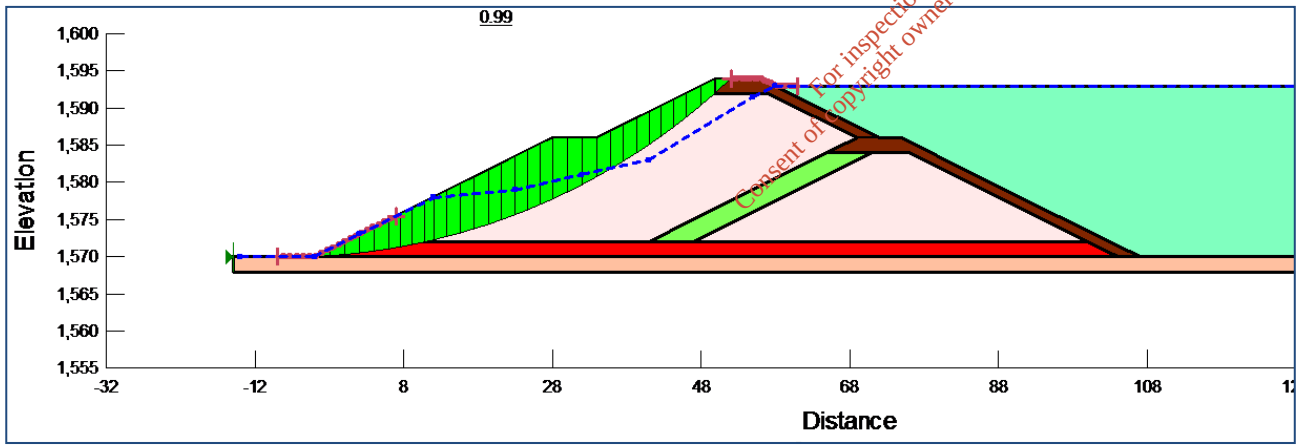


Figure 3.18 Pseudo - Static Analysis with Drainage Blanket blocked (Phreatic Surface at 1/3 Dam height)

EPA Export 06-01-2017:02:02:08

Note:

- The factor of safety for the static and pseudo-static cases for the internal drainage system operational are satisfactory.

- Where the drainage system is non-operational, the factor of safety for the static condition is satisfactory.
- In the statistically unlikely event of an earthquake, the factor of safety is 0.99 which under these conservative conditions, is acceptable.

As the dam wall incorporates a downstream drainage blanket and an upstream zone of Type A1 and A2 low permeability material together with the lining system, it is very unlikely that the phreatic surface would exit at a point one third of the dam height.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:08

3.8 Spillway

This type of perimeter dam used for tailings storage, which has no external catchment area, is normally operated without spillways. There is always adequate control on the tailings water level which can be achieved by adjusting the discharges into the TMF and removal of tailings water by pumping from the TSF to the plant site. However, a spillway is required post-closure to control water levels and discharges. The spillway will be constructed prior to closure of the new cell.

The level of the tailings water in the TSF will be dependent on the discharge from the mill into the facility, water reclaim from the facility and the effective rainfall. Both the discharge and reclaim are controlled by the mill operators and can be adjusted at short notice.

The probable maximum precipitation (PMP) for this area will be of the order of 250 mm over 24 hours which is readily retained within the freeboard of the facility. The spillway will be located and designed in detail closer to the end of the life of the Stage 6 facility.

The restoration cap of Stage 5, adjacent to the northern wall, will be at an elevation of 67.29 m AOD. The spillway will be located in the south east corner of the Stage 6 dam wall where the reclaim pumps are located. In the event of premature closure the wall would be cut down to accommodate a lower tailings level.

The water will be discharged into the eastern perimeter interceptor channel. However, the final location will be dependent on the location of the return water pumps which will ensure the lowest tailings level and the location of the sand ramp where the shortest route from the mill is also the south east corner of Stage 6. If this was chosen for the sand line, then the return pumps and spillway would be located in the south west corner of the Stage 6 dam wall.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:08

3.9 Operations

General

Stage 6 is composite lined and special care will be required in order to prevent damage to the lining system. Generally, the typical causes of damage are from dropping equipment on the lining, dropping and dragging pipelines or the installation and movement of the return water pumps.

Stage 6 will be operated similar to the existing TSF by discharging the tailings from spigots from the dam crest. The spigots will be open sequentially and the tailings will be discharged uniformly over the TMF.

The discharge spigots will be spaced at 50 metre centres and two tailings lines will be operated around the facility in opposite directions. Unlike the current Stage 5 operation, there will be a considerable depth between the crest and the basin floor initially. A slotted discharge pipe from the valve to the floor of the basin will be required, ref Figure 3.19.

The slotted discharge pipe will be anchored on top of the in filled tyre surcharge which is place directly on 500 g/m^2 carbon rich geotextile which in turn is placed on the lining. Alternatively to slots, the end of the pipe could be cut off as the tailings rises although this would be a more hazardous operation as the operator would have to climb down the dam slope using the tyres supporting the pipe with a chain saw

For inspection purposes only. Consent of copyright owner required for any other use.

During the operation of Phase 1 and Phase 2 the tailings level will be filled to a point leaving a '**free board'** of 1 metre:

- Phase 1 Crest elevation 59.29 – Tailings fill level 14.29
  - Phase 1 will be complete
- Phase 2 Crest elevation 67.29 – Final tailings level 66.29

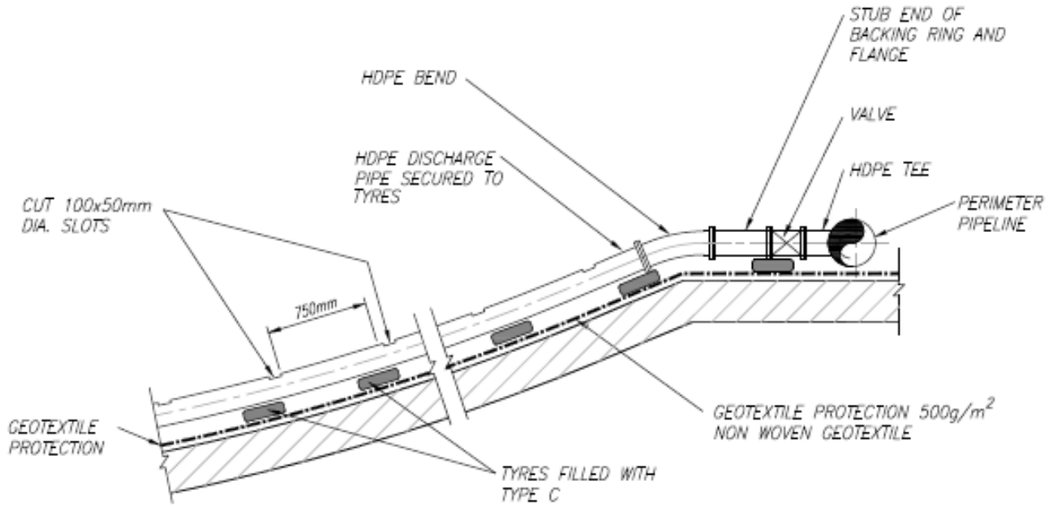
The pond water level will be kept to 1.5m below the crest during operations.

The tailings will be placed to a final elevation of 66.29 m AOD (Phase 2) and it is expected that the tailings will beach at a slope gradient of about 0.5% towards the reclaim pumps. The beach slope will be carefully controlled during operations.

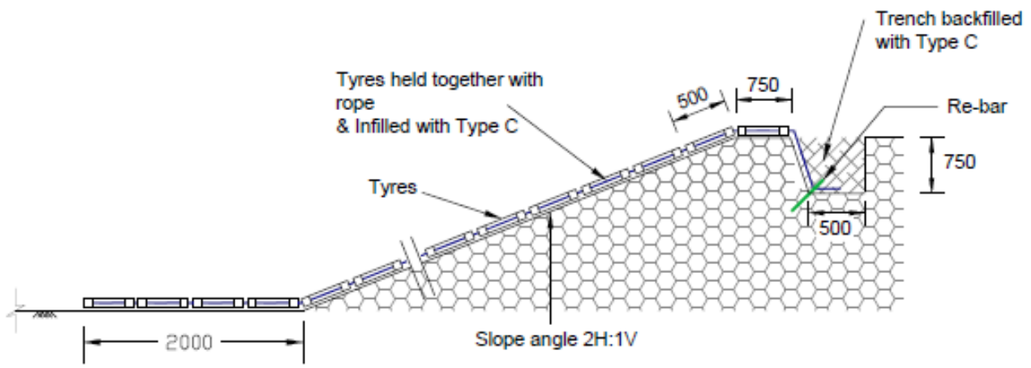
Where the reclaim pumps are located, a continuous protection (liner protection) of in filled tyres will be required some 20 m wide. This is illustrated Figure 3.19 Tailings pipeline arrangement.

The optimum location of the reclaim pumps is firstly along the existing northern wall of Stage 5 in the south east sector where the future spillway can discharge into the eastern perimeter interceptor channel.
The second option is along the existing northern wall but in the south west sector where the future spillway can discharge into the western perimeter interceptor channel.

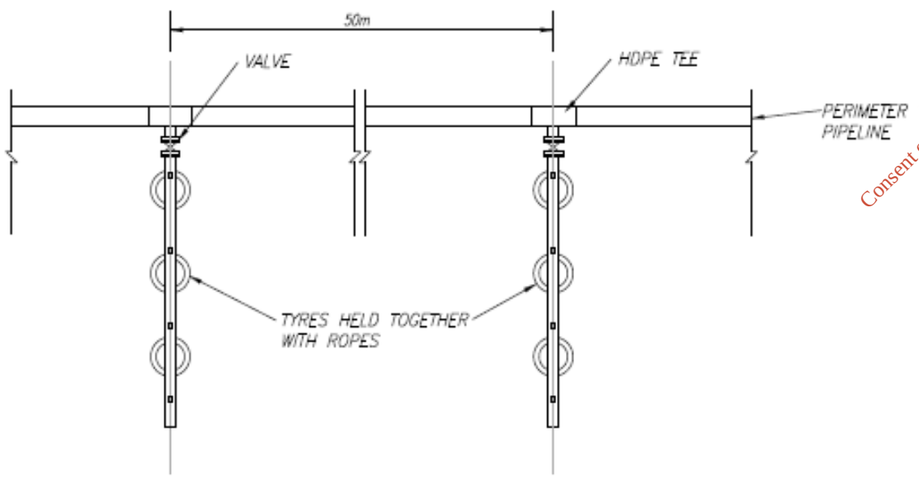
EPA Export 06-01-2017:02:02:08



TYPICAL SECTION OF DISTRIBUTION PIPE

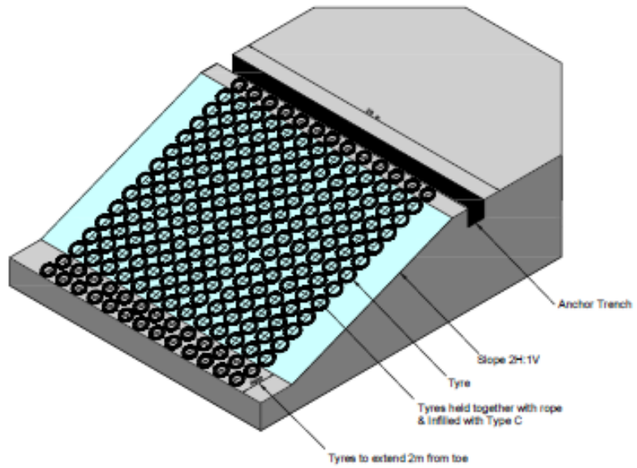


TYPICAL SECTION SHOWING ARRANGEMENT OF TYRES ON SLOPES AT LOCATION OF RECLAIM PUMPS AND SAND LINE



TYPICAL LAYOUT OF DISTRIBUTION SYSTEM

For inspection purposes only.
Consent of copyright owner required for any other use.



TYPICAL LAYOUT SHOWING ARRANGEMENT OF TYRES ON SLOPES AT LOCATION OF RECLAIM PUMPS AND SAND LINE

Figure 3.19 Tailings pipeline arrangement

EPA Export 06-01-2017:02:02:08

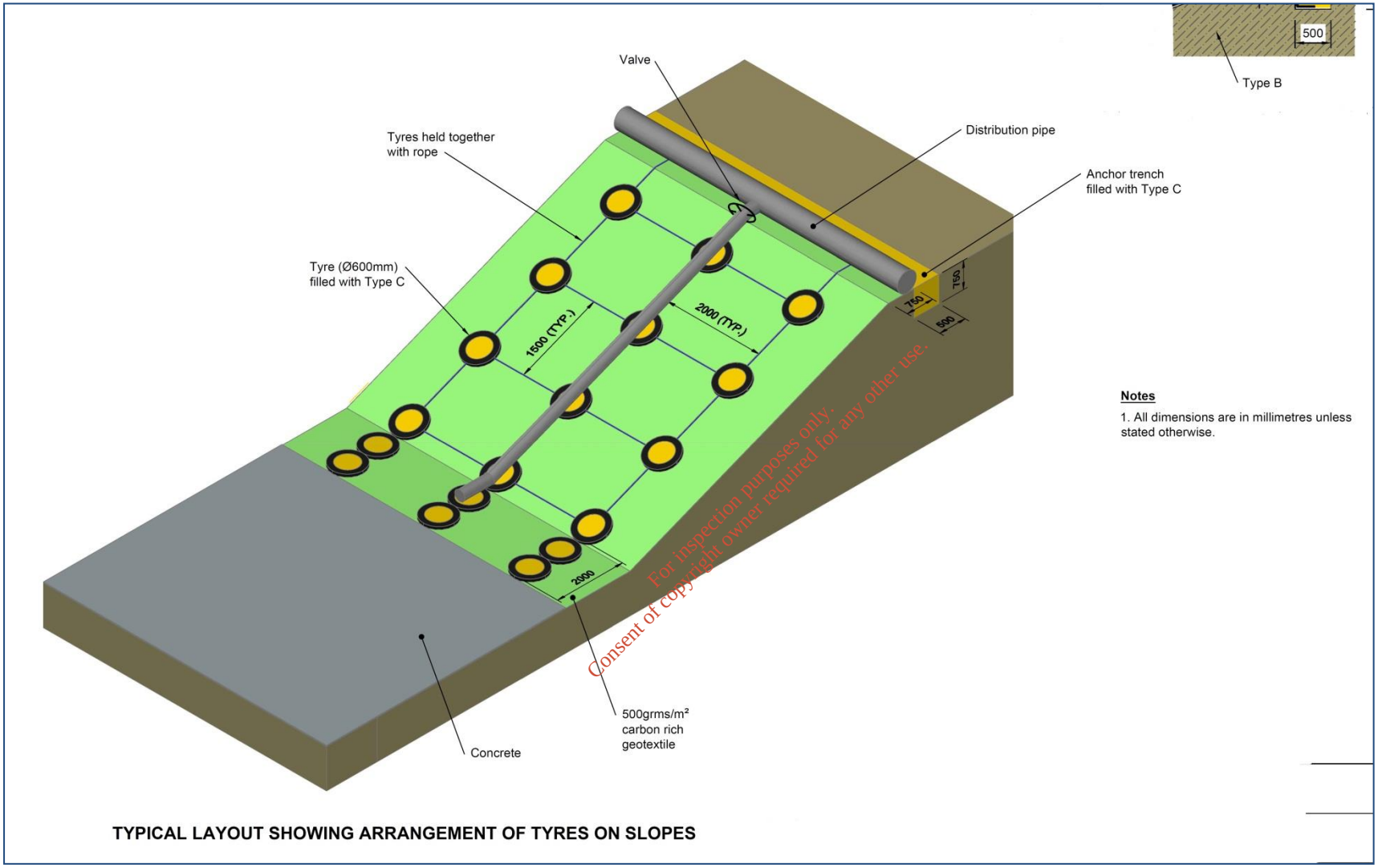
The sand line also poses a potential challenge as this would be discharged from a 600 mm diameter pipe. Again the liner will be protected with a minimum 20 m wide continuous in filled tyre protection as indicated in figure 3.19.

This line will be located on the northern wall of Stage 5 where the composite lining and lining protection can be installed for both the phases from the beginning.

To prevent damage of the lining at the point of discharge and to provide surcharge for the base, the basin should be filled with a minimum of 1 m of water equating to approximately 430,000 m^3.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.20 Line protection – tyre arrangement

EPA Export 06-01-2017:02:02:08

3.10 Piezometer and Groundwater Monitoring

The groundwater monitoring system for the TSF is presented in figure 3.21 and indicates piezometers and monitoring wells at 5 locations.

The monitoring wells will be located beyond the downstream toe and adjacent to the perimeter access road but subject to any anomalies indicated by the resistivity and microgravity survey which would indicate the presence of any water bearing fissures.

The piezometers will be installed into the foundations and above the drainage blanket at the base of the dam fill from the crest at 59.29 m AOD for the first phase of Stage 6. These would then be replaced during the construction of the second phase of Stage 6 with two piezometers installed on the crest and two piezometers on the intermediate bench.

The construction of the piezometers and wells are shown in Figure 3.22.

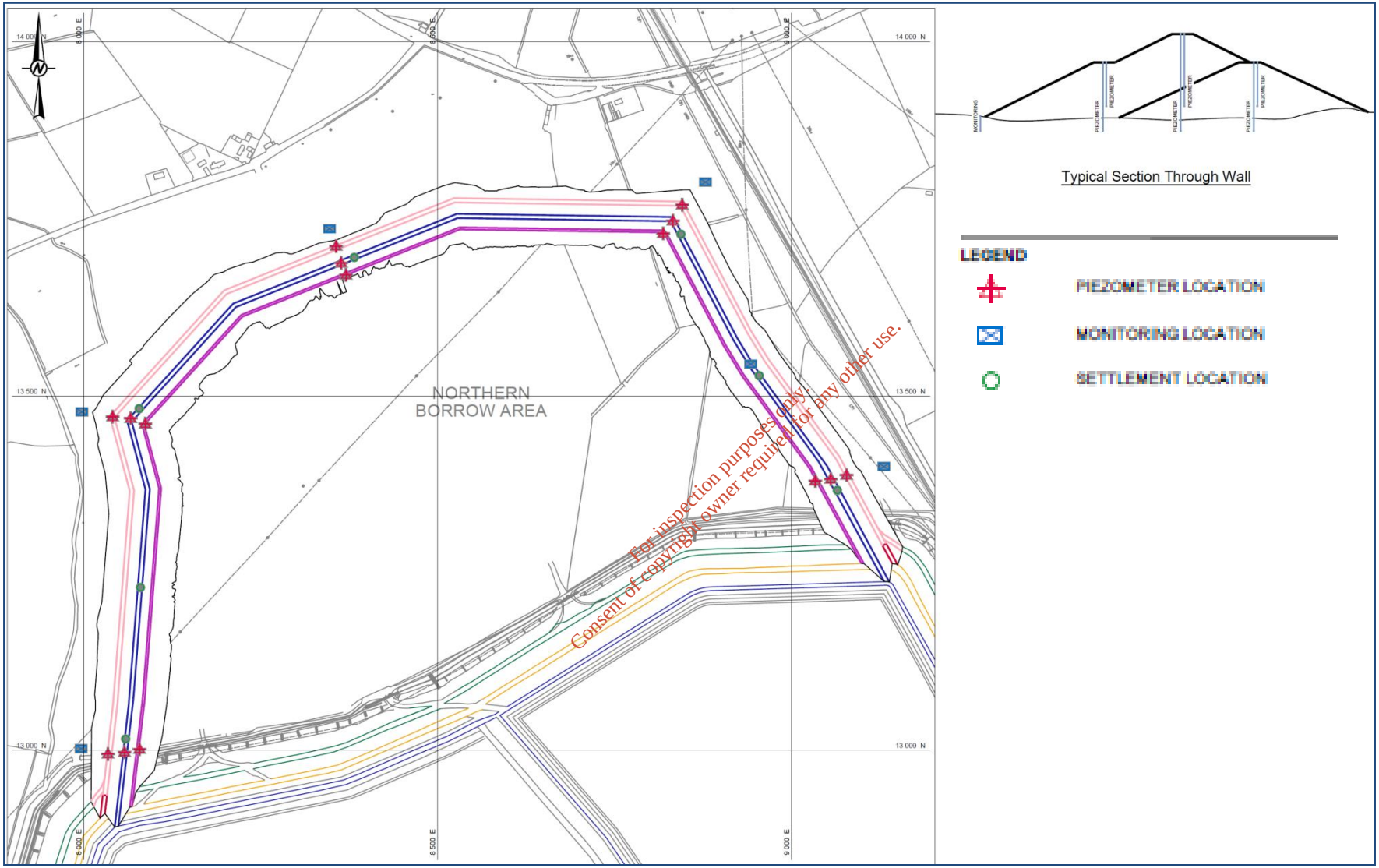
The water level and water quality sampling will be undertaken in accordance with the company's industrial emissions license (EPA P0 516-03).

For inspection purposes only.
Consent of copyright owner required for any other use.

3.11 Settlement Monitoring Points

Settlement monitoring of the dam wall will be undertaken at seven locations as shown on figure 3.21.

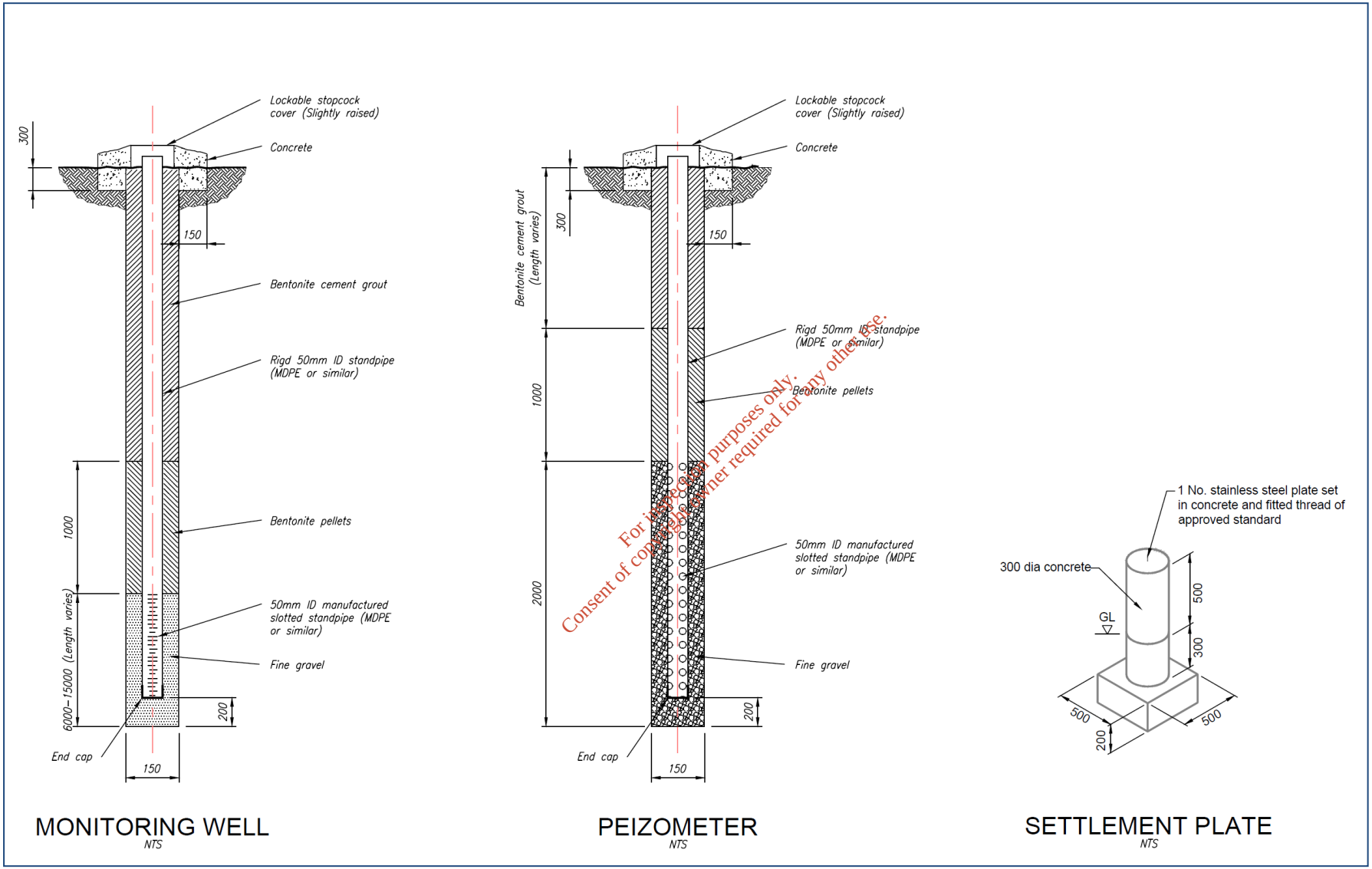
EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.21 Monitoring locations: Plan and section

EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.22 Monitoring instrumentation detail

EPA Export 06-01-2017:02:02:08

3.12 Construction

3.12.1 General

Unlike previous dam construction projects there will be no time restraint for placing the construction materials due to the fact that there will be little to no excess pore pressure development in the foundation glacial tills compared to the Stage 4 and Stage 5 upstream raises {Which were founded on tailings}.

Therefore, there will be no restriction on the rate of rising (construction) of the dam wall or on the size (capacity) or number of earth moving trucks.

It is proposed to use 40 tonne capacity dump trucks rather than the 25 tonnes used to build the Stage 4 and 5 raises. The bulldozers spreading the material in the dam wall to be the size of a D8. Using larger plant and increasing the number of dump trucks will significantly increase productivity.

The total bulk volume of fill to be removed from within the basin area of Stage 6 is 757,000 m^3.

The total bulk volume of construction material to build Phase 1 is 557,000 m^3 including access ramp construction

Table 3.12 below present a number of scenarios detailing the likely duration of the build phases based on various construction ('fill') rates.

Consent of copyright owner required for any other use. For inspection purposes only.

Table 3.12 Timetable Vs Average Construction Volumes

Construction Fill Vol. m^3 Phase 1. Crest elevation 59.29 m AOD	**557,000**	**557,000**	**557,000**	**557,000**	**557,000**
Season	1	1.5	2	2.5	3
Weeks	30	45	60	75	90
Average Vol. m^3/week	18,567	12,378	9,283	7,427	6,189
Construction Fill Vol. m^3 Phase 2 Crest elevation 67.29 m AOD	**1,170,000**	**1,170,000**	**1,170,000**	**1,170,000**	**1,170,000**
Season	1	1.5	2	2.5	3
Weeks	30	45	60	75	90
Average Vol. m^3/week	39,000	26,000	19,500	15,600	13,000

EPA Export 06-01-2017:02:02:08

3.12.2 Indicative project time scale

Note:
The successful movement and placement of natural materials (Soil/clay) is weather dependent and the production rate can be altered due to unseasonal rainfall.

Phase 1: Construction material volume 557,000 m³

- To complete phase 1 at a rate of 18,500 m3/week would take 30 weeks
- To complete phase 1 at a rate of 15,500 m3/week would take 36 weeks

For Phase 1, the total area to be lined is c. 530,000 m² of which about 81% will be the dam floor. Liner installation is also weather dependent and is impacted by adverse rainfall, wind and temperature.

Placing lining on the basin floor is quicker than placing liner on the side slopes because of the greater length of roll that can be placed and the less welds required.

The anticipated average weekly installation rate would be c. 20,000 m³: This equates to a 27 week completion timescale. The lining will extend onto the existing north dam wall of the existing TSF.

For inspection purposes only.
Consent of copyright owner required for any other use.

Note:
The operational timescale for Stage 6 Phase 1, in terms of tailings capacity, will be approximately 6.5 years [subject to mine backfilling rate].

Phase 2: Construction material volume 1,170,000 m³

- To complete phase 2 at a rate of 18,500 m3/week would take 63 weeks
- To complete phase 2 at a rate of 15,500 m3/week would take 76 weeks

The area of the dam wall to be lined is 74,000m² which would be completed in c. 7 weeks.

Note:
The operational timescale for Stage 6 Phase 2, in terms of tailings capacity, will be approximately 5 years [subject to mine backfilling rate].

3.12.2.1 Construction duration

At the higher average production/construction rate the combine total number of production weeks would be 93 weeks

At the lower average production/construction rate the combine total number of production weeks would be 112 weeks.

EPA Export 06-01-2017:02:02:08

3.13 Tailings Characteristics

The physical and chemical characteristics of the deposited tailings will remain unchanged from those deposited previously (see Tables 3.13 and 3.14).

Table 3.13 Tailings Particle Size Distribution

Screen Fraction (microns)	Current Size Distribution (weight %)	Estimated Future Size Distribution (weight %)
+ 44	13.6	0
- 44 + 33	13.8	6.7
- 33 + 23	10.5	5.9
- 23 + 15	9.8	11.8
- 15 + 11	13.2	21.5
- 11	39.1	54.1
Total	100	100

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:08

Table 3.14 Tailings Geochemistry

Parameter	Symbol	Units	Mean
pH	pH	pH units	8.3
Total Cyanide	CN	(mg/kg)	1
Zinc	Zn	(mg/kg)	2430
Lead	Pb	(mg/kg)	1929
Arsenic	As	(mg/kg)	619
Iron	Fe	(mg/kg)	19614
Copper	Cu	(mg/kg)	87
Mercury	Hg	(mg/kg)	1.0
Cobalt	Co	(mg/kg)	15
Calcium	Ca	(mg/kg)	203571
Magnesium	Mg	(mg/kg)	17150
Sulphate	SO4	(mg/kg)	8517
Sulphide	SO2	(mg/kg)	18100
Silver	Ag	(mg/kg)	0.5
Aluminium	Al	(mg/kg)	1717
Boron	B	(mg/kg)	10.0
Barium	Ba	(mg/kg)	53.3
Beryllium	Be	(mg/kg)	<0.5
Bismuth	Bi	(mg/kg)	3.2
Cadmium	Cd	(mg/kg)	4.2
Chromium	Cr	(mg/kg)	27.0
Gallium	Ga	(mg/kg)	<10
Potassium	K	(mg/kg)	2400
Lanthanum	La	(mg/kg)	<10
Manganese	Mn	(mg/kg)	1194
Molybdenum	Mo	(mg/kg)	1.0
Nickl	Ni	(mg/kg)	52.6
Phosphosus	P	(mg/kg)	514
Antimony	Sb	(mg/kg)	76.6
Scandium	Sc	(mg/kg)	1.6
Strintium	Sr	(mg/kg)	561
Thorium	Th	(mg/kg)	<20
Thallium	Tl	(mg/kg)	20.0
Titanium	Ti	(mg/kg)	16.7
Uranium	U	(mg/kg)	<10
Vandium	V	(mg/kg)	3.8
Tungsten	W	(mg/kg)	<10

For inspection purposes only.
Consent of copyright owner required for any other use.

Note:

- Mean values based on data assembled over the period 2002 – 2015
- All values are expressed as mg/kg (parts per million) dry weight except where shown otherwise.

EPA Export 06-01-2017:02:02:08

3.14 Closure and Decommissioning

In 1996 Tara Mines produced a Closure Plan for the Randalstown Tailings Facility that incorporates engineering and environmental considerations relating to closure of the facility (Reclamation and Closure Plan for the Randalstown Tailings Impoundment, Golder Associates, 1996).

An updated version of the Closure Remediation and Aftercare Management Plan (CRAMP) for the tailing facility was submitted to the EPA in May 2015.

The CRAMP has been amended to take account of the proposed Stage 6 and the proposed ICW.

A copy of the Reclamation and Closure Plan is submitted with this EIS.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:08

Project Description Part B - Integrated Constructed Wetland (ICW)

3.15 Introduction

It is proposed to construct an Integrated Constructed Wetland (ICW) as a suitable Passive Treatment System (PTS) for the management of runoff from the existing and proposed areas of the TSF in the post closure phase of the facilities lifecycle.

The ICW will be located south of the TSF and will extend over and area of c. 12 hectares, ref figure 3.23.
The surface area the tailings storage facility including the proposed stage 6 would be c 200 ha.

The TSF will be capped as part of the Closure Plan and all intercepting rain water will require collection, management and treatment prior to discharge to surface waters.

The Company's **Closure Remediation and Aftercare Management Plan**[5] (CRAMP) detail the phased approach to success decommissioning from:

- The closure phase followed by
- The active aftercare Phase
    - Involving post-closure monitoring and maintenance which could last for five to ten years.
    - Followed by the passive phase where monitoring and maintenance is reduced and this could also last for five to ten years.

For inspection purposes only.
Consent of copyright owner required for any other use.

After these phases the reclaimed area of tailings facility should be stable and is expected to be self-sustaining in the longer term. The individual time periods will be based on the success of the rehabilitation programme.

One essential component of the CRAMP is the management of surface water runoff from the site.

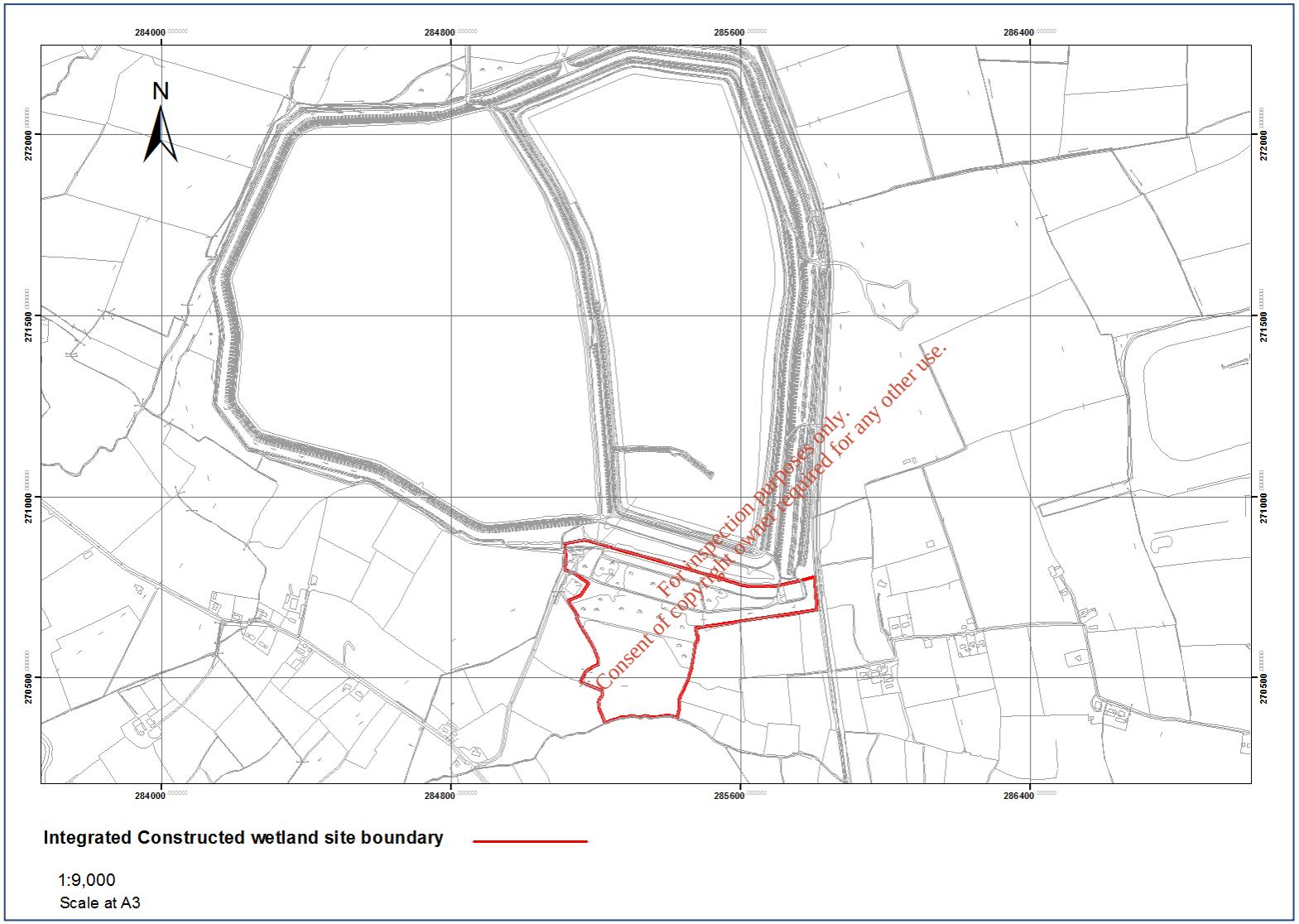
Under normal operating condition at the TSF water is treated and stored before it is recycled to the processing plant at the main mine site. Excess water is discharged to the river Boyne under the company's Industrial Emissions Licence (ref. EPA, P0 516-03).

Post closure and remediation water recycling will cease and runoff from the TSF site will be treated in the intended ICW prior to eventual discharge to the River Blackwater.

Surface water flows will flow by gravity to the ICW. Here water will be treated to the required levels prior to discharge to the Blackwater River, at a discharge point south east of the TSF and ICW sites.

[5] Refer to EIS Appendix

EPA Export 06-01-2017:02:02:08



Consent of copyright owner required for any other use.
For inspection purposes only.

Figure 3.23 ICW site location

EPA Export 06-01-2017:02:02:08

3.16 'Passive Treatment System' - Integrated Constructed Wetland

An integrated constructed wetland is a shallow surface flow wetland, which mimics the role and structure of naturally occurring helophyte (emergent vegetation) wetlands (Department of Environment, Community & Local Government, 2010).

These vegetated wetland ecosystems have proven most effective in cleansing water of a wide range of nutrients and pollutants. ICW systems have shallow water depths (typically 10-25cm deep) and densely vegetated with appropriate emergent plant species to intercept and treat/cleanse through-flowing water. Treatment is achieved through a combination of physical, chemical and biological processes.

The ICW concept is a site-specific design approach to the broad and widely used application of constructed wetlands. ICWs are distinguished from other constructed wetland approaches through the application of explicit integrated design to facilitate the widest possible range of ecological conditions that are normally found in natural vegetated wetlands, including amongst others, their soils, aerobic and anaerobic water, plant and animal ecologies. In addition, the ICW concept strives to optimally achieve a 'Landscape fit' and 'Habitat Restoration/Biodiversity' into its site-specific designs. Whilst these additional considerations may necessitate larger land area when compared with areas in other constructed wetland designs, these larger land area requirements facilitate a more sustainable range of the physical, chemical and biological processes and affect an associated hydraulic residence time often required for the removal of more difficult and emerging contaminants. The relatively larger land area espoused in ICW designs also delivers better sustainable environmental outcomes, requiring less maintenance and more self-managing than that obtained from lesser-sized constructed wetland systems.

Consent of copyright owner required for any other use.
For inspection purposes only.

3.16.1 Key Benefits of an ICW

The major advantage of the ICW approach is that it explicitly looks for wider societal gains through the use of reanimated wetlands in dealing with water-vectored pollutants. The approach is broadly one that optimises benefits rather than simply maximising for pollution control alone and can be outlined as follows:

- The 'total' management of water (all water on a site is given due consideration).
- Lower capital costs (typically >60% saving on capital) compared to alternative more conventional treatment methods.
- Utilisation of available local/on-site materials for construction of ICW.
- Low operation and maintenance costs (typically >90% less than conventional systems).
- Controlled discharge of intercepted water by releasing water slowly from the in-line intercepting ICW ponds (even diminishing or eliminating surface water discharge). This is of special significance at Tara Mines where large volumes of water may be generated during heavy precipitation events.
- Capture/retrieval (recycling) of water-vectored materials such as phosphorus and organic matter.

EPA Export 06-01-2017:02:02:08

- Carbon sequestration (storage) – accumulating vegetation necromass.
- Development of new wetland-dependent resources.
- Facilitate awareness of the values of wetlands (and nature generally).
- Opportunities for recreation and education.
- Robust system capable to withstand extreme load variations (weather events and seasonal fluctuations).
- Sustainable design and construction ensuring a long operational life (50-100+ years).
- Minimal management and capacity for self-regulation.
- The site is not irrevocably lost and is ideally enhanced in the long-term facilitating further development.
- Opportunities are provided for habitat development and biological diversification.
- Addresses legislative requirements; Water Framework Directive, Nitrates Directive, Convention on Biodiversity.
- Takes a broader ecological approach rather than one solely based on environmental considerations alone.

3.16.2 Integrated Constructed Wetland treatment

For inspection purposes only.
Consent of copyright owner required for any other use.

The primary vegetation types used in ICWs are emergent plant species (helophytes). These species have evolved to enable their roots to successfully grow in soils with no available or limited oxygen. Growing vertically through and above the water column they provide a support structure for the highly functional biofilms that are the 'work-horses' of the treatment system.

With most of their leaves in the air they facilitate the interception of precipitation and have transpiration rates, which together reduces water through-flow. They have specially adapted tissues that facilitate oxygen storage and its transportation from the leaves through the stem to the roots. Soil and water characteristics influence the type and performance of plant species for each wetland segment of an ICW.

As 'open systems', the hydrology of an ICW is complex. At least 6 different flow-paths across, though, above, below and between the intercepting emergent vegetation and between ponds may apply. In addition, the helophyte vegetation canopy intercepts precipitation year-round reducing through-fall, losing water through transpiration and influencing water loss through evaporation. To these may be added precipitation, ground water infiltration/exfiltration and embankment runoff, as well as seasonal factors such as freezing or prolonged drought. Notwithstanding these complexities, the performance of all monitored ICW systems including an existing ICW for mine drainage over the past 18 years have shown them to be sustainable efficacious treatment additions to the Irish landscape whilst also providing many important additional ecosystem services.

EPA Export 06-01-2017:02:02:08

Processes of metal removal

The table 3.15 below shows the main processes of metal removal.

Table 3.15 Processes of metal removal

Medium	Processes
Vegetation	Ion uptake/translocation Adsorption Organic decomposition Filtration
Water	Evaporation Dilution Complex formation Decomposition Microbial oxidation/reduction Precipitation
Substrate	Microbial oxidation/reduction Ion exchange Precipitation Adsorption Chelation Chemical (organic) decomposition

For inspection purposes only.
Consent of copyright owner required for any other use.

Cation exchange capacity is the measure of ability of a substrate to adsorb positively charged ions (such as metal ions) by exchanging them for other ions bound to the molecular structure of the substance. The process requires a continuous supply of fresh organic matter (produced by the plants - detritus).

Studies have shown that plants can colonise heavily metal polluted areas. The plants as well as providing organic material for adsorption of metals also absorb a wide range of metals themselves, thus providing an important role in the removal process. Bacteria and other micro-organisms facilitate the removal of metals by direct accumulation of metals into their body structure.

Hydrology is probably the single most important determinant for the establishment and maintenance of wetland processes. The permanent or periodic saturation of a wetland results in anaerobic conditions in the soil under which wetland biogeochemical processes occur. These processes cause the development of characteristic wetland soils, which support a dominant plant community adapted to living in saturated soils (Sheoran et al, 2006, Mitsch and Gosselink, 1993, ITRC, 2003).

The concentrations of heavy metal ions removed from solution in wetlands is determined by interacting processes of settling, sedimentation, sorptions, co-

EPA Export 06-01-2017:02:02:08

precipitation, cation exchange, photodegradation, phytoaccumulation, biodegradation, microbial activity and plant uptake (Sheoran et al, 2006).

The known ability of wetlands to reduce metal and sulphate concentrations has been further examined by Tara Mines through the set-up of a meso-scale ICW trial.

3.17 Proposed ICW design

The layout for the proposed ICW and associated features is illustrated in figure 3.24 and 3.25 and detailed in Appendix 3.1

- This drawing outlines the area for the ICW, the layout and associated works and features.

Based on long-term monitoring data[6] the estimated annual flows to the ICW would be c. 800,000m^{3,} with monthly and daily rates variables depending on seasonal (meteorological) influences.

A seasonal water balance is provided in below. The water balance has calculated variable outflows, with no flows to or from the ICW in summer months. A summary of volumes is provided in during proposed ICW is based on influent average flows as shown in Table 3.16 below.

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 3.16 ICW Water balance

Flow rates	Season			
	Spring	Summer	Autumn	Winter
Influent discharge m^3	170,138	-74,258	221,742	462,108
ICW effluent discharge m^3	154,725	-51,435	198,565	475,215
ICW Daily average m^3	1719	0	2206	5280

The quality of the influent water to the proposed ICW will be variable over time, however in preparing the design of the ICW a conservative approach to water quality is taken.

As the TSF is not yet capped/rehabilitated and necessary runoff water quality data is unavailable, water quality data from water arising from the interceptor channels is available.

[6] Meteorological: Daily rainfall , Evaporation, Transpiration
Hydrological: Seepage capture , Interceptor channel flow rates

EPA Export 06-01-2017:02:02:08

3.17.1 Research - Meso-scale Integrated constructed wetland trial

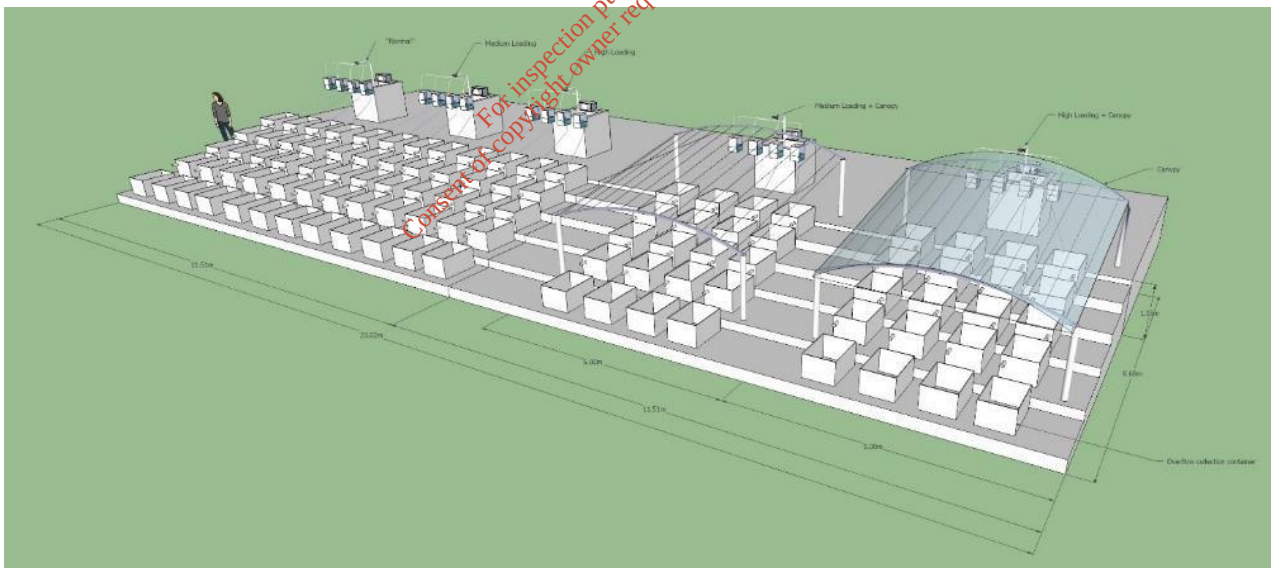
In advance of preparing an ICW design, hydraulic flows and quality of the waters to be treated need to be assessed. These characteristics , along with potential performance through an ICW has been examined on site by the setup of a Meso-scale ICW. The establishment and monitoring of a Meso-scale ICW provides, through highly replicated experiment, an understanding of key factors that aide in the design of a full-scale ICW system, thereby ensuring the sustainable passive treatment of all drainage from the TSF.

A Meso-scale ICW trial setup commenced in May 2015 with the system being commissioned in August 2015. The trial is set to continue for the next 12-18 months.

The Meso-scale approach uses a highly replicated ICW design. This design has been used previously in Ireland and has been found to be highly robust and mimic full-scale ICW system performance found elsewhere in Ireland (Harrington *et al.*, 2012; Harrington *et al.*, 2011; Harrington and Scholz, 2010).

The Meso-scale consists of 20 individual systems, which are divided into 5 treatments with 4 replicates each. The high level of replication (x4) ensures reliability in the recorded data as well as being able to rule out anomalies should they occur, or to be examined if they are isolated to a single replicate. Figure 1 below, provides a conceptual layout of the Meso-scale test-bed with all 20 systems arranged.

For inspection purposes only.
Consent of copyright owner required for any other use.



Basic conceptual image of a full meso-scale test-bed.

The Meso-scale ICW trial has been running since August 2015 has been operated under constant operational flow (see plate 3.1 below).

Macrophyte growth, system stability and overall operational conditions have remained steady since the trial was commissioned. The removal of compounds, such as Sulphates (SO_4) has been relatively consistent in the trial, with rates recorded up to 73.8% with an average over the trial thus far of 64.3%. The heavy metal removal is good with rates of 78% & 91% recorded for key parameters such as Antimony and Zinc respectively. Lead

EPA Export 06-01-2017:02:02:08

reduction is also good, with concentrations in the outlets at limits below detection (<0.002µg/l).

Further operation of the trial and updates to the meso-scale, including the addition of organic material to assess further performance potential in parameters, especially sulphates, is planned in order to obtain additional data.

For inspection purposes only.
Consent of copyright owner required for any other use.

Plate 3.1 Trial ICW site at the Randalstown TSF (Sept 2015)

EPA Export 06-01-2017:02:02:08

3.17.2 Proposed PTS/ICW

An ICW area of 100,000m² is provided in the design to provide treatment and management of all flows from the TMF following capping, ref Figure 3.24 & 3.25.

This area will provide management of flows during all-weather events, including storm and dry conditions.

The proposed ICW will comprise a series of 5 ponds whereby water will flow by gravity from the TSF cap and interceptor channel to Pond 1 and then continue by gravity through the ponds, before discharging via pipeline to the Blackwater River.

Table 3.17 ICW Pond and treatment areas

ICW Pond No.	Treatment area
Pond 1	13,800m²
Pond 2	19,550m²
Pond 3	28,350m²
Pond 4	21,650m²
Pond 5	16,850m²
Total	100,000m²

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:08

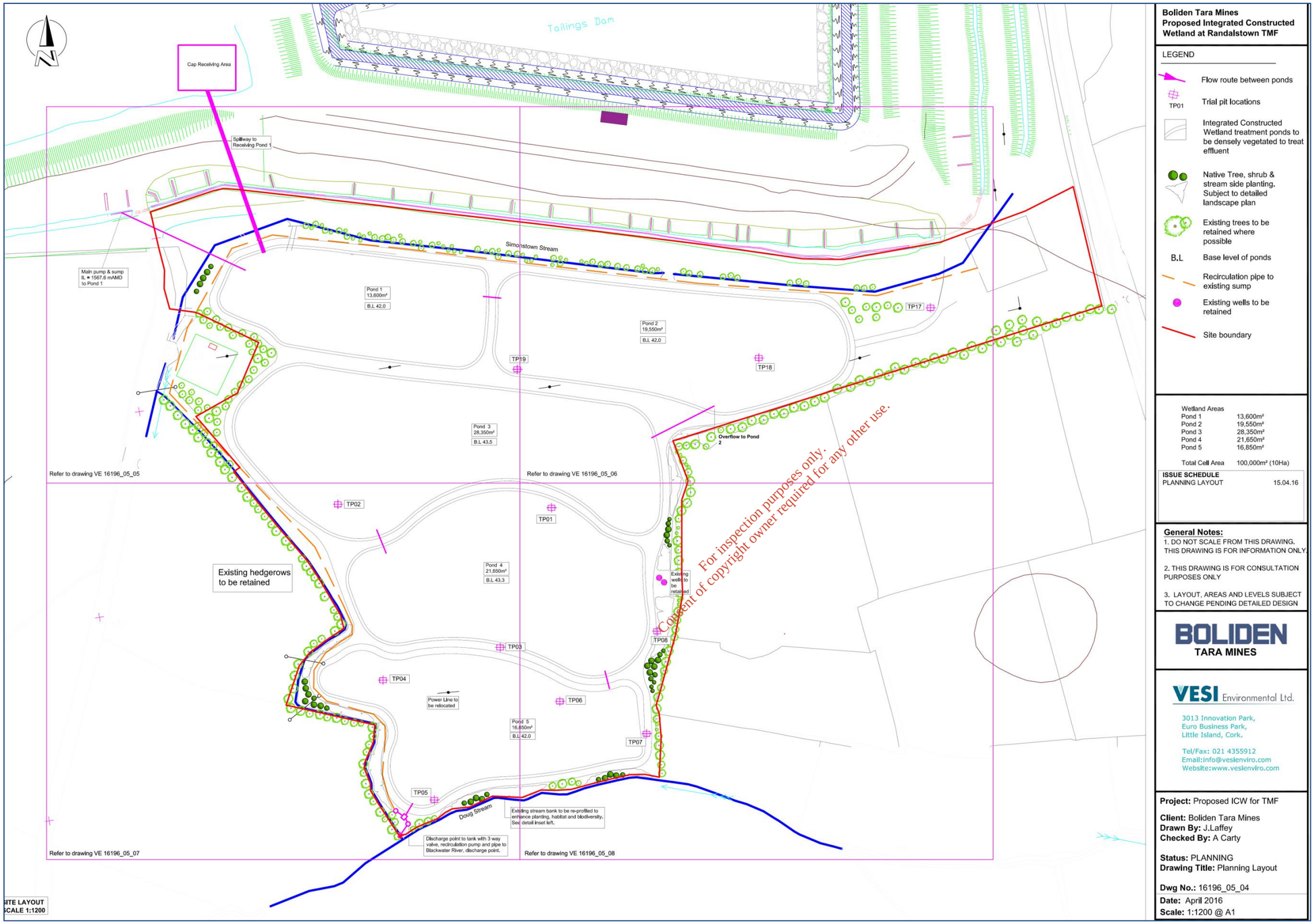
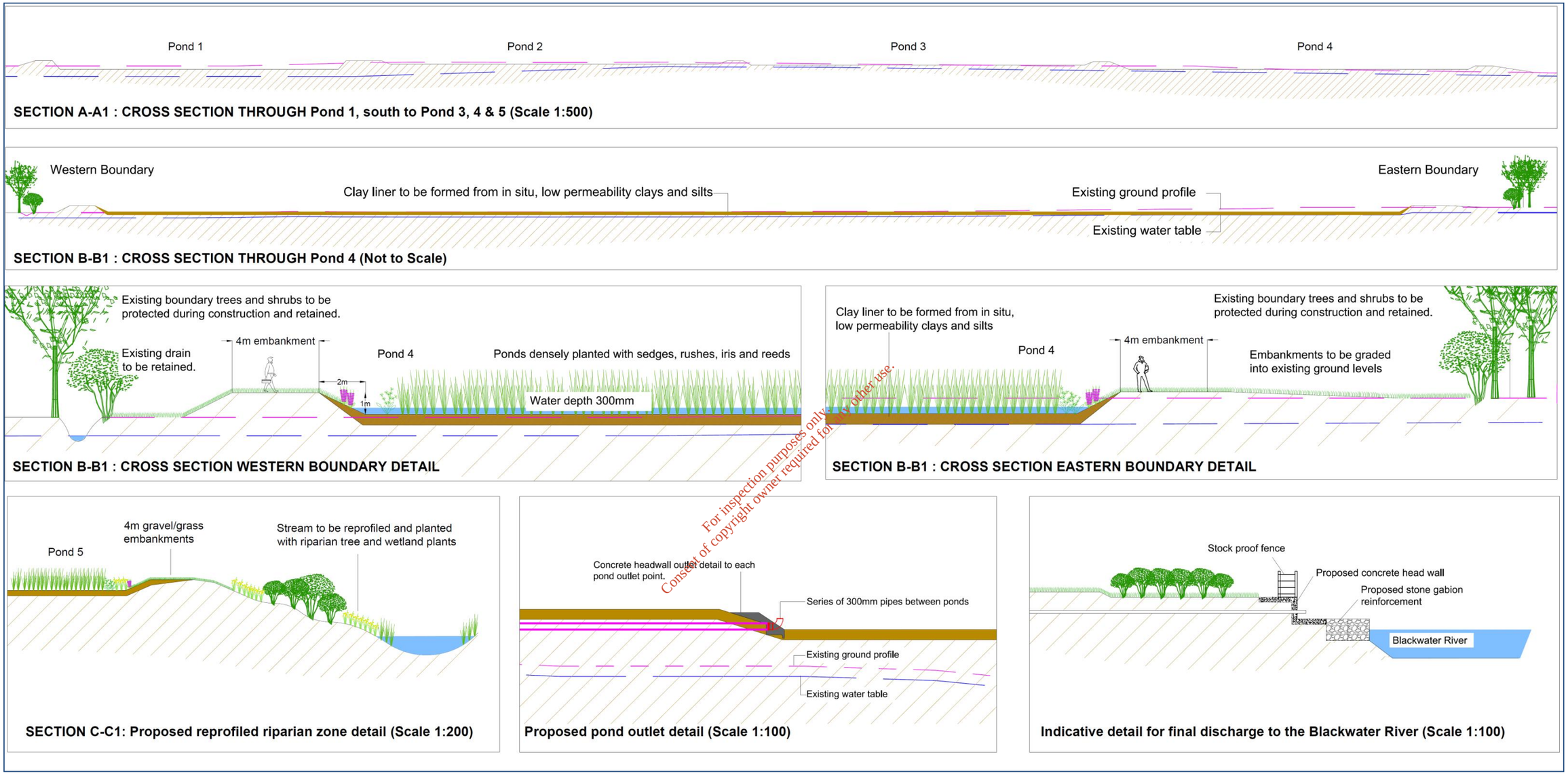


Figure 3.24 ICW Layout

EPA Export 06-01-2017:02:02:08



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.25 ICW layout

EPA Export 06-01-2017:02:02:08

3.18 Site assessment and suitability

Site characteristics and ground conditions are an important in assessing the suitability of a site for an ICW, as well as determining an appropriate design and construction method for the system. Site investigation works were undertaken on the proposed ICW site, this included excavating trial pits to determine the type and depth of the soils. Visual assessment and laboratory analysis of the soils was undertaken.

Further details of the site assessment, including site characteristics and ground conditions is provided in Appendix 3.1.

A summary of the findings of the desk study and site investigation is provided in Table 3.18 and 3.19.

Table 3.18 Desk study

Groundwater vulnerability	Moderate/High
Sub-soils	Sandstone Till/Glacofluvial sands/gravels
Aquifer classification	Lm - Locally Important Aquifer
Groundwater Response	R1
Surface water features	Doug Stream to the Southern Boundary, Simonstown Stream to the western boundary. River Blackwater located 1.5km from site
Designated Areas	River Blackwater (site no. 002299)

For inspection purposes only. Consent of copyright owner required for any other use.

Table 3.19 Site investigation

Flora	The proposed site is agricultural grassland, with hedgerow to the north, west and east boundaries of the site. Hedgerow comprised primarily hawthorn, Ash & Beech.
Topography	Gently sloping, north to south
Trial pit excavations	Clay/Silt ~1.5m below ground level, bedrock not encountered

EPA Export 06-01-2017:02:02:09

The information obtained from the site investigation and the desk study has been reviewed to assess the suitability of an ICW for the site. The presence of suitable soil material and depth on site will provide suitable building material for the creation of the pond embankments and liner. The onsite soils also ensure adequate treatment and containment of waters within the system, whilst also ensuring protection to the surface and groundwater sources.

Following the site investigation and the desk study, it has been determined that the development and operation of an ICW is not expected to have any adverse impacts on the surrounding aquatic or terrestrial environment. ICW systems are designed to be as efficient in their construction as they are in their operation, whereby the use of building materials, in so far as suitable and available, are sourced locally. The main building materials are ideally local soil material, with imported soil/gravel, if necessary, only required for the upper surfaces of the roadways.

3.19 Construction of ICW

The main earthworks involved in the development of the ICW is leveling, excavation and placement of soils for the enclosing embankments around each pond and for the access roadways. Due to the nature of the ground conditions these earthworks should ideally be undertaken between April-October.

Consent of copyright owner required for any other use.
For inspection purposes only.

The main earthworks are not expected to take longer than 4-5 months to complete, however the overall works could take 9-12 months. The wetland ponds are generally constructed starting from the top (pond 1) and working down (Pond 5). {Figure 3.26}.

As each pond is complete or near complete it can be planted, so that the planting then works down the system behind the main earthworks. This process generally allows the commissioning of the system as soon after the earthworks and planting is completed.

Typical operational water depth within each treatment cell/pond is between 150 mm - 300 mm, with a capacity to allow for increased water depth during high rainfall events. The treatment wetland ponds will generally have a minimum embankment height of 1m to allow for high magnitude precipitation events and necromass accumulation.

The pond embankments are sloped with a gradient of between 1:1.5 - 1:2. The upper embankments will be a minimum 4m wide where possible to allow for access and maintenance. The ICW cells/ponds are interconnected using a series of 300mm diameter pipes. The pipes are placed at the base of the wetland floor and water levels can be managed within each pond by placing adjustable bends on the outlet pipe of each pond. Additional pipes or overflows may be included to allow for management and flow control during storm events.

The critical element of the construction works is the formation and treatment of the base of the cells and the embankments to achieve the required permeability value to prevent excess rates of exfiltration from the wetland system. The excavation of the ponds and the formation of the embankments of the ICW will be undertaken using

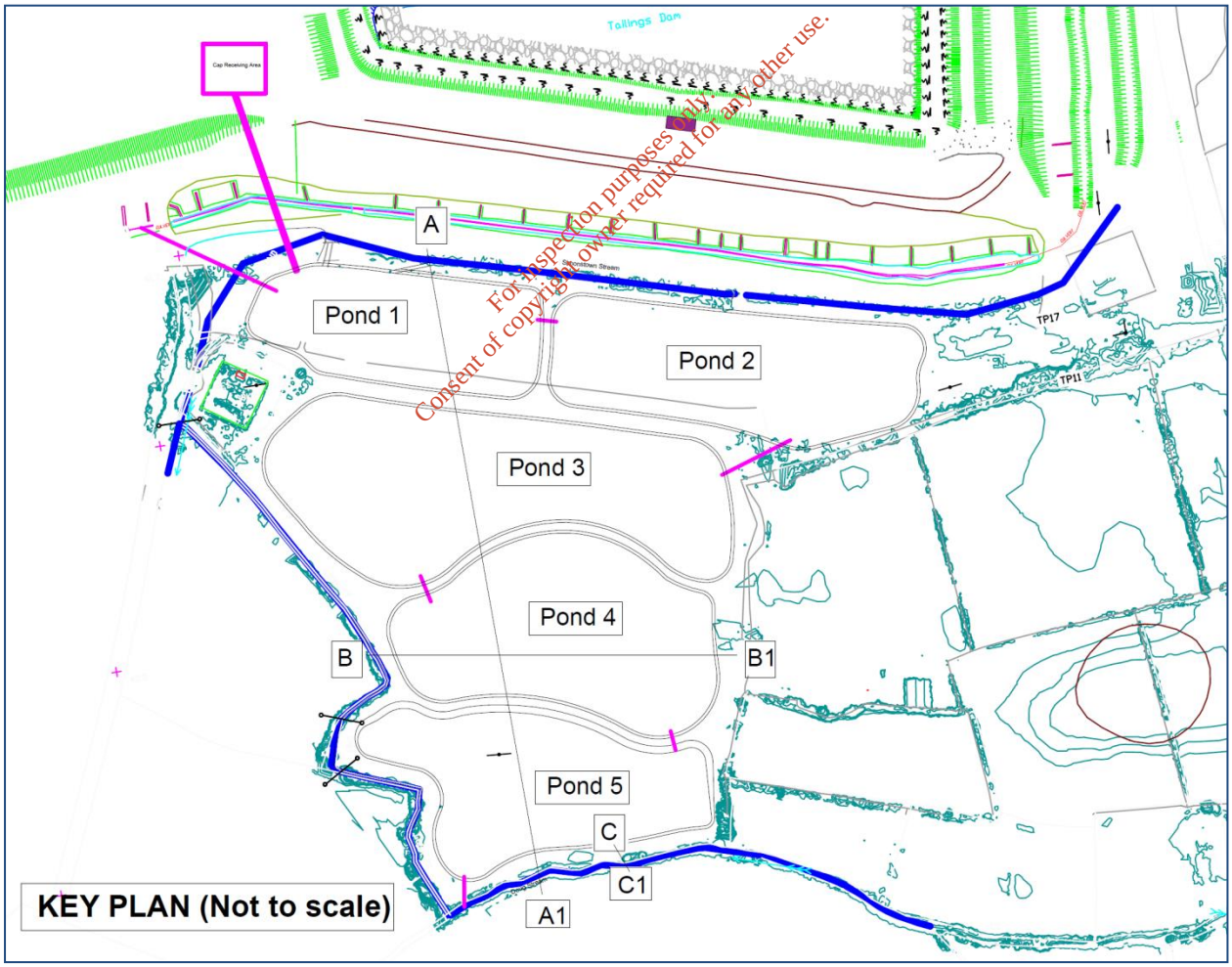
EPA Export 06-01-2017:02:02:09

material available on and within the site. The aim is to ensure that there is a minimum of 1000mm thickness of compacted/cohesive material at the base of each pond, with the upper 500mm having a suitably low permeability. The base and embankments of the ponds will be tracked and compacted to ensure the required permeability is uniformly achieved over the entire pond area.

On completion testing of the soil liner can be undertaken to demonstrate the minimum permeability required has been achieved for the wetland base and sides. This, together with on-going surface and groundwater monitoring will verify that the management of the MIW using an ICW is effective in protecting both surface and groundwater sources.

Access to the ICW when constructed is an important element for maintenance and amenity services on site. The site will be serviced by existing access roads and proposed roadways. The access roads will be for vehicular and pedestrian access, with existing access to the north and north east of the site being retained.

Existing fence lines will be retained where possible and suitable. Additional fencing will be placed around other areas of the site to include stock-proof fencing around the site boundary.



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 3.26 ICW Pond layout

EPA Export 06-01-2017:02:02:09

3.20 ICW water levels

The proposed ICW will under normal operation conditions have 150-200mm of water in the ponds. There is the option of having deeper water within Pond 1 and Pond 2 should it be deemed appropriate as part of the operation, efficiency and management of influent flows. The system has capacity to attenuate flows within the system by allowing water levels to fluctuate depending on influent flows and weather conditions, ensuring that the system reduces surface flow discharges.

The structure of the ICW, with its high embankments (1.0m) and dense vegetation facilitate fluctuating depth of all inflows, the complete containment of effluent and hydraulic losses through evaporation, plant transpiration and plant interception.

Water levels will be managed appropriately for the weather, vegetation and ground conditions, ensuring that the soils do not completely dry out. Proper water level management is also necessary for the plants especially during the initial stage of the ICW development. However, wetland vegetation is very adaptable when established to cope with varying conditions. The main wetland species include *Carex riparia, Glyceria maxima* and *Typha latifolia*, along with up to 20+ other native plant species. Details on appropriate management of water levels and wetland vegetation will be included in the site specific operation and maintenance plan.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

3.21 Discharge quality and flow rates

Initial monitoring of the BTML trial programme {meso-scale ICW} has shown that ICWs can manage and treat heavy metals and sulphate concentrations. Removal rates for sulphate of 70-80% have been observed.

The information from the meso-scale along with the over 1 year of data (qualitative and quantitative) from the operational ICW at the *Galmoy Mines* TSF, Kilkenny, demonstrate that the proposed ICW at Randalstown can be operated to manage hydraulic flows within the system as well as reduce pollutant loading in the through flowing waters.

3.22 Hydraulic discharges

The volume of runoff from the capped TMF to be managed and treated is c. 800,000m^3/yr. The preliminary water balance provided in Table 3.16 and Appendix 3.1 shows that flows will be variable to and from the ICW. The conservative values applied in the calculations indicate an annual 10% reduction in discharge volumes, with no discharge during summer months. Galmoy Mines ICW treats and manages the drainage from the site's capped TMF. The volumes treated there, such as will be the case at Tara once capped are weather dependent, yielding no discharge from the ICW for over 5 months in 2015. This demonstrates the high evapotranspiration rate within ICWs.

consent of copyright owner required for any other use. For inspection purposes only.

As flows reduce and cease from the ICW during summer months, capacity (freeboard) is built up in the system, so that there will be a lag time between no flows in the summer to flows commencing in the autumn. In the existing ICW at Galmoy Mines, the discharge from the system in 2015 only commenced again late September. The proposed ICW to be located to the south of the TMF at Tara Mines will provide sustainable management of hydraulic flows as well as a buffer between the TMF and receiving waters.

3.23 Discharge pipeline

During the period after decommissioning (the active aftercare phase) water from the TSF will continue to be recycled to the mine site and will be discharged through the normal water management system (to the river Boyne).

Until such time as the ICW can consistently demonstrate its effectiveness, this routing will continue.

Once the ICW has been proven effective in meeting the requisite water quality criteria for discharge effluent form the facility will be directed via an installed pipeline to the river Blackwater.

The propose route for the discharge pipeline is shown in figure 3.27.

EPA Export 06-01-2017:02:02:09

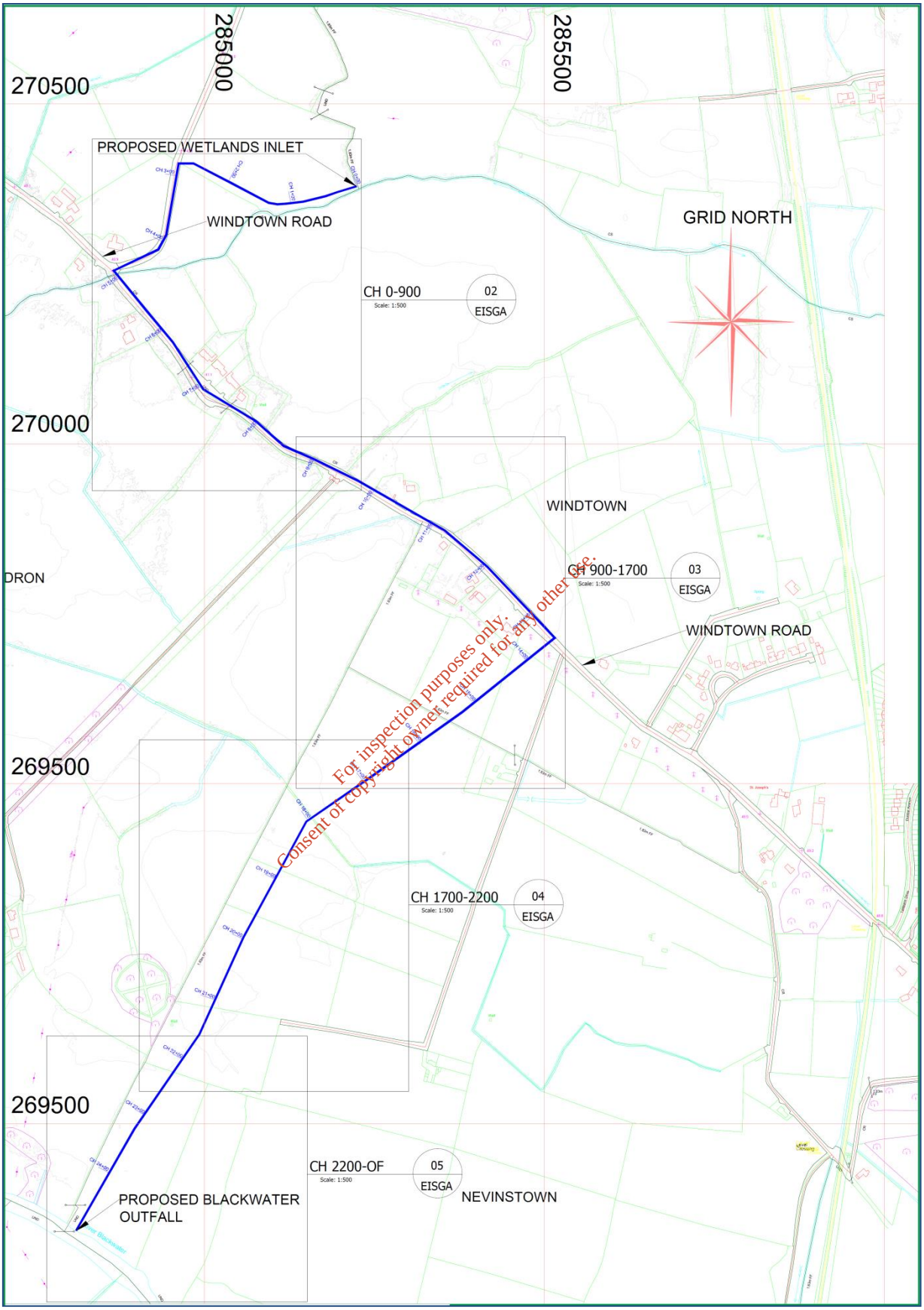


Figure 3.27 propose pipeline route to the river Blackwater

EPA Export 06-01-2017:02:02:09

3.23.1 Pipeline installation

The high density polyethylene (HDPE), PE100 grade, pipe will have an outer diameter of 630mm and an internal diameter of 540mm.

The pipeline will be laid in section and will run approximately 2.5 km southward to the river Blackwater.

The discharge from the ICW will enter the pipeline and flow by gravity to the river (in keeping with the passive nature of the system).

The outfall point to the river will be at E 284810, N 268840

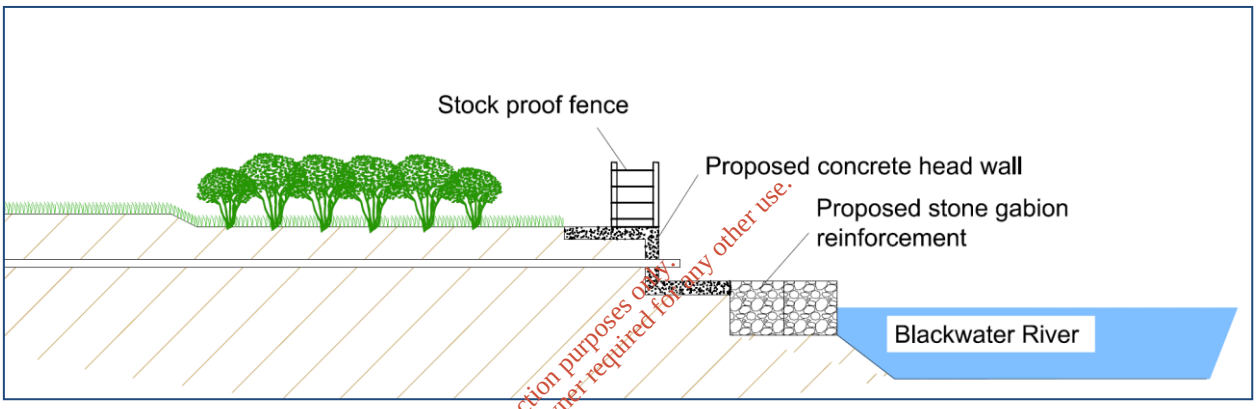


Figure 3.28 Outfall point at river

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

REFERENCES

Tailings Facility

1.1 Golder Associates. Technical Memo to Boliden Tara Mines Ltd. Stage 6 TMF Options Study. July 2015. No. 1532091.501
1.2 Golder Associates. Report to Boliden Tara Mines Ltd. Conceptual Design for the Stage 6 Tailings Management Facility. October 2015. Report No. 532091.501
2.1 Golder Associates. Report to Outokumpu, Tara mines Ltd on assessment of palaeokarstic features in relation to the tailings impoundment, June 1996, Report No. 95512034 / 96512012
2.2 Golder Associates. Report to Kilborn Engineering Ltd, Geotechnical Investigation Tara Mines Ltd, Tailings Dam, Vol. 2, H.Q.Golder Associates Ltd, May 1974, Report No. L73074/2.
2.3 Boulton, G.S., A.S., Clayton, K.M. and Kenning, M.S., 1977, A British Ice Sheet Model and Patterns of Glacial Erosion and Deposition in Britain. In: British Quaternary Studies - Recent Advances, ed. F.W. Shottun, p. 231-245.
2.4 Schmidt, W. and Scott, T.M., 1984, Florida Karst - Its Relationship to Geologic Structure and Stratigraphy. In: Sinkholes: Their Geology, Engineering and Environmental Impact; Proceedings of the First Multi-Disciplinary Conference on Sinkholes, ed. Barry F. Beck, p. 11-16.
2.5 Golder Associates. Draft Report to Outokumpu Tara Mines on the Design of the Stage 4 Dam Raise, 1996 Report No. 93512044/6.
3.1 Golder Associates. Draft Report to Outokumpu Tara Mines on the Assessment of the Northern Borrow Property and Construction of Stage 4B, 2001.
3.2 Golder Associates. Report to Outokumpu Zinc Tara Mines on Additional Site Investigation Adjacent to the Northern Borrow Area for Purpose of Tailings Dam Raise. March 1996 Report No. 95512098.
3.3 Golder Associates. Report to Outokumpu Zinc Tara Mines on site investigation in Simonstown and Clonmagaddan borrow areas for purpose of tailings dam raise, November 1994, Report No. 93512044/3.
3.4 Golder Associates Geophysical Report Seven Fields Borrow Area
3.5 Golder Associates Geophysical Report Northern, Seven Fields and Simonstown Borrow Areas.
3.6 Archaeological Study
4.1 Knight Piesold (1996). Outokumpu Tara Mines Limited. Randalstown Tailings Facility Stage IV. Environmental Impact Statement Draft No.1 April 1996.
5.1 Roger Musson, Seismicity and Earthquake Hazard in the UK, British Geological Survey, 2002.
5.2 International Committee of Large Dams (ICOLD), Dam Design Criteria, 1988.
6.1 Leakage through Liners Constructed with Geomembranes. Part II. Composite Liners. J. P. Giroud, et al., Geotextiles and Geomembranes, 8(4) pp71-111 1989.
6.2 Rate of Leakage through a Composite Liner due to Geomembrane Defects. J. P. Giroud, et al., Geotextiles and Geomembranes, 11(1) pp1-28 1992
6.3 SLOPE/W, Geoslope International, Slope Stability Program, Version 7.15
10.1 Golder Associates Ltd. (2008). Report to Boliden Tara Mines Ltd, Reclamation and Closure plan for the Randalstown Tailings Facility Following the Stage 5 Raise. 2009, Report no. 08514150063.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:09

Passive treatment/integrated constructed wetlands

Becerra-Jurado, G., Harrington, R., Kelly-Quinn, M. 2012. A review of the potential of surface flow constructed wetlands to enhance macroinvertebrate diversity in agricultural landscapes with particular reference to Integrated Constructed Wetlands (ICWs). Hydrobiologia. 692(1): 121-130.

Becerra-Jurado, G., Johnson, J., Feeley, H., Harrington, R., Kelly-Quinn, M. 2010. The potential of integrated constructed wetlands (ICWs) to enhance macroinvertebrate diversity in agricultural landscapes. Wetlands. 30(3): 393-404.

Harrington, C., Scholz, M. 2010. Assessment of pre-digested piggery wastewater treatment operations with surface flow integrated constructed wetland systems. *Bioresource Technology* 101: 7713-7723.

Harrington, C., Scholz, M., Culleton, N., Lawlor, P. G. 2011. Meso-scale systems used for the examination of different integrated constructed wetland operations. J*ournal of Environmental Science and Health Part A* 46: 783-788.

Harrington, C., Scholz, M., Culleton, N., Lawlor, P. G. 2012. The use of integrated constructed wetlands (ICW) for the treatment of separated swine wastewaters. *Hydrobiologia* 692: 111-119.

Sheoran, A.S. and Sheoran, V., 2006. Heavy metal removal mechanism of acid mine drainage in wetlands: a critical review. *Minerals engineering*, *19*(2), pp.105-116.

Becerra-Jurado, G., Callanan, M., Gioria, M., Baars, J. B., Harrington, R., Kelly-Quinn, M. 2009. Comparison of macroinvertebrate community structure and driving environmental factors in natural and wastewater treatment ponds. Hydrobiologia. 634(1): 153-165.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

Section 4 Ecology - Terrestrial

4.1 Introduction

Tara Mines is the largest Lead and Zinc mine in Europe, located on the outskirts of Navan in Co. Meath. The capacity of the existing Tailings Storage Facility (TSF) at Randalstown will be reached by 2020 therefore an extension is required to facilitate mining post 2020.

- It is proposed to extend the existing TSF laterally in a northerly direction.
    - Here after the proposed facility will be referred to as *TSF Stage 6*.
    - The proposal facility will cover a footprint area of c. 58 hectares, extend to a height of 22 m above ground level and will provide a potential a storage volume of approximately 9.6 million cubic metres [13.6 million tonnes].

- The second part of the proposed development is the construction of an Integrated Constructed wetland (ICW). The proposal facility will cover a footprint area of c. 12 hectares. The function of the wetland is to provide a passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle.
    - Treated water will discharge from the ICW to the river Blackwater via a buried HDPE pipeline.

For inspection purposes only.
Consent of copyright owner required for any other use.

This section of the EIS provides a complete baseline of ecological data for the "proposed location of the developments. Detailed project description provided in section 3. The site locations are identified in figures 4.1.

The primary aim of this project is to provide a baseline of the ecological status of the Northern and Seven Fields Borrow Area, within which the footprint of the Stage 6 TSF is confined. A comprehensive baseline of the aquatic aspects of ecology and hydrology are provided elsewhere.

The objectives of this flora and fauna survey are:-

- To survey the ecological habitats within the study area;
- To produce a habitat map for the study area to Fossitt Level 3;
- To highlight elements or particular areas of specific potential for biodiversity or conservation interest (including any as highlighted in the County Meath Biodiversity Action Plan);
- To identify the potential presence and effectiveness of ecological corridors and/or stepping stones within the study area, linking the study area to adjoining areas of potential biodiversity interest; and
- To assess and make recommendations on conservation priorities regarding the identified biodiversity resource of the site.

EPA Export 06-01-2017:02:02:09

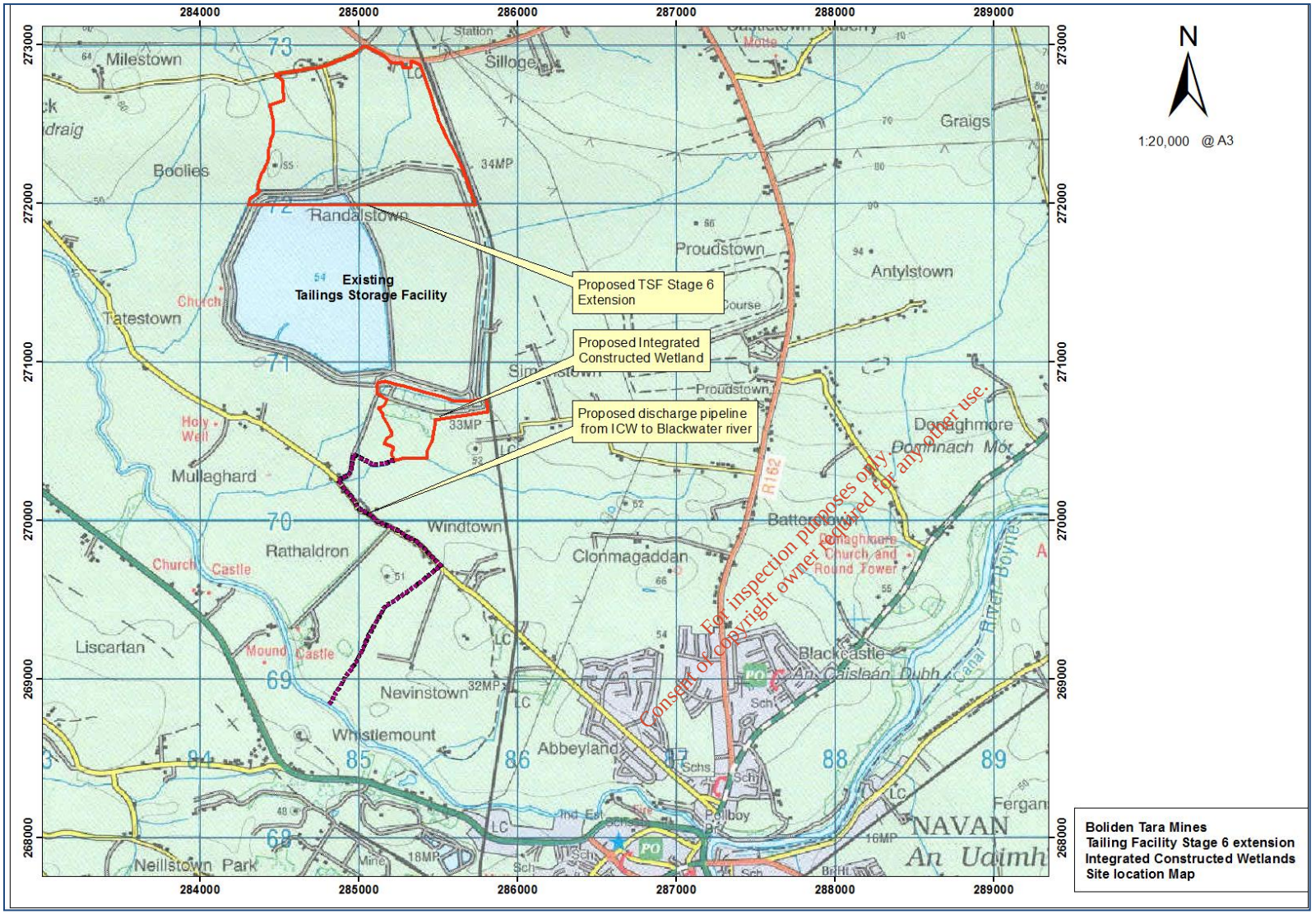


Figure 4.1 Site location map.

EPA Export 06-01-2017:02:02:09

4.1.1 Site description- Stage 6

The footprint of the proposed Stage 6 TSF is confined to the existing borrow area. The majority of the footprint has been exposed during works. It is envisaged that rock that can be excavated will be utilised in the construction of the dam walls and drainage. Ref Figures 4.2& 4.3

The foundation of the dam walls will be either glacial till or bedrock. There are areas within the footprint that have been restored utilising topsoil, and this will be removed and stockpiled within the site boundary and outside of the footprint of Stage 6. Topsoil stockpiles that are present around the perimeter of the borrow area will be left in place if outside of the Stage 6 footprint. Any topsoil stockpiles within the basin area will be removed and stockpiled outside of the dam.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.2 Satellite imagery of proposed stage 6 development site with with site boundary in red (Scale 1:5,000)

EPA Export 06-01-2017:02:02:09

Figure 4.3 Image illustrating the location of the proposed Stage 6 facility (foreground) relative to existing TSF

For inspection purposes only.
Consent of copyright owner required for any other use.

4.1.2 Site description- Integrated Constructed wetland

It is proposed to construct an Integrated Constructed Wetland (ICW) as a suitable Passive Treatment System (PTS) for the management of runoff from the existing and proposed areas of the TSF in the post closure phase of the facilities lifecycle.

The ICW will be located south of the TSF in the townland of Simonstown and will extend over and area of c. 12 hectares, ref figure 4.4.

EPA Export 06-01-2017:02:02:09

Figure 4.4 Satellite imagery of proposed ICW development site with site boundary in red (Scale 1:5,000)

Consent of copyright owner required for any other use.
For inspection purposes only.

The main earthworks involved in the development of the ICW will be leveling, excavation and placement of soils for the enclosing embankments around each pond and for the access roadways. As each pond is complete or near complete it can be planted, so that the planting then works down the system behind the main earthworks. This process generally allows the commissioning of the system as soon after the earthworks and planting is completed.

The construction will lead to the replacement of c 10 ha of grassland habitat (GA1- Improved agricultural grassland) and c. 1.5 hectares of modified woodland (WD2 consisting of mixed broadleaved/conifer woodland) with the wetlands ecosystem.

EPA Export 06-01-2017:02:02:09

The proposed site south of the TSF consists of two distinct land types that can be classified as:

- GA1 Improved grassland and
- WD2 Mixed broadleaved/conifer woodland/ WS1 Scrub

The grassland is highly modified and managed . Reseeding and application of fertilisers to produce a grass crop for beef production has resulted in low species diversity.

The grass sward is dominated by common agricultural species, mainly the grass species perennial rye-grass *Lolium perenne* and crested dog's tail *Cynosurus cristatus*, and the herbaceous species creeping buttercup *Ranunculus repens*, narrow-leaved plantain *Plantago lanceolata,* and clovers (*Trifolium repens* and *T. pratense*). In places ragwort *Senecio jacobea,* nettles *Urtica dioica* and thistles (*Cirsium* spp.) occur.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.5 Site of proposed ICW - GA1. Improved grassland

Hedgerows WL1 provide the field boundaries. The hedges are well established and of good quality. The hedges have not been cut recently and are increasing in height and expanding in width. There is a good scatter of tree standards, mostly ash *Fraxinus excelsior* some of which are fairly mature. The other main hedge forming trees and shrubs are hawthorn *Crataegus monogyna,* blackthorn *Prunus spinosa*, and elder *Sambucus nigra,* with some sycamore *Acer pseudoplatanus*, elm *Ulmus* spp., cherry *Prunus avium*, willow *Salix* spp., holly *Ilex aquifolium* and at least one crab apple *Malus domesticus*.

Brambles *Rubus fruticosus* are frequent in the lower parts of the hedges and wild roses *Rosa* spp. are present. Ivy *Hedera helix* is frequent and occurs in most of the trees. Most of the hedges are accompanied by drainage channels FL4. Within the channels, wetland species such as fool's watercress *Apium nodiflorum* and watercress *Nasturtium officinale* are present.

EPA Export 06-01-2017:02:02:09

Figure 4.6 Site of proposed ICW- WD2 Mixed broadleaved/conifer woodland/WS1 Scrub

The wooded area consists of a mixture of mature broadleaved and conifers and scrub. This area, within the boundary fense of the tailings facility, is highly modifeied, its origins lie in the sites landscaping plan. The trees planted in ordered lines are inter strewn with ESB poles, site access road ways and other infrastructure.

Over the years the site has been managed and maintained to not impede site operations (ref Plates 1 thru 5)

For inspection purposes only.
Consent of copyright owner required for any other use.

Plate 1 ESB infrastructure

EPA Export 06-01-2017:02:02:09

Plate 2 Overhead powerlines trasecting the site

Plate 3 Site substation

Plate 4 Bare ground and Scrub

Plate 5 Site access roads and high voltage ESB cables and poles

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

4.1.3 Site description- ICW discharge pipeline

The high density polyethylene (HDPE), PE100 grade, pipe will have an outer diameter of 630mm and an internal diameter of 540mm.

The pipeline will be laid in section and will run approximately 2.5 km southward to the river Blackwater.

The discharge from the ICW will enter the pipeline and flow by gravity to the river (in keeping with the passive nature of the system).

The outfall point to the river will be at E 284810, N 268840

The route of the pipeline is from the outfall of the ICW running southwards to the river Blackwater. The pipeline will pass through the townlands of Simonstown, Windtown and Nevisntown (ref figure 4.7 Pipeline route).

The proposed route consists of mainly a single and types that can be classified as:

- GA1 Improved grassland

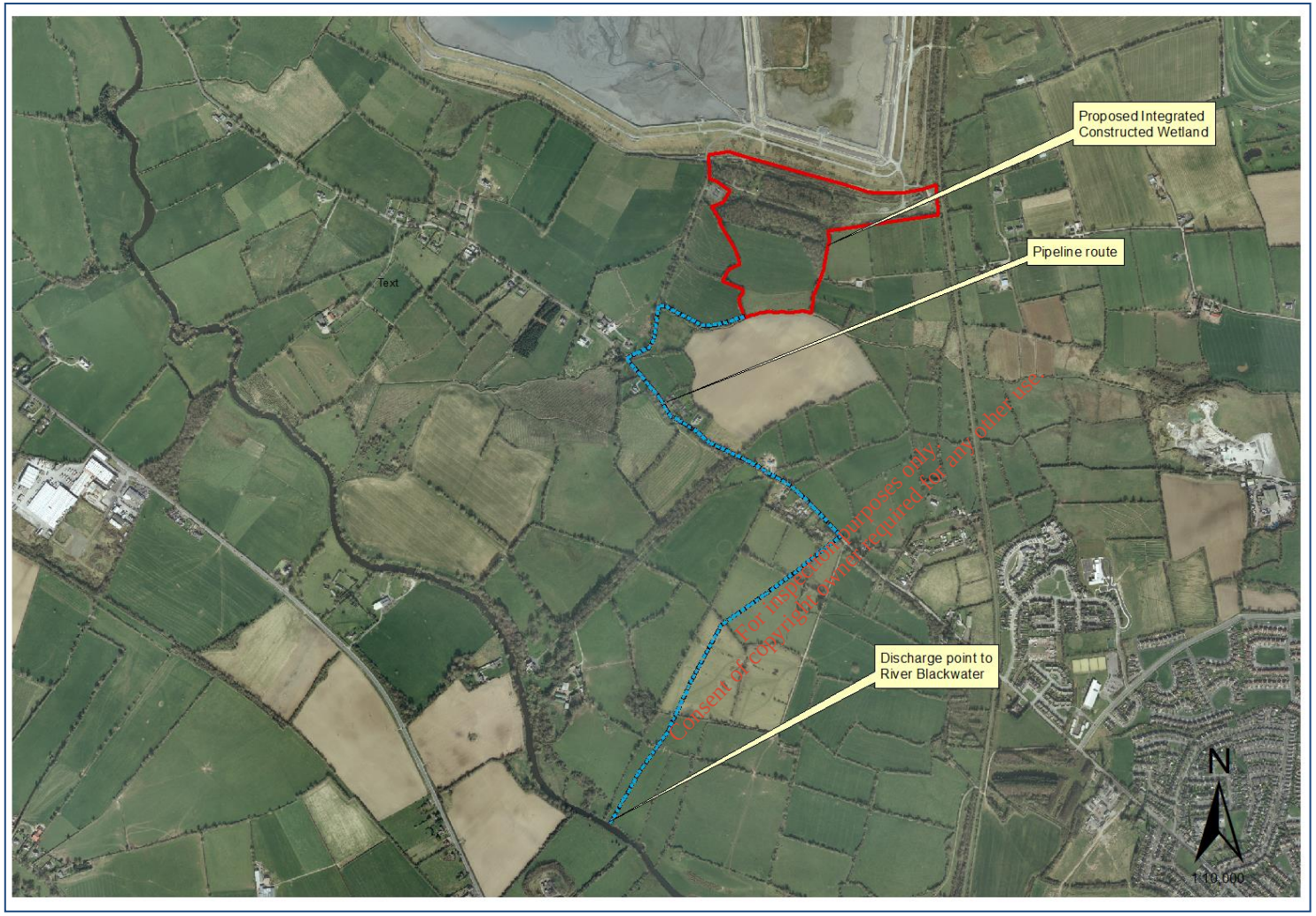
Consent of copyright owner required for any other use. For inspection purposes only.

The pipeline will leave the ICW site , passing through a agricultural field in improved grassland.

From there the pipeline will follow the path of the public road, the Windtown road towards Nevinstown and hense toward the river Blackwater south across lands under the control of the company.
The lands in Nevinstown are also classified as GA1 improved grassland.
The grassland is highly modified and managed . Reseeding and application of fertilisers to produce a grass crop for beef production has resulted in low species diversity.

The grass sward is dominated by common agricultural species, mainly the grass species perennial rye-grass *Lolium perenne* and crested dog's tail *Cynosurus cristatus*, and the herbaceous species creeping buttercup *Ranunculus repens*, narrow-leaved plantain *Plantago lanceolata,* and clovers (*Trifolium repens* and *T. pratense*). In places ragwort *Senecio jacobea,* nettles *Urtica dioica* and thistles (*Cirsium* spp.) occur.

EPA Export 06-01-2017:02:02:09



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.7 Pipeline route to the river Blackwater

EPA Export 06-01-2017:02:02:09

Plate 6 Simonstown, GA1

Plate 7 Simonstown GA1 & WL1

Plate 8 Blackwater river Bank

Plate 9 Nevinstown, GA1

For inspection purposes only.
Consent of copyright owner required for any other use.

The majority of the route is dominated by improved grassland, either pasture or meadow, with hedgerows the main field boundary type. Several patches of scrub occur, and there are stands of planted woodland in the northern sector of the Nevinstown site.

A typical range of bird species associated with improved grassland and hedgerows occur within the site. Crows were plentiful, with rook (Corvus frugilegus), jackdaw (Corvus monedula), hooded crow (Corvus corone) and magpie (Pica pica) all present. Jackdaws nest in the derelict buildings. Starlings (Sturnus vulgaris), meadow pipits (Anthus pratensis) and woodpigeons (Columba palumbus) were also recorded in the pasture fields. Small bird species recorded in the hedgerows included robin (Erithacus rubecula), wren (Troglodytes troglodytes), blackbird (Turdus merula), song thrush (Turdus philomelos), blue tit (Parus caeruleus), coal tit (Parus ater), goldcrest (Regulus

EPA Export 06-01-2017:02:02:09

regulus), chiffchaff (Phylloscopus collybita), chaffinch (Fringilla coelebs) and bullfinch (Pyrrhula pyrrhula). Most of these species would probably nest.

The section of the River Blackwater in the vicinity of the site supports a range of wetland bird species, with mallard (Anas platyrhynchos), moorhen (Gallinula chloropus), grey heron (Ardea cinerea), grey wagtail (Motacilla cinerea) and little grebe (Tachybaptus ruficollis) observed on the day of survey. The river also appears suitable for kingfisher (Alcedo atthis).

The main channel of the River Blackwater forms the southern boundary of the Nevinstown lands. The proposed works will take place proximate to the river Blackwater, one of the primary constituents of the River Boyne and River Blackwater SAC and the River Boyne and River Blackwater SPA. Upon reaching the north bank of the river Blackwater in the Nevinstown area the risk to the protected site become greater.

There are numerous records of species of conservation interest within the 10 km squares in and around the development site (N75, N76, N77, N85, N86, N87, N95, N96 and N97 - source NPWS) including Otter (Lutra lutra), Red Squirrel (Sciurius vulgaris), Meadow Saxifrage (Saxifraga granulata), Meadow Barley (Hordeum secalinum) Red Hemp-nettle (Galeopsis angustifolium) and Hairy St. John's Wort (Hypericum hirsutum). Although not listed within the NPWS database, there is certainly also Kingfisher and most likely one or more species of Lamprey present along this stretch of the Blackwater, in addition to several species of Bat.

For inspection purposes only. Consent of copyright owner required for any other use.

The habitat provides potentially suitable habitat for several species of conservation value, particularly several nesting species of bird such as Sedge Warbler (Acrocephalus schoenobaenus) and Reed Warbler (Acrocephalus scirpaeus). The hedgerows and individual trees present potentially provide foraging, commuting and roosting opportunities for a number of bat species (all of which are listed on Annex IV of the EU Habitats Directive).

There is potential for several species of conservation concern, including the Annex II (EU Habitats Directive) mammal species Otter, the Annex I (EU Birds Directive) bird species Kingfisher and numerous bat species (all Irish species of which are listed on Annex IV of the EU Birds Directive) to be impacted upon by the proposed works.

EPA Export 06-01-2017:02:02:09

4.2 Existing Environment

Establishing the existing ecology in the environs of the proposed developments

4.2.1Desk Study

4.2.1.1NPWS database

The primary body consulted with regard to matters involving ecology within the Republic of Ireland is the National Parks and Wildlife Service (NPWS). The role of the NPWS is:

- To secure the conservation of a representative range of ecosystems and maintain and enhance populations of flora and fauna in Ireland;
- To implement the EU Habitats and Birds Directives;
- To designate and advise on the protection of Natural Heritage Areas (NHA) having particular regard to the need to consult with interested parties;
- To make the necessary arrangements for the implementation of National and EU legislation and policies and for the ratification and implementation of the range of international Conventions and Agreements relating to the natural heritage; and
- To manage, maintain and develop State-owned National Parks and Nature Reserves.

Consent of copyright owner required for any other use. For inspection purposes only.

The desk study as pertaining to this survey involved:

- Assessing the scoping response of the Department of Arts, Heritage and the Gaeltacht (National Parks and Wildlife Service) to the pre-planning enquiry regarding the proposed development (Reference G Pre00260/2015); and
- Querying the NPWS database for information pertaining to habitats and species of conservation concern, in addition to designated sites (Special Areas of Conservation (SAC), Special Protection Areas (SPA), Natural Heritage Areas (NHA) and Proposed Natural Heritage Areas (pNHA)) occurring in the vicinity of the proposed development.

4.2.1.2 Meath Development and National/Meath Biodiversity Action Plans

It is an objective (NH OBJ 1) of the 2013 – 2019 Meath County Development Plan to:

- "*…Implement, in partnership with the Department of Arts, Heritage and the Gaeltacht, relevant stakeholders and the community, the objectives and actions of Actions for Biodiversity 2011 – 2016; Ireland's National Biodiversity Plan that relate to the remit and functions of Meath County Council and the County Meath Biodiversity Plan and any revisions thereof…*"

The National Biodiversity Action Plan (2011 – 2016) recommended, amongst other actions that:

- Each local Authority to publish a Local Biodiversity Action Plan or review existing plans; and

EPA Export 06-01-2017:02:02:09

- Each local Authority designate a suitably qualified officer for natural heritage conservation matters in its area.

The primary function of the County Meath Biodiversity Action Plan is to "*…provide a framework and series of actions to conserve, enhance and raise awareness of Meath's rich biodiversity and to maximise the contribution that it makes to social, economic and environmental well-being of the county, taking into account local, national and international, including European priorities…*"

As part of this desk study, the current Meath Biodiversity Action Plan was examined, and habitats of ecological value in a national and local context (as identified within the Meath Biodiversity Action Plan) were identified. Having been informed by field surveys, the desk study would make possible the recognition of any potential impacts on such habitats allowing potential impacts to be taken into account during the drawing up of mitigation measures.

4.3 Field surveys

4.3.1Botanical/Habitat surveys

4.3.1.1 General vegetation surveys

Field surveys of vegetation were carried out during August of 2015 by Dr Emma Reeves, within the optimal timeframe for such surveys. Nomenclature follows "Webb's An Irish Flora" (2012 – 8th Edn), "Mosses and Liverworts of Britain and Ireland a Field Guide" (2010) and "Lichens An Illustrated Guide to the British and Irish Species" (5th Edn 2005).

The botanical and habitat survey consisted of walk-over surveys through the Stage 6 TSF footprint. The surveys recorded all species of flora observed occurring within the study area. The botanical survey placed particular emphasis on rare, protected or annexed habitats/species by reference to:

- Irish Plant Red Data Book;
- Habitats listed on Annex I of the EU Habitats Directive;
- Species listed on Annex II of the EU Habitats Directive; and
- Ecological stepping stones and ecological corridors (as covered under Article 10 of the EU Habitats Directive.

In addition to a complete species list, written descriptions of all habitats within the receiving environment were recorded, to include the dominant species occurring within each habitat. Photographs of representative areas of each habitat are presented. An evaluation of the ecological significance of flora and habitats occurring within the site relative to surrounding habitats was also undertaken.

4.3.1.2 Species of Invasive Alien Plants[7]

The human introduction of alien plant species into ecosystems (intentionally or unintentionally) is historically a common-place occurrence. The vast majority of these alien plant species, when introduced into a foreign ecosystem for which

[7] As listed on Part (1) of the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations of 2011

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:09

they are not adapted, will die without specific care. In a small number of cases, however, these plants can come to dominate the ecosystem into which they have been introduced and become "Invasive". There is presently a great deal of concern regarding the potential for invasive plant species to threaten the species composition, community structure and overall biodiversity of native Irish habitats. Invasive species can change the character and/or condition of an ecosystem over an extensive area through several mechanisms, depending on the species of plant and the nature of the habitat. Given the disturbed nature of the proposed development site, specific cognisance was given to the potential presence of Alien Invasive Plant Species within the development footprint. There are more than 30 species on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations of 2011. Riparian systems are particularly vulnerable to plant invasions owing largely to the naturally high disturbance frequencies within riparian habitats and the rapidity with which an invasive can spread utilising the medium of flowing water. In addition, there has been an historic tendency for people to plant "ornamental" species beside water. As a result, the vast majority of the species listed on the Third Schedule are associated broadly with riparian systems, occurring within the water course, or proliferating along the bank (see Table 4.1).

Consent of copyright owner required for any other use. For inspection purposes only.

Table 4.1: List of plant species appearing on the Third Schedule

Common Name	Latin Name	Associated with freshwater habitats
American skunk-cabbage	*Lysichiton americanus*	*Yes*
Red alga	*Grateloupia doryphora*	*No*
Brazilian giant-rhubarb	*Gunnera manicata*	*Yes*
Broad-leaved rush	*Juncus planifolius*	*Yes*
Cape pondweed	*Aponogeton distachyos*	*Yes*
Cord-grasses	*Spartina (all species hybrids)*	*No*
Curly waterweed	*Lagarosiphon major*	*Yes*
Dwarf eel-grass	*Zostera japonica*	*No*
Fanwort	*Cabomba caroliniana*	*Yes*
Floating pennywort	*Hydrocotyle ranunculoides*	*Yes*
Fringed water-lily	*Nymphoides peltata*	*Yes*
Giant hogweed	*Heracleum mantegazzianum*	*Yes*
Giant knotweed	*Fallopia sachalinensis*	*Yes*
Giant-rhubarb	*Gunnera tinctoria*	*Yes*
Giant salvinia	*Salvinia molesta*	*Yes*

EPA Export 06-01-2017:02:02:09

Common Name	Latin Name	Associated with freshwater habitats
Himalayan balsam	*Impatiens glandulifera*	*Yes*
Himalayan knotweed	*Persicaria wallichii*	*Yes*
Hottentot-fig	*Carpobrotus edulis*	*No*
Japanese knotweed	*Fallopia japonica*	*Yes*
Large-flowered waterweed	*Egeria densa*	*Yes*
Mile-a-minute weed	*Persicaria perfoliata*	*Yes*
New Zealand pigmyweed	*Crassula helmsii*	*Yes*
Parrot's feather	*Myriophyllum aquaticum*	*Yes*
Rhododendron	*Rhododendron ponticum*	*No*
Salmonberry	*Rubus spectabilis*	*Yes*
Sea-buckthorn	*Hippophae rhamnoides*	*No*
Spanish bluebell	*Hyacinthoides hispanica*	*No*
Three-cornered leek	*Allium triquetrum*	*No*
Wakame	*Undaria pinnatifida*	*No*
Water chestnut	*Trapa natans*	*Yes*
Water fern	*Azolla filiculoides*	*Yes*
Water lettuce	*Pistia stratiotes*	*Yes*
Water-primrose	*Ludwigia (all species)*	*Yes*
Waterweeds	*Elodea (all species)*	*Yes*
Wireweed	*Sargassum muticum*	*Marine/transition*

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:09

Of the species listed in Part (1) of the Third Schedule, three species are of particular note given the nature of the proposed development. These species spread terrestrially very aggressively under conditions of disturbance, establish sizeable populations very quickly, and are capable of inflicting a high degree of ecological damage within short spaces of time.

These species are:

- Japanese Knotweed (*Fallopia Japonica);*
- Himalayan Balsam (*Impatiens glandulifera*); and
- Giant Hogweed (*Heracleum mantegazzianum*).

It is imperative that should any of these species be identified as occurring within, or adjacent to the proposed development footprint that an Invasive Species Management and Control Plan is drawn up and implemented in order to completely eradicate any populations of these plants from the site **prior** to any development.

4.3.2 Habitat Mapping

Field maps were prepared utilising a base-map provided by Boliden Tara Mines Ltd and ESRI Digital Globe Satellite Imagery. Field maps were prepared prior to surveys, allowing the surveyor to mark pertinent information (habitat type, location of unusual species, etc.) on field maps. These field maps were then utilised to generate a habitat map in ArcGIS 10.2. Habitat mapping was carried out based on "Best Practice Guidance for Habitat Survey and Mapping" (Smith *et al* 2011).

For inspection purposes only.
Consent of copyright owner required for any other use.

4.3.3 Bird Surveys

4.3.3.1 General Bird Survey – summer bird surveys

Bird Watch Ireland and the RSPB NI have agreed a list of priority bird species for conservation action on the island of Ireland. These Birds of Conservation Concern in Ireland are published in a list known as the BoCCI List. In this BoCCI List, birds are classified into three separate lists (Red, Amber and Green), based on the conservation status of the bird and hence conservation priority. The Red List birds are of high conservation concern, the Amber List birds are of medium conservation concern and the Green List birds are not considered threatened.
Bird surveys were carried on 21st July 2015 and 6th August 2015 utilising transects through the study area (see Figure 4.8) following a modified common bird census or Brown & Shepherd survey. Transects were walked at a slow pace, with all bird species observed noted and recorded. Where any indications of breeding (juvenile birds, eggs, nest remains, etc.) were observed, they were recorded. Any species present during the surveys were, in line with the Precautionary Principle, presumed to be breeding at, or in the vicinity of the proposed development site.

EPA Export 06-01-2017:02:02:09

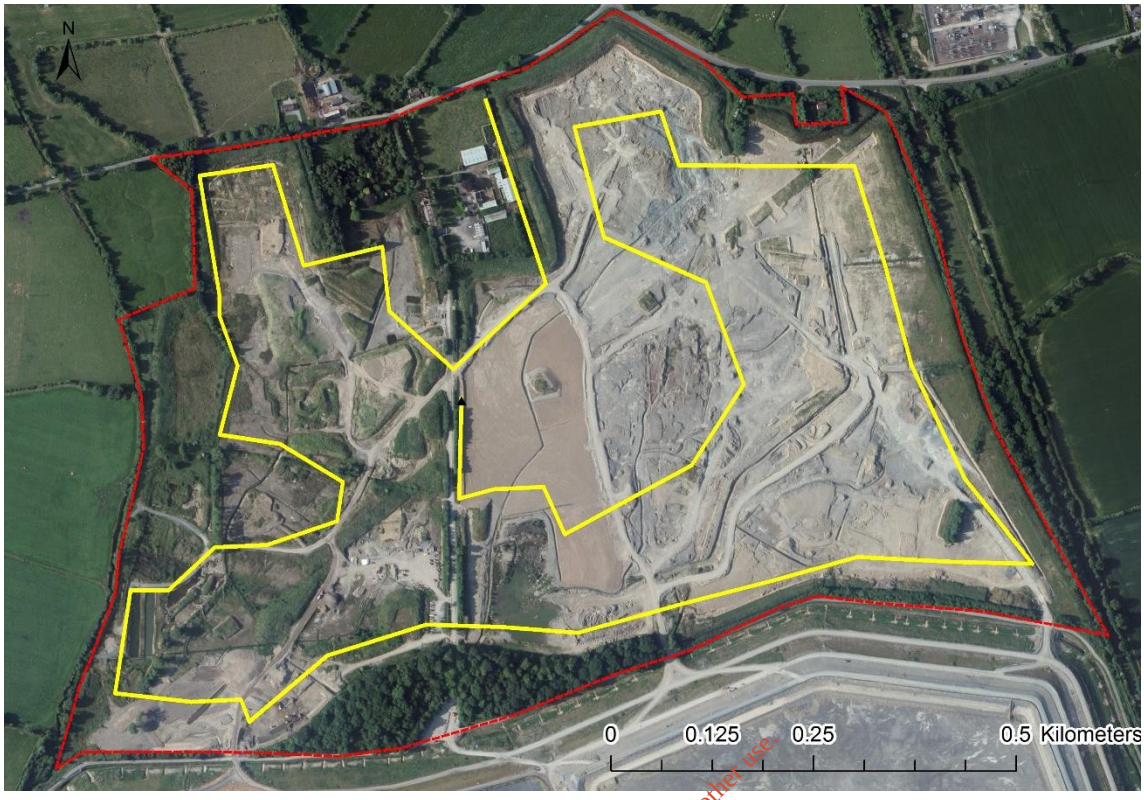


Figure 4.8 Map indicating transect route taken during bird surveys (red = site boundary, yellow = transect)

For inspection purposes only.
Consent of copyright owner required for any other use.

The purpose of bird surveys was to:

- Record any priority species (Annex I, Red or Amber listed) occurring within or adjacent to the proposed development site during the survey period (July/August), which were assumed to be breeding populations; and
- Identify any areas of habitat of particular interest with regard to avian biodiversity.

4.3.3.2 Kingfisher Survey

The importance of the biodiversity of Ireland's waterways is reflected in the designation of many of our waterways under the Birds and Habitats Directives. A number of species of European significance occur on our waterways including the Kingfisher (*Alcedo atthis*), which is listed on Annex I of the EU Birds Directive. In 2010 (Cummins *et al*), six major river systems - the Rivers Barrow, Blackwater (Munster), Boyne, Clare, Moy and Nore (in addition to two smaller systems, the Rivers Gill and Illen) – were surveyed in order to assess the distribution and abundance of Kingfisher in representative habitats throughout Ireland. Kingfisher were recorded on all river systems surveyed. Given the proximity of the development site to a water-body connecting the site to a Special Protection Area designated for Kingfisher (River Boyne and River Blackwater SPA), a Kingfisher survey was carried out within suitable habitat. There are several small water bodies, drainage ditches and "Blake's Stream" occurring within the footprint of the Stage 6 TSF. Although not ostensibly suitable for Kingfisher based on the desk study and the degree of disturbance

EPA Export 06-01-2017:02:02:09

within the site, Kingfisher are known to occur in the general area. The surveys were undertaken outside of the breeding season and the primary goal of Kingfisher surveys was:

- To identify if there areas suitable for nesting Kingfisher within the site; and
- To note any indications of foraging Kingfisher within the survey areas.

Kingfisher surveys were carried out on the 6th of August and the 29th of August under optimal conditions (clear visibility, no rain, no wind), after the methodology as presented in "Assessment of the distribution and abundance of Kingfisher *Alcedo atthis* and other riparian birds on six SAC river systems in Ireland" (Cummins *et al*, 2010) – which was prepared by Birdwatch Ireland for the NPWS. Blake's Stream and a number of associated water bodies were utilised as a line transect.

4.3.3.3 (Breeding) Wader Survey (Lapwing, Curlew, Redshank, etc.)

In tandem with the general bird survey, a (breeding) wader survey was carried out at the site (it was too late in the season to carry out a breeding wader survey, but presence of waders such as Lapwing, Curlew or Redshank on site would be indicative of possible breeding). These surveys were based on the methodology being utilised for the 2015 National breeding Curlew Survey.

For inspection purposes only.
Consent of copyright owner required for any other use.

4.3.3.4 Raptors

It was deemed that a dedicated raptor survey of the site was not required owing to the habitats present (highly disturbed, largely comprised of ED2 and ED3 habitats). Raptors observed during the bird surveys were noted.

4.3.3.5 Winter bird surveys of species of conservation concern

Previous surveys have indicated that the TSF is utilised by several species of conservation concern, including Whooper Swan and Golden Plover, both of which are listed on Annex I of the EU Birds Directive. In addition, significant numbers of Lapwing, Black-headed Gull, Great Black-backed Gull and Curlew have been observed to roost at the TSF. Peregrine Falcon, a species listed on Annex I of the EU Birds Directive has been noted hunting over the TSF during the winter season. The current proposed development will not impact on the use of the TSF by these species (large flocks of these species occur on the TSF and are habituated to vehicular disturbances). In the future, however, as the TSF is decommissioned in phases, the roosting habitat provided will be moved, and finally when Tara Mines is decommissioned, the TSF will be capped and the largest inland water body in Co. Meath will no longer be available for these species. For this reason (which can be considered a cumulative impact), it was deemed necessary to carry out winter bird surveys in order to establish the numbers and species currently utilising the TSF for roosting. Surveys were carried out on a bi-monthly basis during the months October (2015) through March (2016) inclusive. The primary aim of these surveys was to identify numbers and species of birds utilising the TSF for roosting. To this end, each survey consisted of 3 components:

EPA Export 06-01-2017:02:02:09

(1) A pre-dawn survey which started 60 minutes before sunrise and ended 15 minutes after sunrise – the primary aims of this survey was to identify species roosting overnight and to record flight paths of the main species of conservation concern (the Annex I species Whooper Swan and Golden Plover). Whooper Swan move between roosting sites and foraging sites at early dawn, and presence on site one hour before sunrise (in total darkness, light measured using a ETI-1301 Light Meter set to record Lux) ensured that these flights were recorded. Digital night vision (Yukon Ranger) was used to observe birds before sufficient light was available to utilise conventional optics (Opticron DBA Oasis 10X42 binoculars in combination with an Opticron ES 100 GA ED spotting scope fitted with either an SDL v2 (27 – 80x magnification) or a HDF (magnification 107x wide angle) eyepiece.

This survey also aimed to identify any flocks of Golden Plover (and/or Lapwing) returning to the TSF from nocturnal foraging in surrounding farmland. Survey conditions were noted on record sheets, and flight paths recorded. Pre-dawn surveys were carried out along a transect as indicated in Figure 4.8. A Viewshed of the transect (based on an observer height of 1.8 m and a flight height of 30m), based on OSI DEM data (see figure 4.10) was generated in ArcGIS 10.2 utilising the Spatial Analyst extension – this demonstrates the visibility of birds flying at 30m or higher from the transect used (see Figure 4.1);

(2) A mid-day survey, which recorded any species utilising the TSF as a day-time roosting site. The duration of the mid-day survey was dependent on the activity present on the day, as it served as a "snapshot" of birds utilising the TSF. The survey typically lasted 60 minutes. If Golden Plover were present on the TSF, a transect was not walked, as human activity was observed to disturb the flock, and on one occasion the flock departed the TSF owing to observer disturbance. Rather, the boundary of the TSF was driven (see Figure 4.2), stopping at strategic points (which varied owing to flock movements) to ascertain an accurate count. Golden Plover were regularly observed in numbers in excess of 2000. Owing to the very large numbers and movement within the flock, estimates of numbers were ascertained by counting the numbers of birds present in a field of view, and then moving the field of view; and

(3) A dusk survey, which started 15 – 25 minutes prior to sunset and ended 60 minutes after sunset (in total darkness, light measured using a ETI-1301 Light Meter set to record Lux). The primary aims of this survey were to record species roosting overnight and to record flight paths of the main species of conservation concern returning to the TSF from day-time foraging sites.

Digital night vision (Yukon Ranger) was used to observe birds when sufficient light was no longer available to utilise conventional optics (Opticron DBA Oasis 10X42 binoculars in combination with an Opticron ES 100 GA ED spotting scope fitted with either an SDL v2 (27 – 80x magnification) or a HDF (magnification 107x wide angle) eyepiece. This survey also aimed to identify any flocks of Golden Plover (and/or

For inspection purposes only. Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

Lapwing) departing the TSF to engage in nocturnal foraging in surrounding farmland. Survey conditions were noted on record sheets, and flight paths recorded. The majority of dusk surveys were carried out along the transect as indicated in Figure 4.8.

During latter surveys, Golden Plover were present and for this reason the boundary of the TSF was driven as a transect as for mid-day surveys (see Figure 4.2).

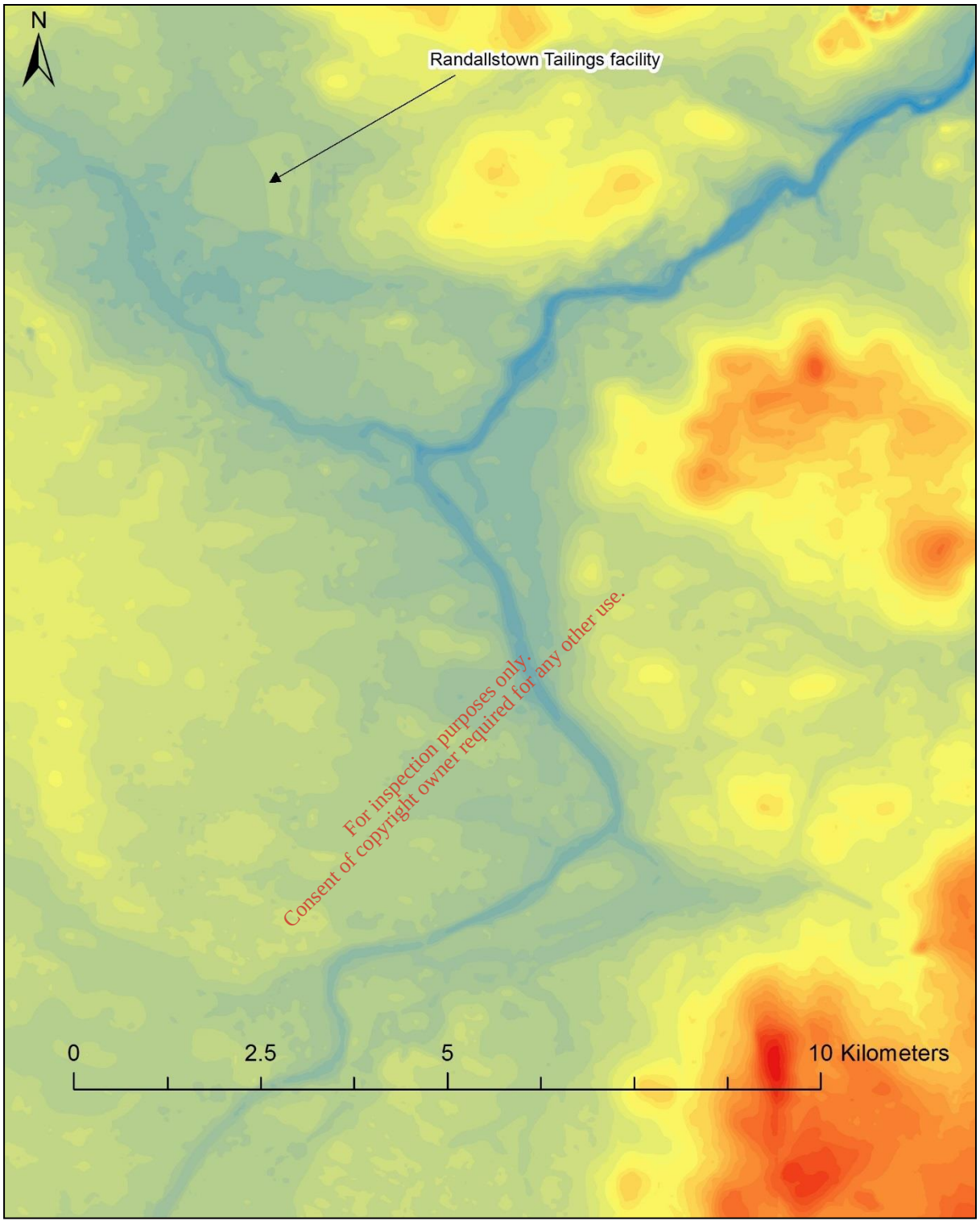
For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.9 Map indicating walked transect (yellow line) relative to the TSF (scale 1:7,500)

EPA Export 06-01-2017:02:02:09



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.10 Digital Elevation Map (DEM) as generated utilising OSI data

EPA Export 06-01-2017:02:02:09

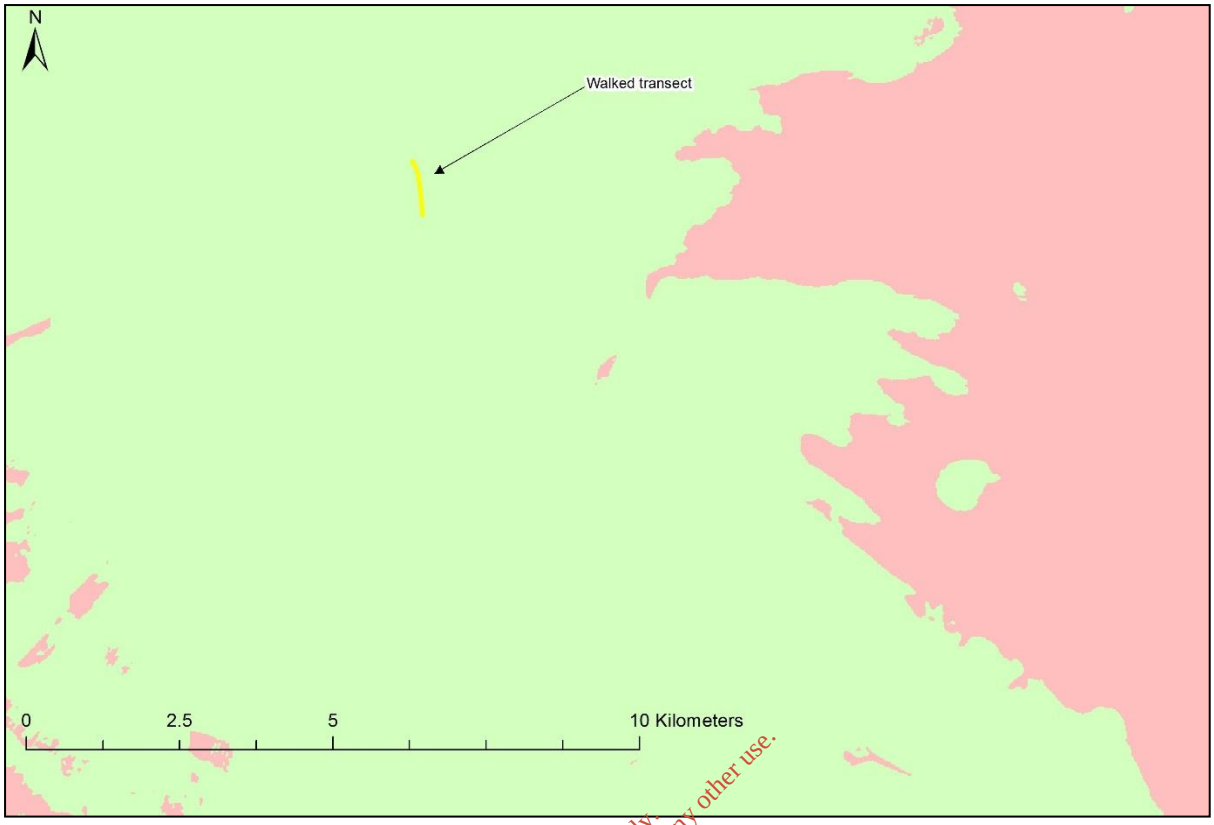


Figure 4.11 Viewshed (based on observer level of 1.8m and flight height of 30m) from walked transect, with visibility represented by green and lack of visibility represented by pink

For inspection purposes only.
Consent of copyright owner required for any other use.

4.3.4 Blackwater – Nevinstow townland

A minimum of 17 birds were observed/heard within the immediate vicinity of the survey area. There was, however, no evidence for any ground-nesting birds occurring within the area of the proposed enabling works, or any evidence of breeding Sedge Warbler or Reed Warbler. Indeed, there was no evidence of Reed Warbler in the immediate vicinity. An illustration of the birds observed, their breeding status within the footprint of the proposed works (habitat type FS3), and their BoCCI status (as indicated by colour – green, amber or red) is given below.

EPA Export 06-01-2017:02:02:09

Figure 4.12 Map indicating driven transect,

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

Table 4.2 Birds recorded during the breeding bird survey on the morning of June 23rd 2014

Common Name	*Latin Name*	*Evidence for Breeding within Survey area*
Willow Warbler	Phylloscopus trochilus	NO
Chiff Chaff	Phylloscopus collybita	NO
Chaffinch	Fringilla coelebs	NO
Sedge Warbler	Acrocephalus schoenobaenus	NO
Blackbird	Turdus Merula	NO
Pied Wagtail	Motacilla alba	NO
Jackdaw	Corvus monedula	NO
Greenfinch	Carduelis chloris	NO
Robin	Erithacus rubecula	NO
Dunnock	Prunella modularis	NO
Goldcrest	Regulus regulus	NO
Moorhen	Gallinula chloroplus	NO
Grey Heron	Ardea Cinerea	NO
Long tailed Tit	Aegithalos caudatus	NO
Great Tit	Parus ater	NO
Blue Tit	Parus caeruleus	NO
Wood Pigeon	Columba palumbus	NO

For inspection purposes only.
Consent of copyright owner required for any other use.

4.3.5 Mammal Surveys

4.3.5.1General Mammal Survey (including Badger)

General mammal surveys were carried out over the period July-September. Surveys included surveys of the footprint of Stage 6 TSF through direct observations (seeing the animal), observation of faeces, prey remains, shelters, hair, etc. Generally, the footprint of the proposed development is not suitable for mammals owing to regular disturbance. There is, however, a significant area of mature woodland (2.9 Ha) that appears on the 6" Historic Maps, indicating that the woodland is of significant age (see Figure 4.13). This area of woodland is suitable for numerous species of mammal. Regularly utilised wildlife trails within the woodland were identified and trail cameras deployed. These trail cameras are equipped with an infrared flash, enabling the capture of both still and video footage at night without being detected. A comprehensive survey of the woodland for any indications of Badger setts was carried out.

EPA Export 06-01-2017:02:02:09

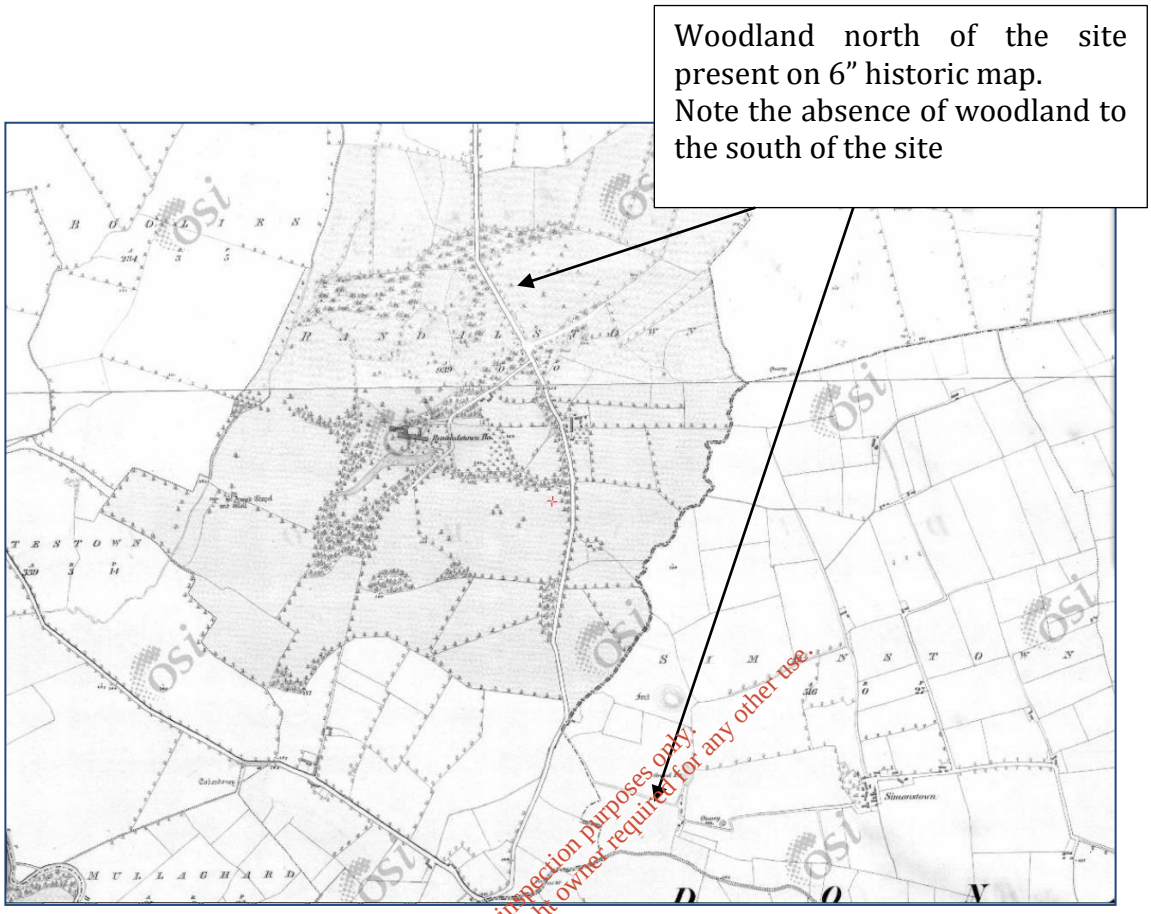


Figure 4.13 Historic 6" Map indicating location of woodland

Consent of copyright owner required for any other use.
For inspection purposes only.

4.3.5.2 Spring Badger survey at identified sett

During the general mammal surveys, an apparently disused sett was identified within the development footprint. Badger surveys are best conducted from November to April, owing to limitations to visibility associated with vegetation at other times of the year. Badger territorial activity is high from mid-January to March and surveys at this time are most efficient in identification of badger paths, latrines and feeding signs. For this reason, additional surveys were carried out at the site of the identified sett and *environs* during January and February, and infrared trail cameras were placed in the immediate vicinity of the sett, and in an open section of the woodland habitat to assess usage of the habitat during this period.

EPA Export 06-01-2017:02:02:09

Plate6 Photograph illustrating location of trail camera (in red) in optimal location for capturing passing activity

For inspection purposes only.
Consent of copyright owner required for any other use.

4.3.5.3 Otter Survey

Otter (*Lutra lutra*) is a primarily piscivorous species, depending largely on salmonids but also consuming frogs, crayfish, etc. Otter surveys were carried out in tandem with Kingfisher surveys on the 6th of August and the 29th of August under optimal conditions based on the methodology as presented by NPWS in the Irish Wildlife Manual 76 (National Otter Survey of Ireland 2010/12 – Reid *et al.,* 2013), with a survey being carried out for spraints (but also recording other signs, such as footprints, fish remains, slides, etc.) along the transect.

4.3.5.4 Bat surveys - summer

Two types of bat surveys were undertaken within the footprint of the Stage 6 TSF:

Survey type 1:Static monitors

Surveys were carried out during the period July/August/September utilising a number of Pettersson D500x Ultrasound recording unit. These units are ultrasound recording units, intended for long-term recording of bat calls. The triggering system allows the device to start recording as a sound is detected. The D500X detects the full spectrum of ultrasound and records in real time. It provides much more detailed data than either frequency division or time

EPA Export 06-01-2017:02:02:09

expansion detectors. The D500x unit was pre-programed to record all bat-passes occurring during the period between 30 minutes before sunset and 30 minutes after sunrise throughout the survey periods. The unit is powered by an external battery, with 128 GB of internal memory, which is more than sufficient to allow unbroken surveying of all bat activity during the survey period.

Following an initial day-time survey on the 24th of July, a Pettersson D500x unit was deployed roughly in the centre of the footprint of the Stage 6 TSF at an angle of 30° in order to assess the activity of bats passing over this area. Activity at this site was recorded between the 24th of July and the 6th of August.
During the period 7th August until the 20th of August, two Pettersson units were deployed along the laneway and associated hedgerow between the Sillogue entrance to the Borrow Pit Area and the Mature Woodland. These units recorded bat activity along a commuting corridor identified during an emergence survey on July 23rd. An additional Pettersson D500x unit was deployed at "Blake's House" between the 6th of August and the 9th of August, a derelict building at the Sillogue entrance to the Borrow Area in order to assess the potential use of the building as a roost.
On the 20th of August, a Pettersson D500x Unit was deployed at a small pond immediately adjacent to the area of mature woodland. This unit monitored activity at this pond over the period 20/08/15 – 23/08/15.
On the 10th of September, a Pettersson D500x Unit was again deployed in the vicinity of the small pond and monitored activity here over the period 10/09/15 – 11/09/15.

Consent of copyright owner required for any other use.
For inspection purposes only.

The locations of the monitors are illustrated in Figure 4.14.

Figure 4.14 Map identifying locations of Pettersson D500x units and dates deployed (informed by hand-held surveys)

EPA Export 06-01-2017:02:02:09

Survey type 2:Utilising hand-held detectors and transects through the survey area

Three emergence surveys were carried out during the period July/August/September utilising hand-held bat detectors (Pettersson D200 and EM3+ Echometer) while walking transects through the site.
The July survey (23rd July – sunset 21:43) was carried out by Dr Patrick Moran and concentrated on identifying areas of activity throughout the survey area. The survey began/ended at 21:15/23:15. Conditions were ideal during the emergence survey, with a starting temperature of 15°C, no wind and no rain. The August survey was carried out by Dr Patrick Moran on the 28th of August (sunset 20:27) and concentrated on the main avenue between the Sillogue entrance and the area of mature woodland as this was found to be the area of peak activity during the July survey. The survey began/ended at 20:00/22:15. Weather conditions were optimal (starting temp 13°C, no wind, no rain) throughout the survey period. The September survey was carried out by Dr Patrick Moran on the 9th of September (sunset 19:59) and concentrated on the pond and area of woodland around the pond, which was identified as being of high importance to local bats. The survey began/ended at 19:00/21:30). Weather conditions were optimal (starting temp 12°C, no wind, no rain).

Consent of copyright owner required for any other use. For inspection purposes only.

4.3.5.5 Bat surveys – winter

Two potentially important roosting sites having been identified during summer bat surveys, it was deemed necessary to carry out winter surveys to determine if these sites were being utilised as hibernation roost sites. The changeable weather conditions, and hibernation of bats in Ireland would indicate that the use of hand-held detectors during the winter season would yield little or no information regarding bat usage of habitats. In order to determine if either the woodland along the southern boundary of the proposed development footprint or the habitat provided by "Blake's House" and associated mature gardens are utilised as winter roosting habitats, a Pettersson D500x ultrasound recording unit was placed at both sites between the 11th of November 2015 and February 14th 2016. Utilising this equipment, the activity of any bats emerging from hibernation to briefly feed, defecate, etc. during a mild-spell will be recorded. A photograph illustrating the D500x unit placed within the woodland habitat is shown in plate 7.

EPA Export 06-01-2017:02:02:09

Plate 7 D500x unit located in woodland

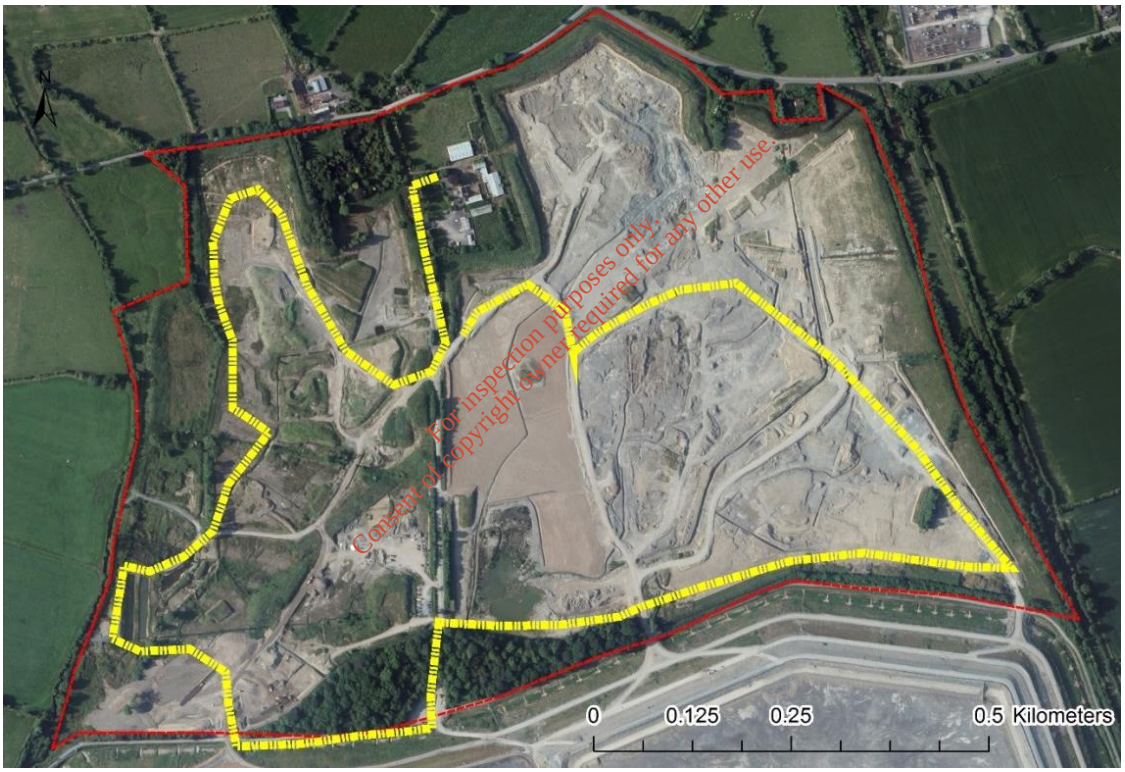
For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

4.3.6 Selected Invertebrate Groups

Butterfly

The diversity of Butterfly species occurring on site was surveyed during July (21st) and August (6th) under suitable conditions following a modified version of the methodology utilised for the National Butterfly Monitoring Scheme as run by the National Biodiversity Data Centre. Line transects were walked and all butterfly species (and any day-flying moth species) observed were recorded. Surveys were carried out at temperatures of 16°C/18°C and at approximately 70%/80% sunshine (on average). Transects were walked at a slow and steady pace, counting all butterflies seen within a fixed distance: 2.5 m either side, 5 m ahead and 5 m above. The same route was taken (within an error margin of 1-2 metres) for each survey. The approximate route is indicated in Figure 4.15



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.15 Transect route taken during Butterfly (and Bee/Bumblebee) surveys (yellow dashed)

EPA Export 06-01-2017:02:02:09

Bees and Bumblebees

Bees and Bumblebees surveys were carried out according to the National Bumblebee monitoring scheme methodology (the same transect routes are utilised as the butterfly surveys as the two are carried out in tandem). Surveys were carried out during July (21st) and August (6th) at temperatures of 16°C/18°C and at approximately 70%/80% sunshine (on average). The transect was walked at a slow and steady pace, counting all bees and bumblebees seen within a fixed distance: 2.5 m either side, 5 m ahead and 5 m above.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

4.4 Results

4.4.1 Desk Study

4.4.1.1 Review of National Parks and Wildlife Service database

The desk study primarily involved the consultation of the NPWS data-base, which is publically accessible for records pertaining to the vicinity of the proposed development. This flora and fauna assessment was carried out based on the pre-planning scoping response of the Department.

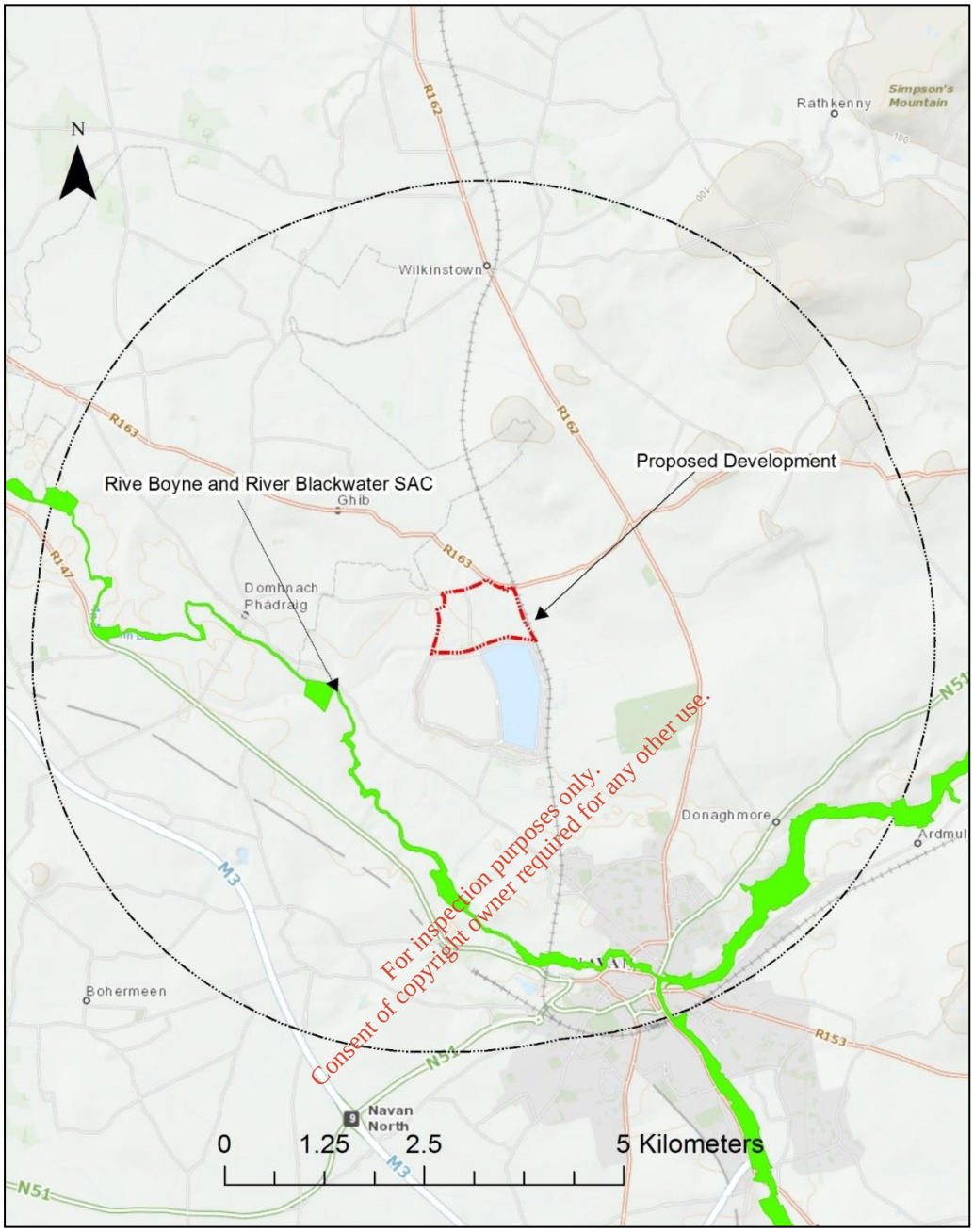
There are numerous records of species of conservation concern occurring within those 10km squares in the vicinity of the proposed development (N76, N77, N78, N86, N87, N88, N96, N97 and N98 – source NPWS). These include Otter (*Lutra lutra*), Red Squirrel (*Sciurius vulgaris*), Betony (*Stachys officinalis*), Annual Knawel (*Schleranthus annuus*), Meadow Saxifrage (*Saxifraga granulata*), Meadow Barley (*Hordeum secalinum*) and Hairy St. John's Wort (*Hypericum hirsutum*).

Although not listed within the NPWS database, the Annex II (Habitats Directive) species Kingfisher (*Alcedo atthis*) and Annex I (Birds Directive) species Whooper Swan (*Cygnus cygnus*), Golden Plover (*Pluvialis apricaria*) and Peregrine Falcon (*Falco peregrinus*) are known to occur within 5 km of the proposed development footprint. In fact, Whooper Swan, Golden Plover and Peregrine Falcon have been recorded occurring within habitat at the TSF, in addition to a number of other species of conservation concern, including Lapwing (*Vanellus vanellus*), Curlew (*Numenius arquata*) and Yellowhammer (*Emberiza citrinella*). The habitat in the vicinity of the TSF (immediately adjacent to the proposed development) provides a *refugia* for numerous species of conservation concern, largely owing to the semi-natural nature of habitats present and a lack of direct human disturbance (the animals utilising this area appear to have habituated to the presence of vehicles, but are sensitive to disturbance by humans outside of vehicles).

Consent of copyright owner required for any other use. For inspection purposes only.

In addition to a desk-top search of species of conservation concern occurring within the vicinity of the proposed development, a GIS-based analysis of sites designated for conservation interests (Special Area of Conservation (SAC), Special Protection Area (SPA), Natural Heritage Area (NHA) and Proposed Natural Heritage Area(pNHA)) occurring within 5 km of the proposed development was carried out. There are no NHAs or pNHAs occurring within 5 km of the proposed development site. There is one site designated as a Special Area of Conservation (SAC) and one site designated as a Special Protection Area (SPA) occurring within 5 km of the proposed development. Of note, there is a Source-Pathway-Receptor (S-P-R) linkage between the proposed development and both of these Natura 2000 sites in the form of the Yellow River, a tributary of the Blackwater, one of the primary components of both sites. Maps indicating the location of these Natura 2000 sites are indicated in Figure 4.16 and Figure 4.17. The proximity of the proposed development to these Natura 2000 sites, and the presence of a S-P-R linkage indicates that Appropriate Assessment of the proposed development is required.

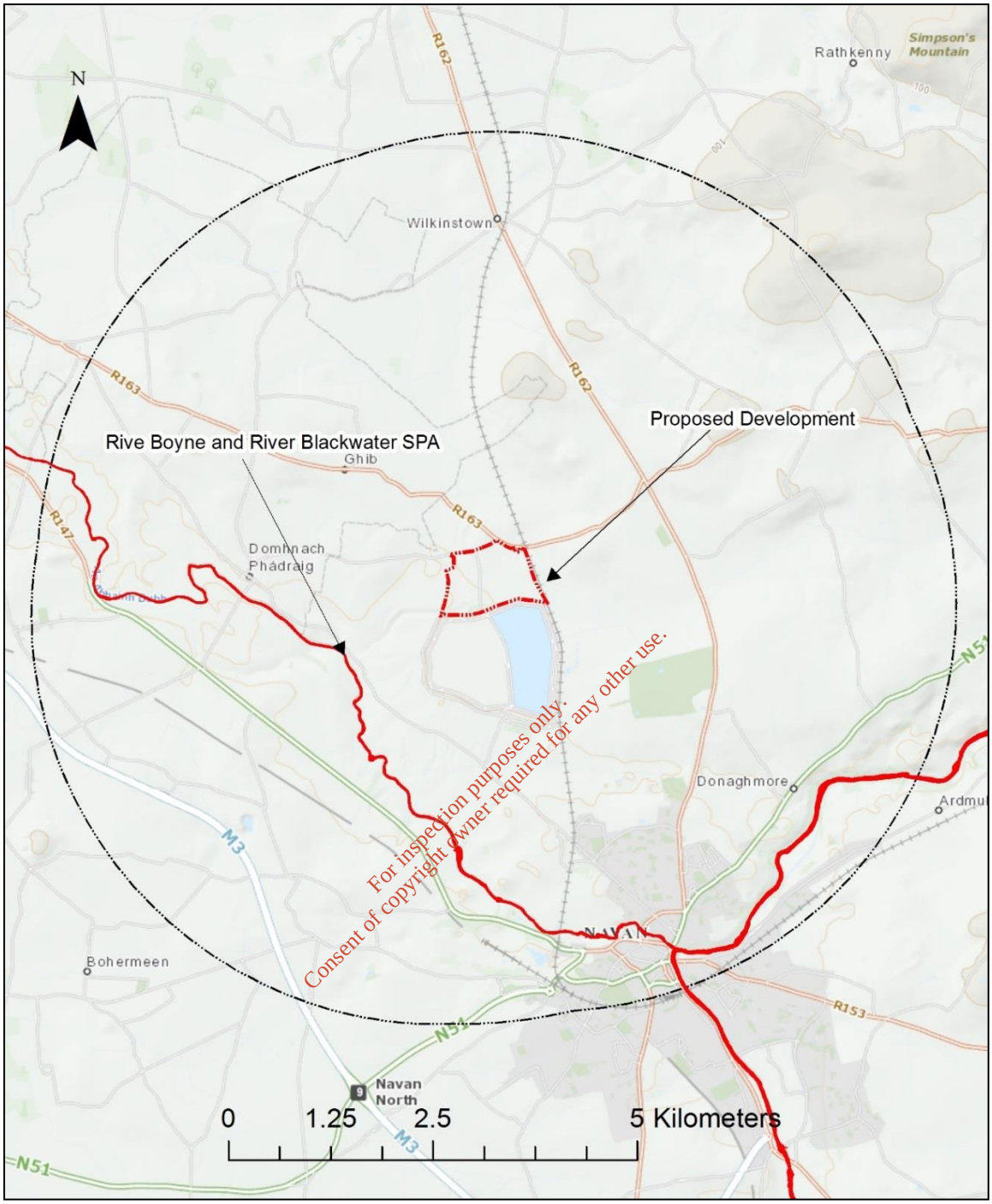
EPA Export 06-01-2017:02:02:09



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.16 Map illustrating location of proposed development relative to **SACs**

EPA Export 06-01-2017:02:02:09



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.17 Map illustrating location of proposed development relative to SPAs

A description of the two Natura 2000 sites is provided , based primarily on the Natura 2000 form for each site (including information regarding qualifying interests, threats/vulnerabilities and the conservation status of the individual sites). Much of this information is presented in tabular form with specific codes.

There is also presented information regarding the conservation status of qualifying interests (of SACs) on a national scale – this information is sourced from the 2013 publication (NPWS) "The Status of EU Protected Habitats and Species in Ireland".

EPA Export 06-01-2017:02:02:09

River Boyne and River Blackwater SAC – site code 002299

This site comprises most of the freshwater element of the River Boyne from upriver of the Boyne Aqueduct at Drogheda, the Blackwater River as far as Lough Ramor and the principal Boyne tributaries, notably the Deel, Stoneyford and Tremblestown Rivers. This system drains a considerable area of Counties Meath and Westmeath and smaller areas of Cavan and Louth. The underlying geology is Carboniferous Limestone for the most part with areas of Upper, Lower and Middle well represented. In the vicinity of Kells Silurian Quartzite is present while close to Trim are Carboniferous Shales and Sandstones. The rivers flow through a landscape dominated by intensive agriculture, mostly of improved grassland but also cereals. Much of the river channels were subject to arterial drainage schemes in the past. Natural flood-plains now exist along only limited stretches of river, though often there is a fringe of reed swamp, freshwater marsh, wet grassland or deciduous wet woodland. Along some parts, notably between Drogheda and Slane, are stands of tall, mature mixed woodland.

Substantial areas of improved grassland and arable land are included in site for water quality reasons. There are many medium to large sized towns adjacent to but not within the site.
The main channel of the Boyne contains a good example of alluvial woodland of the *Salicetum albo-fragilis* type which has developed on three alluvium islands. Alkaline fen vegetation is well represented at Lough Shesk, where there is a very fine example of habitat succession from open water to raised bog. The Boyne and its tributaries is one of Ireland's premier game fisheries and offers a wide range of angling, from fishing for spring salmon and grilse to sea trout fishing and extensive brown trout fishing. The site is one of the most important in eastern Ireland for *Salmo salar* and has very extensive spawning grounds. The site also has an important population of *Lampetra fluviatilis*, though the distribution or abundance of this species is not well known. *Lutra lutra* is widespread throughout the site. Some of the grassland areas along the Boyne and Blackwater are used by a nationally important winter flock of *Cygnus cygnus*. Several Red Data Book plants occur within the site, with *Pyrola rotundifolia*, *Poa palustris* and *Juncus compressus*. Also occurring are a number of Red Data Book animals, notably *Meles meles*, *Martes martes* and *Rana temporaria*. The River Boyne is a designated Salmonid Water under the EU Freshwater Fish Directive.

A synopsis of the threats and pressures associated with the site (as indicated in the Natura 2000 form) is presented in Table 4.3.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

Table 4.2: Impacts and activities with high impact on this site

Negative Impacts			
Rank	Threats and pressures [code]	Pollution (optional) [code]	inside/outside [i|o|b]
H	A04		i
H	B		i
M	J02		i
H	A01		o
H	A08		i
H	A08		o
H	A01		i
H	F02.03		i
M	G01.01		i
M	B		o
M	E03		i
H	E01.03		o
H	E01		o
H	D01.02		i
H	A04		o
H	D01.02		o
M	G01.02		i

Rank: H = high, M = medium, L = low

Positive Impacts			
Rank	Activities, management [code]	Pollution (optional) [code]	inside/outside [i|o|b]
H	F02.03		i
M	G01.02		i
M	G01.01		i

For inspection purposes only. Consent of copyright owner required for any other use.

The primary conservation objective of this site is to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected.

[7230] Alkaline Fens

Alkaline fens are typically calcareous basin or flush fen systems with extensive areas of species-rich small sedge communities. These fen systems are often a complex mosaic of habitats, with co-occurring tall sedge beds, reedbeds, wet grasslands, springs and open-water. The habitat is characterised by a broad range of small to medium Carex spp., carpets of brown mosses and high species diversity including black bog-rush (*Schoenus nigricans*), blunt-flowered rush (*Juncus subnodulous*), devil's bit scabious (*Succisa pratensis*), hemp agrimony (*Eupatorium cannabinum*) and purple moor-grass (*Molinia caerulea*). This habitat requires a high water table, a calcareous, low nutrient water supply and minimal water level fluctuation. Low intensity mowing and/or grazing are also very important for maintaining species richness. In Ireland, the most extensive areas of alkaline fens are thought to occur in lowland basins underlain by limestone groundwater bodies with a karstic or poorly productive flow regime. Alkaline fens within upland and lowland flushes, along the fringes of calcareous lakes (e.g. Lough Corrib) and within turloughs, dune slacks and machair are thought to be more limited in local extent but more widespread. The current distribution and range maps provide a more refined estimate of the national habitat extent since 2007, but further survey is needed. Some losses of fen habitat are considered to have occurred since the Directive came into force, though the magnitude of the loss is unknown. The main pressures were identified as peat extraction, wetland reclamation and infilling. Wetland habitats are afforded additional protection under recent Agriculture Environmental Impact Assessment Regulations, however the Overall Status is considered to be

EPA Export 06-01-2017:02:02:09

Bad due to the pressures outlined; the overall trend is Unknown due to the absence of a national survey for this habitat.

[91EO] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

Riparian forests of ash (*Fraxinus excelsior*) and alder (*Alnus glutinosa*) occurs on heavy soils which are periodically inundated by the annual rise of river levels, but which are otherwise well drained and aerated during low water. The herbaceous layer includes many tall species such as remote sedge (*Carex remota*), gypsywort (*Lycopus europaeus*), common nettle (*Urtica dioica*) and water avens (*Geum rivale*). In addition there are gallery forests of tall willows alongside river channels and occasionally on river islands, where the tree roots are almost continuously submerged. They are dominated by white willow (*Salix alba*), common osier (*S. viminalis*) and almond willow (*S. triandra*), sometimes with grey willow (*S. cinerea*) but alder is relatively rare. This habitat has suffered considerable historic losses and is highly fragmented. Non-native and invasive species especially sycamore (*Acer pseudoplatanus*) and beech (*Fagus sylvatica*), and problematic native species such as bramble (*Rubus fruticosus*) and common nettle (*Urtica dioica*) (a consequence of under grazing) are regarded as the main pressures impacting this habitat. The Overall Status is assessed as Bad due to these ongoing pressures and highly fragmented nature of this habitat. There have been national efforts to remove non-native and invasive plant species reinstate correct hydrological regimes and generally to improve the conservation status of alluvial woodlands. Some substantial areas have been rehabilitated, and this is the main reason for the improving trend reported since the 2007 assessment.

For inspection purposes only.
Consent of copyright owner required for any other use.

[1099] *Lampetra fluviatilis*

The river lamprey (*Lampetra fluviatilis*) breeds in freshwater rivers and streams. Adults spawn in spring, excavating shallow nests in gravels and stones. After hatching, the larvae called ammocoetes drift or swim downstream to areas of river bed with a fine silt composition. They burrow into this bed material and live as filter feeders over a period of years before transforming into young adult fish. As adults they are parasitic, attaching to and feeding on larger fish in coastal waters. They can grow to 30cm at maturity at which stage they re-enter freshwater to spawn. The adult fish die after spawning. River and brook lamprey are indistinguishable as larvae, living as filter feeders in sediment. The mature adult forms are clearly distinguishable on the basis of body size. The two types of lamprey are considered by many in the same context as the brown trout / sea trout pairing, with a similar absence of genetic discriminators. Lamprey surveys in Ireland have necessarily focussed on juvenile lamprey. Consequently, the vast majority of available data relates to “Lampetra sp.” and cannot be assigned to one species or the other. For the above reasons the brook lamprey and the river lamprey are assessed jointly. There are extensive areas of suitable habitat and no significant pressures impacting these species. The Overall Status is therefore assessed as Favourable.

[1106] *Salmo salar*

The range of the Atlantic salmon (*Salmo salar*) extends in an arc from northern Portugal in the east, to New England, United States in the west. Salmon use rivers

EPA Export 06-01-2017:02:02:09

to reproduce and as nursery areas. Eggs are deposited during the winter in a depression, called a redd, excavated in river gravels. The eggs develop protected within the substrate and during spring hatch into alevins, which in turn develop into fry. The fry feed for the summer and over the autumn, gradually becoming parr. Fry and parr feed primarily upon invertebrates. The Irish population generally comprises fish that spend two winters (small numbers spend one or three winters) in freshwater before going to sea, in spring, as smolts at around 10-25cm in length. Adults spend one to three years at sea where growth rates are much greater. They feed upon crustaceans and fish (e.g. capelin and sandeels) as they migrate to feeding grounds in the North Atlantic. The majority of Irish fish spend one winter at sea before returning to their natal rivers, mainly during the summer, as grilse. Smaller numbers spend two or even three winters at sea, returning mainly in spring, hence "spring" salmon. There has been a recent stabilisation of the numbers of salmon spawning in Ireland and an increasing number of salmon rivers meeting their conservation limits, however low rates of marine survival are of concern. Different units were used to measure population size in 2007; there is no genuine change in the overall population estimate. There are numerous threats to the freshwater habitat and vigilance is required to ensure the maintenance of good quality habitat which salmon require to thrive. The salmon population is still low in comparison to previous decades and so, in the absence of a recovery, the Overall Status is assessed as Inadequate.

Consent of copyright owner required for any other use. For inspection purposes only.

[1355] *Lutra lutra*

Dramatic declines, leading in some cases to extinctions, occurred in many European otter (*Lutra lutra*) populations during the latter half of the 20th Century, however, Ireland has remained a stronghold for the species. Otters have two basic requirements: aquatic prey and safe refuges where they can rest. In Ireland, otter populations are found along rivers, lakes and coasts, where fish and other prey are abundant, and where the bank-side habitat offers plenty of cover. The otter is an opportunistic predator with a broad and varied diet. In coastal areas fish, crabs and molluscs are known to be eaten. In freshwater areas a variety of fish from sticklebacks to salmon and eels will be taken, while crayfish and frogs can be important locally or seasonally. The main threats to the otter include habitat destruction (including river drainage and the clearance of bank-side vegetation); pollution, particularly organic pollution resulting in fish kills; and accidental deaths (road traffic and fishing gear). The otter is currently widespread throughout Ireland and present in a wide variety of habitat types. Previous concerns about population decline have been allayed and the latest estimate puts the population at approximately 15-20,000 animals. Therefore the Overall Status is assessed as Favourable.

A synopsis of the conservation status of this site is provided in Table 4.3 and

Table 4.4.

EPA Export 06-01-2017:02:02:09

Table 4.3: Conservation assessment of Annex I habitat occurring at the site

Annex I Habitat types						Site assessment			
Code	PF	NP	Cover [ha]	Cave [number]	Data quality	A|B|C|D	A|B|C		
						Representativity	Relative Surface	Conservation	Global
7230			23.21		M	B	C	B	B
91E0			23.21		M	B	B	B	B

Table 4.4: Species referred to in Article 4 of Directive 2009/147/EC and listed in Annex II of Directive 92/43/EEC and site evaluation for them

Species					Population in the site					Site assessment			
G	Code	Scientific Name	S	NP	T	Size		Unit	Cat.	D.qual.	A|B|C|D	A|B|C	
						Min	Max				Pop.	Con.	Iso.	Glo.
B	A038	Cygnus cygnus			w	50	200	i		G	C	B	C	B
F	1099	Lampetra fluviatilis			r				P	M	C	B	C	B
M	1355	Lutra lutra			p				P	M	C	A	C	A
F	1106	Salmo salar			r				C	M	C	B	C	B

For inspection purposes only. Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:09

River Boyne and River Blackwater SPA – site code 004232

The River Boyne and River Blackwater SPA is a long linear site that comprises stretches of the River Boyne and several of its tributaries: most of the site is in Co Meath but it extends also into Counties Cavan, Louth and Westmeath. It includes the following river sections: The River Boyne from the M1 motorway bridge, west of Drogheda, to the junction with the Royal Canal, west of Longwood, Co Meath; the River Blackwater from its junction with the River Boyne in Navan to the junction with Lough Ramor in Co Cavan; the Tremblestown River (and Athboy River) from the junction with the River Boyne at Kilnagross Bridge to the bridge in Athboy, Co Meath; the Stoneyford River from its junction with the River Boyne to Stonestone Bridge in Co. Westmeath; the River Deel from its junction with the River Boyne to Cummer Bridge, Co.Westmeath. The site includes the river channel and marginal vegetation.
The River Boyne and River Blackwater SPA supports nationally important numbers of *Alcedo atthis*. Other species which occur within the site include *Cygnus olor*, *Anas crecca*, *Anas platyrhynchos*, *Phalacrocorax carbo*, *Ardea cinerea*, *Gallinula chloropus*, *Gallinago gallinago* and *Riparia riparia*.

A synopsis of the threats and pressures associated with the site (as indicated in the Natura 2000 form) is presented in Table 4.5.

Table 4.5: Impacts and activities with high impact on this site

Negative Impacts			
Rank	Threats and pressures [code]	Pollution (optional) [code]	inside/outside [i|o|b]
H	D01.02		o
M	J02		i
H	D01.02		
H	E01		o
H	E01.03		o

Positive Impacts			
Rank	Activities, management [code]	Pollution (optional) [code]	inside/outside [i|o|b]
L	X		i

Rank: H = high, M = medium, L = low
Pollution: N = Nitrogen input, P = Phosphor/Phosphate input, A = Acid input/acidification, T = toxic inorganic chemicals, O = toxic organic chemicals, X = Mixed pollutions
i = inside, o = outside, b = both

For inspection purposes only. Consent of copyright owner required for any other use.

The primary conservation objective of this site is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:

- Kingfisher (*Alcedo atthis*)

A synopsis of the conservation status of this site is provided in table 4.6

.

EPA Export 06-01-2017:02:02:09

Table 4.6: Species referred to in Article 4 of Directive 2009/147/EC and listed in Annex II of Directive 92/43/EEC and site evaluation for them

Species					Population in the site						Site assessment			
G	Code	Scientific Name	S	NP	T	Size		Unit	Cat.	D.qual.	A|B|C|D	A|B|C		
						Min	Max				Pop.	Con.	Iso.	Glo.
B	A229	Alcedo atthis			r	19	19	p		G	C	B	C	B
B	A052	Anas crecca			w	166	166	i		G	C	B	C	C
B	A053	Anas platyrhynchos			w	219	219	i		G	C	B	C	C
B	A028	Ardea cinerea			w	44	44	i		G	C	B	C	C
B	A017	Phalacrocorax carbo			w	36	36	i		G	C	B	C	C

4.4.1.2 County Development and Biodiversity Action Plans

It is an objective (NH OBJ 1) of the 2013 – 2019 Meath County Development Plan to :

- "*…Implement, in partnership with the Department of Arts, Heritage and the Gaeltacht, relevant stakeholders and the community, the objectives and actions of Actions for Biodiversity 2011 – 2016; Ireland's National Biodiversity Plan that relate to the remit and functions of Meath County Council and the County Meath Biodiversity Plan and any revisions thereof…*"

For inspection purposes only.
Consent of copyright owner required for any other use.

The primary function of the County Meath Biodiversity Action Plan is to "*…provide a framework and series of actions to conserve, enhance and raise awareness of Meath's rich biodiversity and to maximise the contribution that it makes to social, economic and environmental well-being of the county, taking into account local, national and international, including European priorities…*"

As part of the desk study, habitats of ecological value in a national and local context as identified within the Meath Biodiversity Action Plan were identified, and having been informed by the field surveys, any potential impacts on such habitats were recognised and taken into account during the drawing up of mitigation measures.

The (Draft) County Meath Biodiversity Action Plan 2015 – 2020 has a number of primary objectives:

- To raise awareness of biodiversity in Meath, it's value and the issues facing it. This series of flora and fauna surveys (in addition to future monitoring and mitigation/habitat enhancement measures) will be part of the Environmental Impact Statement for the extension of the Tailings-management Facility. In addition to the records being submitted to the National Biodiversity Data Centre, this document will be publically

EPA Export 06-01-2017:02:02:09

available, and will raise awareness of the biodiversity within the *environs* of the proposed development (as regards the TSF) and the benefits to biodiversity when the mitigation/habitat enhancement measures are put in place.

- To better understand the biodiversity of Meath. Associated with the proposed development, is a comprehensive monitoring program, which will provide in-depth information regarding a number of species of key importance to biodiversity within Meath, with particular regard to bats, and to overwintering water-birds (in particular Whooper Swan, Golden Plover and Lapwing). The TSF is the largest inland open water body in Meath. Perhaps more importantly, this habitat is entirely free of persecution in the form of hunting, etc. As a result, the TSF, of which the proposed development will comprise an extension, has become a *refugia* for numerous species, which are relatively uncommon throughout the rest of the County. Indeed, the earthen banks surrounding the TSF are likely the single largest area of semi-natural grassland in Co. Meath. The proposed development will increase the proportion of this habitat present at the site. Through monitoring the key species of flora and fauna at the site, the overall biodiversity of the site, and the County, will be greatly enhanced.
- To conserve and enhance habitats and species in Meath, taking into account of national and local priorities. Associated with the proposed development, are a number of prescribed mitigation measures, which are designed to enhance the conservation status of a number of habitats and species of conservation concern within the proposed development footprint. These include:
    a) One of the primary terrestrial impacts of the proposed development is the loss of approximately 2.9 Ha of Mixed Broadleaved Woodland habitat (WD1). This habitat exists as an "island" of habitat between the existing TSF and the Sillogue Borrow Pit, into which the planned Stage 6 will extend. The mitigation measures prescribed include the creation of an area of approximately 9 Ha of woodland, comprised of Native species (and importantly of native provenance) of a range of ages and sizes, in addition to the "transplantation" of some of the larger (dead) trees from the existing area of woodland to the compensatory habitat. This habitat, unlike the existing "Island" of habitat will be situated adjacent to a major ecological corridor in the form of the Yellow River.
    b) There is, within the footprint of the proposed development, a small, man-made attenuation pond on Blake's Stream adjacent to the mature woodland was created approximately 10 years ago. This pond has been colonised by numerous species of wetland plants, invertebrates and fish and has become a locally important foraging site for both birds and bats. The proximity of the pond to the woodland provides optimal conditions for numerous species of bat, as roosting habitat and a variety of foraging habitat are provided in close proximity. This pond, like the adjacent woodland will be removed during the proposed development. There are

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:09

numerous other smaller ponds throughout the development foot-print that will also be removed during the proposed development. By means of providing compensatory habitat, a permanent, constructed pond, of approximately 1 – 1.5 ha in area will be located to the north-west of Stage 6 of the TSF, immediately adjacent to "Blake's House" and garden (in which there are numerous mature trees, and a derelict building, both of which provide suitable roosting habitat for a number of bat species). This pond will not only replace that habitat lost, but will greatly enhance the quality of the habitat over what currently exists, and improve its connectivity with the greater countryside.

c) There is currently (during the winter/spring 2016) open water within the existing stages of the Tailings-management Facility. This water body provides a roosting site of high regional importance for a number of species of Gull, Lapwing, Mute Swan and two species listed on Annex I of the EU Birds Directive – Golden Plover and Whooper Swan. The habitat present within the Tailings-management Facility is dynamic, with the exact location of open water changing location slightly as different stages of the Tailings-management Facility are commissioned and decommissioned. Eventually, the lifetime of the mine will come to an end and the Tailings-management Facility will be decommissioned. This will result in the loss of the largest inland water-body in Co. Meath. In the absence mitigation measures, this decommissioning stage has the potential to impact on local and regional populations of avifauna. Much of the land surrounding the Tailings-management Facility is in the ownership of Tara Mines, and this presents an opportunity for the construction of a wetland habitat of significant proportions adjacent to the Tailings-Management Facility. The provision of an extensive wetland ecosystem presents the opportunity to not only provide compensatory habitat for over-wintering roosting birds, but the prospect to provide potentially one of the most biodiverse ecosystems in Co. Meath, with potential over-winter roosting and foraging habitat for birds such as Whooper Swan. In addition, such a wetland system may attract species rare in Meath, such as visiting Hen Harrier during winter months. Such a wetland system would provide breeding habitat for a variety of wetland birds, rare in the largely agricultural landscape of Meath. An initial consultation with Tara Mines has identified approximately 25ha of potentially suitable land, which could be converted to a mosaic of wetland habitats. The design of any proposed wetland must be informed by the guidance of both hydrogeology and ecology such as to maintain and enhance the ecological integrity of the Natura 2000 network, and in particular the River Boyne and River Blackwater SAC and SPA. Of importance to note, the proposed compensatory habitat, which would almost certainly comprise the largest contiguous habitat of its type in Co Meath and is immediately adjacent to the Navan to Kingscourt railway line. In addition to being one of the most important ecological corridors in

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:09

Meath, this railway line is to be made a cycle-way in the near future. Tara Mines have provisionally agreed to the installation of a raised boardwalk through some sections of the proposed wetland compensatory habitat (similar to that at Pollardstown Fen) and agreed in principle to allow access to the public from the railway line corridor. In addition to providing an invaluable ecological resource on the outskirts of the increasingly urbanised area of Navan town, if managed appropriately, this wetland area could provide a significant educational and tourist resource within Meath, accessible from the Navan – Kingscourt cycleway.

- To foster active participation to help biodiversity in Meath, encouraging a partnership approach to help our species and habitats. The biodiversity in the *environs* of the TSF has been improved by the presence of the TSF passively, through the removal of human disturbance (disregarding the disturbance associated with the working of the TSF itself, the *environs* is subject to virtually no regular human intervention). There has been a natural colonisation of the *environs* by a large contingent of Ireland's native flora and fauna. The mitigation/habitat enhancement measures as proposed within this flora and fauna survey will foster active participation to improve the biodiversity of the TSF and *environs*.

The proposed development, therefore, complies with Objectives (1) – (4) of the (Draft) Meath Biodiversity Action Plan 2015 – 2020.

A number of the proposed actions of the (Draft) Meath Biodiversity Action Plan 2015 – 2020 are of particular note with regards to the proposed development:

- In accordance with Action 3 of the "Proposed Objectives and Actions of the (Draft) Meath Biodiversity Action Plan 2015 – 2020", all records collected as part of the ecological surveys undertaken will be submitted to the National Biodiversity Data Centre through their online record submission system.
- In accordance with Action 5 of the "Proposed Objectives and Actions of the (Draft) Meath Biodiversity Action Plan 2015 – 2020", the monitoring of Alien Invasive Species within the proposed development footprint will be undertaken as part of the post development monitoring.
- In accordance with Action 13 of the "Proposed Objectives and Actions of the (Draft) Meath Biodiversity Action Plan 2015 – 2020", which aims to "*… Develop an access to biodiversity programme at publically accessible sites to promote important habitats and species…"*, post-decommissioning, there will be put in place plans to make accessible to the public areas of high biodiversity (in particular, plans to develop a mosaic of wetland habitat immediately adjacent to the disused Navan – Kingscourt rail line, which is to be made into a greenway).
- In accordance with Action 21 of the "Proposed Objectives and Actions of the (Draft) Meath Biodiversity Action Plan 2015 – 2020", which aims to "*…Commission an inventory of all sites of local nature conservation importance by utilising existing survey data (e.g. hedgerow, wetland and trees surveys) and further fieldwork in under surveyed areas. List the sites in any future County Development Plans to guide planning decisions…*", monitoring of the proposed development site and all associated mitigation measures will be monitored for a minimum of a 10 year period.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:10

This will provide an in-depth analysis of the flora and fauna present within this site, which owing to the undisturbed nature of the TSF as it matures is of high regional ecological significance, particularly with regard to overwintering birds.

4.4.2 Field Surveys

4.4.2.1 Botanical/Habitat surveys

In excess of 140 species were recorded within the Northern and Seven Fields Borrow Area.

A full species list of all species of flora is presented in Appendix 4.2 description of the habitats observed, and the dominant species present within habitat types are presented in the following sections, along with photographs of representative areas of habitat.

4.4.2.2 Freshwater Habitats

Man-made pond (FL8)

There are throughout the proposed development footprint a number of small, man-made ponds that serve as attenuation ponds on Blake's stream as it passes through the site. While the majority of these ponds are rather small and of limited ecological significance owing to the lack of connectivity of good quality stream habitat between ponds (although a pair of Mute Swan successfully reared 3 signets in the vicinity of one of these ponds), along the southern boundary of the site, there is a significant pond covering just under 1ha in area. This pond is approximately 10 years in age, and is connected to both Blake's stream and a number of drainage ditches. Along much of the boundary of the pond is emergent vegetation, largely comprised of species such as *Typha latifolia, Mentha aquatica, Sparganium erectum, Juncus articulatus, Myosotis scorpiodes* and *Veronica beccabunga*. This pond is of high local ecological importance, providing foraging for a number of species of bat, in addition to a number of bird species. Invertebrate sampling determined that there is a relatively diverse (relative to Blake's stream) assemblage of invertebrates present within the pond, and this is almost certainly the attraction for bat and bird species.

Consent of copyright owner required for any other use. For inspection purposes only.

This pond is located less than 500 m from the Yellow River, to which it is linked both physically and ecologically by Blake's stream. It is located approximately the same distance from the Navan-Kingscourt railway line ecological corridor, to which it is connected by a length of hedgerow. In addition, this pond is immediately adjacent to a sizeable (approximately 2.9ha) mixed broadleaved woodland habitat, which provides roosting habitat for a number of species of bat. The pond is also serviced by an ecological corridor in the form of the laneway and associated hedgerow leading to the Sillogue entrance to the development site. While present as an "Island" of habitat within a large area of very limited ecological significance, this pond is well enough connected via ecological corridors to provide an important *refugia* habitat for many species of both flora and fauna.

EPA Export 06-01-2017:02:02:10

Figure 4.18 Photograph illustrating FL8 habitat observed to be used by large numbers of ducks and Daubenton's Bats

For inspection purposes only.
Consent of copyright owner required for any other use.

FW1 – Blake's Stream

Blake's stream is a relatively small watercourse that appears to have been redirected on several occasions in the recent past. Along much of it length, it is of low ecological significance, with little or no vegetation, very low invertebrate diversity and no associated hedgerow habitat.

The man-made attenuation ponds (Figure 4.18) along its course, however, are of higher ecological importance, and as the stream approaches its confluence with the *Yellow River* on the western boundary of the proposed development footprint, the diversity of flora and fauna occurring within the stream increase greatly.

Deeper areas of the stream have an associated emergent flora, with species such as *Typha latifolia, Phalarus arundinacea, Glyceria maxima, Phragmites australis* and *Spharganium erectum* abundant, while typical species such as *Apium nodiflorum, Veronica beccabunga, Mentha aquatica, Cardamine pratensis, Equisetum palustre* and *Samolus valerandi* occur along the damp margins of the stream. The change in biological diversity (increasing towards the Yellow River) within *Blake's Stream* is demonstrated by a comparison of Figure 4.19 - which shows *Blake's stream* at the northern end and Figure 4.5, which shows Blake's stream immediately before it joins the *Yellow River*.

EPA Export 06-01-2017:02:02:10

Figure 4.19 The northern end of Blake's stream as it passes through the development footprint

For inspection purposes only.
Consent of copyright owner required for any other use.

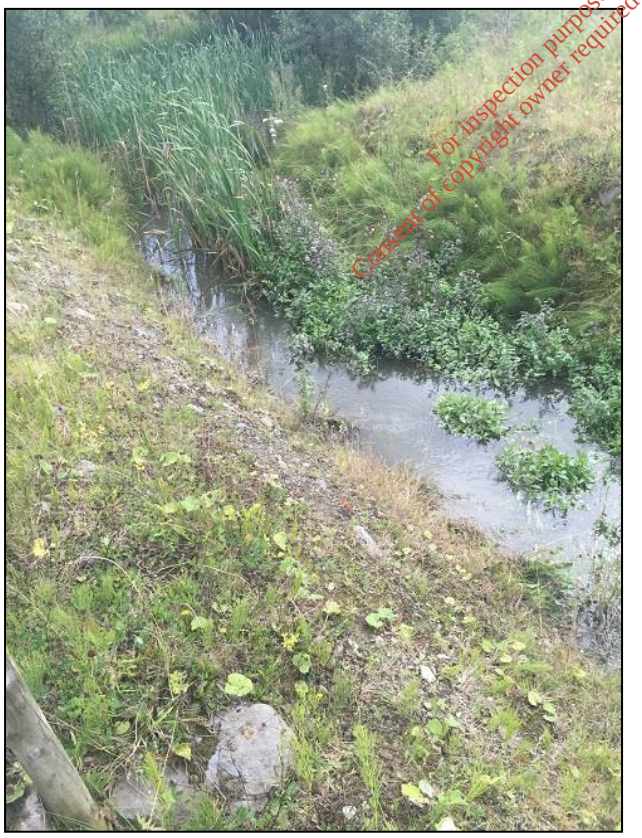


Figure 4.20 Blake's stream immediately before it joins the Yellow River

EPA Export 06-01-2017:02:02:10

FW4 – Drainage ditches

There are present throughout the development footprint numerous drainage ditches. These drainage ditch habitats are for the most part of limited ecological significance as they are undergoing regular disturbance, and are rather ephemeral in nature. The extent of vegetation associated with the drainage ditch habitats are dependent on the age and degree of disturbance. Where ditches are recently formed, or subject to regular disturbance, vegetation is virtually absent. Where ditches are more established, vegetation similar to that found within attenuation ponds is present, dominated by species such as *Typha latifolia* and *Juncus* species.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.21 Photograph illustrating an example of recently excavated drainage ditch habitat

EPA Export 06-01-2017:02:02:10

4.4.2.3 Grassland Habitats

Photographs of representative habitat are presented in Figure 4.22 thru figure 4.24.

Improved Agricultural Grassland (GA1)

There are significant areas of habitat within the survey area that are probably best described as improved agricultural grassland (GA1). These areas of habitat have until recently been heavily disturbed habitats, which have very recently been reseeded and fertilised. The habitat is dominated by *Lolium perenne* (>90%) and the herbaceous component is almost entirely comprised of *Trifolium repens*.

Figure 4.22 Photograph illustrating newly reseeded GA1-type habitat within the survey area

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.23 Recently reseeded and fertilised area of grassland, best described as GA1

EPA Export 06-01-2017:02:02:10

GS1 – Semi-improved dry calcareous grassland

Along the western boundary of the site, where recent disturbance has been minimal, there are small patches of what could be considered slightly improved semi-natural dry calcareous grassland habitat (GS1). This habitat is typified by the dominance of fine grasses, such as *Festuca rubra, Cynosurus cristata* and *Agrostis capillaris*. The herb component in this habitat is dominated by species such as *Daucus carota, Achillea millefolium* and *Lotus corniculatus*. This habitat type is reminiscent of the relatively species-rich grassland habitat that exists on the slopes of the existing Tailings Facility, and it is likely that this habitat has been "seeded" from this adjacent grassland. It is important to note that the grassland in the vicinity of the TSF likely represents the largest contiguous area of semi-natural grassland of its type in Co. Meath. The proposed development will result in a very significant increase in the area of this habitat type, which is increasingly rare in County Meath.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.24 Photograph illustrating GS1 habitat, which dominates the embankments of the xisting Tailings storage facility

EPA Export 06-01-2017:02:02:10

4.4.2.4 Disturbed Ground Habitats(ED)

A large proportion of the survey area is characterised by exposed sand, gravel, rock and soil – which corresponds to the "Disturbed Ground" habitat classification as proposed by Fossitt (2000). The ED habitat type varies throughout the survey area, depending largely on disturbance levels. Those areas in which disturbance levels are very high, or areas which have undergone recent soil-removal processes are almost entirely devoid of vegetation. Some areas of disturbed ground have revegetated through natural or artificial means (reseeding and fertilisation). There are present throughout the areas of disturbed ground habitat other features, such as drainage ditches in addition to a mosaic of small areas of habitat such as woodland, dry calcareous grassland and ponds.

ED2 – Exposed Bare Ground

Exposed bare ground (ED2) is, by far the most abundant habitat type within the survey area, having been formed through the removal of material from the site. This habitat type varies in vegetation cover depending on how recently disturbance has occurred, but in general vegetation is largely absent. In those areas in which soil has recently been removed, vegetation is completely absent. There are areas in which species such as *Tussilago farfara* are beginning to gain a foothold as disturbance becomes less frequent. Where disturbance has occurred less recently, ED2 gives way to ED3 – Recolonising Bare Ground and there is revegetation to varying degrees.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.25 ED2 habitat, which is largely devoid of any vegetation

EPA Export 06-01-2017:02:02:10

Photographs illustrating ED2 habitat, virtually devoid of any vegetation

Tussilago farfara and other species in the early stages of recolonising ED2 habitat

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

ED3 – Recolonising Bare Ground

The early stages of recolonising bare ground habitat are typified by the presence of ruderal species, such as *Tussilago farfara, Epilobium hirsutum, Urtica dioica, Epilobium parviflorum, Chamerion angustifolium, Arctium minor, Atriplex prostrata, Poa annua, Brassica rapa, Matricaria discoidea* and *Reseda luteola*. As the revegetation process continues, grass species begin to comprise a significant component of the vegetation, with *Arrhenatherum elatius, Elytrigia repens, Agrostis stolonifera, Dactylis glomerata*, *Holcus lanatus, Cynosurus cristatus, Festuca rubra* and *Catapodium rigidium* – and grasses become dominant in some areas. With a further progression of time, herbaceous species such as *Medicago sativa, Anagallis arvensis, Vicia cracca, Cirsium arvense, Cirsium vulgare, Hypochaeris radicata, Hypericum tetrapterum, Calystegia sepium, Daucus carota, Achillea millefolium, Galium aparine, Lapsana communis, Odontites vernum, Plantago lanceolata, Prunella vulgaris, Rumex crispus, Rumex obtusifolius* and *Senecio jacobaea* begin to form a significant component of the vegetation community.

In some areas, the ED3 habitat is more wet in nature, and this is reflected in a different assemblage of species, dominated by damp-loving species such as *Juncus effuses, Juncus inflexis, Juncus bufonius, Juncus articulatus, Carex panicea, Filipendula ulmaria, Scrophularia auriculata, Persicaria maculosa, Samolus valerandi, Veronica beccabunga* and *Carex nigra*. Some of these damp areas of ED3 are associated with drainage ditches (FW4) and the recolonising margins of habitats associated with Blake's Stream as it passes through the survey area.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.26 Photograph illustrating ED3 habitat (in mosaic with ED2 habitat) in various degrees of revegetation

EPA Export 06-01-2017:02:02:10

Figure 4.27 Panoramic photographic of ED3 habitat in various stages of recolonization

Figure 4.28 Mosaic of ED2 and ED3 habitat.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

Figure 4.29 Area of ED3 habitat almost entirely dominated by *Cirsium vulgare*

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.30 Area of wet ED3 habitat associated with a drainage ditch (FW4)

EPA Export 06-01-2017:02:02:10

4.4.2.5 Woodland and Scrub Habitats

This category of habitat is dominated by structural elements comprised of trees, shrubs or brambles. Woodland habitat is dominated by trees, with canopy height typically greater than 5m. The primary division in woodland habitat classification concerns the nature of the woodland vegetation – chiefly whether the species are native or non-native. While naturalised, species such as Beech, Sycamore and Horse Chestnut, which are often classified as native are non-native species, and can even be invasive (Sycamore, if left un-managed can quickly come to dominate a woodland into which it has been introduced). Also included here are hedgerow/treeline habitats and scrub habitats.

Mixed Broadleaved Woodland WD1

Occurring along the southern boundary of the proposed development footprint is a significant area (approximately 2.9 ha) of Mixed Broadleaved Woodland (WD1). The canopy is dominated by *Fagus sylvatica,* but *Acer pseudoplatanus, Fraxinus excelsior* and *Quercus robur* are also present in significant proportions. The shrub layer is rather under-developed, likely owing to a lack of management, with very little regeneration (apart from *Acer pseudoplatanus*). It consists largely of *Ilex aquifolium, Sambucus nigra* and *Crataegus monogyna*. The herbaceous layer, as is typical for a woodland in Ireland dominated by Beech, is species poor - dominated almost entirely by *Hedera helix* and *Rubus fruticosus* agg. There are numerous ferns present, including *Dryopteris filix-mas and Polystichum setiferum.* Some common understorey herbs are present, such as *Geranium robertianum* and *Geranium robertianum*.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.31 Photograph illustrating WD1 Habitat

EPA Export 06-01-2017:02:02:10

Figure 4.32 Understory of WD1 (Stage 6 site) – Species poor, but with evidence of use by Badger

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.33 ICW Site WD2 mixed broadleaved/conifer woodland

EPA Export 06-01-2017:02:02:10

Linear woodland and scrub - WL1/WL2

A hedgerow (WL1) forms the boundary of much of the survey area, with sections perhaps better described as tree-lines along the disused Navan – Kingscourt railway line. The species present within the WL1/WL2 habitat are typical for this region, dominated by *Fraxinus excelsior, Crataegus monogyna, Prunus spinosa* and *Sambucus nigra* with occasional *Acer pseudoplatanus* and other non-natives. The hedgerows have an understorey component comprised of numerous species, including *Lapsana communis, Heracleum sphondylium, Urtica dioica* and *Galium aparine* with grasses such as *Dactylis glomerata, Elytrigia repens* and *Arrhenatherum elatius* abundant. Climbing species such as *Rosa canina* and *Solanum dulcumare* are also present.

These hedgerow and treeline habitats are of very high local importance ecologically, as they represent significant commuting/foraging corridors for numerous groups of fauna (bats, birds, etc.), in addition to providing habitat for roosting/nesting/setts/dens, etc. within the primarily agricultural landscape of County Meath. The hedgerow and treeline habitat occurring along the Navan-Kingscourt railway line is of very high regional ecological importance, as this provides a virtually unbroken ecological corridor for over 30 kilometres through a landscape dominated by intensive agriculture. This corridor runs in close proximity to several "Biodiversity Hotspots" such as Whitewood Lake, just south of Kilmainhamwood.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.34 Photograph illustrating WL1/WL2 habitat occurring at the eastern boundary of the survey area, occurring along the disused Navan to Kingscourt railway line

Scrub -WS1

There are present throughout the proposed development footprint, most particularly in the western section, small, isolated patches of scrub habitat. This scrub habitat is most frequently associated with drainage ditches or attenuation ponds, and tends to be dominated by species such as *Betula pubescens, Salix cinerea, Salix aurita, Ulex europaeus* and *Rubus fruticosus* agg. This wet scrub habitat has likely developed in areas of recolonised grassland, where there is little grazing by hare or rabbit to maintain the grassland habitat. In the absence of grazing or management, the climax vegetation across most of Ireland is woodland, and scrub is successional to the development of woodland. Figure

EPA Export 06-01-2017:02:02:10

4.35 illustrates the development of scrub habitat, primarily willow scrub, in the vicinity of a number of small attenuation ponds on Blake's stream, just before it joins with the Yellow River. The habitat is for the most part, dominated by *Salix cinerea*, with numerous *Juncus* species with *Chamerion angustifolia* prevalent along disturbed edges, and grasses such as *Helictotrichon pubescens, Agrostis stolonifera, Holcus lanatus* and *Poa trivialis*.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.35 Photograph illustrating scrub development in the vicinity of FL8 habitat

Figure 4.x Scrub area ICW Site

EPA Export 06-01-2017:02:02:10

4.4.3 European Communities (Birds and Natural Habitats) Regulations 2011

Species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations of 2011

No Alien Invasive Plant Species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations of 2011 were identified as occurring within the footprint of the Stage 6 TSF.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

4.4.5 Bird Surveys

4.4.5.1 General bird surveys

A total of 30 species of bird were observed to occur within the survey area. Within the poorly colonised ED3 habitat and ED4 habitat, Meadow Pipits, Swallows and Sand Martin were present, and there were indications of breeding Sand Martin in the form of small colonies on banks of spoil. Within those areas of ED3 that were more significantly vegetated, seed-eating species such as Goldfinch, Lesser Redpoll and Siskin occurred in small flocks. A pair of Raven occupied a territory in the vicinity of "Blake's House" at the Sillogue entrance to the Borrow Pit Area. A pair of Buzzard were also present, likely with a nest within the hedgerow along the western boundary of the survey area. The woodland habitat and hedgerow habitat present within and at the periphery of the survey area was the most species diverse, with species such as Blackbird, Wren, Goldcrest, Robin, Blue Tit, Great Tit and Dunnock all abundant. A pair of breeding Sparrowhawk were located in the woodland area also. There are several small wetland areas occurring within the survey area. Toward the south-western corner of the site are two small, linear ponds, part of Blake's Stream. A pair of mute swan and 3 Signets were present on these ponds, in addition to several pair of Moorhen. The large pond adjacent to the Woodland area was heavily utilised by Mallard, with up to 200 birds present. Several Teal, in addition to a pair of Little Grebe were also present on this pond. During winter surveys of the woodland area, Pheasant were found to be numerous.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.36 Breeding Mute Swan occurring within the mosaic of ponds in the south-western corner of the survey site

EPA Export 06-01-2017:02:02:10

Table 4.7: Birds observed to be present on site

Common Name	Latin Name	BoCCI Status
Sparrowhawk	*Accipiter nisus*	Amber
Teal	*Anas crecca*	Amber
Mallard	*Anas platyrhynchos*	Green
Meadow Pipit	*Anthus pratensis*	Red
Grey Heron	*Ardea cinerea*	Green
Buzzard	*Buteo buteo*	Green
Goldfinch	*Carduelis carduelis*	Green
Lesser Redpoll	*Carduelis flammea cabaret*	Green
Siskin	*Carduelis spinus*	Green
Wood Pigeon	*Columba palumbus*	Green
Raven	*Corvus corax*	Green
Hooded Crow	*Corvus corone cornix*	Green
Rook	*Corvus frugilegus*	Green
Jackdaw	*Corvus monedula*	Green
Mute Swan	*Cygnus olor*	Amber
Sand Martin	*Riparia riparia*	Amber
Robin	*Erithacus rubecula*	Amber
Moorhen	*Gallinula chloropus*	Green
Swallow	*Hirundo rustica*	Amber
Pied Wagtail	*Motacilla alba yarrellii*	Green
Blue Tit	*Parus caeruleus*	Green
Great Tit	*Parus major*	Green
Pheasant	*Phasianus colchicus*	Green
Magpie	*Pica pica*	Green
Dunnock	*Prunella modularis*	Green
Goldcrest	*Regulus regulus*	Amber
Little Grebe	*Tachybaptus ruficollis*	Amber
Wren	*Troglodytes troglodytes*	Green
Blackbird	*Turdus merula*	Green
Song Thrush	*Turdus philomelos*	Green

For inspection purposes only.
Consent of copyright owner required for any other use.

Kingfisher Surveys

Targeted Kingfisher surveys were carried within the survey areas in suitable habitat on two occasions (6th and 29th of August). The targeted Kingfisher surveys indicated no evidence of Kingfisher utilising the footprint of the proposed Stage 6 TSF. It must be noted that Kingfisher were not observed utilising any area of the site throughout the entire survey period.

Wader Surveys

No species of wader such as Curlew, Lapwing, Redshank, etc. were observed within the survey area during any surveys. Given the susceptibility of these species to disturbance during breeding (many of which are ground-nesting) and the ongoing works within the proposed development footprint, it is highly

EPA Export 06-01-2017:02:02:10

unlikely that the area would be used for breeding. It is important to note that during the bird survey carried out on 21st July 2015, a Curlew was heard alarm-calling in the vicinity of the Simonstown Borrow Pit. This area of habitat contains a mosaic of wetland/grassland habitats (suitable for breeding Curlew) and it is highly likely that a breeding pair of Curlew occur within this habitat. Breeding Curlew are increasingly rare in Ireland. Of note, during winter bird surveys, Curlew were observed on several occasions, and during the pre-dawn survey carried out on March 8th, a pair of Curlew were observed to exhibit territorial behaviour in the vicinity of the Simonstown Borrow Pit (the pair circling the observer, giving alarm calls). It is almost certain, therefore, that a breeding pair of Curlew occurs within the habitat present at the Simonstown Borrow Pit.

Raptors

Although a dedicated raptor survey was not undertaken, Common Buzzard and Sparrowhawk were observed during the survey of the Borrow Pit area. Until recently, Kestrel were commonly observed in the vicinity of the 'Borrow pit' area. The occurrence of Common Buzzard and the absence of Kestrel, once the most commonly observed bird of prey in Ireland, within the survey area reflects the decline in Kestrel and increase in Buzzard numbers on a national scale. During the winter bird surveys, a Peregrine Falcon was observed hunting over the TSF on several occasions.

For inspection purposes only.
Consent of copyright owner required for any other use.

Winter bird surveys of species of conservation concern

Winter bird surveys were carried out on a bimonthly basis between the months October 2015 and March 2016 inclusive. Dusk, pre-dawn and midday (please note that the field sheet with the results of the 1st midday survey in October were lost before they could be transcribed) surveys were carried out in order to determine the importance of the TSF as:

- A daytime roost (in particular for Golden Plover and Lapwing); and
- A night roost (in particular for Whooper Swan).

The results of the surveys indicate that the TSF is a regionally important (owing to the nature of the habitat – the largest inland water body (entirely contained within) in Co. Meath.

The TSF is utilised as a day roost by both Lapwing and Golden Plover (but in particular the latter). Numbers of Lapwing are greatest in the early months, while numbers of Golden Plover (flocks of which regularly numbered in excess of 2,000 – up to approximately 2,600 recorded on the 18th of February 2016) are greatest in latter months. Golden Plover flocks were observed to roost during the day on (stage 5b) the TSF and to depart as a single flock approximately 30 minutes after sunset. Flocks were generally observed returning toward the end of the pre-dawn surveys.

EPA Export 06-01-2017:02:02:10

Whooper Swan regularly roost at the TSF overnight, in particular during the early months of the winter season (with significant numbers observed during the period October – December), with a peak of 118 Whooper Swan recorded during the dusk survey on the 30th of November 2015. These flocks were observed to arrive at the TSF in the evenings (generally approximately 30 minutes after sunset) from the north and north-east and to depart to the north and north-west, almost certainly part of the flock utilising the Blackwater and its floodplains. It was observed that the extreme volumes of rain in early November resulted in a large body of water on Stage 5b of the TSF, and activity shifted from stage 5a to 5b (with little or no roosting on 5b during October, when there was very little standing water present).

There were regularly observed very high numbers of (in particular) Black-headed Gull and Great Black-backed Gull, and the TSF is likely one of the primary inland winter roosts for these species in Meath. Numbers were often approximated, as in large flocks there was constant bickering and movement.

Peregrine Falcon, an Annex I species was observed hunting over the TSF on numerous occasions during surveys, no doubt attracted by the high numbers of prey items. The results of the winter bird surveys are presented in Appendix 4.3.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

4.5 Mammal Surveys

4.5.1 General Mammal surveys (including badger)

General mammal surveys were carried out throughout the survey period. The general habitat present (ED2 and ED3), the degree of disturbance and the isolation of suitable habitat limits the use of the survey area by mammals (and in particular smaller mammal species). Evidence was observed for Fox (*Vulpes vulpes*), Badger (*Meles meles*), Rabbit (*Oryctolagus cunniculus*), Brown Rat (*Rattus norvegicus*), Pygmy Shrew (*Sorex minutus*), Woodmouse (*Apodemus sylvaticus*) and Grey Squirrel (*Sciurus carolinensis*). An unusually large population of Hare (*Lepus timidus hibernicus*) occurs within the *environs* of the TSF and Hare was the most commonly observed mammal occurring within the survey area. A potential outlier Badger sett within the area of woodland at the southern boundary of the footprint of the proposed development was noted. Subsequent monitoring of the sett over the period January/February 2016 yielded no evidence of use by Badger and it is likely that this population were subject to culling carried out by the Department of Agriculture, Food and the Marine. **A derogation regarding the removal of this sett has been granted from NPWS Refer to appendix 4.1.**

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.37 Hare - the most frequently observed species of mammal within the survey area

EPA Export 06-01-2017:02:02:10

4.5.2 Otter Survey

Given the nature of the habitat present, and the degree of disturbance, it is unlikely that Otter ever forage within the habitat present within the footprint of the proposed Stage 6 TSF. However when one considers the connectivity between the site and the *Rivers Blackwater* and *Boyne*, where Otter are known to occur an Otter surveys were deemed necessary.

At no point throughout the survey period was any evidence of Otter observed.

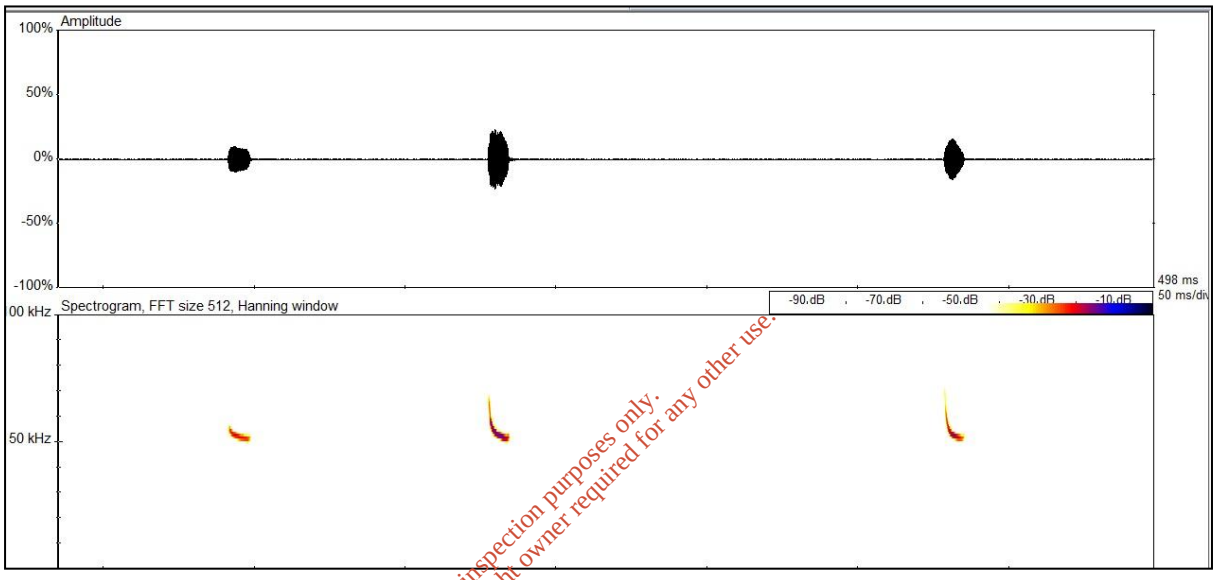
For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

4.6 Bat Surveys - summer

4.6.1 Static monitor bat surveys

The identification of bats from the calls recorded on the Pettersson D500X was accomplished through a combination of sound-analysis software (Batsound 4.2, Kaleidoscope and Sonochiro) and manual interpretation. Illustrations of a sample spectrograph of a Soprano Pipistrelle and the associated power spectrum of one of the calls attained utilising the Batsound software is shown in
Figure 4.38 and
Figure 4.39.



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.38 Spectrograph of the echolocation call of a soprano pipistrelle

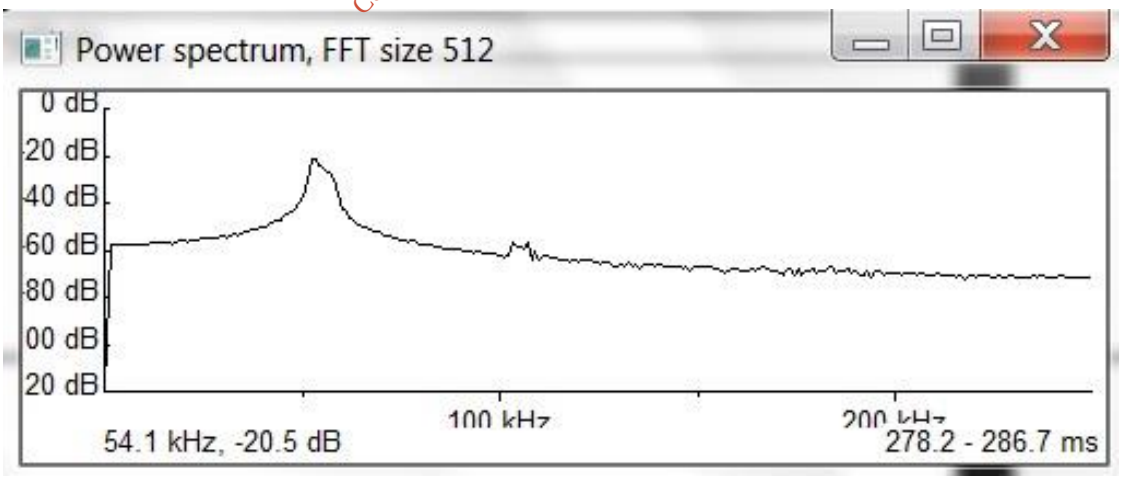


Figure 4.39 Power spectrum of one of the calls, showing that the maximum power of the call is at a frequency of 54.1 kHz

EPA Export 06-01-2017:02:02:10

General Borrow Pit Area

The Pettersson D500x placed to determine bat activity within the general borrow pit area recorded a total of only 33 bat passes over the 17 nights of the survey period between the 21st of July and the 6th of August, with an average of approximately 2 bat passes per night. Four species were recorded – Leisler's Bat, Daubenton's Bat, Common Pipistrelle and Soprano Pipistrelle.

The most commonly recorded activity was that of Leisler's Bat (20). Unexpectedly (given the habitat), Daubenton's Bat was recorded on 5 occasions. Only 8 Pipistrelle passes were recorded (5 Common Pipistrelle and 3 Soprano Pipistrelle). The earliest recorded bat was a Leisler's Bat, detected approximately 20 minutes after sunset on the 31st of July. A detailed breakdown of bat passes by date, time and species is given in Table 4.8.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.40 Location of Pettersson D500x recording activity in general area of the Borrow Pit

Table 4.8: Results of static monitoring broken down by date, time and species in the general borrow pit area.

Date	Time	Species
21/07/2015	22:10:50	Leisler's Bat
21/07/2015	22:44:05	Leisler's Bat
22/07/2015	01:27:34	Leisler's Bat
22/07/2015	04:03:00	Leisler's Bat
22/07/2015	04:13:55	Leisler's Bat
23/07/2015	02:35:32	Leisler's Bat
23/07/2015	22:57:18	Leisler's Bat
23/07/2015	23:08:35	Leisler's Bat

EPA Export 06-01-2017:02:02:10

Date	Time	Species
24/07/2015	02:24:33	Daubenton's Bat
24/07/2015	02:39:15	Common Pipistrelle
24/07/2015	03:48:52	Soprano Pipistrelle
24/07/2015	22:52:45	Daubenton's Bat
24/07/2015	23:21:33	Common Pipistrelle
24/07/2015	23:54:22	Daubenton's Bat
29/07/2015	04:06:55	Daubenton's Bat
29/07/2015	22:13:10	Leisler's Bat
29/07/2015	22:21:54	Common Pipistrelle
29/07/2015	22:24:39	Soprano Pipistrelle
30/07/2015	22:05:33	Leisler's Bat
30/07/2015	22:22:36	Leisler's Bat
30/07/2015	22:41:21	Leisler's Bat
31/07/2015	21:46:14	Leisler's Bat
31/07/2015	22:15:23	Leisler's Bat
01/08/2015	00:09:04	Leisler's Bat
01/08/2015	22:19:46	Leisler's Bat
01/08/2015	22:27:04	Soprano Pipistrelle
01/08/2015	22:35:54	Common Pipistrelle
02/08/2015	04:47:29	Daubenton's Bat
04/08/2015	22:05:17	Leisler's Bat
04/08/2015	22:09:12	Leisler's Bat
04/08/2015	22:28:39	Leisler's Bat
04/08/2015	22:51:46	Leisler's Bat
05/08/2015	02:07:46	Common Pipistrelle

Consent of copyright owner required for any other use. For inspection purposes only.

Site entrance roadway

The July Hand-held survey having identified a potential commuting/foraging corridor, a Pettersson D500x was deployed in the proximity of the Sillogue entrance in order to determine bat activity along the roadway/hedgerow associated with the Sillogue entrance of the Borrow Pit (coming from the south).

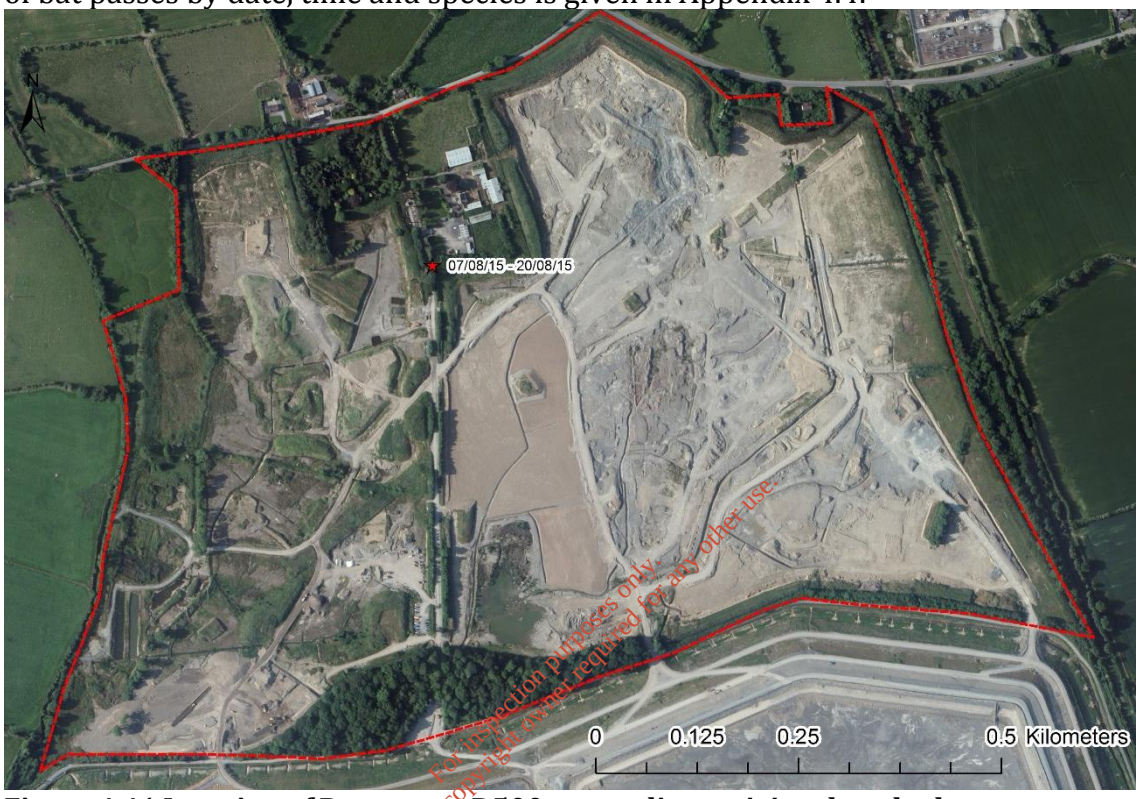
Over 1,200 bat passes were recorded over the 14 nights of the survey period between the 6th of August and 19th of August, with an average of approximately 88 bat passes per night (see Figure 4.41). The unit was deployed with the microphone directed southward to determine if bats were coming from the south. Six species were recorded – Leisler's Bat, Daubenton's Bat, Natterer's Bat, Brown Long-eared Bat, Common Pipistrelle and Soprano Pipistrelle.

The most commonly recorded activity was that of Leisler's Bat (509). Again, Daubenton's Bat was recorded, in more significant numbers, with 66 passes. A small number of Natterer's Bat (4) and Brown Long-eared Bat (7) were recorded irregularly. Significant numbers of Common Pipistrelle (209) and Soprano Pipistrelle (441) were regularly recorded. The earliest recorded bat was a Leisler's Bat, detected approximately 15 minutes before sunset on the 13th of

EPA Export 06-01-2017:02:02:10

July, indicating a strong possibility that there is a Leisler's Bat roost in the immediate vicinity.

Both Common and Soprano Pipistrelle were detected very soon (approximately 5 – 10 minutes) after sunset also, indicating a strong possibility that there are roosts of these two species in the immediate vicinity also. A detailed breakdown of bat passes by date, time and species is given in Appendix 4.4.



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.41 Location of Pettersson D500x recording activity along hedgerow at Sillogue entrance to Borrow Area

Roadway Bisecting Borrow Pit – Southern (Woodland) End

A Pettersson D500x unit was deployed at the woodland end of the north entrance to the site in order to determine (coming from the north) bat activity along the roadway/hedgerow.

A total of 760 bat passes were recorded over the 14 nights of the survey period between the 6th of August and 19th of August, with an average of approximately 54 bat passes per night. The unit was deployed with the microphone directed northward to determine if bats were coming from the north. Six species were again recorded – Leisler's Bat, Daubenton's Bat, Natterer's Bat, Brown Long-eared Bat, Common Pipistrelle and Soprano Pipistrelle, but the composition differed significantly.

The most commonly detected bat was Common Pipistrelle (263). Leisler's Bat (257) and Soprano Pipistrelle (198) were also recorded in relatively high numbers. Daubenton's Bat was recorded, in significant numbers, with 36 passes. While only 2 Natterer's Bat passes were detected, 23 Brown Long-eared Bat

EPA Export 06-01-2017:02:02:10

passes were recorded, with this "hard to detect" species recorded on 9 of the 14 nights surveying.

The earliest recorded bat was a Leisler's Bat, detected approximately 9 minutes after sunset on the 18th of July. Common Pipistrelle, Soprano Pipistrelle. Daubenton's Bat and Natterer's Bat were all detected within 30 minutes of sunset, and given the woodland habitat, the results indicate a strong possibility that there are roosts of these species within the woodland. It is highly likely, given the regularity of recording of the Brown Long-eared Bat that numbers of this species roost in the woodland also. A detailed breakdown of bat passes by date, time and species is given in Appendix 4.4.

Figure 4.42 Location of Pettersson D500x recording activity along hedgerow woodland end of Sillogue entrance roadway

"Blake's House"

There is a derelict house ("Blake's House") located at the northern site boundary. The building which is in an advanced state of disrepair is surrounded by mature trees. Given the setting of the building, surrounded by mature trees and in the vicinity of several ecological corridors, such as the Yellow River, it is considered very likely be a potential roosting site for one or more species of bat. The unsafe state of the building mant a building inspection was not possible on health and safety grounds.

In order to assess activity around the house, a Pettersson D500x unit was deployed over two nights (6th and 7th August). A total of 226 bat passes were detected over the two nights on which the D500x was deployed, with 70 bats of three species (Leisler's Bat, Common Pipistrelle and Soprano Pipistrelle) detected within the period of 1 hour after sunset (the first bat recorded was a

EPA Export 06-01-2017:02:02:10

Leisler's Bat, recorded several minutes before sunset, the second bat recorded was a Soprano Pipistrelle, recorded at 1 minute after sunset).

These results would indicate that the site of Blake's House (building and/or mature trees) likely serves as a roost for modest numbers of Leisler's Bat, Soprano Pipistrelle and Common Pipistrelle. The location of the D500x Unit is indicated in **Error! Reference source not found.**43. This site provides conditions suitable as both maternity and hibernation roosts). A detailed breakdown of bat passes by date, time and species is given in Appendix 4.4.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.43 Location of D500x Unit at Blake's House

Man-made pond adjacent to wooded area

There is located at the southern end of the proposed development foot print, a man-made pond covering an area of just under 1ha immediately adjacent to mature mixed broadleaved woodland. The pond is an attenuation pond on Blake's Stream, with a good cover of vegetation around the northern fringe of *Typha latifolia* and *Iris pseudacorus*.

To the south, approximately 50 m away, is the wooded area that borders the proposed development footprint. A Pettersson D500x unit was deployed at this site between the 20th and the 23rd of August. During this time period, 860 bat passes, of 5 species were recorded (555 X Soprano Pipistrelle, 200 X Leisler's, 52 X Common Pipistrelle, 45 X Daubenton's Bat and 8 X Brown Long-eared Bat).

Of importance to note, a Hand-held survey was carried out on the night of the 22nd of August, during which large numbers of bats were observed flying immediately above the water's surface. It is likely that some of these bats would

EPA Export 06-01-2017:02:02:10

have been missed by the Pettersson D500x as it was placed several feet above water level. It is likely that the numbers of Daubenton's Bat present may have been underestimated by the static monitor. The location of the unit is illustrated in Figure 4.44.

Figure 4.44 Location of Pettersson D500x deployed at pond between 20th and 23rd of August

For inspection purposes only.
Consent of copyright owner required for any other use.

During the September Hand-held survey (09/09/15), night vision was utilised to identify where bats foraging at the pond and adjacent habitat were approaching from. The vast majority were observed to come from within the woodland, suggesting that there may be roosts present. In order to investigate further, a Pettersson D500x unit was deployed beside the pond, facing into the woodland over the narrow strip of grassland habitat.

This unit was left in place on the 10th and 11th of September. During this period, 490 individual bat passes were recorded at this location (364 Soprano Pipistrelle, 55 X Daubenton's Bat, 42 X Leisler's Bat, 27 X Common Pipistrelle and 2 X Brown Long-eared Bat). The results of this static monitoring support the findings of the September Hand-held survey, and it is almost certain that there is a sizeable roost of at minimum, Soprano Pipistrelle and Daubenton's Bat present within the woodland forming the southern boundary of the site.

The location of the unit is illustrated in figure 4.45. A detailed breakdown of bat passes by date, time and species is given in Appendix 4.4.

EPA Export 06-01-2017:02:02:10

Figure 4.45 Location of Pettersson D500x unit deployed at pond between 10/09/15 and 1/09/15

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

July Survey

The July Survey was carried out under optimal conditions (15°C start temperature, 70% R.H, no wind, no rain, clear visibility). Virtually no bat activity was detected throughout the majority of the area of the proposed development footprint during the survey period. The survey commenced at 21:15 (approximately 30 minutes before sunset) and lasted until 23:15 (approximately 90 minutes after sunset).

Four species of bat were detected during the July emergence survey (1 x Leisler's Bat, 14 X Common Pipistrelle, 1 X Soprano Pipistrelle and 12 X Myotis species – the majority likely Daubenton's Bat). The first bat (a Leisler's Bat) was detected at 21:49, shortly after sunset and approached from the south, passing along the existing tailings facility and through the footprint of the proposed development (while foraging).

Almost no bat activity was detected in the remainder of the development footprint, barring along the small roadway running between the northern site entrance and the wooded area (see Figure 4.46). A relatively large number of bats were detected along this corridor, with 14 Common Pipistrelle detected in close succession at 22:06, in addition to 12 Myotis species. These Myotis were almost certain to have been Daubenton's bat, based on subsequent findings.

The emergence of these species within 20 minutes of sunset, indicated a potential roost in the vicinity. The most likely areas for potential roosts were the wooded area at the southern boundary of the development, or Blake's House, at the Sillogue entrance. Static monitors were placed in the vicinity of each of these locations in order to determine likely roosting sites. One other bat was detected during the July hand-held survey – a Soprano Pipistrelle, recorded foraging along the hedgerow at the eastern boundary of the development footprint at 22:46.

The results of the July hand-held survey reflect the results yielded by the static monitoring – there is very little bat activity within the over-all area of the proposed development. The results of the July hand-held survey did, however, suggest an important foraging/commuting route along the laneway between the Sillogue entrance and the woodland at the southern boundary of the proposed development, and indicated that there may be potential roosting sites within the woodland at the southern boundary of the site and/or within the ruins of Blake's House at the Sillogue entrance. The July hand-held survey informed the placement of static monitors, and identified those areas of relatively high bat activity within which to focus the August hand held survey.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:10

Figure 4.46 Map indicating observations of bat activity during the July 2015 hand-held emergence bat survey

For inspection purposes only.
Consent of copyright owner required for any other use.

August Survey

The August Survey was carried out under optimal conditions on the 22nd of August 2015 (13°C start temperature, 96% R.H, no wind, no rain (light drizzle developed during the last 10 minutes of the survey) and clear visibility). The survey commenced at 20:10 (approximately 30 minutes before sunset) and lasted until 22:15 (approximately 90 minutes after sunset). Five species of bat were detected during the August emergence survey (Common Pipistrelle, Soprano Pipistrelle, Daubenton's Bat, Leisler's Bat and Brown Long-eared Bat).

The survey concentrated on the area of the woodland at the southern boundary of the development area, in the vicinity of the bisecting roadway at first, before moving to the east to a man-made pond, having followed bat activity in that direction (see Figure 4.47). The first bat (a Leisler's Bat) was detected at 21:05, approximately 20 minutes after sunset and approached from the west, a number of bats, including Brown Long-eared Bat, Common Pipistrelle, Soprano Pipistrelle and Daubenton's Bat were recorded approaching from the west, and from the north along the roadway. Almost all activity was directed toward the east of the observer's position, and the observer followed the activity. Approximately 50 m to the east of the laneway, is a small, man-made attenuation pond. A large amount of bat activity was detected at this pond, to such an extent that it was not possible to count bat passes or distinguish species based on heterodyne detection. A combination of direct visual observations (utilizing a powerful torch in short bursts) and visual examination of sonograms produced by the Echometer EM3+ identified that there were in the region of approximately 150 bats feeding over the pond, including Common Pipistrelle, Soprano

EPA Export 06-01-2017:02:02:10

Pipistrelle, and a large number (almost certainly in excess of 50 individuals) of Daubenton's Bat feeding over the pond. The August Hand-held survey clarified the issue as to the presence of Daubenton's Bat in the survey area (no activity at all was detected over the tailings pond itself on previous surveys). The survey also indicated a strong likelihood that there is a significant roost of Pipistrelles and/or Daubenton's Bat within the Wooded area along the Southern Boundary of the proposed development footprint and that the attenuation pond immediately adjacent to the woodland is attracting large volumes of feeding bats. The August hand-held survey informed the positioning of Static monitors, in addition to identifying the key area of bat activity within the proposed development footprint.

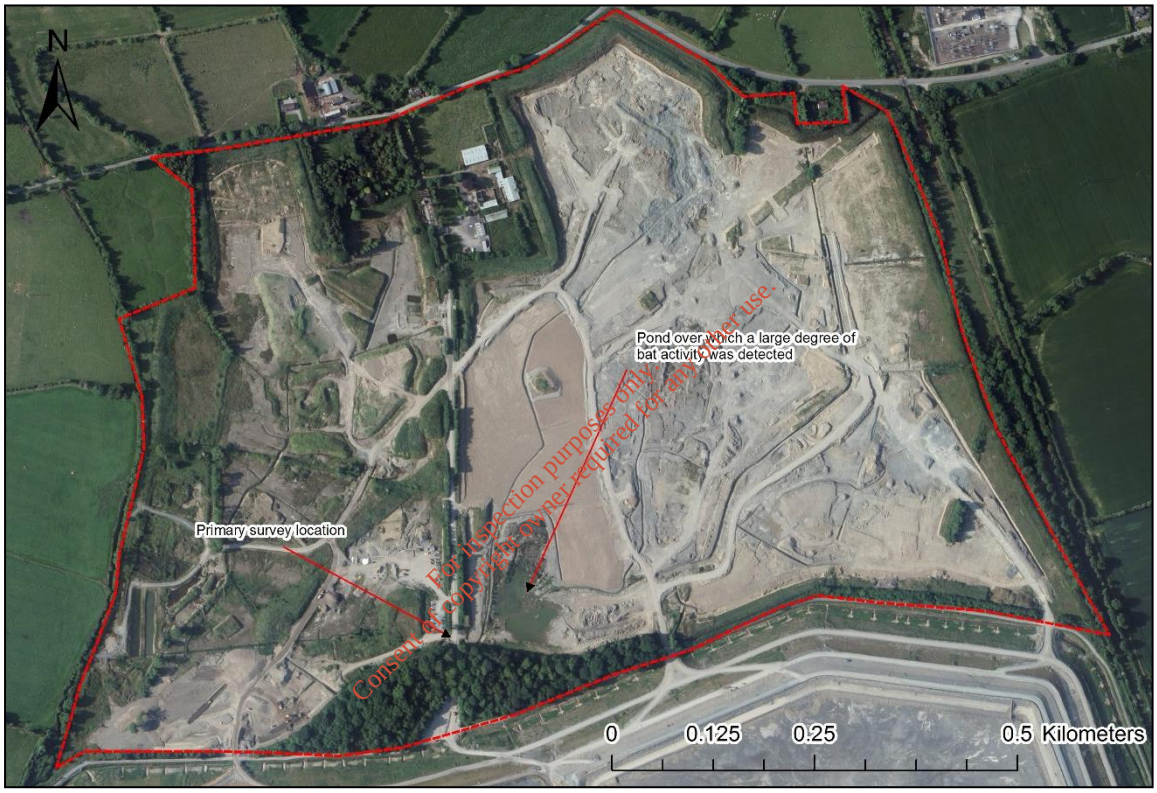


Figure 4.47 Map indicating location of concentration of survey effort

September Survey

The September Survey was carried out under optimal conditions on the 9th of September 2015 (12°C start temperature, 85% R.H, no wind, no rain and clear visibility). The survey commenced at 19:00 (approximately 60 minutes before sunset) and lasted until 21:30 (approximately 90 minutes after sunset). The September survey concentrated on that area in the vicinity of the pond and woodland on the southern boundary of the development footprint that was found to be the focus of bat activity within the development footprint during the previous hand-held surveys. The survey was begun early (approximately 1 hour before sunset) in order to allow for a pre-emergence chatter survey at the woodland edge. No pre-emergence chatter was detected at the woodland edge.
Three species of bat were detected during the September emergence survey (Common Pipistrelle, Soprano Pipistrelle and Daubenton's Bat). Bat activity was, again, so intense as to render the heterodyne monitoring unit of little practical

EPA Export 06-01-2017:02:02:10

use following the initial emergence of bats. The first species observed was a Common Pipistrelle at approximately 20:28, approximately 30 minutes after sunset. This bat emerged from the woodland along the southern boundary of the development footprint. Almost immediately afterward, a number of Soprano Pipistrelle, Common Pipistrelle and Daubenton's Bat also emerged. Numbers of bats and activity were of the extent that it was not possible to accurately count the number of individuals emerging from the woodland. Digital night vision was utilized to augment the survey, in order to identify where bat activity was focused. Large numbers of bats were observed to emerge from the woodland and then re-enter (possibly light sensing activity, which may indicate a roost in the interior of the woodland) the woodland, making it impossible to accurately determine the numbers of bats emerging. Bats emerging from the woodland without re-entering commenced feeding activity (as confirmed by "Feeding Buzzes") over the grassland area immediately adjacent, before proceeding to the pond, where feeding activity continued. Small numbers of bats were also observed utilizing night vision to approach from the east and north, but the majority of bats feeding in the vicinity of the pond were emerging from the woodland, indicating that there is a significant roost of Common Pipistrelle, Soprano Pipistrelle and Daubenton's Bat within the area of woodland. It is also likely that there are small roosts of Brown Long-eared Bat and Natterer's Bat present in this woodland. Intense activity was recorded during the duration of the survey, which finished at 21:30.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

4.6.3 Bat Surveys – winter

Two habitats were identified from summer surveys – Blake's House and gardens and the woodland on the southern boundary of the site, which had significant potential to provide habitat for roosts, both summer and winter. It was, therefore deemed necessary to carry out a winter survey of these two sites to determine if bats utilise either/both of these habitats during the winter. The changeable weather conditions, and hibernation of bats in Ireland would indicate that the use of hand-held detectors during the winter season yields little or no useful information regarding bat usage of habitats. In order to determine if either the woodland along the southern boundary of the proposed development footprint or the habitat provided by "Blake's House" and associated mature gardens are utilised as winter roosting habitats, a Pettersson D500x ultrasound recording unit was placed at both sites between the 11th of November 2015 and February 29th 2016. Utilising this equipment, the activity of any bats emerging from hibernation to briefly feed, defecate, etc. during a mild-spell will be recorded.

Woodland Habitat

No bat activity at all was recorded from the D500x unit placed within the woodland habitat.

Blake's House and associated garden

In contrast to the woodland habitat, significant activity was detected in the vicinity of Blake's House of two species, Common Pipistrelle and Soprano Pipistrelle between the 11th of November and the 20th of December, with social calls recorded well into December. This would indicate that the derelict building at Blake's is almost certainly serving as a winter roost for, at minimum, these two species.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:10

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

4.7 Surveys of selected Invertebrate Groups

4.7.1 Butterfly surveys

Although the summer of 2015 was particularly cold and wet, the lack of diversity of butterfly fauna within the proposed development footprint is almost certainly owing to the lack of habitat present – the majority of vegetated habitat occurring within the proposed development footprint is ED3 or GA1. Only a very limited number of species (6) were observed within the development footprint, while a simultaneous survey of butterfly diversity in the vicinity of the tailings pond (immediately adjacent) yielded 15 species of butterfly, and evidence of a high population of the Cinnabar moth (as evidenced by large numbers of caterpillars on the larval food-plant Ragwort). It was initially planned to carry out a detailed moth survey of the area also, but the poor weather conditions during the summer of 2015 precluded this (the survey was to be carried out using a Robinson moth trap run off a generator – while the Robinson trap yields the highest catch of moths, the Mercury-vapour bulb gets very hot, and if exposed to rain, will explode). The species of butterfly observed during the surveys are listed in Table 5.9.

Table 4.9: Butterflies noted during butterfly surveys

Common Name	Latin Name	Habitat
Large White	*Pieris brassicae*	In flight over ED2
Small White	*Pieris rapae*	In flight over ED2
Green-veined White	*Pieris napi*	In flight over ED2
Small Tortoiseshell	*Aglais urticae*	In small area of ED3
Holly Blue	*Celastrinus argiolius*	Along WL1 at eastern boundary
Peacock	*Inachis io*	In small area of ED3

For inspection purposes only. Consent of copyright owner required for any other use.

4.7.2 Bee and Bumblebee Surveys

Similar to the butterfly survey, the cold, wet summer of 2015 likely did have a negative impact on Bee and Bumblebee populations throughout the country. The lack of diversity observed within the proposed development footprint, however, is almost certainly owing a lack of habitat. While only 2 species were observed to occur within the development footprint (*Bombus lapidarius* and *Bombus pascorum*), during a simultaneous survey of the adjacent habitat at the tailings facility, 5 species observed during the surveys (*Bombus terrestris, Bombus lapidarius, Bombus pascorum, Bombus lucorum* and *Apis melifera*). It must be noted that while 5 species is a relatively poor diversity of Bee and Bumblebee species, within the facility this lack of diversity is almost certainly owing to the poor weather conditions experienced in 2015 (a very cold May, and a cold, wet summer).

EPA Export 06-01-2017:02:02:10

4.7.3 Surface water stream - *Blake's Stream*

Blake's stream is a relatively small watercourse that appears to have been redirected on several occasions in the recent past. Along much of it length, it is of low ecological significance, with little or no vegetation, very low invertebrate diversity and no associated hedgerow habitat. The watercourse is not suitable for use by White-clawed Crayfish (*Austropotamobius pallipes*) and no evidence of this species was observed. Although there are a number of small attenuation ponds present, there was no evidence for Newts (*Trituris vulgaris*) observed during surveys. The Common Frog (*Rana temporaria*) was observed within the vicinity of Blake's stream and is likely ubiquitous throughout the area in suitable habitat. A general invertebrate survey of Blake's stream was carried out. It is important to note that the invertebrate survey as carried out is not intended as an invertebrate survey for use in Q-values, etc. (the impact of the proposed development on aquatic habitats is comprehensively discussed in section 5), but was carried out in order to identify the general diversity of the invertebrates occurring within Blake's Stream and associated water bodies. A synopsis of the individual sampling follows.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

4.7.2.1 Site 1 – Blake's Stream

Sampling Site 1 (at the point of entry onto the development site) on *Blake's Stream* within the proposed development footprint was almost completely devoid of in-stream aquatic or typical riparian emergent vegetation, with relatively steep-sided banks approximately 36 – 40 inches high.

The kick/sweep sampling at this location yielded over 1000 individuals of *Gammarus duebeni* – but no other species. It must be noted that this section of the stream is furthest from the Yellow.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.48 Site 1 sampling point on Blake's Stream at northern end of site

EPA Export 06-01-2017:02:02:10

4.7.2.2 Site 2 Blake's Stream

While this section of Blake's stream had some bank-side vegetation, largely in the form of grasses and ruderals such as *Tussilago farfara* (but with some typical stream-side species, such as *Mentha aquatica*, starting to occur), *Gammarus dubeniii* was the only species sampled, albeit in far lower numbers than at site 1 (approximately 150 individuals). At this site, there was virtually no in-stream vegetation, and the substrate was entirely gravel and rocks.

Figure 4.48 Photograph illustrating habitat present at sampling site 2

For inspection purposes only.
Consent of copyright owner required for any other use.

Site 3 Blake's Stream

The third site sampled along Blake's stream sampled the invertebrate community occurring at the edge of the attenuation pond (which covers an area of approximately 1ha) into which Blake's Stream flows and exits (see Figure 4.49). A high concentration of bat activity, and large numbers of water-fowl, primarily mallard were observed to utilize this pond– which would indicate that there is a substantial invertebrate food source present. This was substantiated by the relative diversity of species sampled at this location.

EPA Export 06-01-2017:02:02:10

Figure 4.49 Photograph illustrating pond occurring at sampling site 3

For inspection purposes only.
Content of copyright owner required for any other use.

At this site, the diversity of species sampled occurring increased significantly. In addition to substantial numbers of *Gammarus dubeniii, Assellus aquaticus* was also present, with large numbers of both Greater Water Boatman (*Notonecta glauca)* adults and nymphs and lesser Water Boatman Adults and nymphs (*Corixidae)*.

While numerous gastropods were sampled, overall, Gastropod diversity was relatively low, with only two species sampled (*Physa fontanilis* and *Lymnaea stagnalis*). Numerous individuals of *Gerris lacustris* and *Gyrinus natator* were sampled. Numerous 3-spined Stickleback were sampled from this site. Despite observations of several adult specimens of a number of dragonfly and damselfly species, only larvae of *Ischnura elegans* were sampled.

There were absent some of the larger predators that might be expected to occur, such as *Dytiscus marginalis, Nepea cinerea* or *Argyroneta aquatica*. The absence of these predators and the low diversity of gastropod species is likely owing to the age of the man-made pond system (approximately 10 years), which was likely only recently colonized by plant and invertebrate life.

EPA Export 06-01-2017:02:02:10

Site 4 – Blake's Stream

Sampling site 4 is located immediately before Blake's Stream discharges to the Yellow River. There was a significant amount of both aquatic and emergent vegetation present within the stream, which was immediately downstream of a number of small attenuation ponds. Both Moorhen and Mute Swan nested in the vicinity of this sampling point.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.50 Photograph illustrating sampling site 4

Sampling site 4 contained the highest diversity of invertebrates of any of the sites, as might be expected owing to the proximity of the site to the confluence of Blake's Stream and the Yellow River, from which species can easily colonise. The numbers of *Gammarus dubeniii* and *Assellus aquaticus* sampled was relatively small, while the numbers of both Greater Water Boatman (*Notonecta glauca)* adults and nymphs and Lesser Water Boatman Adults and nymphs (*Corixidae*) were increased relative to previous sites. Overall numbers of Gastropods increased, as did species diversity, with *Physa fontanilis*, *Lymnaea stagnalis, Lymnea peregra* and *Planorbis planorbis/carinatus* recorded. Several species of Caddis-fly larvae were recorded, with *Athripsoides albifrons, Glossosoma boltoni, Phryganea bipunctata* and *Triaenodes bicolor* present. Numerous larvae of several instars of *Ischnura elegans* were sampled. Stickleback were abundant, both 3-spined and 9-spined. Despite the proximity of the sampling point to the Yellow River, no Trout or Salmon were observed. *Gerris lacustris* and *Gyrinus natator* were numerous.

EPA Export 06-01-2017:02:02:10

4.8 Evaluation of results

Conservation priorities regarding the identified biodiversity resource of the site.

4.8.2 Importance of habitats

4.8.2.1 Freshwater Habitats

Man-made pond (FL8)

There are a number of small, man-made ponds throughout the proposed footprint of the development site that serve as attenuation ponds on *Blake's stream* as it passes through the site. While the majority of these ponds are rather small and of limited ecological significance, there is a larger pond covering just approximately 0.75 acres along the southern boundary of the site.

This pond was formed during the excavation of construction materials for the existing tailings dame. The pond has been in existence for c. 10 years and is fed by Blakes stream and the network of surface drains in the area.

Along much of the boundary of the pond is emergent vegetation, largely comprised of species such as *Typha latifolia, Iris pseudacorus, Mentha aquatica, Spharganium erectum, Juncus articulatus, Myosotis scorpioides* and *Veronica beccabunga*. This pond is of high local ecological importance, providing foraging for a number of species of bat, in addition to a number of bird species. Invertebrate sampling determined that there is a relatively diverse (relative to Blake's stream) assemblage of invertebrates present within the pond, and this is almost certainly the attraction for bat and bird species.

For inspection purposes only.
Consent of copyright owner required for any other use.

This pond is located less than 500 m from the Yellow River, to which it is linked both physically and ecologically by Blake's stream. It is located approximately the same distance from the Navan-Kingscourt railway line ecological corridor, to which it is connected by a length of hedgerow. In addition, this pond is immediately adjacent a sizeable (approximately 2.9ha) mixed broadleaved woodland habitat, which provides roosting habitat for a number of species of bat. The pond is also serviced by an ecological corridor in the form of the site roadway and associated hedgerow leading to the northern site entrance. While present as an "Island" of habitat within a large area of very limited ecological significance, this pond is well enough connected via ecological corridors to provide an important habitat for both flora and fauna.

FW1 – Blake's Stream

Blake's stream is a relatively small watercourse that has been significantly altered and redirected on several occasions to facilitate past construction projects.
Along much of it length, it is of low ecological significance, with little or no vegetation, very low invertebrate diversity and no associated hedgerow habitat.

The man-made attenuation ponds along its course, however, are of much higher ecological importance, and as the stream approaches its confluence with the *Yellow River* on the western boundary of the proposed development footprint, the diversity of flora and fauna occurring within the stream increase greatly.

EPA Export 06-01-2017:02:02:10

Deeper areas of the stream have an associated emergent flora, with species such as *Typha latifolia, Iris pseudacorus, Phalarus arundinacea, Glyceria maxima, Phragmites australis* and *Spharganium erectum* abundant, while typical species such as *Apium nodiflorum, Veronica beccabunga, Mentha aquatica, Cardamine pratensis, Equisetum palustre* and *Samolus valerandi* occur along the damp margins of the stream. Overall, the ecological importance of the majority of this habitat is limited.

FW4 – Drainage ditches

There are present throughout the development footprint numerous drainage ditches. These drainage ditch habitats are for the most part of limited ecological significance as they are undergoing regular disturbance, and are rather ephemeral in nature. The extent of vegetation associated with the drainage ditch habitats are dependent on the age and degree of disturbance.

Where ditches are recently formed, or subject to regular disturbance, vegetation is virtually absent. Where ditches are more established, vegetation similar to that found within attenuation ponds is present, dominated by species such as *Typha latifolia* and *Juncus* species. Overall, the ecological importance of the majority of this habitat is limited.

Grassland and associated habitats

While the vast majority of habitats occurring within the proposed development footprint consist of the habitat types ED2 and ED3, there are present several areas dominated by grassland. The vast majority of these areas are recently reseeded and fertilised areas best described as GA1 – Improved Agricultural Grassland. This habitat is entirely dominated by *Lolium perenne*, with *Trifolium repens* the only herbaceous species occurring in significant abundance. This habitat is of very limited ecological significance.

Consent of copyright owner required for any other use. For inspection purposes only.

There are, scattered throughout the development footprint, primarily along the western boundary, small patches of what is best described as slightly improved semi-natural dry calcareous grassland habitat (GSi1). This habitat type is reminiscent of the relatively species-rich grassland habitat that exists on the slopes of the existing Tailings-Management Facility (TSF). It is almost certain that these areas of habitat have been "colonised" from this adjacent grassland.

While the grassland habitats occurring within the proposed development footprint are of limited ecological significance owing to type (GA1) or size (GSi1) of the habitats in question, the proposed development will result in a very significant increase in the area and continuity of the GSi1 grassland habitat type, which is increasingly rare in the intensively farmed County of Meath.

EPA Export 06-01-2017:02:02:10

Disturbed Ground Habitats(ED)

A large proportion of the survey area is characterised by exposed sand, gravel, rock and soil. The ED habitat type varies throughout the survey area, depending largely on disturbance levels. Those areas in which disturbance levels are very high, or areas which have undergone recent soil-removal processes are almost entirely devoid of vegetation. Some areas of disturbed ground have revegetated through natural or artificial means (reseeding and fertilisation). There are present throughout the areas of disturbed ground habitat other features, such as drainage ditches in addition to a mosaic of small areas of habitat such as scrub, dry calcareous grassland and ponds.

ED2 – Exposed Bare Ground

Exposed bare ground (ED2) is, by far the most abundant habitat type within the survey area, having been formed through the removal of material from the site. This habitat type varies in vegetation cover depending on how recently disturbance has occurred, but in general vegetation is largely absent. This habitat is of very limited ecological significance.

ED3 – Recolonising Bare Ground

The vegetation composition of the ED3 habitat occurring is dependent largely on disturbance levels and how long it has been since the habitat was last disturbed. There are some areas where the moisture content of the soil is also a defining factor. This habitat can be suitable for a number of species of conservation concern, such as *Acinos arvensis* and *Galeopsis angustifolia* (both Flora Protection Order Species) and *Erigeron acer* (Red-data listed). There was no evidence observed for any of these species of conservation concern. As a whole, the ED3 habitat, which is, by its nature ephemeral, is of limited ecological significance.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:10

4.8.3 Woodland and Scrub Habitats

Mixed Broadleaved Woodland WD1

Occurring along the southern boundary of the proposed development footprint is a significant area (approximately 2.9 ha) of Mixed Broadleaved Woodland (WD1). This woodland, although dominated by non-native species and with a rather under-developed shrub layer and a very poor herbaceous layer is of high local ecological importance to a number of species, including at minimum 6 species of bat. In addition, there is evidence that Badger may utilise the woodland. This area of woodland is, of course of high local significance to the local bird population, and a pair of Sparrowhawk were found to be nesting within the woodland. The loss of this woodland could represent a significant negative impact on local fauna. Further surveys are currently underway, primarily a year-long bat assessment and an assessment of use by Badger to design and implement mitigation measures such that the net impact on local fauna of the loss of this area of woodland will be positive through the provision of compensatory habitat of greater size, and superior quality.

WL1/WL2

The hedgerow and treeline habitats present within and around the proposed development footprint are of very high local importance ecologically, as they represent significant commuting/foraging corridors for numerous groups of fauna (bats, birds, etc.), in addition to providing habitat for roosting/nesting/setts/dens, etc. within the primarily agricultural landscape of County Meath. For the most part, there will be little negative impact of the proposed development on the hedgerow/treeline network. The hedgerow and treeline habitat occurring along the Navan- Kingscourt railway line is of greatest ecological importance (this provides a virtually unbroken ecological corridor for over 30 kilometres through a landscape dominated by intensive agriculture) and this corridor will not be impacted upon by the proposed development. The primary hedgerow/treeline habitat that will be lost is that habitat responsible for linking the "island" of woodland described in 4.5.1.4.1. The proposed development will result in the removal of this island of woodland, and the hedgerows connecting it to the wider countryside.

For inspection purposes only. Consent of copyright owner required for any other use.

The loss of this woodland and associated hedgerow could represent a significant negative impact on local fauna. The design and implementation of suitable mitigation measures, however, will ensure that the net impact on local fauna of the loss of this habitat will be positive through the provision of compensatory habitat of greater size, and superior quality.

WS1

There are present throughout the proposed development footprint, most particularly in the western section, small, isolated patches of scrub habitat. This scrub habitat is most frequently associated with drainage ditches or attenuation ponds. The most important ecological function of this scrub habitat is the provision of nesting sites for numerous species of bird. While the loss of the scrub habitat represents a very slight negative impact of the proposed development, the provision of compensatory habitat (a replacement pond and associated scrub habitat) will ensure that the net ecological impact of the proposed development is positive.

EPA Export 06-01-2017:02:02:10

4.9 Importance of ecological corridors and "stepping stones"

4.9.1 Blake's Stream

Blake's Stream, as it currently exists, does not provide an ecological corridor of any great significance. The lack of any significant associated vegetation, and in particular the lack of any form of associated hedgerow limits the functionality of this water course as an ecological corridor. The stream passes through much of the ED2 habitat within the Sillogue Borrow Put area, and there is not a great deal of invertebrate diversity present throughout this section, being entirely dominated by *Gammarus dubeniii.* As Blake's Stream approaches the Yellow River, the floral and faunal diversity of the stream increases greatly, indicating that the stream is being slowly colonised from downstream. The most important component of the Blake's Stream corridor are the numerous attenuation ponds, and in particular that pond adjacent to the Woodland area.

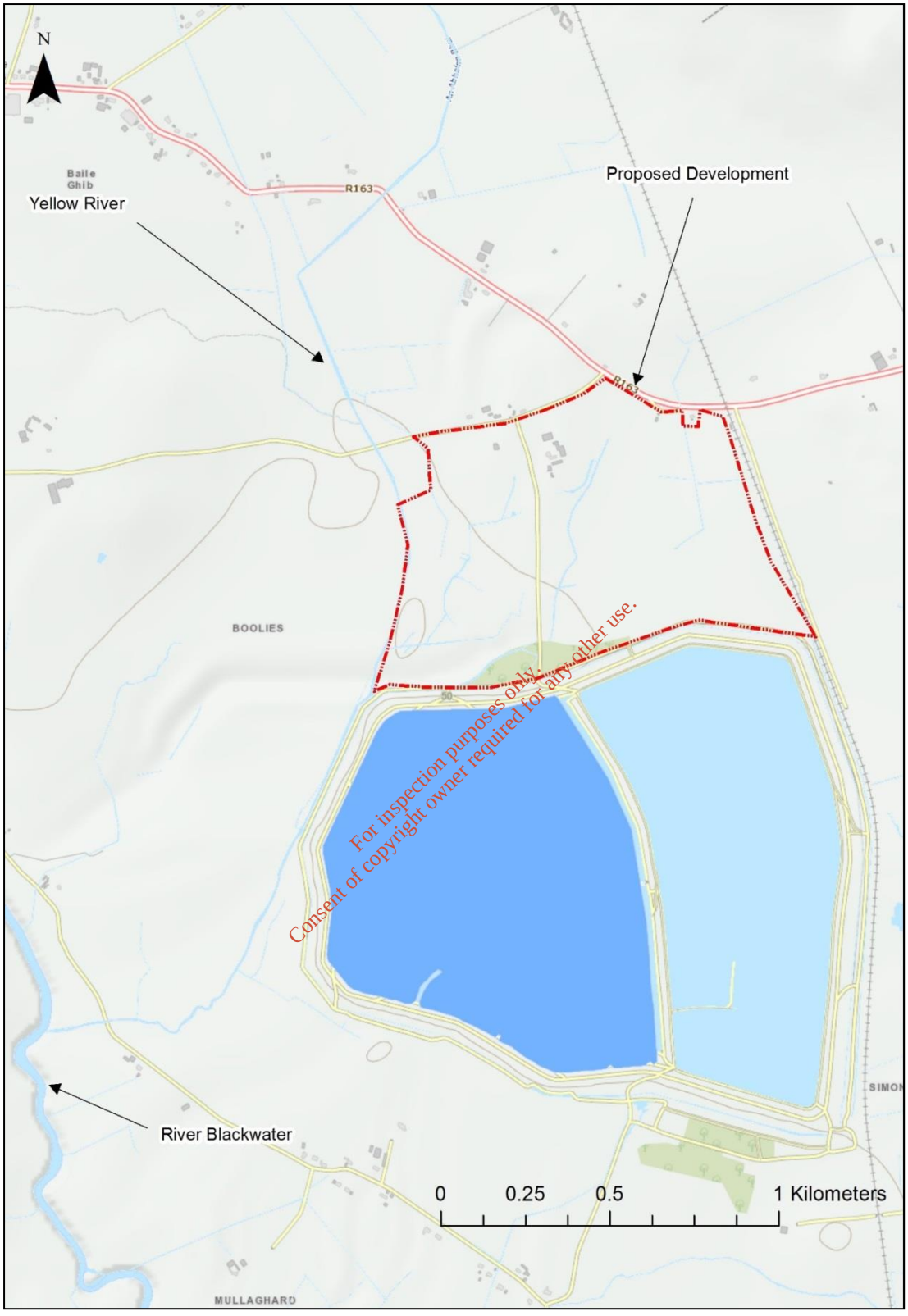
4.9.2 The Yellow River

The Yellow River flows in a north-south direction passing immediately adjacent to the eastern boundary of the proposed development site. In contrast to Blake's stream as it runs through the site, the Yellow River is an ecological corridor of high local significance. The Yellow River flows through largely agricultural land before joining the River Blackwater, one of the main ecological corridors in Meath, less than 1 km downstream of the proposed development. The Yellow River is associated with hedgerow for much of its length and represents a significant ecological corridor within the largely agricultural landscape of Meath. While the quality of the water in the Yellow River is only of Q-value 3 according to the EPA database (latest Q-data available from 2012), the corridor is likely of high local importance with regard to avifauna and also to commuting and foraging bats (and potentially Otter). Of particular significance, the Yellow River is likely of high importance as a commuting/foraging corridor for both Daubenton's Bat and the Kingfisher.

For inspection purposes only.
Consent of copyright owner required for any other use.

Considering the Kingfisher is the qualifying interest for the River Boyne and River Blackwater Special Protection Area, and given this species preferences for small channels off the main river for breeding sites, any habitat along the Yellow River suitable for breeding Kingfisher is of high local significance. In summary, the Yellow River is an ecological corridor of high local and possibly regional importance, largely owing to its connectivity with the River Blackwater, one of the primary constituents of the River Boyne and River Blackwater Special Area of Conservation and the River Boyne and River Blackwater Special Protection Area.

EPA Export 06-01-2017:02:02:10



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.51 Map illustrating location of the Yellow River relative to the proposed development and the *River Blackwater*

EPA Export 06-01-2017:02:02:10

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.52 Proposed development site, *Yellow River* and *River Blackwater* superimposed on an aerial image of surrounding land use

EPA Export 06-01-2017:02:02:10

4.9.3 The Navan – Kingscourt Rail-line

There is a disused railway line running between Navan in Co. Meath and Kingscourt in Co Cavan. Passenger services were withdrawn along this stretch of rail in 1947, and although utilised for the transport of gypsum for a time, the line between Navan and Kingscourt was eventually closed altogether and is currently in an over-grown state for much of its length, with areas beginning to scrub over.

Associated with much of the length of this railway is hedgerow/treeline habitat, occurring on both east and west boundaries. This railway line, therefore, serves as a major ecological corridor throughout - possibly one of the most important regional ecological corridors in Meath owing to the lack of disturbance or lighting along much of its length. This habitat is likely of very high regional significance as regards bats, providing substantial commuting, foraging and roosting habitat along its 30 km length. The railway line has also been observed by the author to be a commuting route for the Annex I Bird Species Whooper Swan, which travel along the corridor, foraging in adjacent agricultural land.

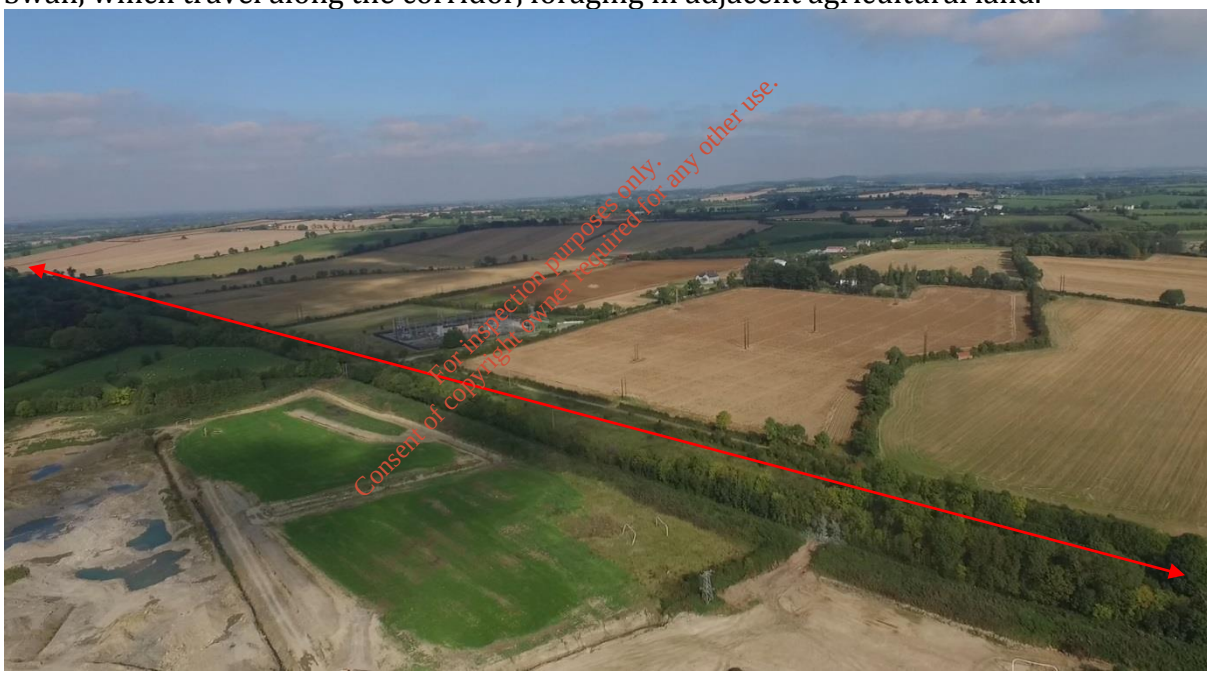

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.53 Hedgerow/Treeline habitat associated with the east and west side of the Navan to Kingscourt railway line as it passes along the eastern boundary of the development footprint

The proposed development will have no negative ecological impact on this ecological corridor. Indeed, assuming a similar habitat to that which currently exists in the *environs* of the Tailings Facility (a mosaic of semi-natural grassland, scrub and woodland habitats) develops in the vicinity of the proposed development, there will almost certainly be positive ecological impacts.

EPA Export 06-01-2017:02:02:10

The ecological corridor as provided by the railway line links several "Islands" of habitat (such as Whitewood Lough at Kilmainhamwood) to the River Blackwater, over which the Railway line passes. The provision of a significant area of additional semi-natural habitat along the route of this ecological corridor will enhance the ecological integrity of the corridor, which will in turn provide a means by which the habitat can be colonised.

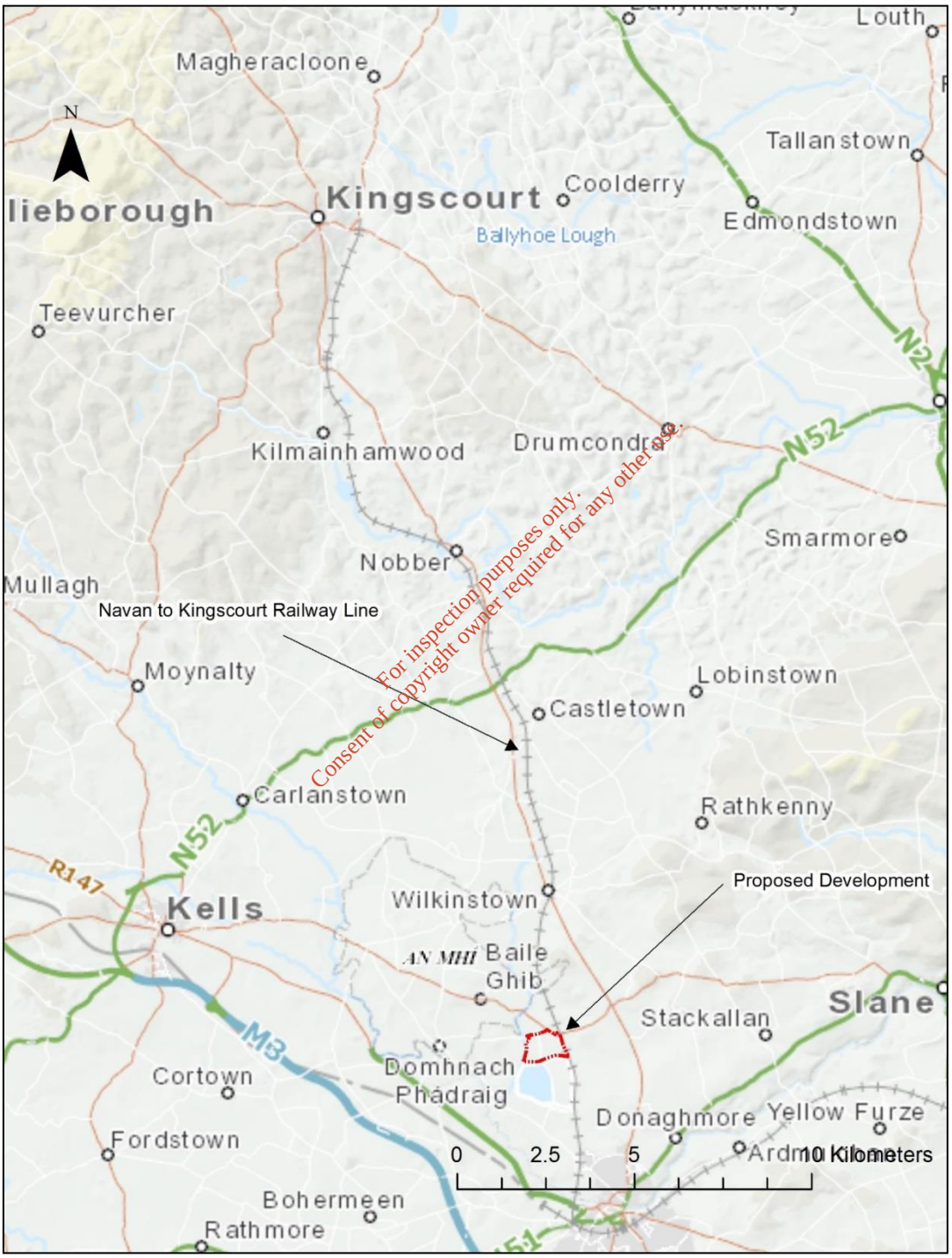


Figure 4.54 Map indicating the location of the Navan to Kingscourt railway line relative to the proposed development

EPA Export 06-01-2017:02:02:10

4.9.4 The Hedgerow/Treeline network

The hedgerow/treeline network as it exists in Ireland is an invaluable and likely unique resource, providing extensive ecological/commuting corridors that link much of the island of Ireland. In the primarily agricultural landscape of Ireland, hedgerow/treeline habitats, in addition to providing commuting corridors, are a hugely important source of both food and shelter. Much of Ireland's hedgerow network consists of Hawthorn and Ash, the former of which provides a plentiful supply of food (hawthorn berries) for a huge variety of bird species during winter months. Many of Ireland's overwintering visitors, such as Fieldfare and Redwing in addition to many of our resident bird species are heavily dependent on this resource to live through the winter. The hedgerow/treeline network in and around the proposed development footprint is, therefore, of huge local and regional ecological importance.

The bulk of the hedgerow/treeline habitat resource present within the proposed development footprint is located around the boundary of the development area and will not be significantly impacted upon by the proposed development. Based on aerial imagery, approximately 1 – 1.5 km of hedgerow habitat will be lost owing to the proposed development. Given, however, that the proposed development will result in the replacement of largely ED2 and ED3 habitat of limited ecological with a significant area of semi-natural grassland similar to that occurring at the existing TSF immediately adjacent to the boundary hedgerow/treeline habitats, and given the mitigation measures to be implemented regarding replacement woodland and pond habitats, the proposed development will have a net positive ecological impact on the majority of the hedgerow/treeline resource within and adjacent to the proposed development footprint. This will be achieved through the provision of a significant foraging area and food source (natural grassland) immediately adjacent to the hedgerow/treeline habitat. The prevalence of the Red-listed Yellow Hammer, a relatively rare species of bird whose adult diet is largely comprised of grass seeds, within the habitat in the vicinity of the TSF is evidence of this.

Consent of copyright owner required for any other use. For inspection purposes only.

4.9.5 Woodland

Occurring along the southern boundary of the proposed development footprint is a significant area (approximately 2.9 ha) of Mixed Broadleaved Woodland (WD1). The canopy is dominated by *Fagus sylvatica,* but *Acer pseudoplatanus, Fraxinus excelsior* and *Quercus robur* are also present in significant proportions. The shrub layer is rather under-developed, likely owing to a lack of management, with very little regeneration (apart from *Acer pseudoplatanus*). It consists largely of *Ilex aquifolium, Sambucus nigra* and *Crataegus monogyna*. The herbaceous layer, as is typical for a woodland in Ireland dominated by Beech, is species poor - dominated almost entirely by *Hedera helix* and *Rubus fruticosus* agg. There are numerous ferns present, including *Dryopteris filix-mas and Polystichum setiferum.* Some common understorey herbs are present, such as *Geranium robertianum* and *Geranium robertianum*. This woodland provides a *refugia* for numerous species of plant and animal in the overall landscape, and is of particular importance for birds and bats. A currently disused Badger sett is located within

EPA Export 06-01-2017:02:02:10

this woodland. The presence of this woodland on the 1st Edition OSI maps indicates that it has served a function as an ecological stepping stone for likely, at minimum, two centuries.

4.9.6 Waterbodies

The water bodies occurring within the proposed development footprint itself are of largely of limited ecological value owing to their ephemeral nature and relatively young age. The small water bodies (attenuation ponds) present within the proposed development footprint do provide foraging and breeding opportunities for numerous species of bird, and the largest pond, occurring adjacent to the woodland on the southern boundary of the proposed development was observed to be heavily utilised by several species of bat.

Of importance, however, the proposed development is part of the TSF, which comprises the largest inland water body (contained completely within) in Meath. The TSF has particular importance as an ecological stepping stone for over-wintering birds. Winter bird surveys have identified that the existing TSF serves as an important roosting site for numerous species of conservation concern, including Whooper Swan, Golden Plover, Lapwing, Black-headed Gull, Great Black-backed Gull and Mallard. While the proposed development will have no negative impact on the use of the existing TSF by overwintering birds (indeed, it will have a positive impact by providing similar habitat immediately adjacent when the existing stages of the TSF are decommissioned), in the long-term, when mining operations cease and the TSF is decommissioned, there will be a loss of one of the most important ecological stepping stones in Meath.

For inspection purposes only.
Consent of copyright owner required for any other use.

While the habitat management plan for the decommissioning of the TSF can take into account the ecological stepping stone function served by the overall TSF and *environs*, the open water habitat cannot be left uncapped.

EPA Export 06-01-2017:02:02:10

4.10 Protected species

In general, the habitats present within the proposed development footprint are of very limited ecological significance, and there were no habitats listed on Annex I, or species listed on Annex II of the EU Habitats Directive observed to occur within the proposed development footprint. While a number of species of conservation concern were observed to be present within the development footprint, such as Hare and the Common Frog, given the abundance of suitable habitat immediately adjacent to the proposed development footprint (within the TSF), the proposed development will have no significant long-term negative impact on these species. Indeed, in the long-term, the proposed development will have a positive impact on these species as a large proportion of the ED2 and ED3 habitat currently existing within the footprint will be replaced with semi-natural grassland. A permanent pond (in contrast to the existing attenuation ponds) constructed solely for the purposes of providing suitable habitat for flora and fauna associated with this habitat (including the Common Frog and possibly Newt at some point in the future) within the proposed development footprint would greatly enhance the (security of the) conservation status such species within the proposed development footprint.

For inspection purposes only.
Consent of copyright owner required for any other use.

4.10.1 Badgers

A Badger sett was identified within the woodland occurring along the southern boundary of the proposed development footprint. Surveys yielded no evidence of Badger utilising the sett, or indeed the habitat within the proposed development footprint.
This woodland area is to be removed and in the absence of mitigation measures, there could potentially be significant negative impacts on the local Badger population. **An derogation regarding the removal of the sett has been granted by NPWS, ref appendix 4.1.**

4.10.2 Bats

All Irish bat species are protected under both European and Domestic legislation. All bats occurring in Ireland are listed on Annex IV of the EU Habitats Directive. Plants and animals listed on Annex IV of the Habitats Directive are strictly protected wherever they occur. Under Irish Law (Irish Wildlife Act 1976 and Wildlife (Amendment) Act 2000) it is a criminal offence to intentionally harm or disturb a bat in its place of rest. A substantial body of bat surveys were carried out over the period July – September 2015 throughout the proposed development footprint. While the majority of the proposed development footprint is not of importance as regards the local bat population (comprising largely of ED2 and ED3 habitat, open in nature with little vegetation cover), two habitats present were identified that are of high local significance, with a minimum of six species (Common Pipistrelle, Soprano Pipistrelle, Leisler's Bat, Daubenton's Bat, Natterer's Bat and Brown Long-eared Bat) of bat occurring. One

EPA Export 06-01-2017:02:02:10

of these habitats (the woodland) is to be removed in the course of the proposed development, and mitigation measures are required in order to prevent any long-term negative impacts on the local bat population – these are addressed below.

A derogation regarding the removal of the woodland and potential impacts on bats has been granted by NPWS, ref appendix 4.1

4.11 Invasive Alien Plant Species

There are more than 30 species listed on Part 1 of the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations of 2011. Three species listed on Part 1 of the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations of 2011 are of primary concern regarding the proposed development:

Japanese Knotweed (*Fallopia japonica*)

This plant is a rhizomatous perennial, capable of reaching 2m in height. This plant spreads exclusively by vegetative means, but spreads very aggressively.

The plant is capable of forming extensive monoculture stands. There is a negative impact on ecosystem function and biodiversity through a number of mechanisms – primarily through the shading-out of native plants due to the rapidity with which large stands of the plant can form.

For inspection purposes only.
Consent of copyright owner required for any other use.

In addition, this plant has a deleterious effect on the banks of waterways owing to the fact that during the winter, when *F. japonica* dies back, there is little or no vegetation growing underneath and hence nothing to prevent erosion of the bank. This species is well established in Ireland and is rapidly spreading throughout the country, especially by roadsides and along watercourses.

Giant Hogweed (*Heracleum mantegazzianum*)

Giant Hogweed, as its name suggests, can reach heights of 5m. This perennial reproduces exclusively by seed, but can produce up to 100,000 seeds per individual, with up to 90% germination rate. In addition to this, this plant is capable of self-fertilisation, which means that one plant is capable of resulting in the invasion of a new habitat. Like *F. japonica*, it is the tendency of Giant Hogweed to grow very tall very quickly, forming a monospecific stand that results in the negative impact of this species on native biodiversity. It is, however, the phototoxic sap of this species, and the increasing number of human injuries associated with this sap that has made *H. mantegazzianum* one of Europe's most problematic invasive species. This species is not yet a major problem along the roadsides of Co. Meath, but is recorded occurring alongside the River Boyne and the River Nanny.

EPA Export 06-01-2017:02:02:10

Himalayan Balsam (*Impatiens glandulifera*)
Himalayan Balsam is one of the tallest annuals occurring in Europe, growing up to 150 cm. It is a native of the Himalayas and has rapidly become one of the most problematic of invasive species in Europe, particularly along watercourses. The dominance of large stands of *I. glandulifera* along watercourses causes problems for stream management in addition to the negative impact on native flora due to the formation of large monoculture stands. The massive production of nectar to induce pollinators, in addition to the "explosive" means by which seeds are spread (pods explode on contact, hurling seeds away from the parent plant) contribute to the ability of this plant to out-compete native species. This plant is recognised as a significant threat to riparian biodiversity along Ireland's waterways. This species has recently become more prevalent in Meath, recorded along adjacent to the River Boyne.

No species listed on Part 1 of the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 was observed to occur anywhere within the proposed development footprint (or adjacent).

It must be taken into account, however, that the nature of the proposed development, with the importation of a large quantity of material, and the presence of HGVs moving to and from the site would indicate that the proposed development is at high risk as regards the potential for the inadvertent importation of propagules of Alien Invasive Plant Species.

For inspection purposes only.
Consent of copyright owner required for any other use.

Prior to any development taking place, a detailed Alien Invasive Plant Species Management and Control Plan be drawn up and implemented.

The primary objectives of an Invasive Species Management and Control Plan should include:

- To prevent the introduction of any species of alien invasive plant to the site; and
- To prevent the spread/dispersal of any alien invasive plant species both within the site and off-site in the event of inadvertent introduction.

The intent of an Invasive Species Management and Control Plan is that all material, equipment and vehicles must arrive at the development site free of any invasive plant species propagules and that all equipment and material leaving the site must be free of any invasive plant species propagules.

EPA Export 06-01-2017:02:02:10

4.12 Mitigation Measures

4.12.1 Summary of key conservation priorities

In general, the footprint of the proposed development is of limited ecological value, consisting primarily of ED2 habitat, with some ED3 interspersed throughout and some rehabilitated GA1.
The ED2 habitat is disturbed to such an extent that there has been very little colonisation by vegetation, and none of the species of conservation concern that might be associated with such a habitat (such as *Acinos arvensis*, *Galeopsis angustifolia, Erigeron acer,* etc., which typically occur within quarries under the heavily disturbed conditions) are present. The ED3 habitat is typical of recolonising bare soil habitat in this part of Meath, dominated by typical ruderal species abundant throughout any disturbed habitat. The GA1 habitat, which has been newly fertilised and seeded is very species poor, and again is of very limited ecological value.

Woodland Habitat
In contrast, the woodland occurring along the southern boundary of the proposed development footprint is of high local ecological significance. While not comprising native species (for example, *Fagus sylvatica* is abundant throughout) this, significant area of mature woodland (2.9 Ha) appears on the 6" Historic Maps, indicating that the woodland is of significant age (see Figure 4.55).

For inspection purposes only. Consent of copyright owner required for any other use.

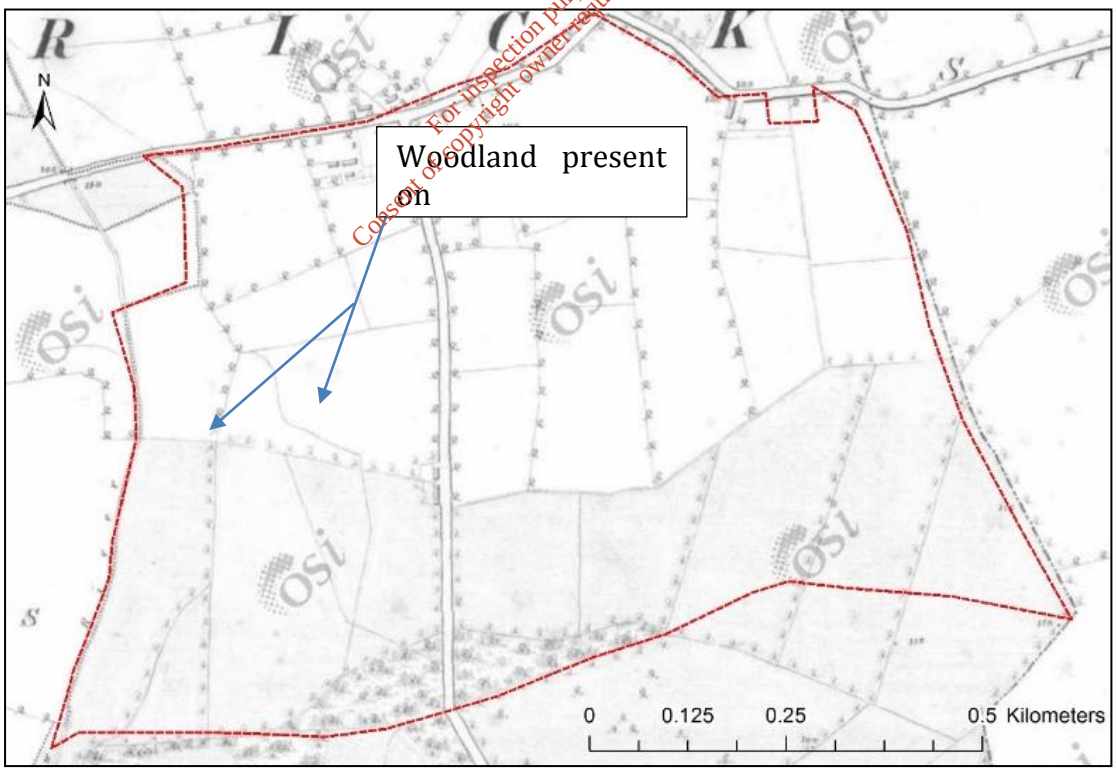


Figure 4.55 Historic 6" Map indicating location of woodland present, which is still present within the Stage 6 footprint

While not of great botanical interest, as it is largely comprised of non-native species, this woodland does provide an island of mature woodland habitat in a

EPA Export 06-01-2017:02:02:11

largely agricultural (notwithstanding the presence of the Tailings facility immediately adjacent) landscape, providing a *refugia* for numerous mammal and bird species (see figure 4.56).

There is evidence of prior use of the woodland by Badger (*Meles meles*) with a sett present within the woodland (no activity was detected during the ecological surveys). Sparrowhawk (*Accipiter nisus*) nest in this woodland, and a minimum of 3 fledged chicks were observed calling in the late summer months. Of primary importance, is the recording of a minimum of 6 species of bat in the immediate vicinity of this woodland (Common Pipistrelle, Soprano Pipistrelle, Leisler's Bat, Daubenton's Bat, Natterer's Bat and Brown Long-eared Bat). It is entirely possible that further species (such as Whiskered Bat) utilise this habitat as it is suitable for a number of other species.

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 4.56 Mature woodland present at the southern boundary of the development footprint

Attenuation pond adjacent to woodland

Located adjacent to the woodland habitat as described above, is a man-made pond covering an area of just under 1 acre (see 57). The pond is an attenuation pond on Blake's Stream, and was created approximately 10 years ago. There is a good cover of vegetation around the northern fringe of the pond with *Typha latifolia* and *Iris pseudacorus*. To the south, approximately 50 m away, is the mature woodland area. This pond, while relatively small in size, was observed to support flocks of up to approximately 200 foraging mallard (it is possible that a pond of this size could support several breeding pair), with Teal and Little Grebe also present. Of high local ecological importance, this pond was observed to be an area in which several species of bat, including Common Pipistrelle, Soprano Pipistrelle and Daubenton's Bat gathered in significant numbers to forage. While

EPA Export 06-01-2017:02:02:11

many of these bats appeared to roost in the wooded area adjacent, it was evident that there were bats commuting (primarily along the roadway leading to the Sillogue entrance) from outside of the development footprint to this area. While the vast majority of the proposed development footprint is almost without bat activity, this small area of habitat, in conjunction with the woodland area, supports a significant population of bats.

Figure 4.57 Aerial image of pond habitat, with fringe of wetland vegetation evident to the north

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

Use of the Tailings facility by avifauna

While the construction of Stage 6 is unlikely to have a direct impact on the use of the existing tailings facility by over-wintering birds, it must be taken into account as regards cumulative impacts.

The existing tailings facility acts as a repository for tailings but also acts as a reservoir were water is stored pending reuse in the processing plant or discharge to the river Boyne under licence.

Winter bird surveys carried out during the period October 2015 – March 2016 inclusive determined that the TSF provides a roosting site of high regional importance for a number of species of bird, including two species listed on Annex I of the EU Birds Directive – Golden Plover and Whooper Swan. In addition, large numbers of Black-headed Gull and Great Black-back Gull, which habitually roost here, Lapwing, Curlew, Shelduck and Mallard were observed.

The existing tailings dam is compartmentalised to distinct operational stages: Satge 5A western sector and Stage 5B makes up the eastern sector.

As part of the companys closure restoration and after care management plan (CRAMP[8]) it is planned to decommission the use of the tailings facility by placing an engineered soil cap over the entire surface area.

For inspection purposes only.
Consent of copyright owner required for any other use.

This will take place on a phased basis starting with Stage 5a. The impact on over-wintering bird species will be minimised by the phased alteration of usage between stages has been the standard procedure since the facilities inception.

The proposed development will provide Stage 6 of the mines tailings-management facility, and it is envisaged that when Stage 5b is decommissioned, Stage 6 will be commissioned, providing an alternative habitat for overwintering birds to roost.

Eventually, however, the mining operation will cease, and the largest inland water body in Co Meath will be capped as part of the decommissioning plan.

Mitigation - provision of increased area of semi-natural grassland habitat

The *environs* of the tailings facility currently represents possibly the largest contiguous area of semi-natural grassland habitat in Meath. This habitat supports a huge diversity of grassland species, and is an invaluable *refugia* for species of both flora and fauna. A biodiversity survey of this habitat was carried out in 2006, and is currently being updated. The habitats in the vicinity of the TSF are well serviced as regards ecological corridors owing to the presence of the Navan-Kingscourt railway line and associated hedgerow/treeline habitat, which provides a route through which many species can colonise any suitable habitats along its length, in addition to the presence of the Yellow River which

[8] CRAMP 2016

EPA Export 06-01-2017:02:02:11

flows along the western boundary before joining the River Blackwater. The habitat as currently exists within the proposed development footprint, comprised largely of ED2, ED3 and GA1 are of very limited ecological value. In contrast, the habitat that will be provided as a by-product of the proposed development will be of high local, and potentially regional importance with regards to ecology. While small areas of habitat of ecological value, such as the area of mixed broad-leaved woodland and adjacent pond will be lost during the proposed development, mitigation measures are proposed that will more than compensate for the loss of these habitats.

4.12.2 Invasive Plant Species Control and Management Plan

Prior to any development taking place, a detailed Alien Invasive Plant Species Management and Control Plan be should be drawn up and implemented.
The primary objectives of an Invasive Species Management and Control Plan should include:

- To prevent the introduction of any species of alien invasive plant to the site; and
- To prevent the spread/dispersal of any alien invasive plant species both within the site and off-site in the event of inadvertent introduction.

The intent of the Invasive Plant Species Management and Control Plan is that all material, equipment and vehicles must arrive at the development site free of any invasive plant species propagules and that all equipment and material leaving the site must be free of any invasive plant species propagules.

For inspection purposes only.
Consent of copyright owner required for any other use.

4.12.3 Loss of Woodland Habitat - Mitigation

There will be a loss of a significant area of almost 3ha of mature woodland habitat (WD1), which is utilised by a number of species of mammals and birds. This woodland has not been managed, and is likely approaching over-mature status, with little in the way of regeneration. These over-mature trees provide ideal conditions for several species of birds and bats. It is important note that this woodland contains a high proportion of non-native species, such as Beech and Sycamore.
In order to mitigate against the loss of this habitat, it is recommended that a major planting of native trees (of native provenance) be undertaken in order to provide habitat of greater value, both quantitatively and qualitatively. The species used should comprise *Quercus robur, Fraxinus excelsior, Ilex aquifolium, Betula pubescens, Alnus glutinosa* and *Corylus avellana*. The area to be planted should be planted at a minimum density of 500 trees per hectare. It is recommended that a minimum of 10 trees of 20 – 25 cm girth (of each of species) per hectare be planted. The remainder of planting should be of a variety of girth categories (for each species). Smaller saplings must be provided with suitable protection in order to ensure that they are not destroyed by the significant population of Hare in the vicinity. It is proposed that the compensatory habitat (approximately 9ha) will be located along the ecological corridor provided by the

EPA Export 06-01-2017:02:02:11

Yellow River, to the south east of the Tailings Facility (see Figure 4.58). The presence of the ecological corridor will facilitate bats utilising this corridor encountering the compensatory habitat.

Figure 4.58 Proposed planting area relative to the approximate footprint of the proposed development

For inspection purposes only.
Consent of copyright owner required for any other use.

The provision of this compensatory woodland habitat will be a marked improvement (both in area and ecological significance) on the habitat to be removed:

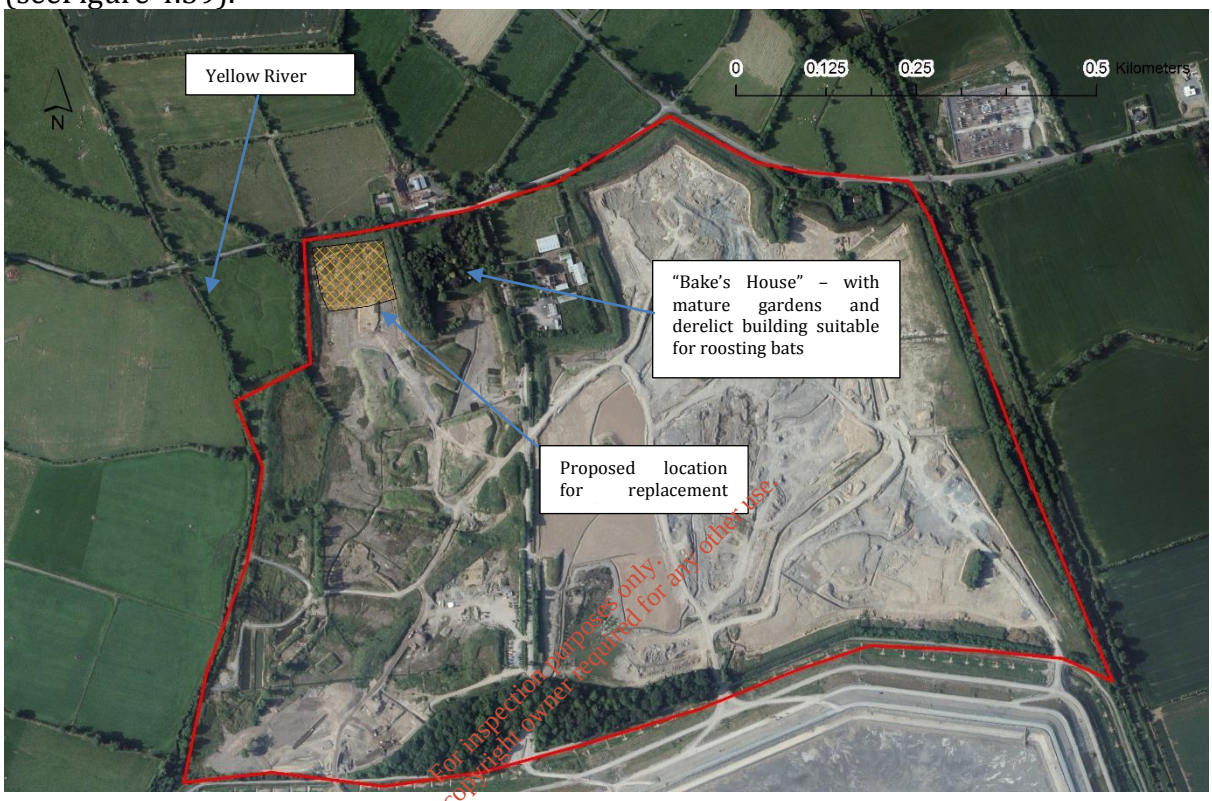
- The woodland area will be almost three times the size of that area of woodland to be removed;
- The woodland will consist of native trees, of native provenance;
- The woodland will consist of trees of a wide range of ages, which will improve the future prospects for natural regeneration;
- The woodland will be serviced by an important ecological corridor in the form of the Yellow River. The woodland area to be removed is somewhat isolated, being located as an "island" of habitat, connected to other habitat by somewhat "Gappy" hedges

4.12.4 Loss of Pond Habitat – Mitigation

The small man-made attenuation pond on Blake's Stream adjacent to the mature woodland was created approximately 10 years ago. This pond has been colonised by numerous species of wetland plants, invertebrates and fish and has become a locally important foraging site for both birds and bats. The proximity of the pond to the woodland provides optimal conditions for numerous species of bat, as roosting habitat and a variety of foraging habitat are provided in close proximity. This pond, like the adjacent woodland will be removed during the

EPA Export 06-01-2017:02:02:11

proposed development. In the absence of mitigation measures, this has the potential to have an impact on the local bat population through the removal of a heavily-utilised foraging area. There are numerous other smaller ponds throughout the development foot-print that will also be removed during the proposed development. It is recommended, therefore, to provide compensatory habitat in the form of a newly constructed pond, of approximately 1 acre in area (seeFigure 4.59).



Consent of copyright owner required for any other use.
For inspection purposes only.

Figure 4.59 Proposed pond compensatory habitat

It is envisaged that the compensatory pond habitat would be in put place before the proposed development takes place. It is recommended that the compensatory pond habitat be "seeded" with plants and invertebrates from the ponds to be removed during the development. This would simply entail removing sections of plants and associated substrate from the donor site and transplanting them to the compensatory habitat. This will "kick-start" the development of the pond into a productive ecosystem, and it may be possible to get this process underway prior to the removal of the existing ponds within the footprint development.

When constructing the pond, there is an ideal opportunity to create at least one island in the centre of the pond, in order to facilitate the breeding of water-birds. It is important that on such an island, there is at least one gently sloping gradient (preferably sheltered from the prevailing wind), allowing chicks to enter and exit the water with ease. Currently within the development footprint, there is no suitable habitat for nesting Kingfisher (*Alcedo atthis*), the qualifying interest for the River Boyne and River Blackwater SPA.

EPA Export 06-01-2017:02:02:11

The construction of the pond provides the opportunity to create suitable habitat for nesting Kingfisher, which will be immediately adjacent to both the new pond habitat, and the Yellow River. Suitable Kingfisher nesting habitat comprises tall, vertical banks (minimum 2m above the waterline) comprising soft material (sand/mud) into which they can dig their burrows.

It is recommended that one side of the island within the constructed pond be comprised of such suitable habitat for nesting kingfisher, which usually construct their tunnels approximately 50 cm from the top of the bank, with the tunnel and chamber being up to 1 m long. This habitat would also be ideal for Sand Martin, which do occur within the development footprint, although the nesting sites are not optimal and there were signs of predation. The provision of suitable habitat on an island would provide a great deal of protection against such predation.

It is recommended that initially, the island be seeded with commercial grass seed in order to help consolidate the material from which it is made. The planting of a small number of Birch, Alder and Willow saplings will also assist in this. It is envisaged that after a brief number of years, the island will become naturally vegetated.

When aquatic plants and associated invertebrates become well established within the compensatory pond habitat, this habitat will provide ideal conditions for foraging bats of numerous species. In addition, the location of the pond adjacent to Blake's House and associated mature gardens (with a variety of mature and ivy-covered trees) would indicate that there will be a variety of potential roosting habitats available in the immediate vicinity. Blake's House (which is currently being monitored in the long-term to assess its usage by bats for roosting) is in a severe state of disrepair. It is recommended that in order to maximise the potential for the building to serve as a potential bat roost, a minimum of three bat boxes of the type "1FQ Schwegler Bat Roost for external walls" be installed on the exterior of the building. The 1FQ Bat Roost is ideal for all types of bats which inhabit buildings. The shape and design make it equally attractive to bats as a roost or nursery. The structure of the 1FQ has been designed with bat-behaviour in mind. For example, the outside of the front panel has been roughened to enable the animals to land and hang onto it securely. Access is via a step-like recess which enables even young and inexperienced bats, to safely access the box. The inside of the box has rough pieces of wood incorporated which provide good insulation and are also used by the bats as perches. The internal layout provides three different areas from which bats can hang and which offer different levels of light and temperature. There are also non-slip areas, gaps ranging from 1.5 to 3.5cm in width and various places for individuals to hide. Installation of the 1FQ is achieved using the four screws and plugs provided. The back panel is initially screwed onto the wall (using four screws) and then the front panel is attached to this. It can easily be attached to most types of external brick, timber or concrete and can also be placed inside a roof space. The box should be positioned a minimum of three metres above the ground and where there is a clear flight path for bats entering and leaving.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:11

The location of the proposed compensatory pond habitat immediately adjacent to hedgerows, and in close proximity to the Yellow River provides for several ecological corridors which might be used to travel to and from the constructed habitat. It would be ideal if the constructed pond were linked via a constructed water-course to the Yellow River, which would provide a direct corridor for the colonisation of the new pond by the flora and fauna occurring in the Yellow River, provide an attenuation area for the Yellow River in times of flood and provide a commuting corridor for bats (and potentially Kingfisher) to arrive at the newly constructed habitat.

4.13 Decommissioning- Potential impacts on roosting birds - Mitigation

There is currently open water within the operational tailings facility. This water body provides a roosting site of high regional importance for a number of species of Gull, Lapwing, Mute Swan and two species listed on Annex I of the EU Birds Directive – Golden Plover and Whooper Swan. The habitat present within the Tailings-management facility is dynamic, with the exact location of open water changing location slightly as different stages of the Tailings-management facility are commissioned and decommissioned. Eventually, the lifetime of the mine will come to an end and the Tailings-management Facility will be decommissioned. This will result in the loss of the largest inland water-body in Co. Meath. In the absence mitigation measures, this decommissioning stage has the potential to impact on local and regional populations of avifauna.

Consent of copyright owner required for any other use. For inspection purposes only.

Some of the land surrounding the tailings storage facility is in the ownership of Tara Mines, and this presents an opportunity for the construction of a wetland habitat of significant proportions adjacent to the facility.

The provision of an extensive wetland ecosystem presents the opportunity to not only provide compensatory habitat for over-wintering roosting birds, but the prospect to provide potentially one of the most biodiverse ecosystems in Co. Meath, with potential over-winter roosting and foraging habitat for birds such as Whooper Swan. In addition, such a wetland system may attract species rare in Meath, such as visiting Hen Harrier during winter months. Such a wetland system would provide breeding habitat for a variety of wetland birds, rare in the largely agricultural landscape of Meath. Tara Mines has identified approximately 12 ha of potentially suitable land, which could be converted to a mosaic of wetland habitats (see Figure 4.60).

The design of the proposed wetland, designed for water-treatment, will provide a wetland habitat that will compensate for loss of roosting habitat of over-wintering birds within the open-water area of the Tailings facility.

The design of any proposed wetland will be informed by the guidance of both hydrogeology and ecology such as to maintain and enhance the ecological integrity of the Natura 2000 network, and in particular the River Boyne and River Blackwater SAC and SPA.

EPA Export 06-01-2017:02:02:11

Of importance to note, the proposed compensatory habitat, which would almost certainly comprise the largest contiguous habitat of its type in Co Meath and is immediately adjacent to the Navan to Kingscourt railway line. In addition to being one of the most important ecological corridors in Meath, this railway line is to be made a cycle-way in the near future. Tara Mines have provisionally agreed to the installation of a raised boardwalk through some sections of the proposed wetland compensatory habitat (similar to that at Pollardstown Fen) and agreed in principle to allow access to the public from the railway line corridor. In addition to providing an invaluable ecological resource on the outskirts of the increasingly urbanised area of Navan town, if managed appropriately, this wetland area could provide a significant educational and tourist resource within Meath, accessible from the Navan – Kingscourt cycleway.

4.14 Pipeline installation

Much of the pipeline will run through area not considered environmentally these sections are relating to the pipeline origin and mid-section. However as the pipeline enters the Nevinstown area and nears the Blackwater the potential for environmental impact increases.

The proposed works will take place proximate to and along the bank of the river Blackwater, one of the primary constituents of the River Boyne and River Blackwater SAC/SPA. The proposed works will involve excavation of material and moving of said material within the SAC and immediately adjacent to/within the SPA, and therefore has the potential to impact on both of these Natura 2000 sites.

For inspection purposes only.
Consent of copyright owner required for any other use.

4.14.1 Potential Direct, Indirect or Secondary Impacts

The proposed works are located immediately within the River Boyne and River Blackwater SAC/SPA, and there potential for direct impacts upon these Natura 2000 sites associated with the proposed works. The primary source of impacts are:

- Impacts on any Annex I habitat occurring within the footprint of the works;
- Impacts on any Annex II/IV species (EU Habitats Directive) within and or immediately adjacent to the proposed works;
- Impacts on any Annex I bird species (EU Birds Directive) occurring within or immediately adjacent to the proposed works;
- The proposed works entail excavations immediately adjacent to the River Blackwater, which may impact upon the water quality of the water course;
- The works will involve the use of heavy machinery, with the potential for contamination of the River Blackwater by associated hydrocarbons, etc;

There is also the possibility of secondary impacts, with any of the impacts listed above having an impact on any sites/species linked physically or ecologically to these Natura 2000 sites.

EPA Export 06-01-2017:02:02:11

Many of the habitats and species for which the Natura 2000 sites occurring within 15 km of the proposed development are designated, are directly or indirectly dependent on water quality/hydrology. A reduction in water quality, or changes to local hydrology could negatively impact upon the conservation status of these sites with regard to habitat quality and size, and with regard to the ecological integrity of those species occurring within the sites.

The potential for impacts upon Natura 2000 sites within 15 km of the development is summarized in table 4.10.

The potential impact upon the site in the event of negative impacts is summarized in table 4.11. The potential impacts on qualifying interests of Natura 2000 sites within the 15 km study area identified as potentially at risk are summarised in 4.12.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

Table 4.11 Potential for impacts upon Natura 2000 sites within 15 km

Site Name	Direct Impacts	Indirect/ Secondary Impacts	Resource require-ments	Emissions	Excavation requirements	Duration of construction and operation
River Boyne and River Blackwater SAC	Potential impacts on habitats and or species for which the SAC has been designated	Potential impacts on local water quality Potential disturbance of species of conservation concern Potential 2° impacts	None predicted	Potential indirect impacts on the River Blackwater through changes in water quality/	Potential indirect impacts on local water quality/hydrology. Potential disturbance of species of conservation concern Potential 2° impacts on Annex I bird species	Potential indirect impacts on local water quality/hydrology. Potential disturbance of species of conservation concern Potential 2° impacts on Annex I bird species
River Boyne and River Blackwater SPA	Potential impacts on habitats and or species for which the SPA has been designated	Potential indirect impacts on local water quality/hydrology. Potential disturbance of species of conservation concern Potential 2° impacts on Annex I bird species	None predicted	Potential indirect impacts on the River Blackwater through changes in water quality/ hydrology	Potential indirect impacts on local water quality/hydrology. Potential disturbance of species of conservation concern Potential 2° impacts on Annex I bird species	Potential indirect impacts on local water quality/hydrology. Potential disturbance of species of conservation concern Potential 2° impacts on Annex I bird species

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

Table 4.12 Potential changes to Natura 2000 sites within 15 km of the proposed development

Site Name	Reduction of habitat area	Disturbance to key species	Habitat/species fragmentation	Reduction in species density	Changes in Key Indicators of Conservation Value	Climate change
River Boyne and River Blackwater SAC	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	None Predicted
River Boyne and River Blackwater SPA	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	Potential impacts on water quality/hydrology Potential disturbance of species of conservation concern Potential secondary impacts on Annex I bird species	None Predicted

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:11

Table4.13 Potential impacts on Qualifying Interests of Natura 2000 sites identified as at risk of impact

Site name	Qualifying Interest	Potential Impact
River Boyne and River Blackwater SAC	[1099] *Lampetra fluviatilis*	Potential impacts through changes in water quality and hydrology
	[1106] *Salmo salar* (only on fresh water)	Potential impacts through changes in water quality and hydrology
	[1355] *Lutra lutra*	Potential impacts through changes in water quality and hydrology Potential impacts through disturbance
	[7230] Alkaline Fens	Potential impacts through changes in water quality and hydrology
	[91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* – Priority Habitat	Potential impacts through changes in water quality and hydrology
River Boyne and River Blackwater SPA	*Alcedo atthis [breeding]*	Potential impacts through disturbance Potential 2° impacts

For inspection purposes only.
Consent of copyright owner required for any other use.

In addition, although not a qualifying interest, [7220] petrifying springs with tufa formation (*Cratoneurion*), a priority habitat listed on Annex I of the EU Habitats Directive, do occur along the River Boyne and River Blackwater SAC and are particularly vulnerable to any changes in hydrology or water quality.

EPA Export 06-01-2017:02:02:11

4.14.2 Gauging of Impacts on Natura 2000 sites

The potential impacts of the proposed development on Natura 2000 sites are gauged using a checklist, which aids in determining whether the proposed works have the potential to have a significant negative impact on any Natura 2000 site. This checklist consists of a number of pertinent questions as set out in table 4.14.

Table 4.14 Potential of the proposed development to impact upon Natura 2000 sites in the absence of any mitigation/ precautionary measures.

Does the Plan have the potential to:	Yes/No
Cause delays in progress towards achieving the conservation objectives of the Natura 2000 site?	YES
Interrupt progress toward achieving the conservation objectives of the Natura 2000 site?	YES
Disrupt those factors helping to maintain the favourable conditions at the Natura 2000 site?	YES
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the Natura 2000 site?	YES
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the Natura 2000 site functions as a habitat or ecosystem?	YES
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the Natura 2000 site?	YES
Interfere with predicted or expected natural changes to the Natura 2000 site (such as water dynamics or chemical composition)?	YES
Reduce the area of key habitats within the Natura 2000 site?	YES
Reduce the population of key species of the Natura 2000 site?	YES
Alter the balance between key species of the Natura 2000 site?	YES
Reduce the biodiversity of the Natura 2000 site?	YES
Result in disturbance that could affect population size or density or the balance between key species within the Natura 2000 site?	YES
Result in fragmentation?	YES
Result in the loss or reduction of key features of Natura 2000 sites?	YES

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:11

4.14.3 Sources and significance of impacts

The primary sources of concern with regard to potential impacts of the proposed works on the Natura 2000 network, and their significance are:

- The works will take place within the River Boyne and River Blackwater SAC and within/adjacent to the River Boyne and River Blackwater SPA. Given that there was no Annex I habitat present at the site, and no suitable Otter Holt/Kingfisher nesting sites along the bank where the works are to be carried out, however, it is considered that the risk of direct impacts is negligible;
- The potential for impacts on ground water/surface water/hydrology during excavation and infilling, leading to impacts on the quality of the River Boyne and River Blackwater SAC/SPA. It is considered, however, that the risk of contamination can be reduced to a negligible level through the implementation of suitable mitigation/preventative measures;
- The potential for increased disturbance to species of conservation concern dependent on the Natura 2000 sites and the immediate environs. In particular, there is a potential for impact on Otter and Kingfisher through disturbance. It is considered, however, that the risk of disturbance can be reduced to a negligible level through the implementation of suitable mitigation/preventative measures.

In addition, it should be noted that the proposed development is located immediately adjacent to a major bat commuting/foraging corridor in the form of the River Blackwater and that any stretches of hedgerow or single trees, are likely to be utilised by several species of bat, during foraging, commuting and possibly even roosting.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

4.15 Mitigation – On-going and planned monitoring

4.15.1 Monitoring of bats

A bat monitoring program is currently underway, monitoring the bat usage of the Woodland Area, the adjacent pond, Blake's House and the area in which it is proposed to construct a pond by means of compensatory habitat for the loss of the attenuation pond adjacent to the woodland. This bat monitoring involves the deployment, simultaneously of four Pettersson D500x Ultrasound recording units at the four sites. These units are pre-programed to record all bat-passes occurring during the period between 30 minutes before sunset and 30 minutes after sunrise throughout a year-long survey period, which commenced in November 2015. This monitoring will provide an extremely comprehensive and robust baseline of the usage of the different habitats by bats within the proposed development footprint, and will allow the success of proposed mitigation measures to be adjudged both qualitatively and quantitatively.

The derogation granted by NPWS has outlined a very comprehensive monitoring program, which will monitor the success of mitigation measures as regards bats over a period of, at minimum, 10 years.

4.15.2 Winter Bird Monitoring

A comprehensive survey of over-wintering birds roosting on Stage 5a/b was undertaken during the period October 2015 and March 2016 inclusive. This monitoring identified that the Tailings management facility is of high regional importance to roosting birds both at night (for species such as Whooper Swan), and during the day (for species such as Golden Plover and Lapwing, which tend to forage nocturnally in surrounding agricultural land).

For inspection purposes only. Consent of copyright owner required for any other use.

It is recommended that these winter bird surveys be carried out on an annual basis to monitor the usage of the TSF and any changes associated with the phased closing/opening of different stages. This monitoring will inform the decommissioning plan when mining operations cease.

4.15.3 Monitoring of woodland for use by Badger

The sett present in the woodland to be removed (for which derogation has been granted) has not been observed to be utilised by Badger during surveys. It is recommended that monitoring regarding Badgers in the vicinity be comprised of two phases:

Monitoring of the disused sett should be undertaken to ensure that the sett is not "reoccupied" during the interval between any granting of derogation and commencement of works. Works to the sett (as regards "soft –blocking" and then removing) cannot be undertaken until September 2016 at the earliest owing to the importance of the woodland habitat to the local bat population (subject of a separate derogation). It is therefore recommended that the sett be monitored utilising infra-red trail cameras located at the sett, such as to record any activity detected.

EPA Export 06-01-2017:02:02:11

Monitoring of compensatory habitat – it is recommended that annual monitoring of the compensatory woodland habitat be undertaken such as to identify if and when the compensatory habitat is colonised by badgers. This monitoring should take the form of traditional surveying for tracks, trails and setts within the compensatory habitat. Upon any discovery of the colonisation of the compensatory habitat by Badger, the population should be monitored on a biannual basis to determine the nature of any setts and the success of any setts established.

Biennial reports of monitoring will be submitted to NPWS such as to ensure the compliance of the proposed development with the terms of any derogation.

4.15.4 Monitoring of habitats/flora: *environs* of the TSF

In order to monitor the development of habitat, and the habitat currently present within the *environs* of the TSF, habitat mapping and full floral surveys of the area will be conducted on an on-going basis every three years. This strategy is in compliance with Objectives (2) – (4) of the (Draft) Meath Biodiversity Action Plan 2015 – 2020, and will greatly enhance the understanding of biodiversity within (relatively) undisturbed habitats in Meath. In combination with other monitoring, the TSF will be one of the most intensively surveyed areas within Co. Meath as regards biodiversity.

Consent of copyright owner required for any other use. For inspection purposes only.

4.15.5 Monitoring of Nocturnal Macro-moths

Previous surveys have found that there is a wide biodiversity of nocturnal macro month species present within the vicinity of the TSF (almost certainly owing to the semi-natural status of the vegetation occurring here). Moths and butterflies are often utilised as "indicator species" of invertebrate biodiversity of a site. Although nocturnal macro moth surveys of the TSF were planned for 2015, these surveys could not be undertaken owing to inclement weather conditions. Monitoring of nocturnal macro moths (March – October) will take place in tandem with monitoring of habitats/flora present within the *environs* of the TSF (i.e. every three years, weather permitting).

EPA Export 06-01-2017:02:02:11

4.15.6 Mitigation/Preventative measures during the pipeline installation

The main concerns regarding the potential impacts of the proposed works on the Natura 2000 network are:

- Impacts on water quality and/or hydrology;
- Impacts through disturbance on Otter and/or Kingfisher; and
- Impacts on Bat species associated with the SAC/SPA.

There is potential for impacts on water quality and/or hydrology during the excavation of the material.

The following mitigation measures should be implemented to militate against these potential impacts. For the most part, it will be the responsibility of the site engineer and foreman to ensure that the mitigation measures are put in place.

- The works will be supervised by the site engineer under the direction of the Company's environmental department.
- Haulage pathways/roads should be as regulated as possible in order to keep compaction to a minimum.
- Vegetation is one of the primary means by which the movement of suspended solids in run-off can be reduced. All vegetation should be retained where possible and areas in which vegetation has been removed during excavation should be allowed to regenerate naturally as quickly as possible. These areas **should not** be planted up with commercially available seed, but must be allowed to regenerate naturally. It is planned to undertake the works in the near future during the height of the growing season and it should not take disturbed areas long to re-vegetate naturally.
- Hedgerows provide essential ecological corridors throughout the agricultural landscape. It is recommended that all hedgerow habitat/trees be retained intact. It is further recommended that a buffer zone of a minimum of 5 m be put in place adjacent to hedgerows/trees such as to protect roots from damage during excavation works. This buffer zone should be taped off, and the importance of the buffer zone should be pointed out during all site inductions.
- It is imperative that at no time should any material or effluent associated with the proposed works enter the River Blackwater.
- All excavation should be timed to minimise risk of potential erosion by minimising the tie period during which works are carried out and restricting works to dry spells of weather, halting works during periods of heavy rain to minimise soil compaction/disturbance, and restricting vehicular and equipment access or provide working surfaces/pads.
- Potentially hazardous materials on site (including fuels, lubricants and hydraulic fluids, solvents, oils, paints, etc.) must be stored a minimum of 100 m from the river and should be carefully handled to avoid spillage. Material of this nature must be properly secured against unauthorised access or vandalism, and provided with spill containment according to codes of practice. All machinery/equipment used on site must be fully services and maintained in such a way as to minimise the potential for any leaks/spillage of diesel, oil, etc. Any spillages must immediately be reported to the site foreman, who

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

should act appropriately to prevent any potential contamination of the River Blackwater.

- Meath County Council has committed policies supporting Sustainable Urban Drainage Systems (SUDS). The potential for contamination of the River Blackwater, through run-off of polluted surface water must be addressed in any SUDS for the works, with measures to ensure that no contamination occurs outlined.

There is potential for the proposed works to disturb several species of conservation concern, including several species for which the SAC/SPA has been designated.

In order to minimise the potential for any impacts

- Works should be undertaken with maximum efficiency and completed as quickly as it is possible to safely do so. The works are located close to the centre of a busy town, and most resident animals should be habituated to a certain degree of disturbance. There was ample evidence on site that the area is subjected to regular disturbance by fishermen and dog-walkers.

- While the river bank immediately adjacent to the works was not particularly suitable for either Otter holts or Kingfisher nests, there were several trees with branches overhanging the river. These trees are likely of very high importance to foraging Kingfisher and should be avoided during excavation.

Consent of copyright owner required for any other use. For inspection purposes only.

- It is also considered that there is potential for negative impacts on several bat species, all of which are listed on Annex IV of the EU Habitats Directive. The river itself, and associated hedgerows provide essential ecological corridors throughout the agricultural landscape for bats. It is recommended that all hedgerow habitat/single trees be retained intact to minimise any potential negative impacts on bats. It is further recommended that a buffer zone of a minimum of 10 m be put in place adjacent to hedgerows such as to protect roots from damage during construction works. This buffer zone should be taped off, and the importance of the buffer zone should be pointed out during all site inductions.

EPA Export 06-01-2017:02:02:11

Section 5 Ecology - Surface water

5.1 Introduction

This Aquatic Ecology Flora and Fauna chapter was prepared on behalf of the Boliden Ltd. Tara Mines (Tara Mines) by TOBIN Consulting Engineers (hereafter known as TOBIN). The Aquatic Ecology Assessment was undertaken by the TOBIN Ecology team of qualified ecologists. All elements of the assessment were conducted in accordance with, and taking cognisance of, Irish and European legislation, as well as all relevant best practice guidelines.

5.1.1 Background

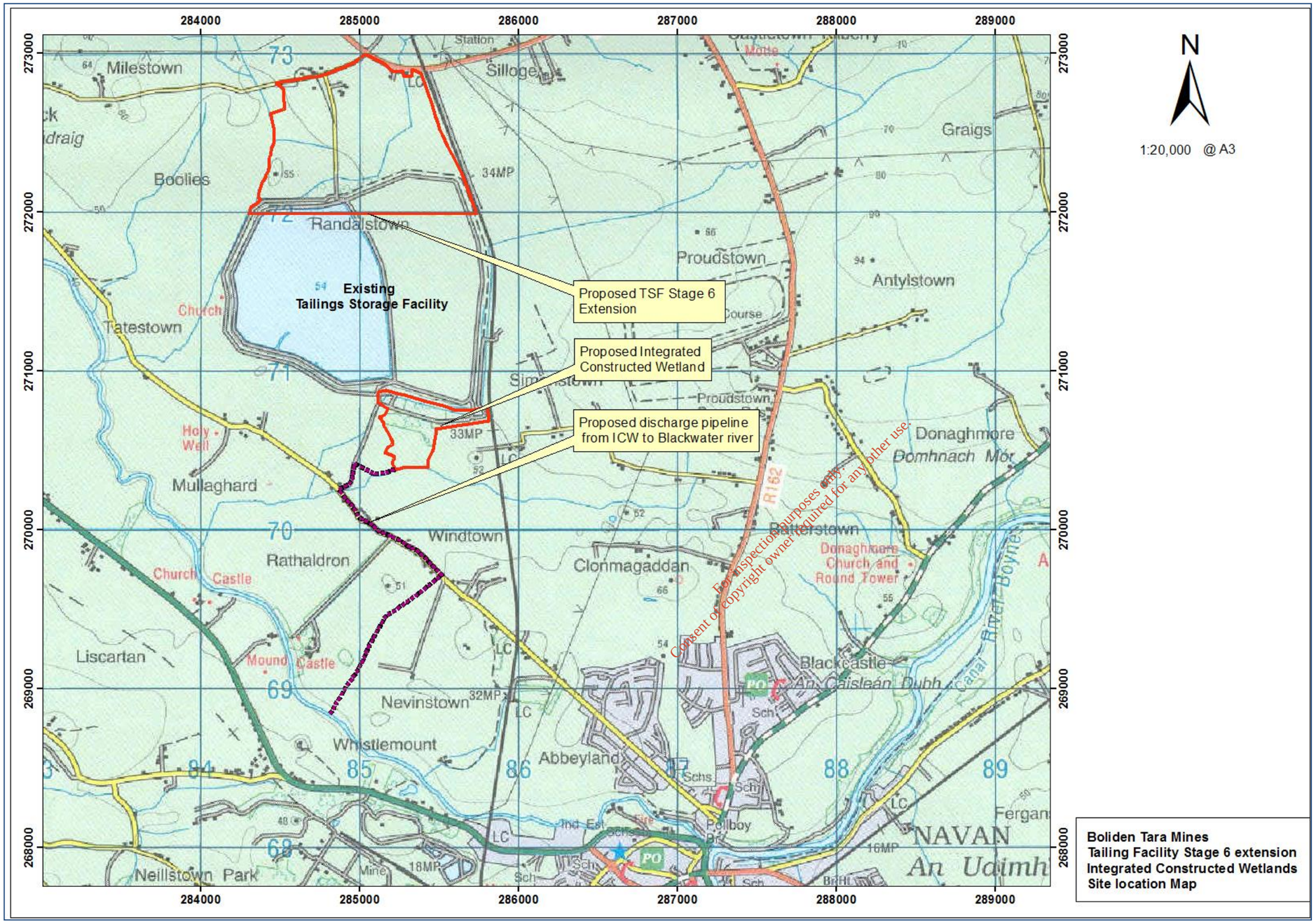
Since its inception the tailings facility has been constructed and operated in seven stages, Stages 1, 2, 3 (lateral extensions) and the more recent Stage 4A, 4B, 5A and 5B (upstream vertical extensions), using combinations of temporary and permanent embankment walls.
The existing TSF, enclosing a footprint area of approximately 171 ha, serves as containment for tailings to settle and consolidate, as well as a storage area for water that is circulated back to the processing plant at Knockumber for reuse in the processing plant or for eventual discharge to the *River Boyne*.

For inspection purposes only.
Consent of copyright owner required for any other use.

- **It is proposed to extend the existing TSF laterally in a northerly direction.**
    - **Here after the proposed facility will be referred to as *TSF Stage 6*.**
    - **The proposal facility will cover a footprint area of c. 58 hectares, extend to a height of 22 m above ground level and will provide a potential a storage volume of approximately 9.6 million cubic metres [13.6 million tonnes].**

- **The second part of the proposed development is the construction of an Integrated Constructed wetland (ICW). The proposal facility will cover a footprint area of c. 12 hectares. The function of the wetland is to provide a passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle.**
    - **Treated water will discharge from the ICW to the river Blackwater via a buried HDPE pipeline.**

EPA Export 06-01-2017:02:02:11



Consent of copyright owner required for any other use.
For inspection purposes only.

Figure 5.1 Site location map. Proposed Stage 6 extension north of the existing TSF and the proposed ICW south of the TSF site. Pipeline route to the river Blackwater.

EPA Export 06-01-2017:02:02:11

5.1.2 Overview of the proposed development

An overview of the proposed development is set out in order to provide a framework upon which the Aquatic Ecology assessment has been based.

The information presented below is based on the project description described in EIS Section 3, Project Description

.

The proposed extension to the TSF will comprise:

- The construction of the proposed Stage 6 tailings pond
  - In two phases; Phase1 and Phase 2
- The operation phase of the proposed Stage 6 tailings pond, including treatment of excess tailings pond supernatant water and surface water run-off within the existing treatment scenario via a recirculation system.
- Finally, the decommissioning of Stage 6 will include the decommissioned Stage 5 site and surface water run-off from both areas will be treated via a constructed wetland system and subsequently discharged to the River Blackwater.

The construction of the proposed Stage 6 tailings pond

The conceptual design for the Stage 6 TMF has been carried out by Golder Associates and is described in detail in the design report (Golder Associates, 2016). The approximate basin area for Stage 6 is given as 58 ha. and the crest elevations of the downstream raises coincide with the crest elevations of the existing facility.

For inspection purposes only.
Consent of copyright owner required for any other use.

Key aspects of the Stage 6 design are as follows:

- The dam would be located in the existing borrow area north of the existing TSF;
- The dam would be raised to and elevation of 67.29 mAOD in two phases;
- The *Blakes Stream* would be redirected to cross the northern borrow area 400-600m north of its current route.
- A composite lining system would be in place which consists of a high density polyethylene (HDPE) geomembrane over a geo-synthetic clay liner (GCL). The lining system would be placed on the upstream slopes of the dam wall and basin area.

Material required to construct the Stage 6 extension is estimated as 1,900,000 m^3 of local material from different sources.

Borrow material would need to be removed from the Stage 6 footprint to bring the base elevation down to 45.29 maOD prior to placing the lining.

EPA Export 06-01-2017:02:02:11

.
The existing drainage system within the TSF will be modified to accommodate the extra storage capacity provided by Stage 6, but the previous system would still operate as designed for the Stage 5 raise.

As such the existing water reticulation system will continue to operate, i.e. water will be pumped back to the mine and subsequently discharged to the River Boyne, under the existing IE licence.

The decommissioning plan for the site includes provision for off from both the existing and proposed TSF extension to be treated via a construction wetland system and subsequently discharged to the River Blackwater

Both the quality and volume of flow will be monitored following capping of Stage 5A (during operation of Stage 5B) and subsequent capping of 5B, so that the design of the closure treatment system can be finalised.

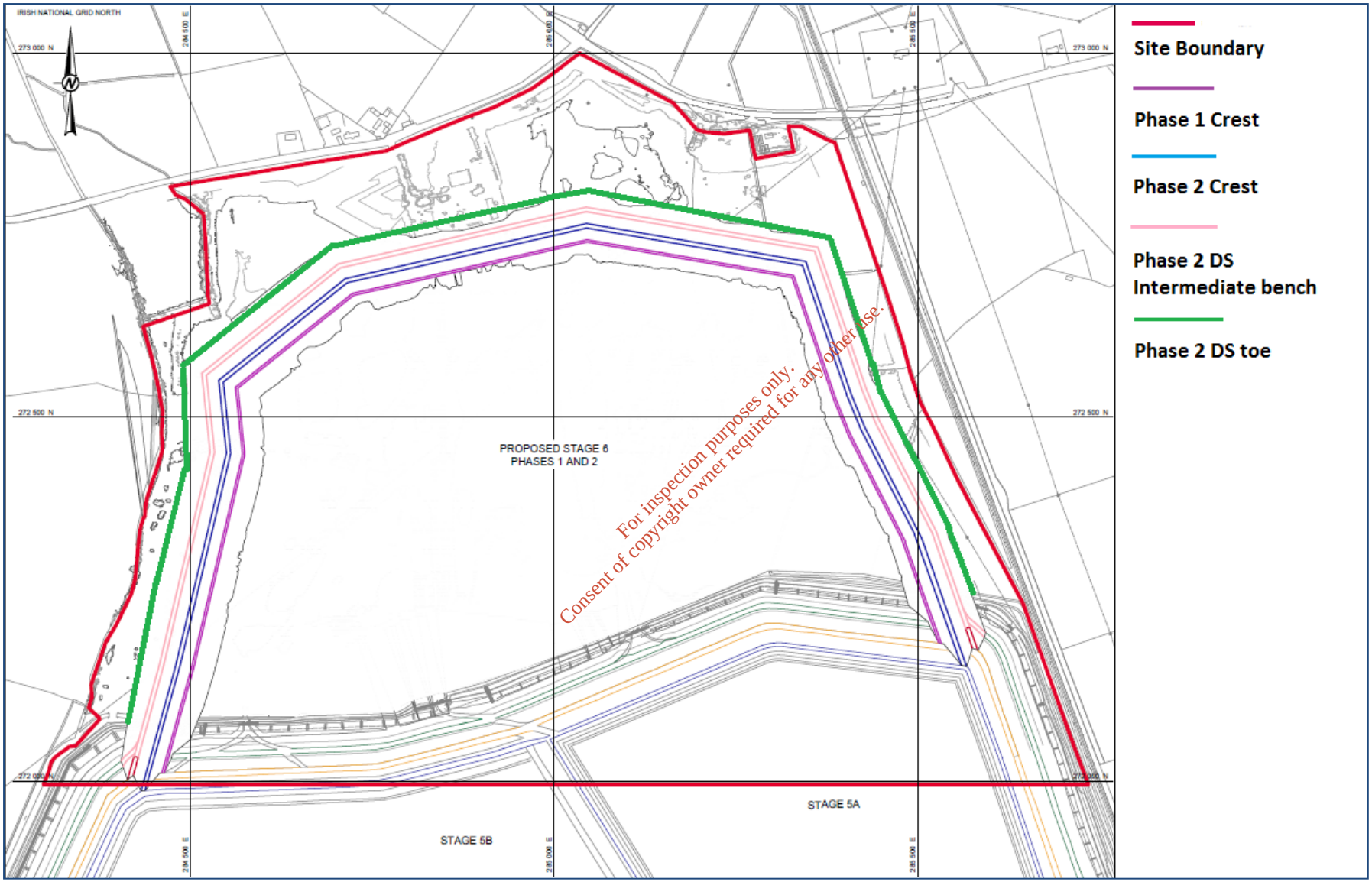
The designs will be such that impacts on surface water will be minor due to treatment and dilution. Water collected in the interceptor channel will discharge by gravity to a passive treatment works. It is intended that the treatment system will reduce concentrations of sulphate and metals to acceptable levels for discharge to the Blackwater River. The existing water treatment methods which are in place have been monitored since 2004. The water contamination levels and treatment standards prior to discharge are evaluated as being similar, given the same character of operation processes and material; therefore these historical monitoring values were used to estimate the potential input.

For inspection purposes only.
Consent of copyright owner required for any other use.

This chapter provides an assessment of the potential impacts of the proposed design plan on the Aquatic Flora and Fauna of the receiving environment; both within the site boundary and the wider study area, i.e. the zone of influence. Specific effort is made to consider potential for significant effects on Annex I and Annex II species and habitats; qualifying interests of European Sites and aquatic ecological interests identified as being key ecological receptors in the local context.

The key components of the proposed project are identified in Figures 5.2, 5.3 and 5.4.

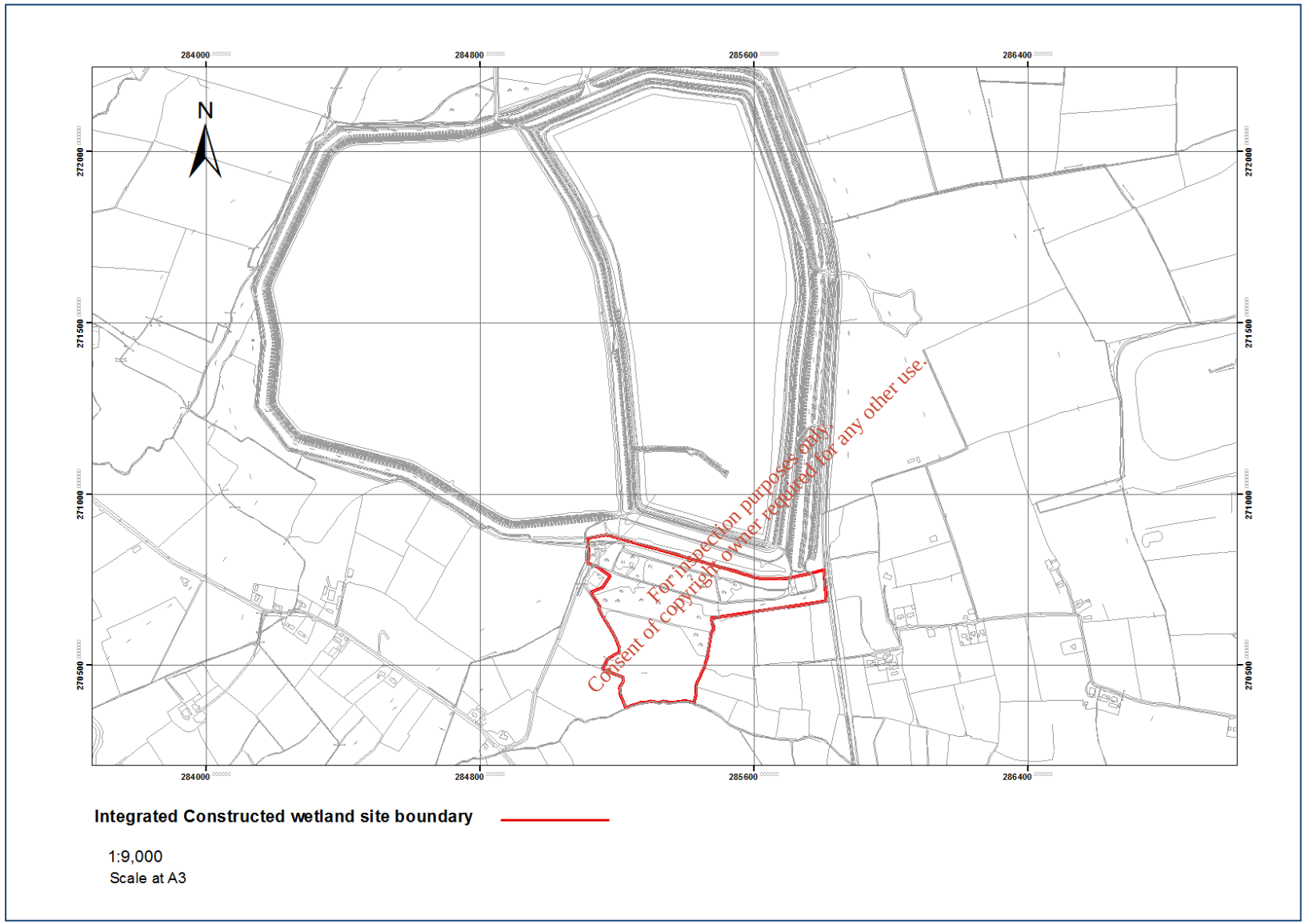
EPA Export 06-01-2017:02:02:11



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 5.2. Proposed location of the Stage 6 TSF extension north of the (red outline) the existing Stage 5 TMF.

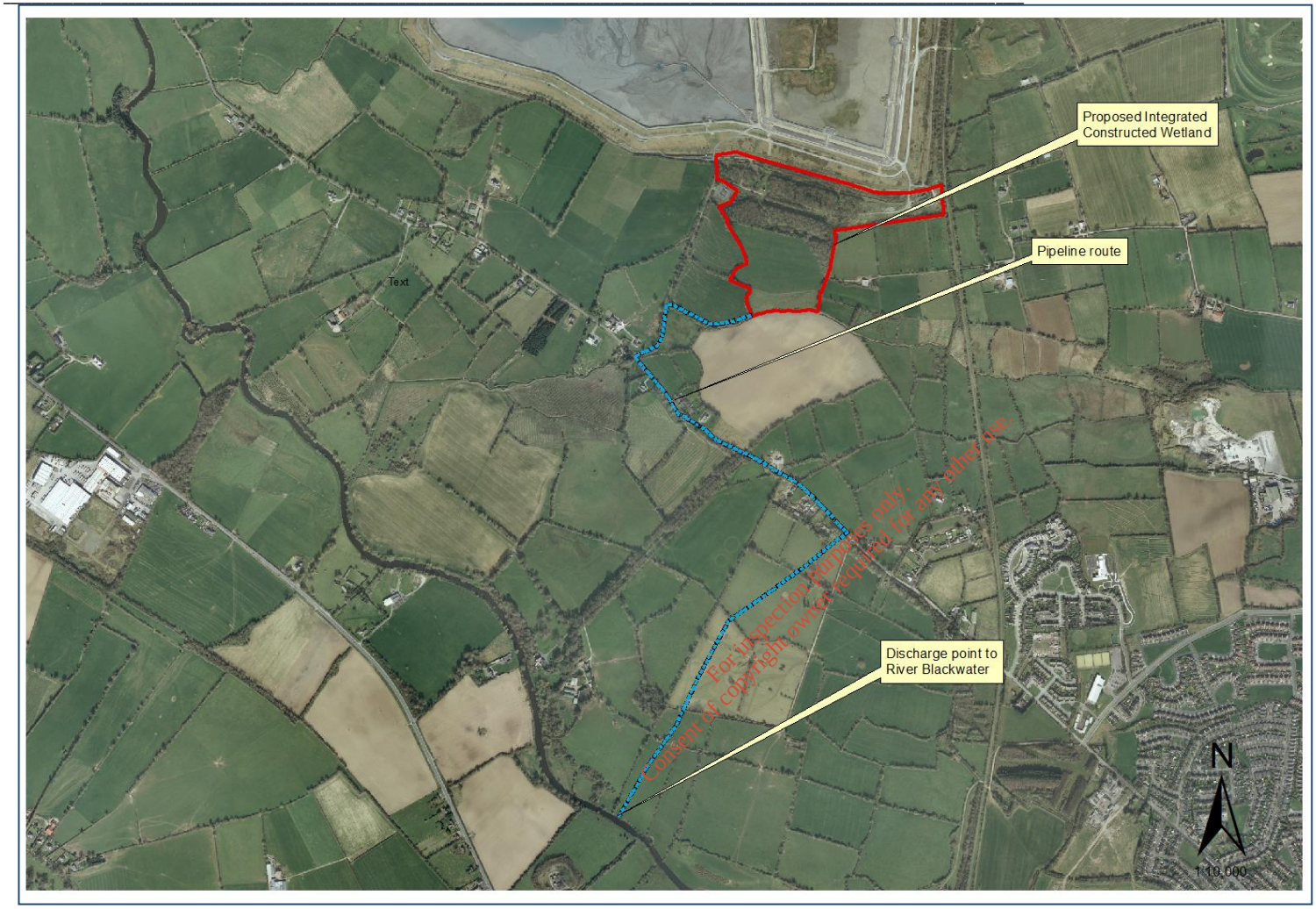
EPA Export 06-01-2017:02:02:11



Consent of copyright owner required for any other use.
For inspection purposes only.

Figure 5.3. Proposed location of the constructed wetland treatment facility (red outline), to the south of the existing Stage 5 TMF

EPA Export 06-01-2017:02:02:11



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 5.4 Pipeline route to the river *Blackwater*

EPA Export 06-01-2017:02:02:11

5.2 Methodology

5.2.1 Desktop Review

The ecological desktop study completed for the proposed development comprised the following elements:

- Review of the NPWS website (www.npws.ie)
  - Identification of European Sites designated for aquatic qualifying interests, with identification of potential pathways for effects;
  - Review of the NPWS site synopses and conservation objectives for European Sites where potential pathways were identified with respect to aquatic qualifying interests;
  - Identification of aquatic species recorded from the study area, listed on the NPWS protected species database.
- Review of the EPA (www.epa.ie) biological water quality monitoring (Q-value) dataset for the Blackwater River and associated tributaries;
- Review of the National Biodiversity Data Centre (www.biodiversityireland.ie) records for aquatic ecological receptors within the proposed development site and wider zone of influence.
- A review of historical and contemporary ecological desk and field studies which were undertaken on behalf of Tara Mines between 2007 and 2015; the results of these studies are included as part of this Aquatic Ecology Assessment.
  - Environmental Impact Statement (2009, AECOM);
  - Stage 1 of an Appropriate Assessment (2010 by Biosphere Environmental Services);
  - Flora and Fauna assessment (2015 Forest, Environmental Research & Services Ltd.); and
  - Natura Impact Statement for the discharge of groundwater (2010, TOBIN Consulting Engineers).

For inspection purposes only.
Consent of copyright owner required for any other use.

5.2.2 Field Surveys

Walkover surveys of the proposed development site and downstream reaches of affected tributaries were conducted to assess the aquatic habitats available on site, as well as in the surrounding area. This survey included reaches of the *Yellow River*, *Simonstown Stream*, *Blakes Stream* and *Duog Stream.*

The aquatic ecological interests were identified and assessed with reference to the potential for watercourses and aquatic habitats within the development site, or connected to the development, to support key aquatic ecological receptors. Specific attention was paid to the potential for the occurrence of, and the connection to, the qualifying interests of the River Boyne and River Blackwater SAC downstream. The aquatic ecological survey placed emphasis on the identification of the following:

a) The presence of aquatic or water-dependant habitats listed on Annex I of the EU Habitats Directive; and

b) The presence of aquatic or water-dependant species listed on Annex II of the EU Habitats Directive.

EPA Export 06-01-2017:02:02:11

5.2.3 Evaluation

It is necessary to identify the value of ecological features within the study area in order to evaluate the significance and magnitude of possible impacts. The ecological field survey and impact assessment has been prepared in line with the following guidelines:

- Guidelines on the information to be contained in Environmental Impact Statements (EPA 2002);
- Advice Notes on current practice in the preparation of Environmental Impact Statements (EPA, 2003);
- Chartered Institute of Ecology and Environmental Management Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM 2016).

Ecological survey results were evaluated to determine the significance of identified features located in the study area on an importance scale ranging from international-national-county-local. The local scale is approximately equivalent to one 10 km square but can be operationally defined to reflect the character of the area of interest, or the area of the proposed development. Because most sites will fall within the local scale, this is sub-divided into two categories: high value local importance and low value local importance. The criteria used are based on ecological impact assessment criteria set out in the NRA guidelines for ecological impact assessment (2009) and are shown in Table 5.1

Consent of copyright owner required for any other use. For inspection purposes only.

The evaluation of impacts is broadly based on guidance offered by the Institute of Environmental and Ecological Management (IEEM) in the published *Guidelines for Ecological Impact Assessment* (2016). Impacts are discussed and evaluated in relation to impact type (positive, neutral or negative), character and sensitivity of the affected feature, magnitude, duration, reversibility, timing and frequency. Criteria for describing and assessing impacts and their magnitude are presented in Tables 5.1 and 5.2.

EPA Export 06-01-2017:02:02:11

Table 5.1 Geographic frame of reference used to determine value of ecological resources (NRA 2009).

Importance	Criteria
International Importance	'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. Proposed Special Protection Area (pSPA). Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended). Features essential to maintaining the coherence of the Natura 2000 Network Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level) of the following: -Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or -Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972). Biosphere Reserve (UNESCO Man & The Biosphere Programme) Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). Biogenetic Reserve under the Council of Europe. European Diploma Site under the Council of Europe. Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).
National Importance	Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park. Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

Importance	Criteria
County Importance	Area of Special Amenity. Area subject to a Tree Preservation Order. Area of High Amenity, or equivalent, designated under the County Development Plan. Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. County important populations of species; or viable areas of semi-natural habitats; or natural heritage features identified in the National or Local BAP; if this has been prepared. Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
Local Importance (higher value)	Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (lower value)	• Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; • Sites or features containing non-native species that are of some importance in maintaining habitat links.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

Table 5.2 Criteria Used in Ecological Impact Assessment

Positive or Negative: Is the impact likely to be positive or negative? International and national policy now pushes for projects to deliver positive outcomes for biodiversity.
Character: The type of habitat (e.g. natural or highly modified woodland; mature or recently established, wet or dry) is important, as is the quality of the site (e.g. undamaged active blanket bog).
Significance State whether a site has a designation, such as a SAC or NHA, or contains a listed (Annex I) habitat. The ecological value of a site can be assigned a rating using an evaluation scheme (e.g. undesignated areas of semi natural broadleaved woodland are normally rated as high value, locally important).
Sensitivity: Indicate changes that would significantly alter the character of an aspect of the environment (e.g. changes in hydrology of a wetland due to placing of temporary rubber matting or aluminium road panels).
Magnitude and extent: A scheme may affect only a small part of a site but the area of habitat affected in that location (in hectares) should be given in the context of the total area of such habitat available (e.g. 1ha of a woodland which measures 30ha in total)
Duration: Indicate the time for which the impact is expected to last prior to recovery or reinstatement of impacted habitats and / or species. The duration of an activity may differ from the duration of the resulting impact caused by the activity (e.g. short term construction activities may cause disturbance to birds during the breeding season, however, there may be longer term impacts due to a failure to reproduce in the disturbed area during that season). EPA (2002) timescales used as follows: • Temporary (0-1 years) • Short term (1-7 years) • Medium term (7-15 years) • Long term (15-60 years) • Permanent (60+ years)
Reversibility: Identify whether an ecological impact is permanent (non-reversible) or temporary (reversible – with or without mitigation).
Timing and Frequency: Some changes may only cause an impact if they happened to coincide with critical life-stages or seasons (for example, the bird nesting season). This may be avoided by careful scheduling of the relevant activities.

For inspection purposes only.
Consent of copyright owner required for any other use.

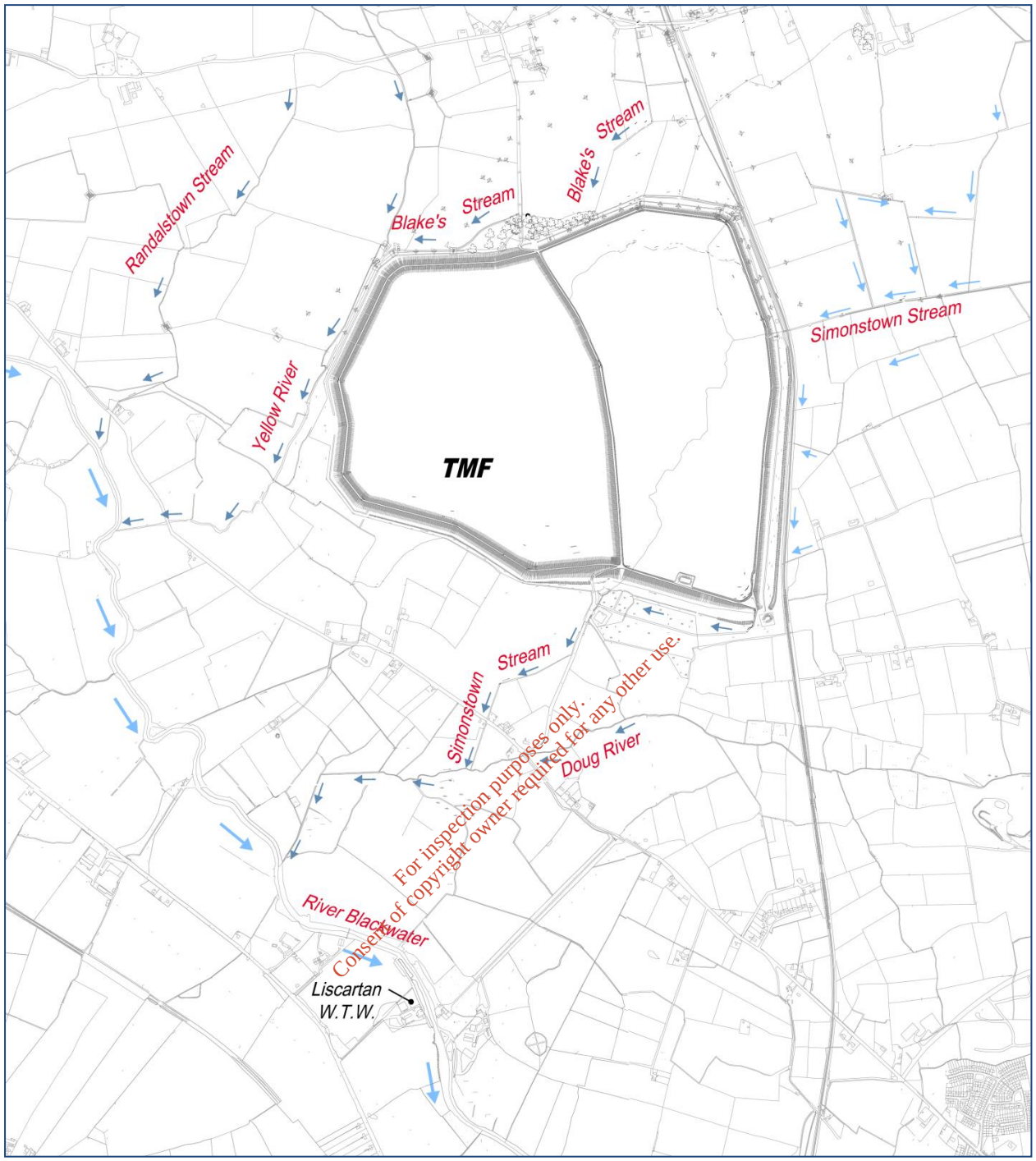
EPA Export 06-01-2017:02:02:11

Table 5.3 Criteria for Assessing Impact Magnitude

Impact Magnitude	Definition
No change	No discernible change in the ecology of the affected feature.
Imperceptible Impact	An impact capable of measurement but without noticeable consequences.
Minor Impact	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary, but these consequences are not considered to significantly affect the distribution or abundance of species or habitats of conservation importance.
Moderate Impact	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary. These consequences are considered to significantly affect the distribution and / or abundance of species or habitats of conservation importance.
Substantial Impact	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary. These consequences are considered to significantly affect species or habitats of high conservation importance and to potentially affect the overall viability of those species or habitats in the wider area.
Major Impact	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary. These consequences are considered to be such that the overall viability of species or habitats of high conservation importance in the wider area is under a very high degree of threat (negative impact) or is likely to increase markedly (positive impact).

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 5.5 Existing tailing facility and surface water network in its environs

EPA Export 06-01-2017:02:02:11

5.3 Receiving Environment

5.3.1 Designated Sites

5.3.1.1 Overview of Designated Sites within the Wider Study Area

The area surrounding the Tara Mines tailings pond site at Randalstown was assessed to identify any European Sites that have a potential link to the development site. A zone of influence for the proposed development was identified, taking account of pathways for impacts to sensitive receptors; particularly with reference to surface water drainage and watercourses.

The recommended 15km buffer zone, in addition to the wider zone of influence of potential aquatic effects was evaluated, resulting in the identification of designated Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), as well as two Natural Heritage Areas: Girley Bog and the Jamestown Bog.

A full detailed review of each designated site is provided below.

With respect to designated European Sites, i.e. Natura 2000 sites, the River Boyne and Blackwater SAC and the River Boyne and Blackwater SPA were identified. A potential pathway was identified between the proposed development and the Boyne Coast and Estuary SAC and the Boyne Estuary SPA via the Boyne and Blackwater Rivers. For this reason, these Natura 2000 sites have also been considered in terms of impacts. The qualifying interests, and pressures/threats to these European Sites identified are summarised in Table 5.4.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

Table 5.4: European Sites and their Qualifying Interests, Conservation Objectives and Threats and Pressures

European Site (including distance from proposed development)	Qualifying Interest(s) and Conservation Status[9]	Conservation Objective[10]	Threats and Pressures[11]
River Boyne and River Blackwater SAC Site Code: 002299 1.25km from Tara Mines	Alkaline Fens Alluvial Forests* River Lamprey (*Lampetra fluviatilis*) Atlantic Salmon (*Salmo salar*) Otter (*Lutra lutra*)	To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the N2000 site has been selected: http://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/ CO002299.pdf.	Forestry (Afforestation) Grazing Human induced change in hydraulic conditions Cultivation / Fertilisation Leisure fishing Discharge Urbanisation Roads & Motorways Walking/ horseriding/ non motorised vehicles
River Boyne and River Blackwater SPA Site Code: 004232 1.25km from Tara Mines	Kingfisher (*Alcedo atthis*)	This objective aims to maintain the favourable conservation condition of Kingfishers in River Boyne and River Blackwater based on a detailed list of attributes and targets. http://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004232.pdf.	Urbanisation Roads & Motorways Human induced change in hydraulic conditions
Boyne Estuary SPA Site Code: 004080 c.30km from Tara	Shelduck *Tadorna tadorna* Oystercatcher *Haematopus ostralegus* Golden Plover *Pluvialis apricaria*	This is a generic conservation objective, which aims to maintain the favourable conservation condition of wintering waterbirds and breeding Little Tern based on a detailed list of attributes and targets.	Urbanisation Siltation, dumping Reclamation Hydrographic changes

Consent of copyright owner required for any other use. For inspection purposes only.

[9] **The Status of EU Protected Habitats and Species in Ireland (Vol II & III), NPWS, 2013. http://www.npws.ie/publications/article17assessments/article172013assessmentdocuments/Article_17_Web_report_habitats_v1.pdf and http://www.npws.ie/publications/article17assessments/article172013assessmentdocuments/Article_17_Web_report_species_v1.pdf**

[10] **Sourced from NPWS website – Conservation Objective Documents http://www.npws.ie/protectedsites/**

[11] **Sourced from Natura 2000 Standard Data Forms (NPWS, November 2013) and/or professional judgement.**

EPA Export 06-01-2017:02:02:11

European Site (including distance from proposed development)	Qualifying Interest(s) and Conservation Status[9]	Conservation Objective[10]	Threats and Pressures[11]
Mines	Grey Plover *Pluvialis squatarola* Lapwing *Vanellus vanellus* Knot *Calidris canutus* Sanderling *Calidris alba* Black-tailed Godwit *Limosa limosa* Redshank *Tringa totanus* Turnstone *Arenaria interpres* Little Tern *Sterna albifrons* Wetlands	http://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004080.pdf.	Golf course Recreation Invasive non native species
Boyne Coast and Estuary SAC Site Code: 001957 c.30km from Tara Mines	Estuaries Mudflats and sandflats not covered by seawater at low tide Salicornia and other annuals colonizing mud and sand Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) Mediterranean salt meadows (*Juncetalia maritimi*) Embryonic shifting dunes Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes') *Fixed coastal dunes with herbaceous vegetation ('grey dunes')	This is a generic conservation objective, which aims to maintain the favourable conservation condition of coastal and marine habitats and species based on a detailed list of attributes and targets. http://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO001957.pdf.	Golf course Urbanisation Household waste disposal Reclamation Recreation Industrial waste disposal

* with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

5.3.1.2 Designated Natura 2000 Sites

River Boyne and Blackwater (SAC):

The River Boyne and the River Blackwater is designated as a Special Area of Conservation (Site Code: 002299). The riverine stretches are designated for alkaline fen and alluvial woodland, both of which are listed in Annex I of the EU Habitats Directive. The site is also selected for the following species listed in Annex II of the EU Habitats Directive, namely Atlantic Salmon, Otter and River Lamprey.

This site comprises most of the freshwater element of the River Boyne from upriver of the Boyne Aqueduct at Drogheda, the Blackwater River as far as Lough Ramor and the principal Boyne tributaries, notably the Deel, Stoneyford and Tremblestown Rivers. This system drains a considerable area of Counties Meath and Westmeath and smaller areas of Cavan and Louth. The underlying geology is Carboniferous Limestone for the most part with areas of Upper, Lower and Middle well represented. In the vicinity of Kells Silurian Quartzite is present while close to Trim are Carboniferous Shales and Sandstones. The rivers flow through a landscape dominated by intensive agriculture, mostly of improved grassland but also cereals. Much of the river channels were subject to arterial drainage schemes in the past. Natural flood-plains now exist along only limited stretches of river, though often there is a fringe of reed swamp, freshwater marsh, wet grassland or deciduous wet woodland. Along some parts, notably between Drogheda and Slane, are stands of tall, mature mixed woodland. Substantial areas of improved grassland and arable land are included in site for water quality reasons. There are many medium to large sized towns adjacent to but not within the site.

Consent of copyright owner required for any other use. For inspection purposes only.

The main channel of the Boyne contains a good example of alluvial woodland of the *Salicetum albo-fragilis* type which has developed on three alluvium islands. Alkaline fen vegetation is well represented at Lough Shesk, where there is a very fine example of habitat succession from open water to raised bog. The Boyne and its tributaries is one of Ireland's premier game fisheries and offers a wide range of angling, from fishing for spring salmon and grilse to sea trout fishing and extensive brown trout fishing. The site is one of the most important in eastern Ireland for *Salmo salar* and has very extensive spawning grounds. The site also has an important population of *Lampetra fluviatilis*, though the distribution or abundance of this species is not well known. *Lutra lutra* is widespread throughout the site. Some of the grassland areas along the Boyne and Blackwater are used by a nationally important winter flock of *Cygnus cygnus*. Several Red Data Book plants occur within the site, with *Pyrola rotundifolia*, *Poa palustris* and *Juncus compressus*. Also occurring are a number of Red Data Book animals, notably *Meles meles*, *Martes martes* and *Rana temporaria*. The River Boyne is a designated Salmonid Water under the EU Freshwater Fish Directive.
The characterisation of the River Boyne, under the Eastern River Basin District (ERBD) Project, indicates that the primary environmental driving force in the Boyne Catchment is considered to be agricultural production. The water quality information suggests that the lengths of unpolluted (Class A) and moderately polluted (Class C) channels have declined, while there is a slight increase in channels classified as slightly polluted (Class B). Impacted river channels were typically located in areas

EPA Export 06-01-2017:02:02:11

with pasture, arable land, peat bogs and downstream of municipal waste water treatment plant (WwTP) outfalls.

The River Boyne and the River Blackwater are classified as "At Risk" water bodies due to the potential for diffuse agricultural pollution and because the River Boyne has been extensively drained in the 1970s and 1980s. The ERDB has not fully assessed the ecological effect of the drainage works, with respect to the aim of achieving "good ecological status".

The qualifying interests of this designation and an evaluation as to whether these are likely to occur within the proposed development site, or within the zone of influence of the development, are set out below and summarised in Table 5.4.

[7230] Alkaline Fens

Alkaline fens are typically calcareous basin or flush fen systems with extensive areas of species-rich small sedge communities. This habitat does not occur within the proposed development site at the Tara Mines Stage 6 TMF, neither are there hydrological or hydrogeological pathways for effects from the proposed development to Annex I fen habitat within the SAC. It is therefore not identified as a key aquatic ecological receptor.

[91EO] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

Riparian forests of ash (*Fraxinus excelsior*) and alder (*Alnus glutinosa*) occurs on heavy soils which are periodically inundated by the annual rise of river levels, but which are otherwise well drained and aerated during low water. This habitat does not occur within the proposed Stage 6 TMF development site, neither are there pathways for impacts identified by which the proposed development may potentially affect this Annex I (priority) habitat within the SAC. It is therefore not identified as a key aquatic ecological receptor.

For inspection purposes only.
Consent of copyright owner required for any other use.

[1099] *Lampetra fluviatilis*

The river lamprey (*Lampetra fluviatilis*) breeds in freshwater rivers and streams. Adults spawn in spring, excavating shallow nests in gravels and stones. After hatching, the larvae called ammocoetes drift or swim downstream to areas of river bed with a fine silt composition. They burrow into this bed material and live as filter feeders over a period of years before transforming into young adult fish. As adults they are parasitic, attaching to and feeding on larger fish in coastal waters. They can grow to 30cm at maturity at which stage they re-enter freshwater to spawn. The adult fish die after spawning. River and brook lamprey are indistinguishable as larvae, living as filter feeders in sediment. The mature adult forms are clearly distinguishable on the basis of body size. The two types of lamprey are considered by many in the same context as the brown trout / sea trout pairing, with a similar absence of genetic discriminators. Lamprey surveys in Ireland have necessarily focussed on juvenile lamprey. Consequently, the vast majority of available data relates to "*Lampetra* sp." and cannot be assigned to one species or the other (O'Connor, 2006). There are extensive areas of suitable habitat and no significant pressures impacting these species. The Overall Status is therefore assessed as Favourable. River lamprey may potentially utilise the Yellow River, outside of the River Boyne and Blackwater SAC designation boundary and are also likely to occur within the River Blackwater,

EPA Export 06-01-2017:02:02:11

downstream of the Yellow River confluence. This species is therefore identified as key aquatic ecological receptor of the proposed development.

[1106] *Salmo salar*

Salmon use rivers to reproduce and as nursery areas. Eggs are deposited during the winter in a depression, called a redd, excavated in river gravels. The eggs develop protected within the substrate and during spring hatch into alevins, which in turn develop into fry. The fry feed for the summer and over the autumn, gradually becoming parr. Fry and parr feed primarily upon invertebrates. The Irish population generally comprises fish that spend two winters (small numbers spend one or three winters) in freshwater before going to sea, in spring, as smolts at around 10-25cm in length. Adults spend one to three years at sea where growth rates are much greater. They feed upon crustaceans and fish (e.g. capelin and sandeels) as they migrate to feeding grounds in the North Atlantic. There are numerous threats to the freshwater habitat and vigilance is required to ensure the maintenance of good quality habitat which salmon require to thrive. The salmon population is still low in comparison to previous decades and so, in the absence of a recovery, the Overall Status is assessed as Inadequate. Atlantic salmon occur in the River Blackwater upstream and downstream of the Yellow River confluence and are therefore identified as a key aquatic ecological receptor.

[1355] *Lutra lutra*

Otters have two basic requirements: aquatic prey and safe refuges where they can rest. The otter is an opportunistic predator with a broad and varied diet. In freshwater areas a variety of fish from sticklebacks to salmon and eels will be taken, while crayfish and frogs can be important locally or seasonally. The main threats to the otter include habitat destruction (including river drainage and the clearance of bank-side vegetation); pollution, particularly organic pollution resulting in fish kills; and accidental deaths (road traffic and fishing gear). The otter is currently widespread throughout Ireland and present in a wide variety of habitat types. Therefore the Overall Status is assessed as Favourable. Although no signs of Otter were recorded during the walkover surveys within the proposed development site and associated watercourses downstream, it is expected that Otter do occur in the Yellow River and also within the River Blackwater downstream. Otter may use the minor tributaries such as the Simonstown Stream and Blakes Stream for commuting. This species is identified as a key aquatic ecological receptor.

For inspection purposes only.
Consent of copyright owner required for any other use.

River Boyne and River Blackwater (SPA)

The River Boyne and River Blackwater SPA (Site Code: 004232) is a long linear site that comprises stretches of the River Boyne and several of its tributaries: most of the site is in Co Meath but it extends also into Counties Cavan, Louth and Westmeath. It includes the following river sections: The River Boyne from the M1 motorway bridge, west of Drogheda, to the junction with the Royal Canal, west of Longwood, Co Meath; the River Blackwater from its junction with the River Boyne in Navan to the junction with Lough Ramor in Co Cavan; the Tremblestown River (and Athboy River) from the junction with the River Boyne at Kilnagross Bridge to the bridge in Athboy, Co Meath; the Stoneyford River from its junction with the River Boyne to Stonestone Bridge in

EPA Export 06-01-2017:02:02:11

Co. Westmeath; the River Deel from its junction with the River Boyne to Cummer Bridge, Co.Westmeath. The site includes the river channel and marginal vegetation.

The River Boyne and River Blackwater SPA supports nationally important numbers of *Alcedo atthis*. Other species which occur within the site include *Cygnus olor*, *Anas crecca*, *Anas platyrhynchos*, *Phalacrocorax carbo*, *Ardea cinerea*, *Gallinula chloropus*, *Gallinago gallinago* and *Riparia riparia*.

The primary conservation objective of this site is to maintain or restore the favourable conservation condition of the Kingfisher. The kingfisher is identified as a terrestrial, water-dependant species, and as such is not identified as a key aquatic ecological receptor; however, the aquatic ecological impact assessment provides an evaluation of the potential for impacts on the feeding habitat and prey for this species. As such, the potential for impacts on this species will be addressed in this assessment.

River Boyne Estuary SPA

This moderately sized coastal site, which is situated below the town of Drogheda, comprises most of the estuary of the Boyne River, a substantial river which drains a large catchment. Apart from one section which is over 1 km wide, its width is mostly less than 500 m. The river channel, which is navigable and dredged, is defined by training walls, these being breached in places. Intertidal flats occur along the sides of the channelled river. The sediments vary from fine muds in the sheltered areas to sandy muds or sands towards the river mouth. The linear stretches of intertidal flats to the north and south of the river mouth are mainly composed of sand. The site is of considerable ornithological importance for wintering waterfowl, with ten species having populations of national importance. Little Tern has bred in the recent past and could do so again in the future. Of particular significance is that two of the wintering species, Golden Plover and Bar-tailed Godwit are listed on Annex I of the E.U. Birds Directive. Little Tern, which last bred successfully at the site in 1996, is also listed on Annex I of this directive. This sites lies approximately 30km south east of the proposed development.

Consent of copyright owner required for any other use. For inspection purposes only.

Taking account of the proposed development description, and the potential significance of any impacts, it is not considered that there are pathways for effects on this designated SPA site which would warrant its inclusion as a key aquatic ecological receptor in this assessment.

Boyne Coast and Estuary SAC

The Boyne Coast and Estuary SAC is a coastal site which includes most of the tidal sections of the River Boyne, intertidal sand- and mudflats, saltmarshes, marginal grassland, and the stretch of coast from Bettystown to Termonfeckin that includes the Mornington and Baltray sand dune systems. The site is of considerable conservation interest as a coastal complex that supports good examples of eight habitats that are listed on Annex I of the E.U. Habitats Directive, including one which is listed with

EPA Export 06-01-2017:02:02:11

priority status, and for the important bird populations that it supports. This site lies approximately 30km south east of the proposed development.

Taking account of the proposed development description, and the potential significance of any impacts, it is not considered that there are pathways for effects on this designated SAC site which would warrant its inclusion as a key aquatic ecological receptor in this assessment.

5.3.1.3 Designated Natural Heritage Sites

Jamestown Bog (NHA)

Jamestown Bog NHA is 7.5 km south west of Tara Mines, situated approximately 8 km west of Navan, mainly in the townlands of Tullaghanstown, Herbertstown and Jamestown in County Meath. The site comprises a raised bog that includes both areas of high bog and cutover bog. The site is bounded on all sides by coniferous forestry and old cutover. There are no pathways for hydrological or hydrogeological effects with respect to aquatic ecological interests associated with this designation; therefore it is not included as a key aquatic ecological receptor.

Girley Bog (NHA)

Girley Bog NHA (Site Code: 001580) is 14.8 km West of Tara Mines, located 7 km south-west of Kells, mainly in the townlands Chamberlainstown, Girley, Drewstown Great and Ethelstown in Co. Meath. The site comprises a raised bog that includes both areas of high bog and cutover bog, and is bounded in parts by coniferous forestry to the south and north. The site is partially divided by a large drain that runs across the high bog. There are no pathways for hydrological or hydrogeological effects with respect to aquatic ecological interests associated with this designation; therefore it is not included as a key aquatic ecological receptor.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:11

5.3.2 Aquatic Habitats and Flora

5.3.2.1 Aquatic Habitats

The TSF site is bounded by the Yellow River to the west, the Simonstown Stream to the east and the Blackwater River to the south. There are also two smaller streams within the vicinity of the site, the Duog to the south east and Blake's Stream which crosses the proposed Stage 6 area from east to west.

Blakes Stream feeds into the Yellow River which is a tributary to the River Blackwater. The River Blackwater forms part of the River Boyne and Blackwater SAC and SPA.

In 2012 EPA biological monitoring on the River Blackwater upstream of the Tara Mines Stage 5 TMF at *Donapatrick Bridge* (Site 1500) recorded biological water quality as Q3-4 (Moderate status, unsatisfactory). This comprises a deterioration from 2009 (Q4, Good Status). There is an EPA monitoring station on the Yellow River, directly downstream of the Tara Mines site, and upstream of the Blackwater confluence. This watercourse has been classified as Q3 (Poor status, unsatisfactory) for an ongoing period, including most recently in 2012. Streams flowing in the vicinity of the Tara Mines operation are already impacted by eutrophication upstream of the tailings facility, as evidenced by the low Q-values and also by the chemical water quality monitoring data undertaken by BTML.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

A site walkover and aquatic ecological survey was undertaken by a TOBIN ecologist on two occasions during 2015. Three aquatic habitats were identified within the proposed development site:

- FL8 – Artificial lakes and ponds (man-made pond)
- FW1 – Watercourses: Blakes Stream, SImonstown Stream and Doug Stream
- FW4 – Drainage ditches

Man Made pond

A pond FL8 occurs in the southern part of the Northern Borrow Area of the site. This pond has bulrushes (*Typha latifolia*) surrounding it, but also contains wetland species such as water horsetail (*Equisetum fluviatale*), branched bur reef (*Sparganium erectum*) and rushes (*Juncus effuses* and *J. Inflexis*). This pond is well established and supports bird species such as Little grebe (*Tachybaptus ruficollis*). This pond is evaluated as being of local importance, lower value with reference to the aquatic ecological interests it supports.

Watercourses: Blakes Stream, Doug Stream, Simonstown Stream, Yellow River

Blake's Stream is a low volume stream which supports minimal aquatic ecological diversity. Habitat within the stream is limited due to ongoing and significant drainage and channelization.

Wetland species such as fool's watercress (*Apium nodiflorum*) and watercress (*Nasturtium officinale*) were recorded. Within the wider area, the Doug Stream is also a low volume river supporting minimal habitat. The Blake's Stream, Simonstown Stream and Doug Stream were all found to be heavily modified and channelised with significant siltation; dominated by slow flow conditions. The Yellow River was surveyed upstream and downstream of the Simonstown Stream confluence which drains the existing Stage 5 TMF, with an additional survey site upstream of its confluence with the River Blackwater. Flows were high on the day of survey. Despite drainage and channelisation works, the field surveys identified that there was gravel/cobble substrate and a high silt load, with no obvious signs of eutrophication or excessive filamentous algae (*Cladophera sp.*) present at both the Yellow and Simonstown Rivers. The Simonstown River, Doug Stream and Blakes Stream are evaluated as being of local importance, lower value. The Yellow River is evaluated as being of County Importance due to the fact that it supports Atlantic salmon, lamprey and brown trout. This watercourse is therefore included as a key aquatic ecological receptor.

Consent of copyright owner required for any other use. For inspection purposes only.

Drainage ditches

The minor drains within the proposed Stage 6 sites (borrow areas) were found to be of low ecological significance, supporting a very low macroinvertebrate diversity which was dominated by *Gammarus* sp. These drains contained no suitable habitat to support protected aquatic invertebrates or fisheries of ecological importance. Drainage ditches are evaluated as be of local importance, lower value.

EPA Export 06-01-2017:02:02:11

5.3.2.2 Invasive Species

There were no invasive aquatic species noted in any of the archive data records assessed as part of the desktop review or identified in any of the field surveys conducted.

5.3.2.3 Rare and Protected Species

The results of the desk based review yielded no records of aquatic Annex I habitats or Annex II protected flora within the proposed development site or zone of influence. Similarly no rare or protected aquatic flora species were identified on site or in the surrounding area.

5.3.3 Aquatic Fauna

5.3.3.1 Invertebrate Survey of Blake's Stream

Kick/sweep sampling of Blake's Stream was carried out in order to determine the nature of the invertebrate communities occurring at a number of sites within the stream. It is important to note that the objective of this survey was not to determine the water quality status of Blake's Stream. Sampling was carried out at the locations indicated in Figure 5.5. Sampling was carried out utilising a standard 1mm mesh hand net. Each site was sampled at 3 locations for approximately 1 minute each. No protected species (such as White-clawed Crayfish) were inadvertently captured during sampling. The samples were placed in labelled buckets and transported to the FERS office for analysis. Having sorted samples in standard white trays, samples were preserved in isopropyl alcohol (surgical spirits tends to leach colour from sampled organisms) for identification utilising a 10X magnification dissecting microscope (where necessary).

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

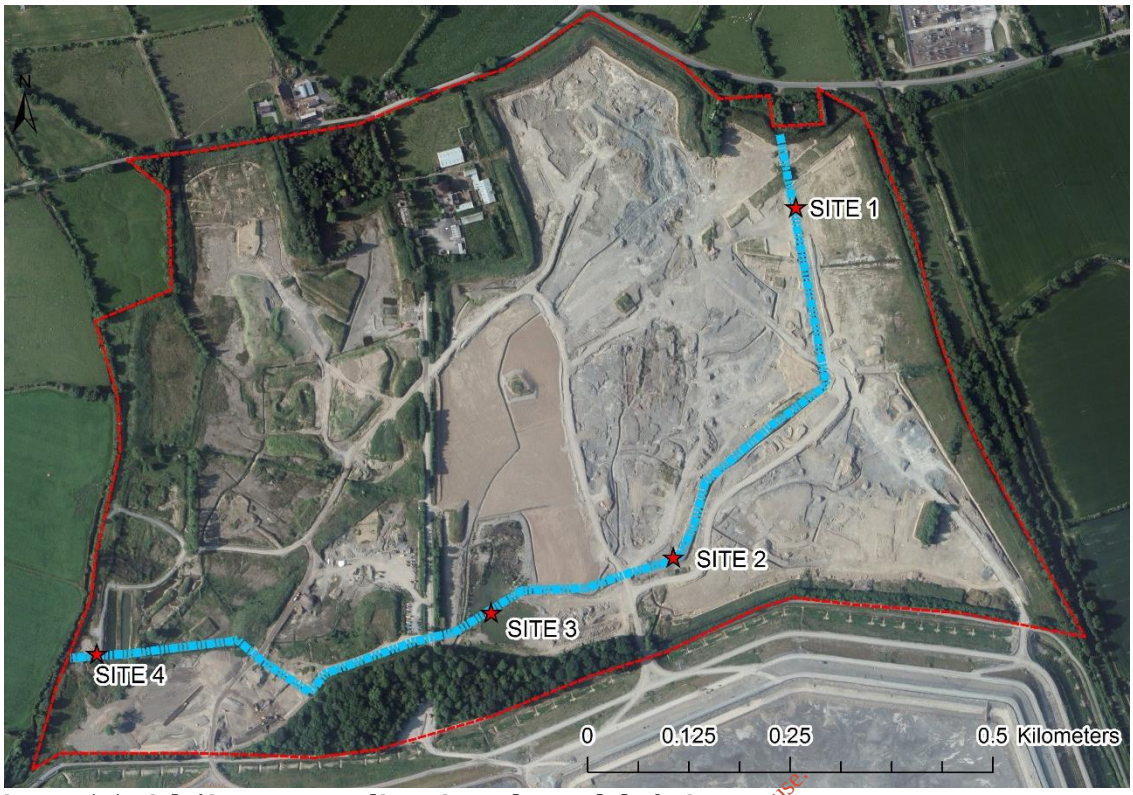


Figure 5.5 Kick/Sweep sampling sites along Blake's Stream

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

5.3.3.2 Other species of conservation concern

White-clawed Crayfish

The White-clawed Crayfish is the only crayfish species (currently known to be) found in Ireland. It is classified as vulnerable and rare in the IUCN Red List of threatened animals and listed under Annex II of the EU Habitats Directive. Ireland is now thought to hold some of the best European stocks of this species, under least threat from external factors (Reynolds 1998). Habitat requirements are good water quality (above 50% oxygen saturation, BOD below 3 ppm) and moderate summer water temperatures (below 20°C). Of note, while they may tolerate disturbance to a certain extent, they are sensitive to acidity and heavy metals. The habitat occurring within the footprint of the proposed development is not suitable for White-clawed Crayfish, freshwater habitat consisting largely of shallow water courses with little shade likely being subject to large variations in water temperature (and thus oxygen content). The water courses in general, are subject to frequent disturbance, and as a result there is relatively little in the way of in-stream or emergent vegetation. While the habitat is unsuitable and it was considered that this species was not present (and therefore no dedicated surveys using funnel traps, etc. were undertaken), sweep/kick samples were examined to determine if this species was present.

Common Frog and Smooth Newt

The Common Frog (*Rana temporaria)* is described in the Ireland Red List No.5 as "*…adaptable species with broad range of habitats used … Have adapted well to garden ponds in UK. Spawns in early spring and then spends rest of the year on land….. Hibernates, typically from November to February. Tadpoles, young frogs and adult frogs all subject to significant levels of predation and populations subject to local booms and declines*…". A small population of Common Frog is considered likely to occur within the habitat occurring within the proposed development footprint (this species is ubiquitous in suitable habitat). Surveys for this species were carried out in tandem with the surveys of freshwater habitats occurring.

The Smooth Newt (*Trituris vulgaris*) is described in the Ireland Red List No. 5 as "*….Breeds in ponds and still water ditches where pH >5. Shows preference for vegetated water bodies with surrounding terrestrial habitats that provide cover for foraging and hibernation …Eggs are laid individually, rather than in clumps or strings, leading to protracted breeding season (March July) during which adults remain in breeding ponds … Egg and tadpole development is temperature dependent. Forage on land for invertebrate prey July to October. Hibernate November – February…".* The habitat occurring within the development footprint is largely unsuitable for this species. The water courses present are, by and large sparsely vegetated, and the surrounding terrestrial habitat is relatively inhospitable for this species. No specific surveys for this species were carried out owing to the unsuitability of the habitat present.

Common Lizard

The Common Lizard (*Lacerta vivipara*) is described in the Ireland Red List No. 5 as "*…Long active season in Ireland with emergence from hibernation as early as the first week in March and autumn records as late as the end of October….. Associated with coastal and heathland habitats, but also locally in rural gardens, stone walls and roadside verges … Needs good habitat structure with open patches for basking and*

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

foraging and areas of cover for protection from predators …. Feeds on a wide range of invertebrates…". The habitat currently occurring within the development footprint is largely unsuitable owing to a lack of cover and extent of exposed habitat. Dedicated Common Lizard surveys were not, therefore carried out. It should be noted, however, that the habitat available when the proposed development is completed, will be ideal for this, Ireland's only native reptile.

Fish species

Salmon (fry and parr) and Brown trout have been recorded from the Yellow River during electro-fishing sampling undertaken by Inland Fisheries Ireland (IFI) as part of the Water Framework Directive (WFD) fish sampling programme. Additional species recorded included minnow (*Phoxinus phoxinus*), gudgeon (*Gobio gobio)*, stoneloach (*Barbatula barbatulus*), stickleback (*Gasterosteus aculeatus*), eel (*Anguilla anguilla*) and lamprey (*Lampetra* sp.). There is a historical record of salmonids from the Simonstown stream (from 1999). Sticklebacks have been recorded in the Simonstown Stream (Biosphere, 2010) and are expected to occur within the Blakes Stream. The Blakes Stream, Simonstown Stream and Doug Stream are identified as being sub-optimal for supporting salmonids within the study area of the proposed development.

Both the Yellow and Simonstown Rivers were identified as providing suitable habitat for juvenile lamprey (river / brook lamprey, *Lampetra* sp.). Although lamprey species were not recorded during the field surveys it is assumed that juveniles would be present within suitable habitat in the Blackwater main channel and in the Yellow River, concentrated within silt deposits along the margin.

Consent of copyright owner required for any other use. For inspection purposes only.

Sampling of sediments, invertebrates and fish have been undertaken for heavy metals over a prolonged period downstream of the Tara Mines TMF discharge. Based on the conclusions of the Biosphere (2010) study there is no evidence to show that heavy metals concentrations (lead and zinc) in sediment are elevated by the project discharges. Similarly, there was no indication of an increase in heavy metals in fish tissue downstream of the Stage 5 TMF, with no concentrations in fish muscle tissue exceeding guidance values. Samples taken from freshwater shrimp (*Gammarus* sp.) tissues showed some small, but statistically insignificant, increases in certain metals downstream of the tailings facilities (Biosphere, 2010).

Atlantic salmon (Annex II species), brown trout (Wildlife Act listed species), and lamprey (Annex II species) are identified as key aquatic ecological receptors in the current impact assessment.

Aquatic Macroinvertebrates

From a review of the National Biodiversity Data Centre records (www.biodiversityireland.ie) there are no records of rare or threatened aquatic invertebrates recorded from the land drains and heavily modified stream channels within the proposed site.

EPA Export 06-01-2017:02:02:11

Neither are there any records from the Yellow River or the River Blackwater, downstream of the Yellow River confluence.

Field surveys of Blake's Stream, Simonstown Stream and Doug Stream recorded a low macroinvertebrate diversity dominated by an assemblage indicative of slow flow conditions and siltation (*Gammarus* sp., snails and cased caddis).

Surveys of the Yellow River found the macroinvertebrate community was again dominated by *Gammarus* sp., with a low diversity of cased-caddis present (Limnophilidae). There are no macroinvertebrates within the proposed development site or within the zone of influence identified as being a key aquatic ecological receptor.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

5.4 Potential Impacts

5.4.1 Designated Sites

The potential for impacts on the designated conservation sites identified as key aquatic ecological receptors are evaluated with regard to the River Boyne and River Blackwater SAC and SPA complex.

5.4.1.1 Construction Phase

Surface water
As identified in the hydrological impact assessment (AECOM, 2015) impacts on surface water quality may arise from surface run-off from the borrow areas which, during the construction period, is likely to contain elevated concentrations of suspended solids. In the event of accidents or spillages from construction machinery, surface run-off may also contain concentrations of hydrocarbons. The predicted long-term increase in concentrations of suspended solids, and the possible occurrence of hydrocarbons, in surface run-off, unless mitigated, could affect the quality of the receiving watercourses (the Simonstown Stream, Blake's Stream and the Yellow and Doug Rivers). Additional drainage ditches excavated during construction may create pathways to these watercourses.

Long term monitoring of water quality from the existing TMF has not identified elevated siltation within the receiving waters; furthermore persistent siltation has not been recorded in the River Blackwater downstream of the TSF site.

The potential for significant heavy metal contamination which may lead to sub-acute bioaccumulation in fish populations has been subject to ongoing monitoring (Biosphere, 2010). Results indicate that the facility is not leading to elevated lead or zinc levels in fish muscle tissue (Brown trout samples below EPA guidelines). On the basis of the monitoring data collected by Tara Mines (Biosphere 2010) the long term heavy metal contamination does not comprise a significant impact on Atlantic salmon or River lamprey populations in the Blackwater main channel. This negates the potential for long-term, significant effects on predators which depend on fish species, including the Annex II listed Otter and the Annex I listed Kingfisher.

Taking account of the construction period proposed for the Stage 6 TMF development (approximately 3 years) there is the potential for medium-term, sub-acute and/or chronic water quality impacts which may potentially affect local water quality in the receiving waters and downstream in the River Blackwater (River Boyne and River Blackwater SAC). Such water quality effects, particularly with regard to suspended solids discharges, heavy metals, or releases of standing water with depleted oxygen or elevated nutrients have the potential to have a long term, negative impact on Atlantic salmon in the Yellow River and in the River Blackwater downstream. A moderate long term negative impact on the wider ecology of the rivers (invertebrate community, fish, otter, birds) is also possible, with consequences for Lamprey, Otter and Kingfisher; species listed as qualifying interests of the River Boyne and River Blackwater SAC and SPA complex.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:11

The scale, extent and duration of the proposed construction works gives rise to the potential for the introduction and spread of non-native, invasive species throughout the site and along the riparian corridors of the watercourses within the study area. This would have considerable negative implications for the riparian quality and instream habitat, including fish habitat productivity in the Yellow River and the River Blackwater within the SAC. Establishment of species such as Japanese knotweed and Himalayan balsam have the potential for significant, long-term, negative impacts on Atlantic salmon and River lamprey within the SAC. Such changes may also affect prey availability and foraging habitat used by Kingfisher, for which the Boyne River SPA is designated.

The potential for significant heavy metal contamination which may lead to sub-acute bioaccumulation in fish populations has been subject to ongoing monitoring (Biosphere, 2010). Results indicate that the facility is not leading to elevated lead or zinc levels in fish muscle tissue (Brown trout samples below EPA guidelines). The potential for long term heavy metal contamination is considered unlikely to be significant with respect to Atlantic salmon or River lamprey populations in the Blackwater main channel.

5.4.1.2 Operational Phase

For inspection purposes only.
Consent of copyright owner required for any other use.

Seepage

Continued monitoring of the TMF since operation of the Stage 5 extension has shown that the interceptor channel is effectively capturing almost all seepage from the tailings storage facility through the embankment walls. As this water is then recycled back to the Stage 5 TMF, a closed water cycle system is operating. AECOM carried out a risk screening exercise on the Stage 6 TMF in March 2015 (AECOM, 2015). Modelling was undertaken to assess the risk to the receptors in the area. For the purposes of the modelling the worst case scenario was assumed. A summary of the findings of the risk modelling is listed below and provides the baseline against which the proposed Stage 6 extension is assessed (AECOM, 2015):

- The risk screening suggests that seepage inputs from the TMF and interceptor channel pose a moderate risk to the surrounding environment, specifically groundwater quality
- The exceedances with regard to sulphate concentrations within the superficial deposits may pose a risk to the future WFD status of the Navan Tailings groundwater body and associated surface water bodies;
- A technical assessment, carried out using a mass balance approach, suggests that sulphate-rich seepage inputs to groundwater pose a low risk to the Yellow River. A mass balance predicts that an annual average sulphate concentration of 2,200mg/l in seeps from the western bank of the TMF would result in non-compliance in groundwater immediately adjacent to the Yellow River, under exceptionally dry conditions;
- A technical assessment, carried out using a remedial targets assessment, suggests that sulphate-rich seepage inputs to the superficial deposits pose a low risk to the River Blackwater; and
- The TMF site is considered to be compliant with the “prevent” and “limit” objectives of the WFD.

EPA Export 06-01-2017:02:02:11

Water Quality

The quality of the treated water output from the Stage 6 TMF is expected to be similar to that of the existing outputs from the existing. On-going water quality monitoring at the existing facility has not identified persistent adverse trends in chemical or biological water quality arising from the site. Background chemical water quality in the River Blackwater, and the tributaries affected by the proposal are currently affected by elevated nutrients (Ammonia, Nitrate and Phosphate) suggesting an impact from agricultural and or human effluent sources. The proposed discharge of the groundwater from the mine site to the TMF is not predicted to result in any appreciable background concentrations of nutrients.

The assimilation capacity of the River Blackwater has been modelled for groundwater discharge from the existing Stage 5 tailings facility (TOBIN, 2010). These results indicate that there is virtually no change in the surface water quality during high or median flow conditions. There is a very slight increase in physio-chemical concentrations during low flow conditions; however, all parameters remain within acceptable ranges (TOBIN, 2010). Based on the results of the calculations the physico-chemical quality of the water is not negatively affected; water quality remains within acceptable ranges for aquatic, livestock and human use.

The suspended solid loading of the existing discharge water is very low and this will continue to be so for the proposed development. Therefore, there is a very low risk of river bed sedimentation. This indicates that the discharge of the groundwater will not impact on the potential of the substrates to support aquatic life. It is essential that discharges of groundwater are kept isolated from spoil or fine sediments at discharge, with sufficient settlement to allow turbidity levels in the receiving waters of the Yellow River and/or the Blackwater to remain within compliance limits of the Salmonid Regulations (1988), i.e. <25 mg/l.

For inspection purposes only.
Consent of copyright owner required for any other use.

Impacts on Surface Water Hydrology and Quality

During operation there would be no direct discharge to surface water from the TMF, although surplus supernatant water would continue to be treated at the mine site and discharged to the River Boyne. Potential impacts, therefore, would be confined to the contribution of seepage to groundwater which may pass as base flow to surface watercourses.

Compliance points and trigger values at the TMF have been put in place to protect the Yellow River and Blackwater River (AECOM, 2015). Trigger values have been set at these compliance points for sulphate and magnesium at 1000 mg/l and 50 mg/l respectively. These concentrations would be used as an alert of a potential future non-compliance at the compliance points and hence at the receptors. The section of the River Blackwater used for potable water supply is at approximately 2.4km south of the TMF and forms the southernmost boundary of the groundwater body. It is unlikely that there is a pathway between the TMF and this section of the River Blackwater, but a compliance point has still been set. The Yellow River has been receiving base flow with elevated sulphate concentrations for some time, however the impact on the Yellow River, and the River Blackwater downstream of the confluence, has been insignificant (AECOM, 2015). The proposed stage 6 extension will incorporates a composite lining system which consists of high density

EPA Export 06-01-2017:02:02:11

polyethylene (HDPE) geomembrane over a geosynthetic clay liner (GCL). The composite lining will overlie a1000 g/m2 which in turn overlies 100 mm of Type C protection material

The quality of the treated water output from the Stage 6 TMF is expected to be similar to that of the existing outputs from the existing facility. The achievement of discharge standards in compliance with the Surface Water Regulations is a design assumption which will be achieved by the proposal; therefore the potential impact of the post-closure discharge on the River Blackwater flow and water quality will be minor. Discharge of storm water will be direct to the Doug Stream.

Impacts on water quality owing to seepage to ground water have not been detected to date. Modelling calculations predict that physico-chemical quality of the water will remain within acceptable limits for humans, livestock and aquatic life with operation of the Stage 6 Area. Currently the suspended solid loading of the discharge water is very low indicating that there is a low risk that the discharge of the groundwater will impact on the potential of the substrates to support aquatic life. The risk of impacts to surface water and hydrology are therefore assessed as low and limited to the contribution of seepage to groundwater which may pass as base flow to surface watercourses.

The decommissioning phase of the proposed development is relevant in terms of assessing cumulative or in combination effects on aquatic habitats and flora. The Stage 6 TMF will be capped at the end of the operations phase. The decommissioning of the Stage 6 TMF, in conjunction with the treatment of surface water run-off from the Stage 5 TMF (which will have been capped at this point) has been evaluated in the Hydrology and Water Quality assessment, EIS Section 8 (AECOM, 2015).

For inspection purposes only. Consent of copyright owner required for any other use.

This assessment states that impacts post-closure are dependent on the effectiveness of the interceptor channel and the passive treatment works (PTS), i.e. the constructed wetland. Further design work for the constructed wetland will be required following capping of Stage 5, when flows and water quality can be estimated with greater certainty; however, a conceptual design has been provided to accompany this application, which is included in the aquatic ecological impact assessment (setion 4) and the CRAMP (included with the EIS).

.

EPA Export 06-01-2017:02:02:11

As described by AECOM (2015) the constructed wetland will incorporate a retention pond, sulphate reducing bioreactor (SRBR) and free water cell (FWC), which will reduce maintenance requirements and enable water to be stored until discharge is appropriate, thus avoiding significantly higher flows in the river. Discharge from the constructed wetland will be to the Blackwater River, downstream of Liscartan. An overflow system will operate during peak rainfall events, whereby diluted water is discharged to the Simonstown Stream and may subsequently be used by livestock.

To meet the requirements for passive treatment works an Integrated Constructed Wetland has been designed (VESI, 2016). Assimilative capacity calculations for the proposed ICW show that after treatment discharged waters will meet the necessary regulatory limits for surface waters (see Appendix 5.1, Table A1). All surface water run-off from the Stage 5 and Stage 6 areas will be captured by the IWC (Appendix 5.1, Tables A2 and A3). With the implementation of the design stage discharge standards, water quality downstream of the ICW in the *Simonstown stream* and the *Blackwater River* within the *River Boyne* and *River Blackwater SPA* will not be impacted once Stage 6 has been decommissioned.

5.4.1.3 Cumulative Impacts

There are no pending plans or project proposals within the immediate vicinity or zone of combined influence of the proposal which would have the potential to give rise to in-combination effects on water quality within the River Blackwater, with reference to the Annex II aquatic species listed as qualifying interests of the River Boyne and River Blackwater SAC, i.e. Atlantic salmon, River lamprey. The background water quality in the River Blackwater, and the tributaries including the Yellow River, Blake's Stream, and Simonstown Stream are evaluated as being of moderate to poor ecological status, with compromised chemical and biological water quality.

For inspection purposes only. Consent of copyright owner required for any other use.

The proposed development has the potential to contribute to cumulative adverse effects on these minor tributaries with respect to channelization and siltation during the construction phase and ongoing sedimentation effects downstream during construction and operation. Cumulative effects with regard to suspended solids, sedimentation of salmonid habitat, and long-term chemical water quality effects (including heavy metals) will be mitigated through effective site management and monitoring protocols to ensure compliance. The potential for cumulative effects with respect to heavy metals is considered minor, and is not significant, based on the results of long term monitoring at the site. Similarly, the low levels of nutrient discharge negate the potential for the development to cumulatively contribute to eutrophication within the River Blackwater sub-catchment, where agriculture and wastewater treatment discharges are contributing to elevated loadings to the receiving waters.

The decommissioning phase of the proposed development is relevant in terms of assessing cumulative or in combination effects. During this phase of the development Stage 6 Area will be capped. The impacts post closure will depend on the effectiveness of the interceptor channel and the passive treatment works (PTS). Design work for the PTS will be required following capping of Stage V when flows and water quality can be estimated with greater certainty.

EPA Export 06-01-2017:02:02:11

Discharge from the PTS will be to the Blackwater River, downstream of the Liscartan water abstraction point. An overflow system will operate during peak rainfall events, whereby diluted water is discharged to the Doug Stream and may subsequently be used by livestock.

To meet the requirements for passive treatment works an Integrated Constructed Wetland has been designed (Vesi, 2016). Assimilative capacity calculations for the proposed ICW show that after treatment discharged waters will meet the necessary regulatory limits for surface waters (Appendix 5.1). All surface water run-off from the Stage 5 and Stage 6 areas will be captured by the IWC (Table 2&3, Appendix 5.1). Water quality downstream of the ICW; the Streamstown River and the Blackwater River, should not be impacted once Stage 6 has been decommissioned.

5.4.2 Aquatic Habitats and Flora

5.4.2.1 Construction Phase

The proposed development will require significant, prolonged earthworks within the existing Stage 5 TMF lands and the proposed Stage 6 TMF works area. The completion of these works will require the diversion of Blake's Stream, a minor watercourse of low local ecological significance and no fisheries value, which occurs within the site.

For inspection purposes only.
Consent of copyright owner required for any other use.

This stream currently flows through the proposed Stage 6 TMF works area and will be diverted to follow a northerly route, joining the Yellow River approximately 600m north of its current confluence. The Yellow River is identified as a key aquatic ecological receptor and as such may be affected indirectly during the construction phase of the proposed development. The AECOM hydrology impact assessment (2015), EIS Section 8, outlines impacts on local hydrology and water quality arising from construction of the Stage 6 area. In summary they are as follows:

- Impacts on groundwater hydrology (arising from dewatering) are assessed as low given that dewatering would be temporary and a maximum of 4 m.
- Contamination of groundwater resulting from accidents of spillages is assessed as high because of shallow groundwater levels during construction and the likely and the likely spillages containing hydrocarbons.
- Dewatering during construction may cause contamination of groundwater as the water table is lowered. Contaminated water may enter groundwater from the interceptor channel and TMF. The significance of the impact is considered to be low if the dewatered groundwater level is not taken below the interceptor channel water level creating a downward head gradient out of the interceptor channel and potentially causing vertical seepage downwards into the superficial deposits in this location.
- Contamination may also occur to groundwater if accidents or spillages occur during the removal of materials from the borrow areas. The

EPA Export 06-01-2017:02:02:11

significance of this impact would be high because of the shallow groundwater level and the likely spillages containing hydrocarbons.

- The new interceptor channel around the Stage 6 would be connected to the existing east and west channels. If not constructed properly the contaminated water from the interceptor channel could enter groundwater. The significance of the impact is considered to be low given that mitigation has been put in place in the design; a perforated pipe in the existing northern channel would continue to capture seepage draining vertically through the existing TMF.

- The removal of impermeable fill materials from the borrow areas would act to increase the vulnerability of the underlying bedrock. The potential increase in the localised vulnerability of the bedrock aquifer is considered to be medium given that all of the available material would be removed. The proposed stage 6 extension will incorporates a composite lining system which consists of high density polyethylene (HDPE) geomembrane over a geosynthetic clay liner (GCL). The composite lining will overlie a 1000 g/m2 geomembrane which in turn overlies 100 mm of Type C protection material

- The diversion of *Blakes Stream*. Requiring the construction of a new river channel; modifications to the existing confluence at the Yellow River and the construction of a new confluence with the Yellow River.

- Impacts on surface water quality may arise from surface run-off from the borrow areas which, during the construction period, is likely to contain elevated concentrations of suspended solids. In the event of accidents or spillages, surface run-off may also contain concentrations of hydrocarbons. The predicted temporary increase in concentrations of suspended solids, and the possible occurrence of hydrocarbons, in surface run-off, unless mitigated, could affect the quality of the receiving watercourses (the Simonstown Stream, Blake's Stream and the Yellow River). Drainage ditches excavated during construction may create pathways to these watercourses.

Consent of copyright owner required for any other use. For inspection purposes only.

During construction groundwater and surface water (streams, ponds, ditches) adjacent to and surrounding the development site will be at risk from contamination owing to spillages containing hydrocarbons and from increased sedimentation owing to elevated concentrations of suspended solids in surface run-off. Taking account of the construction period proposed for the Stage 6 TMF development there is the potential for medium-term, sub-acute and/or chronic water quality impacts which may potentially affect local water quality in the receiving waters. Impacts are considered to be long term negative and range from minor to moderate in the local context. Impacts of a greater geographical significance, with reference to designated conservation sites are evaluated in Section 5.4.1 above.

The Yellow River is identified as being of County importance, while the Simonstown stream, Blakes Stream, Doug Stream and drainage channels within the development site are of local importance, lower value and do no support aquatic ecological interests of significance. Construction works will remove all existing aquatic features (man-made pond, along with a series of smaller ponds and ditches) within the

EPA Export 06-01-2017:02:02:11

development footprint. The aquatic habitat and flora are of low ecological value, resulting in a permanent impact, evaluated as being imperceptible in the local context.

Diversion of Blakes stream will require construction of a new river channel; modifications to the existing confluence at the Yellow River and the construction of a new confluence with the Yellow River. Such works present the opportunity for the implementation of instream enhancement works to improve the ecological structure both in the riparian and instream habitats.

The proposed diversion works and associated instream works will require a finalised design to be agreed with Inland Fisheries Ireland and with input from a qualified aquatic ecologist in order to maximise design features for biodiversity (with cognisance of required flow conveyance) within the newly constructed Blake's Stream diversion corridor. It is imperative that the default trapezoidal channelized corridors are not utilised in any future instream engineering.

The diversion of Blakes Stream will result in a localised, permanent, positive impact at this habitat.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:11

5.4.2.2 Operational Phase

During the operation of the Stage 6 Area and subsequent to the capping of the Stage 5 area, potential impacts on aquatic habitats and flora arise from the following sources (summarised from EIS Section 8):

- A potential impact on groundwater quality is the increased seepage entering groundwater from the Stage 6 extension. The significance of this impact is considered to be low because it is proposed to place a low permeability composite lining system on the upstream dam slopes and basin area of Stage 6. This is an embedded mitigation to prevent further seepage entering groundwater.

- There is a potential impact on groundwater hydrology from the placement of the new lining system. The lining system will create a barrier to groundwater flow in both the superficial and bedrock aquifers. Groundwater levels in the bedrock would be prevented from rising above the lining system due to the low permeability liner and groundwater in the superficial deposits would be prevented from flowing south west across the borrow area towards the Yellow River. This barrier may cause groundwater levels to rise on the northern and north eastern sections of the Stage 6 extension. The significance of this impact is considered to be low for the bedrock aquifer in Stage 6 because most of the area is overlain by superficial deposits with low permeability in some areas and also because an interceptor channel will be excavated around the extension area and will intercept groundwater if it rises above the base of the ditch.. The significance of this impact on shallow groundwater levels in the superficial deposits is considered to be low because a small depth of impermeable superficial deposits have already been removed from the borrow area for the Stage 5 raise and no significant impact has occurred.

For inspection purposes only.
Consent of copyright owner required for any other use.

- During operation there would be no direct discharge to surface water from the TMF, although surplus supernatant water would continue to be treated at the mine site and discharged to the River Boyne. Potential impacts, therefore, would be confined to the contribution of seepage to groundwater which may pass as base flow to surface watercourses.

- The contribution of groundwater from the area characterised by elevated sulphate concentrations to base flow in surface watercourses is generally low, since the affected area constitutes only a small proportion of the total catchment. The Yellow River has been receiving base flow with elevated sulphate concentrations for some time, however the impact on the Yellow River, and the River Blackwater downstream of the confluence, has been insignificant

- Compliance points and trigger values at the TMF have been put in place (AECOM, 2015), EIS Section 8. The compliance points have been put in place to protect the Yellow River and Blackwater River. Ground water monitoring point OB13 would be used as a compliance point in the superficial deposits to help protect the Yellow River and monitoring point sOB4-P2 and BR4 would be used in the superficial deposits and bedrock respectively to help protect the Blackwater River. Trigger values have been set at these compliance points for sulphate and magnesium at 1000 mg/l and 50 mg/l respectively. These concentrations would be used as an alert of a potential future non-compliance at

EPA Export 06-01-2017:02:02:12

the compliance points and hence at the receptors. The section of the River Blackwater used for potable water supply is at approximately 2.4 km south of the TMF and forms the southernmost boundary of the groundwater body. It is unlikely that there is a pathway between the TMF and this section of the River Blackwater, but a compliance point has still been set.

The quality of the treated water output from the Stage 6 TMF is expected to be similar to that of the existing outputs from the existing Stage 5A facility. Impacts on water quality owing to seepage to ground water have not been detected to date. Modelling calculations predict that physico-chemical quality of the water will remain within acceptable limits for humans, livestock and aquatic life with operation of the Stage 6 Area. Currently the suspended solid loading of the discharge water is very low indicating that there is a low risk that the discharge of the groundwater will impact on the potential of the substrates to support aquatic life. The risk of impacts to surface water and hydrology are therefore assessed as low and limited to the contribution of seepage to groundwater which may pass as base flow to surface watercourses. Compliance points and trigger values are in place to protect the Yellow River and the Blackwater River. Data from the existing TMF facility shows insignificant impacts from base flow on the Yellow and Blackwater Rivers. A deterioration in water quality is not predicted to result from operation of the Stage 6 Area. Impacts on aquatic habitats and flora are not predicted.

Potential Impact: Water quality impacts from Stage 6 TMF including seepage from the liner, siltation, heavy metals contamination (affecting Yellow River and Blackwater River)

Consent of copyright owner required for any other use.
For inspection purposes only.

Proposed mitigation: It is proposed to continue the extensive ground and surface water monitoring programme (detailed in the company's IE Licence) during the operations phase of the proposed development. The programme will also include all monitoring commitments and mitigation measures prescribed in the EIS for implementation during the operations stage.

Based on existing data and with compliance monitoring and triggers in place, potential impacts on water quality from seepage are assessed as long term, imperceptible to minor negative, and limited to the local extent.

EPA Export 06-01-2017:02:02:12

5.4.2.3 Cumulative Impacts

The background water quality in the River Blackwater, and the tributaries including the Yellow River, Blake's Stream, and Simonstown Stream are evaluated as being of moderate to poor ecological status, with compromised chemical and biological water quality. The proposed development has the potential to contribute to cumulative adverse effects on these minor tributaries with respect to channelization and siltation during the construction phase and ongoing sedimentation effects downstream during construction and operation. The background condition of the aquatic habitats in these watercourses is identified as been affected by diffuse and chronic siltation and nutrient inputs leading to unsatisfactory ecological status; however, there are no point source in-combination effects identified with respect to any specific plan or project.

Cumulative effects with regard to aquatic habitats are directly connected to elevated suspended solids, sedimentation of substrate affecting aquatic macrophyte diversity, and long-term chemical water quality effects (including heavy metals) which have implications for aquatic macrophytes and the aquatic habitats in general which support ecological diversity.

The potential for cumulative effects with respect to heavy metals is considered imperceptible and not significant, based on the results of monitoring at the site. This evaluation is reached taking account of the background water quality condition and the absence of any other plans or projects that give rise to significant inputs with the Yellow River catchment, or within the Blackwater as a whole. Similarly the low levels of nutrient discharge arising from the proposed development negates the potential for the development to cumulatively contribute to eutrophication within the River Blackwater sub-catchment, where agriculture and wastewater treatment discharges are contributing to elevated loadings to the receiving waters.

For inspection purposes only.
Consent of copyright owner required for any other use.

A cumulative effect of potential increased suspended solids, channelisation and sedimentation in the watercourses around and downstream from the development site has been identified. Impacts arising from this are considered to be long term and minor to moderate negative at a local scale, but imperceptible at a county and international scale, given linkages with the River Boyne and River Blackwater SAC.

The decommissioning phase (placement of a cap on the tailings surface and construction of a wetland system) of the development will bring positive impacts in terms of water quality, and biodiversity.

EPA Export 06-01-2017:02:02:12

5.4.3 Aquatic Fauna

5.4.3.1 Construction Phase

Rivers linked to the proposed development site (Yellow River, Blackwater River) support numerous fish species. Those of Special Conservation Interest in the River Boyne and River Blackwater SAC (Salmon, Lamprey) have been considered above.

Of the other fish species (minnows, stoneloach, gudgeon, eel) likely to be present, Eel are Red Listed Species (King *et al*. 2011). Potential water quality changes resulting from construction works (sedimentation and increased levels of hydrocarbons) may affect eel.

The potential introduction and spread of invasive species during construction works is also likely to have impact on eel populations. These impacts may be long term and could potentially be minor to moderate in the local context, extending to the county extent. Impacts on Annex II species have been assessed as being potentially long term, minor to moderate negative in the local context, potentially extending to the national level.

5.4.3.2 Operational Phase

A deterioration in water quality is not predicted to result from operation of the Stage 6 extension and impacts on aquatic fauna are not predicted. Based on existing data and with compliance monitoring and triggers in place, potential impacts on water quality during the operational phase may give rise to long term, minor to moderate impacts on aquatic fauna in the local context. This may extend to minor to moderate effects in the international context if impacts affecting the designated Natura 2000 sites are not effectively mitigated.

For inspection purposes only.
Consent of copyright owner required for any other use.

5.4.3.3 Cumulative Impacts

A cumulative effect of increased suspended solids, channelisation and sedimentation in the watercourses around and downstream from the development site has been identified (Section 4.2.3). Impacts arising from this are considered to be long term and minor to moderate negative with reference to the presence of Atlantic salmon, brown trout and lamprey species in the Yellow River and linkages with the River Boyne and River Blackwater SAC. The scale of impacts potentially extend from the local and county level to international in scale with reference to the River Boyne and River Blackwater SAC and SPA complex Natura 2000 sites. These impacts are to be mitigated by design, based on plans for the construction of a passive treatment system in the form of Integrated Constructed Wetland.

EPA Export 06-01-2017:02:02:12

5.5 Mitigation Measures

5.5.1 Designated Sites

5.5.1.1 Construction Phase

Potential Impact: Increased levels of suspended solids
Proposed mitigation: The proposed construction works for the Stage 6 TMF will be undertaken over a prolonged period. Surface run-off and dewatering discharges from the borrow areas would be routed through temporary settling ponds to promote the settling of suspended solids. The precise location and size of the settling ponds would vary in response to the changing extent of borrow area working and restoration.

Potential Impact: Fuel spillages
Proposed mitigation: The possibility of significant quantities of fuel or oils entering the surface run-off would be minimised by not storing hydrocarbons (fuel or lubricants) on site.
Fuel will be delivered on a needs be basis by a third party supplier. A dedicated refuling point will be strategically located away from water courses. Spill retention kits will be on hand in the event of a spillage.

An oil absorbent boom and oil interceptor would be installed at the discharge from the temporary settling pond to remove oil contaminants in the surface run-off which might arise from normal operation of the mechanical plant (AECOM, 2015, EIS Section 8).

Consent of copyright owner required for any other use. For inspection purposes only.

Potential Impact: Water quality limits exceeded.

Proposed Mitigation: Construction Environmental Management Plan

In order to ensure water quality parameters within the site are managed effectively throughout the construction period it is proposed to develop a comprehensive Construction Environmental Management Plan to incorporate all elements of the proposed works over the construction period. With reference to aquatic receptors detailed above (and including the sensitive Qualifying Interests of the River Boyne and River Blackwater SAC), the following components will be developed, with input from a suitably qualified aquatic ecologist:

- A Surface Water Management Plan: This will be iterative and will follow an adaptive management structure to ensure its effectiveness in delivery of the surface water quality requirements set out in the Surface Water Regulations (2009) and the Salmonid Regulations (1988). Long term dose-duration calculations and site-specific monitoring criteria will be required to ensure that the construction works are managed within the effective parameters to ensure that discharges from the site will not adversely affect Atlantic Salmon or adult River lamprey, with reference to physiological impacts (particularly on ova, and rearing fry) and siltation and habitat impacts; with implications for populations of both species occurring in natal streams outside of the SAC boundary, i.e.

EPA Export 06-01-2017:02:02:12

within the Yellow River and potentially within the Simonstown Stream. These measures will also benefit other aquatic species, including Eel and Brown Trout.

- An Erosion and Sediment Control Plan: This will provide for the effective management and limitation of sediment run-off and siltation in the tributaries and drains across the site and also provide for long term protection of the Yellow River and the River Blackwater downstream. This Plan will require input from geotechnical engineers, hydrologists, hydrogeologists and aquatic ecologists.
- An Invasive Species Management Plan: The significant earthworks and movement of machinery throughout the construction site over an extended period, taking account of connectivity to the River Boyne and River Blackwater SAC necessitates the preparation and implementation of identification and management protocols for invasive species throughout the site. The potential for the spread of species such as Japanese knotweed or Himalayan balsam is considered high, and thus effective measures for identification and control will be required.

5.5.1.2 Operational Phase

Operational phase impacts arising from the proposed Stage 6 TMF are identified with regard to water quality impacts arising from groundwater seepage and the long-term discharge from the passive discharge from the proposed constructed wetland treatment complex.

Potential Impact: Seepage from Stage 6 area liner (affecting Yellow River and Blackwater River)
Proposed mitigation: The lining system would be put in place to reduce seepage from the TMF. Groundwater and surface water monitoring would continue to be carried out in accordance with permits.

Consent of copyright owner required for any other use.
For inspection purposes only.

Potential Impact: Discharge from the constructed wetland complex (ICW).
Proposed Mitigation: Mitigation is expected to come into effect in the future (>10 years time) and focuses on the delivery of effective compliance monitoring. Taking account of the designation of the Blackwater within the River Boyne and River Blackwater SAC, it is proposed that the constructed wetland treatment system will be tested iteratively and that potential water quality impacts are avoided through a phased and adaptive treatment system, which will be fully operational at the required capacity to effectively treat discharge to the approved standards when the Stage 6 TMF is to be decommissioned and treatment via the passive system is required. In the intervening period, the existing water reticulation system will continue to operate, i.e. water will be pumped back to the mine and subsequently discharged to the River Boyne, under the existing IE licence.

Prior to the operational phase of the Stage 6 TMF it will be necessary to review the company's IE licence.
The success and effectiveness of the existing water quality management and associated monitoring programme, with reference to the existing IE licence, provides assurance that a similar level of implementation and compliance will be achieved in future operations.

EPA Export 06-01-2017:02:02:12

During the decommissioning phase, passive discharges via the proposed integrated constructed wetland (IWC) treatment complex will be tested for compliance prior to commissioning and only proven discharge values and volumes will be permitted from the site, in line with existing operational procedures, until such a time as the wetland complex can be demonstrated to achieve discharge rates in compliance with licence requirements.

5.5.2 Aquatic Habitats and Flora

5.5.2.1 Construction Phase

Potential Impact*:* Contamination of surface watercourses (Yellow River and Blackwater River, Blakes Stream, Simonstown and Duog Stream)

Proposed mitigation: Surface run-off and dewatering discharges from the borrow areas would be routed through temporary settling ponds to promote the settling of suspended solids. The precise location and size of the settling ponds would vary in response to the changing extent of borrow area working and restoration. The possibility of significant quantities of fuel or oils entering the surface run-off would be minimised by the construction of bunds around the fuel/oil storage facility located within the compound and the use of double skinned fuel tanks. Any spillage would be contained within this bund, which would also have a compacted till floor to prevent infiltration of spilt liquids. An oil absorbent boom and oil interceptor would be installed at the discharge from the temporary settling pond to remove oil contaminants in the surface run-off which might arise from normal operation of the mechanical plant.

For inspection purposes only.
Consent of copyright owner required for any other use.

Potential Impact: Loss of aquatic habitats and fauna within the Stage 6 area (man-made pond, Blakes Stream, drainage ditches).
Mitigation: Creation of alternative pond. It is proposed that this pond will be "seeded" with plants and invertebrates form the existing pond (and smaller pools) which will be removed during the development of the Stage 6 area. *Blakes Stream* will be diverted north of its current route and rehabilitation works will be implemented to enhance the biodiversity value of the redirected watercourse.

Potential Impact: Introduction and spread of invasive species
Proposed mitigation: Implementation of an Invasive Species Management Plan. The significant earthworks and movement of machinery throughout the construction site over an extended period, necessitates the preparation and implementation of identification and management protocols for invasive species throughout the site. The potential for the spread of species such as Japanese knotweed or Himalayan balsam is considered high, and thus effective measures for identification and control will be required.

EPA Export 06-01-2017:02:02:12

5.5.2.2 Operational Phase

Potential Impact: Water quality impacts from Stage 6 TMF including seepage from the liner, siltation, heavy metals contamination (affecting Yellow River and Blackwater River)
Proposed mitigation: It is proposed to commission an Operational Environmental Monitoring Programme for the operations phase of the proposed development. This plan will encapsulate all operational monitoring requirements set out in any discharge licence, in addition to including all monitoring commitments and mitigation measures prescribed in the EIS for implementation during the operations stage. This document will be prepared iteratively during the decommissioning of the Stage 5 TMF and will be managed as a live document, incorporating adaptive management processes for continuous improvements in order to manage the operational phase of the proposed development to best available standards and utilising current technologies for the achievement of required water quality standards within the site, in adjacent watercourses and within the Blackwater River downstream. Groundwater and surface water monitoring would continue to be carried out in accordance with permits.

5.5.3 Aquatic Fauna

5.5.3.1 Construction Phase

For inspection purposes only.
Consent of copyright owner required for any other use.

The implementation of stringent measures to limit any increase in suspended solids and in hydrocarbons (owing to spillages) during construction of the Stage 6 area will serve to minimise impacts on species of Special Conservation Interest, linked to the River Boyne and River Blackwater SAC and at the same time serve to minimise impacts on the Red Listed Species, the European Eel.

Potential Impact*:* Contaminating surface watercourses (Yellow River and Blackwater River, Blakes Stream, Simonstown and Duog Stream and aquatic fauna therein)
Proposed mitigation: Surface run-off and dewatering discharges from the borrow areas would be routed through temporary settling ponds to promote the settling of suspended solids. The precise location and size of the settling ponds would vary in response to the changing extent of borrow area working and restoration. The possibility of significant quantities of fuel or oils entering the surface run-off would be minimised by the construction of bunds around the fuel/oil storage facility located within the compound and the use of double skinned fuel tanks. Any spillage would be contained within this bund, which would also have a compacted till floor to prevent infiltration of spilt liquids. An oil absorbent boom and oil interceptor would be installed at the discharge from the temporary settling pond to remove oil contaminants in the surface run-off which might arise from normal operation of the mechanical plant

Potential Impact: Introduction and spread of invasive species
Proposed mitigation: Implementation of an Invasive Species Management Plan. The significant earthworks and movement of machinery throughout the construction site over an extended period, necessitates the preparation and implementation of identification and management protocols for invasive species throughout the site. The

EPA Export 06-01-2017:02:02:12

potential for the spread of species such as Japanese knotweed or Himalayan balsam is considered high, and thus effective measures for identification and control will be required.

5.5.3.2 Operational Phase

Operational phase mitigation for the reduction and avoidance of impacts affecting aquatic fauna are set out in Section 5.2.1 and 5.2.2 above.

5.6 Residual Impacts

Refer to Table 5.5 for summary of residual impacts affecting key aquatic ecological receptors identified within the study area and zone of influence of the proposed development.

5.6.1 Designated Sites

Impacts on designated sites relate to changes in water quality and hydrology arising from the proposed development. Impacts from the spread of invasive species have also been identified. Extensive mitigation measures have been proposed in tandem with monitoring to ensure compliance limits are not exceeded. With these measures in place, residual impacts are assessed as long term, negative and imperceptible to minor at a local level. No significant impacts are identified with regard to the River Boyne and River Blackwater SAC and SPA designations.

Consent of copyright owner required for any other use. For inspection purposes only.

5.6.2 Aquatic Habitats and Flora

Impacts on aquatic habitats and flora relate to direct habitat loss and to changes in water quality and hydrology arising from the proposed development and affecting local and connected streams (Blakes, Doug, Streamstown) and Rivers (Yellow, Blackwater). Mitigation measures have been proposed in tandem with monitoring to ensure compliance limits are not exceeded. With these measures in place, residual impacts are assessed as long term, ranging from imperceptible to minor negative in the local context, with no significant impacts identified.

5.6.3 Aquatic Fauna

Impacts on aquatic fauna relate to direct habitat loss and to changes in water quality and hydrology arising from the proposed development and affecting local and connected streams (Blakes, Doug, Streamstown) and Rivers (Yellow, Blackwater). Impacts from the spread of invasive species have also been identified. Extensive mitigation measures have been proposed in tandem with monitoring to ensure compliance limits are not exceeded. With these measures in place, residual impacts are assessed as long term, ranging from imperceptible to minor in the local context and imperceptible in any wider geographical context.

EPA Export 06-01-2017:02:02:12

Table 5.5. Summary of receptors and their ecological value, impacts and their significance, proposed mitigation measures and residual impacts.

Receptor	Ecological Value	Potential Impact	Significance of potential impact	Mitigation	Residual Impact Evaluation
River Boyne and River Blackwater SAC and SPA complex	International importance	Construction: Increased sedimentation, hydrocarbon spillage, invasive species introduction.	Temporary, long term, minor to moderate local. Potential for minor to moderate effects on the SAC/SPA complex in the absence of mitigation.	Yes	Imperceptible
		Construction: Invasive species introduction.	Temporary, long term, minor to moderate local. Potential for minor to moderate effects on the SAC/SPA complex in the absence of mitigation.	Yes	Imperceptible
		Operation: Seepage, changes to groundwater hydrology	Long term, imperceptible to minor in the local context. No significant effects based on ongoing monitoring data.	Yes	Imperceptible
		Cumulative (channelisation and siltation of minor tributaries linked to Yellow River and Blackwater River)	No plans or projects identified as operating in combination or cumulatively with the proposal.	Yes	Imperceptible
Aquatic habitats and flora (Development footprint)	Local importance (lower value) Not identified as key ecological receptor	Habitat loss and change: loss of man-made pond, drains and diversion of Blakes Stream and creation of new pond.	Permanent minor in the local context, potential for positive long term effects with enhancement design.	Yes	Minor to moderate positive in the local context
		Construction: Risk of contamination, increase in sedimentation from surface run off.	Minor to moderate negative in the absence of mitigation	Yes	Imperceptible to minor in the local context
		Operation: Seepage, changes to groundwater hydrology	Long term minor to moderate impacts in the absence of mitigation	Yes	Imperceptible to minor in the local context

For inspection purposes only. Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

Receptor	Ecological Value	Potential Impact	Significance of potential impact	Mitigation	Residual Impact Evaluation
		Cumulative (discharge from ICW causing water quality impacts)	Long term minor to moderate impacts in the absence of mitigation, ranging from local to international in scale.	Yes	Imperceptible in the local and wider context
		Cumulative (channelisation and siltation of minor tributaries linked to Yellow River and Blackwater River)	Long term minor to moderate impacts in the absence of mitigation	Yes	Imperceptible to minor in the local context
Aquatic fauna (Development footprint)	Local importance (lower value) Not identified as key ecological receptor	Habitat loss and change: loss of man-made pond, drains, diversion of Blakes Stream, creation of new pond.	Long term imperceptible to minor impacts in the absence of mitigation, limited to the local context. Potential for positive long term effects with enhancement design.	Yes	Minor to moderate positive in the local context
Aquatic fauna (Salmonids, eel, lamprey species)	County to International importance	Habitat loss and change: loss of man-made pond, drains, diversion of Blakes Stream, creation of new pond	Long term minor to moderate impacts in the absence of mitigation	Yes	Imperceptible to minor in the local context

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:12

5.7 References

AECOM (2015) TMF Stage 6 Extension – Hydrology and Hydrogeology Environmental Impact Assessment. AECOM, UK. EIS Section 8

Biosphere, 2010. Proposed Extension To Randalstown Tailings Storage Facility: Statement For Appropriate Assessment. Consultant's report prepared by Biosphere Environmental Services Ltd. for Boliden Tara Mines.

CIEEM (2016) Chartered Institute of Ecology and Environmental Management Guidelines for Ecological Impact Assessment in the UK and Ireland. CIEEM.
EPA (2007) Guidelines on the information to be contained in Environmental Impact Statements. EPA. EPA.
EPA (2003) Advice Notes on current practice in the preparation of Environmental Impact Statements. EPA.
Environmental Protection Agency (2013). EPA ENVision Service (internet-based environmental information portal). Available online at: http://maps.epa.ie/internetmapviewer/mapviewer.aspx
European Commission (2000) Managing Natura 2000 sites: The Provisions of Article 6 of the Habitat's Directive 92/43/EEC (EC Environment Directorate-General, 2000).
European Commission (2001) Assessment of Plans and Projects Significantly Affecting Natura 2000 sites: Methodological Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC (European Commission Environment Directorate-General,);
European Communities (Birds and Natural Habitats) Regulations (2011) S.I. No. 477 of 2011, Iris Oifigiúil, 143 pp
Garrigle, M.L., Lucey, J., Clabby, K.J., (1992). Biological assessment of river water quality in Ireland. In Newman, P.J., Piavaux M.A., Sweeting, R.A. (Eds), River Water Quality: Ecological Assessment and Control Commission of the European Communities, Luxembourg, pp. 371-393.
Forest, Environmental & Research Services Ltd. (2015) Flora and Fauna Assessment.
Golder Associates (2009). Report to Boliden Tara Mines Ltd, Reclamation and Closure plan for the Randalstown Tailings Facility Following the Stage 5 Raise. 2009, Report no. 08514150063.
Golder Associates (2016). Boliden Tara Mines: Design for the Stage 6 Tailings Management Facility. Report No. 1532091.502/A.1. Consultant's report prepared by Golder Associates (UK) Ltd.
Kelly, F.L., Matson, R., Connor, L., Feeney, R., Morrissey, E., Coyne, J. and Rocks, K. (2014) Water Framework Directive Fish Stock Survey of Rivers in the Eastern River Basin District. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.
King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011) *Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
NPWS (2013). The Status of EU Protected Habitats and Species in Ireland: Article 17 report. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:12

O'Connor W. (2006) A survey of juvenile lamprey populations in the Boyne Catchment. Irish Wildlife Manuals, No. 24 National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
Tobin (2010). Natura Impact Statement: Proposed Discharge of Groundwater to River Blackwater. Consultant's report prepared by Tobin Consulting Engineers for Boliden Tara Mines.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

Appendix 5.1

Table A1. Assimilative Capacity Calculations for the proposed Integrated Constructed Wetland.

F rec (flow 50%ile) m³/h (Blackwater)	F dis (Max discharge) m³/h (Output from ICW)	F total (River at 50%ile + ICW discharge) m³/h	Parameter	*Units*	Conc receiving water (Blackwater)	Conc discharge (Output from ICW)	C downstream = (F river 50* C back) + (F effluent * C effluent) / (F river 50 + F effluent)	Limit Drinking water mg/l	Surface water Limit mg/l	Compliance
31,000	7,000	38,000	Sulphate as SO4	mg/l	26	500	113.3	187.5	-	**YES**
31,000	7,000	38,000	Chloride as Cl	mg/l	15	40	19.6	250	-	**YES**
31,000	7,000	38,000	Sodium, Filtered as Na	mg/l	9.8	53	17.8	200.00	-	**YES**
31,000	7,000	38,000	Nitrate as N	mg/l	10	1.0	8.34	11.3	-	**YES**
31,000	7,000	38,000	Dissolved Oxygen, Unfixed	mg/l	9.5	9.4	9.48	9.5	-	**YES**
31,000	7,000	38,000	Magnesium, Total as Mg	mg/l	9.0	55	17.5	-	-	**-**
31,000	7,000	38,000	Potassium, Filtered as K	mg/l	3.4	2.9	3.30	-	-	**-**
31,000	7,000	38,000	Nitrite as N	mg/l	2.0	0.080	1.65	0.15	-	**
31,000	7,000	38,000	Iron, Filtered as Fe	mg/l	0.10	0.23	0.124	0.20		**YES**
31,000	7,000	38,000	Aluminium, Filtered as Al	mg/l	0.09	0.10	0.092	0.20	-	**YES**
31,000	7,000	38,000	Manganese, Filtered as Mn	mg/l	0.03	0.06	0.035	0.05	-	**YES**
31,000	7,000	38,000	Zinc, Filtered as Zn	mg/l	0.02	0.035	0.023	0.50	0.1	**YES**
31,000	7,000	38,000	Cyanide, Total as CN	mg/l	0.02	0.009	0.018	0.05	0.01	**YES**

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

F rec (flow 50%ile) m³/h (Blackwater)	F dis (Max discharge) m³/h (Output from ICW)	F total (River at 50%ile + ICW discharge) m³/h	Parameter	*Units*	Conc receiving water (Blackwater)	Conc discharge (Output from ICW)	C downstream = (F river 50* C back) + (F effluent * C effluent) / (F river 50 + F effluent)	Limit Drinking water mg/l	Surface water Limit mg/l	Compliance
31,000	7,000	38,000	Antimony, Filtered as Sb	mg/l	0.01	0.001	0.008	0.005	-	**Reduce LOD in river**
31,000	7,000	38,000	Arsenic, Filtered as As	mg/l	0.01	0.008	0.010	0.01	0.025	**YES**
31,000	7,000	38,000	Copper, Filtered as Cu	mg/l	0.002	0.009	0.003	2.0	0.03	**YES**
31,000	7,000	38,000	Lead, Filtered as Pb	mg/l	0.002	0.003	0.002	0.01	0.007	**YES**
31,000	7,000	38,000	Chromium, Filtered as Cr	mg/l	0.002	0.002	0.002	0.050	0.003	**YES**
31,000	7,000	38,000	Cadmium, Filtered as Cd	mg/l	0.002	0.001	0.002	0.005	0.00025	**Reduce LOD in river**
31,000	7,000	38,000	Mercury, Total as Hg	mg/l	0.001	0.0001	0.001	0.001	0.0001	**YES**

LOD Limit of detection

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

Table A2. Surface Water run-off from Stage 5 and Stage 6 through proposed ICW

Month	Volume through ICW per hectare per hour
January	213
February	158
March	90
April	8
May	-27
June	-43
July	-27
August	37
September	84
October	192
November	214
December	192

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

Table A3. 10Ha ICW Water Balance calculations for proposed ICW

	Tara Mines	100,000m^2				
		194 ha. Drainage area				
	Season	**Spring**	**Summer**	**Autumn**	**Winter**	**Total**
1	Effluent Discharge m³	170138	-74258	221742	462108	**779,730**
2	Rainfall m	0.1822	0.189	0.2363	0.2527	
2.1	Rainfall m³	18220	18930	23630	25270	**86,050**
3	Infiltration rate m	0.0001	0.0001	0.0001	0.0001	
3.1	Infiltration m³	900	900	900	900	**3,600**
4	Transpiration rate m	0.3	0.6	0.4	0.1	
4.1	Transpiration m³	30000	60000	40000	10000	**140,000**
5	Interception rate (% of Rainfall)	15%	50%	25%	5%	
5.1	Interception	2733	9465	5907	1263	**19,368**
6	Discharge m³	154725	-54435	198565	475215	
		Total annual water budget 702,812m^3 10% annual reduction				
6	Daily average m³	1719	0	2206	5280	
	Total water flow to ICW /yr 779,730 m³					

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:12

Section 6 Air

6.1 Introduction

Odour Monitoring Ireland was commissioned by Boliden Tara Mines Limited (BTML) to review existing air quality data and to develop an air quality section of the EIS in order to assess the potential impact to air quality from the proposed Stage 6 development. This study will identify, describe and assess the impact of the development in terms of its impact on air quality.

A desktop air quality assessment has been carried out in the area utilising existing monitoring data collected by BTML and baseline air quality data generated by synoptic EPA monitoring stations in the area. The purpose of this desktop study was to identify existing pollutant trends in the vicinity of the proposed development, and to assess the potential impact of the proposed development. This will establish sufficient spatial information in order to determine compliance with relevant ambient air quality legislation. Additionally, comparison with longer period limit values can be used to establish trends and are important in defining baseline air quality.

This assessment was prepared in accordance with the Guidelines on the information to be contained in Environmental Impact Statements (EPA 2002). This section should be read in conjunction with the site layout plans for the facility.

For inspection purposes only.
Consent of copyright owner required for any other use.

- **It is proposed to extend the existing TSF laterally in a northerly direction.**
    - **Here after the proposed facility will be referred to as *TSF Stage 6*.**
    - **The proposal facility will cover a footprint area of c. 58 hectares, extend to a height of 22 m above ground level and will provide a potential a storage volume of approximately 9.6 million cubic metres [13.6 million tonnes].**

- **The second part of the proposed development is the construction of an Integrated Constructed wetland (ICW). The proposal facility will cover a footprint area of c. 12 hectares. The function of the wetland is to provide a passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle.**
    - **Treated water will discharge from the ICW to the river Blackwater via a buried HDPE pipeline.**

EPA Export 06-01-2017:02:02:12

6.1.1 Study Methodology-Assessment Criteria

The European Union (EU) has introduced several measures to address the issue of air quality management. In 1996, Environmental Ministers agreed a Framework Directive on ambient air quality assessment and management (Council Directive 96/62/EC). As part of the measures to improve air quality, the European Commission has adopted proposals for daughter legislation under Directive 96/62/EC. The first of these directives to be enacted, 1999/30/EC, set limit values in April 2001 that replaced previous limit values that were set by Directives 80/779/EEC, 82/884/EEC and 85/203/EEC. This was again updated through the implementation of the Ambient Air Quality and Cleaner Air for Europe (I) Directive 2008/50/EC. New limit values for sulphur dioxide, PM10, PM2.5 and nitrogen dioxide set by the CAFÉ Directive are detailed in Table 6.1.

The National Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002) transpose those parts of the "Framework" Directive 96/62/EC on ambient air quality assessment and management not transposed by the EPA Act 1992 (Ambient Air Quality Assessment and Management) Regulations 1999 (S.I. No. 33 of 1999). The 2002 Regulations also transpose, in full, the 1st two "Daughter" Directives 1999/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air, and 2000/69/EC relating to limit values for benzene and carbon monoxide in ambient air.

For inspection purposes only.
Consent of copyright owner required for any other use.

Council Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe has revised and combined several existing Ambient Air Quality Standards including Council Directives 96/62/EC, 1999/30/EC and 00/69/EC. With regard to existing ambient air quality standards, it will not modify the standards but will strengthen existing provisions to ensure that non-compliances are removed. It does however set a new ambient standard for PM2.5. With regard to PM2.5, the proposed approach is to establish a limit value of 25 µg/m3, as an annual average (to be attained by 2015), coupled with a non-binding target to reduce human exposure generally to PM2.5 between 2010 and 2020. This exposure reduction target is currently proposed at 20% of the average exposure indicator (AEI). The AEI is based on measurements taken in urban background locations averaged over a three year period.

In 2011, SI 271 of 2002, Air Quality Standards Regulations 2002 was replaced with SI 180 of 2011, Air Quality Standards Regulations 2011 which transposes 2008/50/EC into Irish law. The Air Quality Framework Directive (96/62/EC) sets out the principles of ambient air quality monitoring, assessment and management and was followed by four daughter directives which detailed the limit values for specific pollutants. This is the fourth daughter directive (2004/107/EC) and covers polyaromatic hydrocarbons, arsenic, nickel, cadmium and mercury in ambient air. SI 58 of 2009 transposed the 4th Daughter Directive into Irish law.

The limit values for each species / compound is reported in Table 6.1 & 6.2.

EPA Export 06-01-2017:02:02:12

Table 6.1. Irish and EU Ambient Air Standard (SI180 of 2011) – Limit values.

Pollutant	Regulation	Limit Type	Value
Nitrogen Dioxide	SI 180 of 2011	Hourly limit for protection of human health - not to be exceeded more than 18 times/year-1 hour average	200 µg/m³ NO_2
		Annual limit for protection of human health-Annual	40 µg/m³ NO_2
		Annual limit for protection of vegetation-Annual	30 µg/m³ NO + NO_2
Lead	SI 180 of 2011	Annual limit for protection of human health-Annual average	0.5 µg/m³
Sulphur Dioxide	SI 180 of 2011	Hourly limit for protection of human health – not to be exceeded more than 24 times/year-1 hour average	350 µg/m³
		Daily limit for protection of human health – not to be exceeded more than 3 times/year-24hr average	125 µg/m³
		Annual & Winter limit for the protection of ecosystems-Annual	20 µg/m³
Particulate Matter (PM_{10})	SI 180 of 2011	24-hour limit for protection of human health - not to be exceeded more than 35 times/year-24 hour average	50 µg/m³ PM_{10}
		Annual limit for protection of human health-Annual	40 µg/m³ PM_{10}
Particulate Matter ($PM_{2.5}$)	SI 180 of 2011	Stage 1 - Annual limit for protection of human health-Annual	25 µg/m³ $PM_{2.5}$
		Stage 2 - Annual limit for protection of human health-Annual	20 µg/m³ $PM_{2.5}$
Benzene	SI 180 of 2011	Annual limit for protection of human health	5 µg/m³
Carbon Monoxide	SI 180 of 2011	8-hour limit (on a rolling basis) for protection of human health	10 mg/m³

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

Table 6.2. Irish and EU Ambient Air Standard (SI 58 of 2009) – Target values.

Pollutant	Regulation	Limit Type	Value[1]
Arsenic	SI 58 of 2009	Annual limit for the protection of human health	6.0 NG/M^3
Cadmium	SI 58 of 2009	Annual limit for the protection of human health	5.0 NG/M^3
Nickel	SI 58 of 2009	Annual limit for the protection of human health	20.0 NG/M^3

Notes: [1] denotes that for the total content in the PM_{10} fraction averaged over a total year.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

In the absence of statutory standards, it is common practice to reference other suitable authorities such as the World Health Organisation (WHO), the Danish EPA or derive an ambient air quality guideline from Occupational Exposure Limits (OEL). The concentration guidelines associated with each of the assessment criteria references are listed below in Table 6.3. Although not directly comparable, it is interesting to observe these levels.

The World Health Organisation "Air Quality Guidelines for Europe (2nd Edition) have listed a number of potentially hazardous air pollutants and the potential health impacts to humans as a result of both long and short term exposure. Where possible the WHO have stated a recommended guideline of air quality concentration that is a "safe" level. Where "safe" levels cannot be stated a guideline is included.

The Danish EPA has published "Guidelines for Air Emission Regulation – Limitation of air pollution from installations" in 2002, which contain specific "C values" for a series of air pollutants (modelled predicted ground level impact). These "C-values" are the maximum ground level concentrations permissible based on emissions from installations. The emissions are defined as the ground level concentration (GLC) measured at 1.5 m high.

The Irish National Authority for Occupational safety and Health (NAOSH) has published the "Code of Practice for the Safety, Health and Welfare at Work (Chemical Agent) Regulations" in 2002. These regulations state short term (15 minute) and long term (8 hour) occupational exposure limits for workers exposed to a chemical agent. While these regulations are targeted at worker exposure, it is common practice to use 1/40th of the NAOSH occupational exposure limit as a reference for ambient air in the vicinity of an emission point.

The dusts/metals selected for assessment include those specified in the 4th Daughter Directive and the metals detected in samples of the tailings as analysed at a suitably accredited laboratory.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:12

Table 6.3 Reference Assessment Criteria for Metals in Ambient Air

Compound	4th Daughter Directive (µg/m3)	WHO Guidelines (µg/m3)	Danish C Value (µg/m3)	NAOSH (1/40 OEL (µg/m3)	EPA IE Licence PO516-03 (µg/m3)
Dust	-	-	80	100	40
Nickel	0.02	1	0.10	2.50	
Cadmium	0.005	0.30	0.010	0.62	0.0050
Arsenic	0.006	1	0.010	2.50	0.0060
Lead	0.50	0.50	0.40	3.75	0.50
Chromium	-	1	1	12.50	-
Copper	-	-	10	25	-
Aluminium	-	-	-	276	-
Magnesium	-	-	-	250	-
Iron	-	-	-	25	-
Zinc	-	-	-	-	1.0

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

6.2 Receiving Environment - Air

6.2.1 General

The Tara mine site is situated at Knockumber, 2 km west of Navan, County Meath. The Tailings Storage Facility is located approximately 3 km to the north of the mine and currently covers a footprint area of about 171 ha. The Tailings Facility is situated within a temperate climatic zone of 941.3mm mean annual rainfall. The region can generally be described as rural-agricultural. The surrounding area is comprised of farmland and farm dwellings and residential dwellings. Population density is low with ribbon development along the road network in the area. Immediately adjacent to the west of the Tailings Facility is the Yellow River, which flows into the River Blackwater. The TSF is bounded on the east by the *Navan-Kingscourt* railway line. Navan racecourse is located to the east of the facility. Refer to figure 6.1.

6.2.2 Baseline Air Quality

A total of twelve baseline monitoring stations and a review of available EPA air quality data were chosen to represent the baseline air quality in the vicinity of the existing facility. These locations are listed in *Table 6.4* and *6.5* and presented in *Figure 6.2.* The following monitoring technique was utilised for dust monitoring in the vicinity of the facility. These include:

Consent of copyright owner required for any other use.
For inspection purposes only.

- A network of four directional dust flux gauges as described in British Standard 1747 Part 5 – Methods for Measurement of Air Pollution – Directional Dust Gauges, 1972.
- A network of six total depositional dust gauges as describes in VDI 2119 – Bergerhoff total depositional dust gauges.
- A network of three high volume continuous air samplers performed in accordance with the requirements of SI 244 of 1987 and in accordance with the requirements of the Directive (99/30/EC).
- A PM_{10} sampler in accordance with the requirements of EN1234-1.

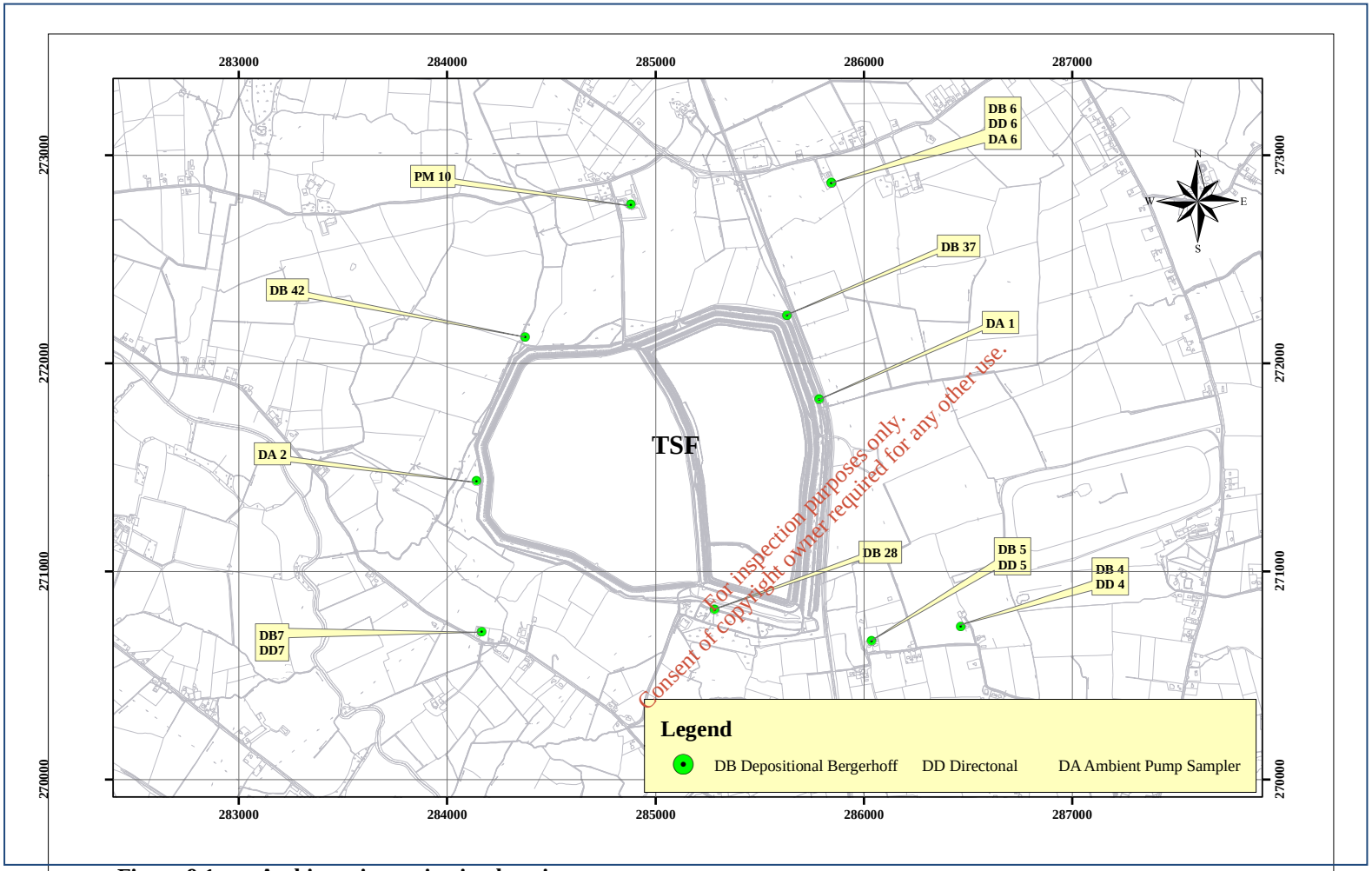
The baseline EPA monitoring stations were chosen as they represent the typical pollutants trends that would be experienced in the Navan area. In addition, it is likely that the concentration values of air quality would tend to be worst case as these monitoring stations were located in towns while the existing facility is located in rural area. As a result of the existing site conditions and the potential for construction, traffic, residential and amenity-derived pollution, the following parameters are reported:

- Benzene and Toluene
- Nitrogen dioxides (NO_2)
- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)
- Particulate matter (PM_{10})
- Dust monitoring and Metals

EPA Export 06-01-2017:02:02:12

Figure 6.1 Site location

EPA Export 06-01-2017:02:02:12



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 9.1 Ambient air monitoring locations

Figure 6.2 Air monitoring locations

EPA Export 06-01-2017:02:02:12

Table 6.4 Description of Air Monitoring Locations

Reference	Monitoring parameters	Description and monitoring location
A1 - Baseline EPA station Rural max averages (Air Quality in Ireland 2014)	Oxides of nitrogen, Sulphur dioxide, $PM_{10, 2.5}$, Benzene, Toluene and Lead, Metals and metals deposition	Monitored by EPA using synoptic stations located in Zone D locations throughout Ireland
PM10	Particulate matter 10 µm particle size	Monitored using high volume PM10 sampler – *see Table 6.5* for 6 grid location
DB6 & DD6	Total depositional dust	Monitored using Bergerhoff gauges and directional gauges– see Table 6.5 for 6 grid location
DB42	Total depositional dust	Monitored using Bergerhoff gauges– see Table 6.5 for 6 grid location
DB37	Total depositional dust	Monitored using Bergerhoff gauges– *see Table 6.5* for 6 grid location
DA1	Continuous ambient air filters	Monitored using high volume continuous air sampler– *see Table 6.5* for 6 grid location
DA2	Continuous ambient air filters	Monitored using high volume continuous air sampler– *see Table 6.5* for 6 grid location
DA6 & DD7	Continuous ambient air filters and Total depositional dust	Monitored using directional gauges and high volume continuous air sampler– *see Table 6.5* for 6 grid location
DB28	Total depositional dust	Monitored using Bergerhoff gauges and directional gauges– *see Table 6.5* for 6 grid location
DB5 & DD5	Total depositional dust	Monitored using Bergerhoff gauges and directional gauges– *see Table 6.5* for 6 grid location
DB4 & DD4	Total depositional dust	Monitored using Bergerhoff gauges and directional gauges– *see Table 6.5* for 6 grid location

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

Table 6.5 Location of Air Monitoring Locations

Monitoring location	X grid reference (m)	Y grid reference (m)
DA1	285786	271826
DA2	284140	271435
DA6	285846	272868
DB4	286466	270734
DB5	286038	270667
DB6[12]	285844	272862
DB28	285283	270817
DB37	285631	272230
DB42	284376	272125
PM 10	284881	272763

6.2.2.1 Benzene and Toluene

The sources associated with individual volatile organic compounds (VOCs) tend to be dependent on the nature of industries in the sample region. Methane is a naturally occurring volatile organic carbon (VOC) from plants and animals but is also generated as a by-product of certain industries. Benzene, Toluene, Ethyl benzene, p/o xylene (BTEX) and other aromatics/alkanes are most likely derived from petrol driven vehicle exhausts. Heavier semi-volatile organic compounds are frequently derived from diesel powered engines. Benzene is a known carcinogen, poisonous by inhalation and a severe eye and moderate skin irritant.

For inspection purposes only. Consent of copyright owner required for any other use.

With reference to the EPA monitoring locations for Zone D locations within the 2014 report (A1), the air quality was monitored for Benzene and Toluene. The desktop baseline results are presented in Table 6.6 for each station.

Table 6.6 Average benzene and toluene concentrations at EPA Monitoring Locations

Location	Benzene (µg/m³)	Toluene (µg/m³)
Monitoring station Zone A – Annual mean	0.94	2.07
Monitoring station Zone C – Annual mean	0.090	--
Limit Value	**5[1]**	**4,800[2]**

Notes: [1] denotes Irish and EU Ambient Air Standard (SI 180 of 2011);
[2] denotes No specific ambient air limits. Rule of thumb is using 1/40th of the 8-hour Occupational Exposure Limit as stated in the National Authority for Occupational Safety and Health 2011 "Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations".

12

EPA Export 06-01-2017:02:02:12

The results illustrated in Table 6.6 at baseline monitoring stations A1 are all in compliance with Irish and EU limit values (i.e. SI 271 of 2002 and EU Directive 2000/69/EC) for Benzene. Average Benzene concentrations were up to 81% lower than the Irish and EU directive limit values. The rule of thumb for guidelines for ambient air quality of volatile organic compounds without legislative limit values is using 1/40th of the 8-hour Occupational Exposure Limit as stated in the National Authority for Occupational Safety and Health 2002 "Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations". Toluene concentrations are well within their respective fractional exposure limit values.

6.2.2.2 Nitrogen Dioxides (NO_2)

Nitrogen is a constituent of both the natural atmosphere and of the biosphere. When industrial metabolism releases nitrogen to the environment it is considered a "pollutant" because of its chemical form: NO, NO_2, and N_2O. These oxides of nitrogen can be toxic to humans, to biota, and they also perturb the chemistry of the global atmosphere. In the transportation sector, the NOx emissions result from internal combustion engines. In power plants and industrial sources, NOx is produced in boilers. The overwhelming fraction of nitrogen oxide emissions arises from the high temperature combustion of fossil fuels; emissions from metal-processing plants and open-air burning of biomass are insignificant.

Consent of copyright owner required for any other use. For inspection purposes only.

Nitrogen dioxide is classed as both a primary pollutant and a secondary pollutant. As a primary pollutant NO_2 is emitted from all combustion processes (such as a gas/oil fired boiler or a car engine). Potentially, the main sources of primary NO_2 for the proposed development will be from vehicle exhausts.

As a secondary pollutant NO_2 is derived from atmospheric reactions of pollutants that are themselves, derived mainly from traffic sources (e.g. volatile organic compounds). Secondary pollution is usually derived from regional sources and may be used as an indicator of general air quality in the region. Nitrogen dioxide has been shown to reduce the pulmonary function of the lungs. Long-term exposure to high concentrations of NO_2 can cause a range of effects, primarily in the lungs, but also in the liver and blood.

With reference to the EPA monitoring locations for Zone D locations within the 2014 report (A1), the air quality was monitored for Nitrogen dioxide. The desktop baseline results are presented in Table 6.7 for each station.

EPA Export 06-01-2017:02:02:12

Table 6.7 Average NO_2 concentrations at EPA Monitoring Locations

Location	Average NO_2 conc. ($\mu g/m^3$)
Monitoring station Zone D Kilkitt – Annual mean	3.0
Monitoring station Zone D Castlebar – Annual mean	8.0
Monitoring station Zone D Enniscorthy – Annual mean	13
Limit value - Annual average	**40**
Limit value 1 hour average	**200**

The dominant source of NO_2 in Ireland appears to be from motor vehicle exhausts and the burners/boiler of space heating of light industry and business units. The measured concentrations of NO_2 at all baseline monitoring stations are within the Irish and EU Ambient Air Standards. All baseline monitoring locations are an average 67.50% lower than currently established Irish and European ambient air regulatory levels for annual averages.

Consent of copyright owner required for any other use. For inspection purposes only.

6.2.2.3 Sulphur Dioxide (SO_2)

Sulphur dioxide is a colourless gas, about 2.50 times as heavy as air, with a suffocating faint sweet odour. Sulphur dioxide occurs in volcanic gases and thus traces of sulphur dioxide are present in the atmosphere. Other sources of sulphur dioxide include smelters and utilities, electrical generation, iron and steel mills, petroleum refineries, pulp and paper mills, metallurgical processes, chemical processes and the combustion of the iron pyrites, which are contained in coal. Small sources include residential, commercial and industrial space heating.

SO_2 can be oxidised to sulphur trioxide, which in the presence of water vapour is readily transformed to sulphuric acid mist. SO_2 is a precursor to sulphates, which are one of the main components of respirable particles in the atmosphere. Health effects caused by exposure to high levels of SO_2 include breathing problems, respiratory illness, changes in the lung's defences, and worsening respiratory and cardiovascular disease. People with asthma or chronic lung or heart disease are the most sensitive to SO_2. It also damages trees and crops. SO_2, along with nitrogen oxides, are the main precursors of acid rain. This contributes to the acidification of lakes and streams, accelerated corrosion of buildings and reduced visibility. SO_2 also causes formation of microscopic acid aerosols, which have serious health implications as well as contributing to climate change.

With reference to the EPA monitoring locations for Zone D locations within the 2014 report (A1), the air quality was monitored for Sulphur dioxide. The desktop baseline results are presented in Table 6.8 for each station.

EPA Export 06-01-2017:02:02:12

Table 6.8 Average SO_2 Concentrations at each EPA Monitoring Locations

Location	Average SO_2 conc. (µg/m³)
Monitoring station Zone D Kilkitt – Annual mean	2.0
Monitoring station Zone D Shannon – Annual mean	3.0
Monitoring station Zone D Enniscorthy – Annual mean	4.0
Limit value - Annual average	**20**

The dominant source of SO_2 in Ireland appears to be from motor vehicle exhausts and the burners/boiler/solid fuel heating single residences and industrial units. The measured concentrations of SO_2 at all monitoring locations are within the Irish and EU Ambient Air Standards. EPA monitoring locations are an average 80% lower than currently established Irish and European ambient air regulatory levels for annual averages.

6.2.2.4 Carbon Monoxide (CO)

Consent of copyright owner required for any other use. For inspection purposes only.

Carbon monoxide is produced as a result of incomplete burning of carbon-containing fuels including coal, wood, charcoal, natural gas, and fuel oil. It can be emitted by combustion sources such as un-vented kerosene and gas heaters, furnaces, woodstoves, gas stoves, fireplaces and water heaters, automobile exhaust from attached garages and tobacco smoke. Carbon monoxide interferes with the distribution of oxygen in the blood to the rest of the body. Depending on the amount inhaled, this gas can impede coordination, worsen cardiovascular conditions, and produce fatigue, headache, weakness, confusion, disorientation, nausea, and dizziness. Very high levels can cause death. The symptoms are sometimes confused with the flu or food poisoning. Foetuses, infants, elderly, and people with heart and respiratory illnesses are particularly at high risk for the adverse health effects of carbon monoxide.

EPA Export 06-01-2017:02:02:12

With reference to the EPA monitoring locations for Zone D locations within the 2014 report (A1), the air quality was monitored for carbon monoxide. The desktop baseline results are presented in Table 6.9 for each station.

Table 6.9 Average ambient baseline CO concentrations at EPA Monitoring Locations

Location	Ambient CO conc. (mg/m3)
Monitoring station Zone D Portlaoise – Annual mean	0.50
Monitoring station Zone D Enniscorthy – Annual mean	0.40
Limit Value	**10**[1]

The dominant source of CO in Ireland appears to be from motor vehicle exhausts and the burners/boiler/solid fuel heating single residences and industrial units. The measured concentrations of CO at all monitoring locations are within the Irish and EU Ambient Air Standards. EPA monitoring locations are an average 95% lower than currently established Irish and European ambient air regulatory levels for annual 8 hour averages.

Consent of copyright owner required for any other use. For inspection purposes only.

6.2.2.5 Particulate Matter (PM_{10} & $PM_{2.5}$)

Major sources of particulates include industrial/residential combustion and processing, energy generation, vehicular emissions and construction projects. The particulate matter created by these processes is responsible for many adverse environmental conditions including reduced visibility, contamination and soiling, but also recognised as a contributory factor to many respiratory medical conditions such as asthma, bronchitis and lung cancer. $PM_{10, 2.5}$ (Particulate Matter 10 and 2.5) refers to particulate matter with an aerodynamically diameter of 10 and 2.50 μm. Generally, such particulate matter remains in the air due to low deposition rates. It is the main particulate matter of concern in Europe and has existing air quality limits.

In order to obtain a baseline PM_{10} for the proposed work area, a PM_{10} analyser was used to monitor the PM_{10} ambient concentration levels at one location (PM10) within the vicinity of the existing tailings pond. Continuous monitoring was performed over the period 2010 to 2015. The monitoring location is presented in Figure 6.1 and Table 6.4 & 6.5. In addition to the onsite monitoring data, EPA baseline data was also used for comparison to compare pollutant trends in general with the sample area. Results are presented in Table 6.10.

The dominant source of PM_{10} in Ireland appears to be from motor vehicle exhausts and the burners/boiler/solid fuel heating single residences, industrial and farming activities. The measured concentrations of PM_{10} at all baseline EPA monitoring locations are within the Irish and EU Ambient Air Standards. EPA

EPA Export 06-01-2017:02:02:12

monitoring locations are an average 56% lower than currently established Irish and European ambient air regulatory levels for 24 hour annual mean values of PM_{10}.

The dominant source of $PM_{2.5}$ in Ireland appears to be from motor vehicle exhausts and the burners/boiler/solid fuel heating single residences, industrial and farming activities. The measured concentrations of $PM_{2.5}$ at all baseline EPA monitoring locations are within the Irish and EU Ambient Air Standards. EPA monitoring locations are an average 52% lower than currently established Irish and European ambient air regulatory levels for 24 hour annual mean values of $PM_{2.5}$.

For onsite monitoring at location PM_{10}, which is due north of the existing Stage 5 facility and located within the proposed Stage 6 extension area, PM_{10} values have been at normal background levels. Measured Annual average concentrations over the time period 2010 to 2015 ranged from 11 to 20 µg/m^3. This is approximately 60% within the annual PM_{10} limit value of 50 µg/m^3. There have been no exceedence above 50 µg/m^3 over the measurement period 2010 to 2015.

Table 6.10 Average ambient PM_{10} concentrations in the vicinity of the existing Randalstown facility and at EPA Monitoring Locations and $PM_{2.5}$ at EPA monitoring stations Zone D

For inspection purposes only. Consent of copyright owner required for any other use.

Monitoring location	Ambient PM_{10} conc. (µg/m^3)
EPA Monitoring stations Zone D Kilkitt – 24 hourly annual mean value	9
EPA Monitoring stations Zone D Enniscorthy – 24 hourly annual mean value	22
EPA Monitoring stations Zone D Claremorris – 24 hourly annual mean value	10
EPA Monitoring stations Zone D Castlebar – 24 hourly annual mean value	12
EPA Monitoring stations Zone D Claremorris – 24 hourly annual mean value PM2.5	5
EPA Monitoring stations Zone D Longford – 24 hourly annual mean value PM2.5	13
PM10 - Annual average (Period 2010)	17
PM10 - Annual average (Period 2011)	15
PM10 - Annual average (Period 2012)	11
PM10 - Annual average (Period 2013)	14
PM10 - Annual average (Period 2014)	19
PM10 - Annual average (Period 2015)	20
Limit Value PM_{10} annual average	**50**
Limit Value $PM_{2.5}$ annual average	**25**

EPA Export 06-01-2017:02:02:12

6.2.2.6 Dust Monitoring

For dust monitoring, samples collected (depending on sampling technique) are subjected to analysis for ambient air concentration, total deposition, zinc, lead, nickel and cadmium. The results of this monitoring programme are submitted routinely to the Environmental Protection Agency and Meath County Council. Such compounds also have stipulated limit value within the existing EPA IE licence PO516-03.

Each of the monitoring techniques utilised measures a slightly different aspect of particulate emission, dispersal and deposition. Deposition, as measured by Bergerhoff type gauges is usually greatest during wet calm weather because wash out of material from the atmosphere adds to the normal fall out of coarse particulate matter. Dust flux, as measured by directional gauges, and total suspended particulates, as measured by high volume samplers, however, tend to be at a maximum during dry windy weather. Consequently, there is not generally a good correlation between dust deposition rate, flux and atmospheric dust concentration.

For inspection purposes only.
Consent of copyright owner required for any other use.

Total Depositional Dust

The results of Total dust deposition monitoring at seven locations in the vicinity of the existing facility over the time period 2010 to 2015 are presented in Table 6.11. Monitoring was performed using Bergerhoff gauges specified in the German Engineering Institute VDI 2119 entitled "Measurement of Dustfall Using the Bergerhoff Instrument (Standard Method)." The purpose of these monitors is to assess the total depositional dust impact in the vicinity of the existing facility.

Dust emitted from near-surface sources (as opposed to that emitted from stacks) rarely extends beyond 250 to 500 m from the point of release. The monitoring gauges are mostly located within or close to the perimeter fence of the Tailings Facility and total deposition rates would be expected to decline dramatically with distance away from the facility.

Currently in Ireland, there are no statutory limits for dust deposition, however, EPA guidance suggest, "a soiling of 350mg/m^2/day is generally considered to pose a soiling nuisance". This value was not exceeded at any of the sample locations with all measured values at least 65% lower than the maximum recommended limit value for nuisance dust.

Total particulate deposition at the tailings facility, recorded using the Bergerhoff gauges (refer to Table 6.11), is highly variable, as expected, ranging from between 27 and 121 mg/m^2/day expressed as an annual average based on monthly monitoring over the period 2010 to 2015. These deposition rates are typical of rural areas in Ireland, and compare well with a monitoring exercise undertaken at greenfield locations for the proposed Lisheen zinc/lead mine in Co. Tipperary (average daily total deposition 45 - 607 mg/m^2/day, recorded

EPA Export 06-01-2017:02:02:12

using "Frisbee gauges") and with the range of monthly values recorded for rural environments in the U.K. (average daily total deposition 8 - 201 mg/m^2/day) (quoted in N.J. Coppin & Montgomery, Dust -Understanding the Solutions. Quarry Management, March 1996).

Over the time period 2010 to 2015 (6 year time period), there have been 0 incidences of total depositional dust exceedence in the vicinity of the facility:

Table 6.11 Total depositional dust levels at each monitoring location in the vicinity of the existing tailings facility

Year	Conc. Range (AA)	Location DB4 [1]	Location DB5 [1]	Location DB6 [1]	Location DB7 [1]	Location DB28 [1]	Location DB37 [1]	Location DB42 [1]
2010	AA	77	36	74	61	60	41	32
2011	AA	55	29	55	45	44	71	47
2012	AA	58	41	51	47	69	96	43
2013	AA	93	27	44	55	55	57	67
2014	AA	121	38	49	54	67	67	79
2015	AA	57	48	52	82	50	76	72
Limit Value	**-**	**350**	**350**	**350**	**350**	**350**	**350**	**350**

Note
AA – Annual average

For inspection purposes only.
Consent of copyright owner required for any other use.

High Volume Particle Sampling

The results of the High Volume Sampling performed at three locations in the vicinity of the existing facility over the time period 2012 to 2015 are presented in Table 6.12. High volume particle sampling was performed in accordance with the requirements of the Air Quality Standards Regulations SI 244 of 1987 and in accordance with the requirements of the Directive (99/30/EC).

SI58 of 2009 limit values and IE Licence limit values as specified in IE Licence PO516-03 for specified metals are listed in *Table 6.2 and 6.3*.

The results of the High Volume Sampler monitoring at three locations around the existing Randalstown Tailing facility for the time period 2012 to 2015 indicate that the current levels of suspended particles are low and well within the IE licence limit value, Danish EPA (80µg/m^3) and the NAOSH guideline (100µg/m^3) (*see Table 6.2, 6.3 and 6.13*).

[1] All Data expressed as mg/m^2/day

EPA Export 06-01-2017:02:02:12

Table 6.12 Ambient air dust concentration levels at each monitoring location in the vicinity of the existing facility

Location	Year	Measurement range	Total solids (µg/m³)	Zinc (µg/m³)	Lead (µg/m³)	Cadmium (µg/m³)	Arsenic (µg/m³)	Nickel (µg/m³)
EPA Zone D Kilkitt	2014	AA	-	-	0.0014	0.00020	0.00030	0.00060
EPA Zone D Castlebar	2014	AA	-	-	0.0015	0.00020	0.00030	0.00080
DA1	2012	AA	14	<0.10	<0.010	<0.010	<0.010	<0.010
	2013	AA	11	<0.10	<0.010	<0.010	<0.010	<0.010
	2014	AA	10	<0.10	<0.010	<0.0050	<0.0060	<0.010
	2015	AA	13	<0.10	<0.010	<0.0050	<0.0060	<0.010
DA6	2012	AA	12	<0.10	<0.010	<0.010	<0.010	<0.010
	2013	AA	11	<0.10	<0.010	<0.010	<0.010	<0.010
	2014	AA	14	<0.10	<0.010	<0.0050	<0.0060	<0.010
	2015	AA	11	<0.10	<0.010	<0.0050	<0.0060	<0.010
DA7	2012	AA	10	<0.10	<0.010	<0.010	<0.010	<0.010
	2013	AA	8	<0.10	<0.010	<0.010	<0.010	<0.010
	2014	AA	7	<0.10	<0.010	<0.0050	<0.0060	<0.010
	2015	AA	7	<0.10	<0.010	<0.0050	<0.0060	<0.010
Limit values SI 58 of 2009	-	AA	-	-	<0.50	<0.0050	<0.0060	-
EPA IE licence P0 516-03	-		40	<1.0	0.50	<0.0050	<0.0060	-

For inspection purposes only. Consent of copyright owner required for any other use.

The data also indicates that, between 2012 and 2015 concentrations of Zinc, Cadmium, Arsenic and Nickel in air ranged from less than <0.0050 to less than 0.10 µg/m³ which is within the guideline limit values published in the IE licence PO516-03, SI58 of 2009, World Health Organisation (WHO), the Danish EPA and NAOSH documents. The recorded lead concentrations also demonstrate compliance with the WHO guideline level of 0.50 to 1.0 µg/m³ for lead in air and the limit of 2 µg/m³ lead in air imposed in BTML licence. The levels of zinc were approximately 0.10 µg/m³.
There are no apparent ambient air guideline values for zinc although the levels detected over the monitoring period 2012 to 2015 were not significant in concentration.

EPA Export 06-01-2017:02:02:12

6.4 POTENTIAL IMPACTS OF THE PROPOSAL

6.4.1 Construction Phase

There is the potential for a number of emissions to atmosphere during the construction of the facility with wind blown dust being most significant. Wind blown dust emissions may arise during the construction phase of the proposed facility, which may impact upon the surrounding environment. The deposition of dust and mud on the local roads is both unsightly and dangerous. Dust may be a particular problem during periods of dry windy weather. There is no anticipated impact from dust emissions when the development has been constructed.

Potential sources of dust from construction and operation include the following:

- The working of the borrow areas,
- The transport of material including vehicles carrying dust on their wheels,
- Un-vegetated stockpiles of construction materials,
- The handling of construction materials for the construction phase of development,
- Construction of the raise.

The construction vehicles, generators, etc., will also give rise to petrol and diesel exhaust emissions, although this is of minor significance compared to dust.

Consent of copyright owner required for any other use. For inspection purposes only.

Construction activities such as demolition, excavation, earth moving and backfilling can generate dust, particularly in dry weather conditions. The extent of dust generation is dependent on the nature of the material (soils, peat, sands, gravels, silts etc.) and the location of the construction activity. In addition, the potential for dust dispersion depends on the local meteorological factors such as rainfall, wind speed and wind direction. Vehicles transporting material to and from the site also have the potential to cause dust generation along the selected haul routes.

Table 6.13 presents the distances within which dust could be expected to result in a nuisance from construction sites for impacts such as soiling (dust nuisance), PM_{10} deposition and vegetation effects. This data has been taken from the National Roads Authority (NRA) *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* and is considered a worst case assessment. These distances present the potential for dust impact with standard mitigation in place.

EPA Export 06-01-2017:02:02:12

Detail of proposed mitigation measures to be implemented as part of the construction phase of the project are presented under the Construction Phase Mitigation section of this report.

Table 6.13 Assessment criteria for the impact of dust from construction, with standard mitigation in place

Source		**Potential distance for significant effects (distance from source)**		
Scale	**Description**	**Soiling**	**PM_{10}**	**Vegetation effects**
Major	Large construction sites with high use of haul roads	100m	25m	25m
Moderate	Moderate sized construction sites with moderate use of haul roads	50m	15m	15m
Minor	Minor construction sites with minor use of haul roads	25m	10m	10m

Source: National Roads Authority, 2006.

The construction phase of this proposal is deemed for the purposes of this assessment to be of a Major scale. Using this screening assessment tool, at a major construction site there is a risk that dust may cause an impact at sensitive receptors within 100m of the source of the dust generated. The nearest residential sensitive receptors to the centre of the subject site is located at a distance of over 100m from the application boundary, therefore, the impact from construction activities can be considered to be imperceptible.

For inspection purposes only. Consent of copyright owner required for any other use.

All sensitive habitats are located at a distance greater than 25m from the emission source as a result the impact on habitats will be imperceptible.

At any one location within the borrow areas, operations and resultant impacts will be only temporary. The dust generated will not contain elevated levels of trace metals and the impact is unlikely to extend far beyond the boundary of the borrow areas.

A Construction Environmental Management Plan (CEMP) incorporating dust mitigation measures will further reduce any impacts significantly and this will be implemented as part of the proposed development.

6.4.1.1 Traffic Emissions

Emissions associated with construction traffic can impact on local air quality. In particular, the proposed routes used for deliveries and any sensitive receptors that line these routes may experience impacts to local air quality.

The potential impact of construction traffic associated with this proposal was estimated as a worst case Annual Average Daily Traffic (AADT) scenario of 400

EPA Export 06-01-2017:02:02:12

(which is approximately 10 times the expected peak AADT so as to assume worst case potential impact) with a mean traffic speed of 20km/hr. The detailed results of the modelling exercise are presented in Table 6.14.

Table 6.14 Predicted contribution of air pollutants to baseline air quality as a result of construction traffic.

Link location	Carbon monoxide Annual mean (µg/m³)	Benzene Annual mean (µg/m³)	Oxides of nitrogen Annual mean (µg/m³)	Particulate matter 10µm	
				Annual mean (µg/m³)	Days > 50 (µg/m³)
Worst case receptor 5m from road centreline on any roadway	<0.06	<0.06	<0.88	<0.16	0

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

6.4.2 Operation Phase

6.4.2.1 Scheduled Emissions

Regarding operations at the proposed development, the only potential emissions will be from dust emissions from the exposed surface areas of tailings. The following mitigation measures are in place and will minimise associated impacts with the operation of the tailings facility.

- An extensive and flexible sprinkler system.
- Backup attachments for sprinkler system to facilitate fire hoses
- A CCTV system in operation which allows continuous 24 hour manned surveillance from the Mill Central Control Room.
- Availability of a trained mine rescue team on a 24 hour call out basis
- Rehabilitation trials to vegetate areas more susceptible to dust blow.
- Application where necessary with suitable dust binding additives to minimise dust blow.

6.4.2.2 Climate

For inspection purposes only.
Consent of copyright owner required for any other use.

The assessment methodology of the existing climatic environment involved a desk-based review of literature including the EU 'Energy and Climate' Package, Energy Policy Framework 2007-2020 (and Review) and Climate Action & Low Carbon Development Bill 2015.

Please refer to Chapters 3 and 9 for description of the surrounding environment.

The prevailing wind direction at the application area is from the southwest as presented in the wind rose for Dublin Airport (2002-2008) in Plate 6.1. Northerly and easterly winds tend to be very infrequent. Wind characteristics vary between a moderate breeze to gales (average 8.20 days with gales per annum). Monthly average wind speeds range between 8.60 and 12.50 knots with highest wind speeds occurring during winter and spring months (January, February and March). Lowest wind speeds were recorded in the June to August period.

Poor dispersion can occur under certain weather characteristics known as inversions that form in very light or calm wind and stable atmospheric conditions. The wind roses presented in Plate 6.1 identifies that such wind conditions are very infrequent (0.50% of hours in the years 2002 to 2008 inclusive).

EPA Export 06-01-2017:02:02:12

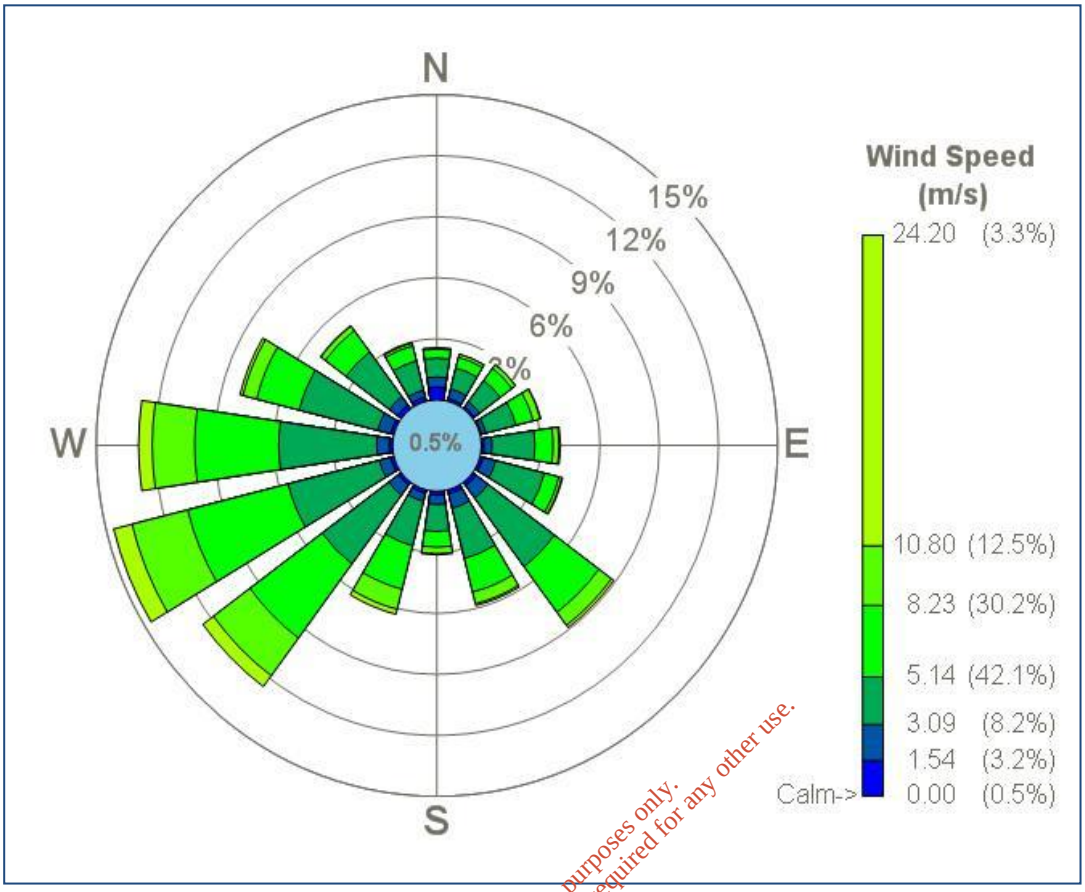


Plate 6.1 Dublin Airport Windrose 2002-2008 inclusive[13]

For inspection purposes only.
Consent of copyright owner required for any other use.

The nearest meteorological station to the application area with long term averages is the Met Éireann Station at Dublin Airport which lies approximately 50 km southeast of the subject site. The weather in the area is influenced by the Irish Sea, resulting in mild, moist weather dominated by cool temperate oceanic air masses. The prevailing wind direction in Ireland is from a quadrant centred on the southwest. These are relatively warm winds and frequently bring rain. Easterly winds are weaker and less frequent and tend to bring cooler weather from the northeast in spring and warmer weather from the southeast in summer. The 30-year averages from the station at Dublin Airport are presented in Table 6.15.

[13] Source: www.met.ie

EPA Export 06-01-2017:02:02:12

Table 6.15 30-year Average Meteorological Data from Dublin Airport (1981-2010)

Parameter	30 yr Average (1981 to 2010)
Mean temperature (^{0}C)	13.30
Mean relative humidity at 0900UTC (%)	83
Mean daily sunshine hours (Hrs)	3.90
Mean Annual total rainfall (mm)	758
Mean wind speed (Knots)	10.30

Source: www.met.ie

Effects of Climate Change in Ireland

The potential effects of climate change on a global scale have been investigated by the Intergovernmental Panel on Climate Change (IPCC). The resulting impacts in Ireland are outlined in the EU 'Energy and Climate' Package, Energy Policy Framework 2007-2020 (and Review) and Climate Action & Low Carbon Development Bill 2015 and include the following:

- Significant increases in winter rainfall, in the order of 10% in the southeast, with a corresponding increase in the water levels in rivers, lakes and soils. Flooding will be more frequent than experienced at present.
- Lower summer rainfall, in the order of 10% in the southern half of the country. Less recharge of reservoirs in the summer leading to more regular and prolonged water shortages than at present.
- An overall annual decrease in rainfall in the east of the country and a resultant decrease in baseline river flows.
- Increased agricultural production, with new crops becoming more viable and potentially reduced agricultural costs. Grass growth could enjoy beneficial effects with an increase of 20% possible with higher temperatures and changes in rainfall patterns.

Consent of copyright owner required for any other use. For inspection purposes only.

A paper entitled *Establishing Reference Climate Change Scenarios for Ireland* (Sweeney & Fealy, 2003) identified future climate change scenarios for Ireland. This paper predicts that the average annual temperature in Ireland will increase by 1.5°C by the 2050's with an average increase in summer temperature of 2°C. These temperature increases are predicted to be accompanied by alterations in precipitation levels. The authors estimate an 11% increase in precipitation levels during the winter periods, whilst a more significant increase in precipitation levels during the summer periods were predicted i.e. 25% by the 2070's.

It is important to note that considerable uncertainty is encountered when attempting to predict future climate scenarios. This uncertainty arises due to the difficulties associated with determining future demographic changes, economic development, technological advancement and future emissions of greenhouse gases to the atmosphere. Further difficulty is associated with the complexity of the climatic system and uncertainty surrounding these processes.

EPA Export 06-01-2017:02:02:12

It is recognised that Ireland cannot, on its own, prevent or ameliorate the impacts of climate change. However, the National Climate Change Strategy 2007-2012 stated that Ireland must meet its responsibilities with regard to reducing CO_2 emissions in partnership with the EU and the global community.

There is a potential for impacts to climate as a result of any development that requires fuel and energy. These impacts are the generation of greenhouse gas emissions (principally carbon dioxide and oxides of nitrogen) from traffic and electrical supply.

6.4.3 "Do-nothing" Scenario

The baseline survey results suggest that air quality in the vicinity of the existing facility and proposed development is good and shows typical levels for an urban area with all pollutants within the relevant Irish and EU limits. If the proposed development were not to take place, the current air pollutant concentrations will remain unchanged. In relation to dust, non-development of the site would result in no movement of soils/sands and no construction activity and therefore no dust creation as a result of construction works.

In addition "Do nothing" scenario would entail constraining the life of the mine to a level which can be accommodated within the existing capacity of the Randalstown Tailings Facility. In practice the consequence of this would be the premature closure of the mining operation in 2013. Whilst some of the potential local environmental impacts, associated primarily with construction activity, would be reduced under a "do-nothing" option, premature closure of the mine would also be associated with the following:

- An inefficient utilisation of natural resources.
- The loss of a significant economic benefit to the local and national economy.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:12

6.5 Remedial or Reductive Measures

6.5.1 Construction Phase

Construction activities are likely to generate some dust emissions. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed and wind direction. In order to ensure that no dust nuisance occurs, a series of measures will be implemented.

- Site roads shall be regularly cleaned (water bowser) and maintained as appropriate.
- Hard surface roads shall be swept to remove mud and aggregate materials from their surface. Any un-surfaced roads shall be restricted to essential site traffic only. Furthermore, any road that has the potential to give rise to fugitive dust may be regularly watered, as appropriate, during extended dry and/or windy conditions.
- Vehicles using site roads shall have their speed restricted, and this speed restriction must be enforced rigidly. Site management dictates speed shall be restricted to 15 km per hour.
- Any vehicles exiting the site shall make use of a wheel wash facility, prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads.
- Public roads outside the site shall be regularly inspected for cleanliness and cleaned as necessary. Aggregates, fine sized material with dust potential will be delivered in covered trucks.
- Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind. The double handling of material will be avoided where possible and drop heights will be minimised during material loading and unloading.
- A dry tailings surface is vulnerable to dust blow when disturbed. An extensive and flexible sprinkler system will be used as required if particularly dusty activities are necessary during dry or windy periods. Temporary stockpiles of filter sand will be covered. In addition where deemed necessary, binding agents will be applied to the surface of material to prevent wind dust blow.
- Diesel engines or plant machinery and trucks shall be properly maintained so that they do not discharge excessive quantities of visible smoke likely to result in a local nuisance.
- A full traffic and dust management plan will be implemented into the Construction Environmental Management Plan (CEMP) in order to minimise such emission as a result of the construction phase of the facility development. This will be generated specifically for the development when detailed design is completed. The UK British Research Establishment (BRE) document "Control of Dust from Construction and Demolition Activities" (Feb 2003) is a best practice guidance document

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:12

for such plans. This document will be used as the basis for any construction dust minimisation plan.

- The dust management plan will be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures to minimise dust emissions.

6.5.2 Operation Phase

It is not anticipated that dust will be a significant problem during the operation (as is the current situation) of the facility as a result of the absence of scheduled emission points and through the implementation of dust management and mitigation techniques where required.

The principal factors that influence the potential for dust generation include:

- The particle size distribution within the deposited tailings
- The moisture content of the tailings
- Exposure to wind
- The presence of a vegetation cover once tailings deposition has ceased.

Consent of copyright owner required for any other use. For inspection purposes only.

The proportion of clay (particles less than 2 µm in diameter) is critical because as little as 5% clay in a homogenous mixture can have a significant effect on the cohesiveness of the tailings as they begin to dry. The clay fraction in tailings at Tara is variable but generally lies in the range of 9 to 17%. It therefore has a significant influence in binding coarser material to the surface and, at the same time, enhances the water holding capacity of the tailings. Tailings that are wet will not give rise to dust blow but as the tailings surface dries a threshold is reached at which wind erosion begins. Experiments have shown that for a sand/silt mixture exposed to a strong breeze (Force 6 or 32 mph) the threshold water content to prevent erosion lies between 4 and 13% depending on the actual proportion of sand and silt in the material. Experience at BTML is that it can take 2 to 6 months for the water content of the deposited tailings to fall to 25% and therefore the potential for excessive dust blow is limited (Ricks & Moynan, 1992).

The Stage 6 raise will increase the overall size of the tailings dam. It is known that wind speed increases with increasing height above the land or sea due to a reduction in frictional forces exerted by the surface. The zone of frictional influence extends to an altitude of approximately 1 kilometer although variations in wind speed are most marked near to the surface. Nevertheless, an increase in tailings pond height of 4 to 6 meters relative to the surrounding land level would have a very small effect on wind speed across the tailings pond surface. Furthermore, the surface of the tailings dam is large enough to exert frictional forces in its own right and this will further diminish the wind gradient effect. Outward extension of the tailings dam will increase the exposure of the tailings surface to wind but it should be noted that Stage 5 will be partially

EPA Export 06-01-2017:02:02:12

decommissioned up to 70% within 2 years of stage 6 commencing. This is important fact in terms of cumulative emissions. Therefore there would be an overall increase in the potential for higher dust levels downwind of the facility albeit marginal.

Under current operational practice, dust control on the tailings surface is achieved by a combination of techniques including:

- Controlled tailings deposition and maintenance of adequate moisture content in the deposited tailings.
- The use of extensive and flexible sprinkler system on exposed areas of tailings as required within the operational part of the Tailings Facility (Stage 5)
- The rapid establishment of a temporary vegetation cover on the surface of non-operational parts of the Tailings Facility.
- The controlled dewatering of the tailings to ensure that a minimum area of tailings beaches is exposed.

For inspection purposes only.
Consent of copyright owner required for any other use.

Potential impacts during operation and post-closure are confined to the emission of dust from tailings surfaces. Monitoring data obtained during the operation of Stages 1,2,3, 4 and 5 together with experience gained elsewhere, indicate that a well-managed tailings storage facility does not normally generate significant amounts of dust.

It is envisaged that the proposed facility development will not have a significant impact on the surrounding air quality. However, as discussed previously a number of mitigation measures have been suggested. Moreover, specific dust monitoring could be carried out during the construction phase of the development if deemed necessary by the planning authority. If the level of dust is found to exceed regulatory guidelines in the vicinity of the site, further mitigation measures will be incorporated into the construction and operation of the proposed development.

6.5.3 Climate

Road traffic and power usage would be expected to be the dominant sources of greenhouse gas emissions as a result of the proposed facility development. Vehicles during construction and power used during operation of the facility will give rise to CO_2 and N_2O emissions as a result of the proposed development.

Emissions of Oxides of nitrogen, Sulphur dioxide, Carbon monoxide and Carbon dioxide will be mitigated by using efficient construction vehicles, appropriate scheduling of construction activities to minimise duration, the shutting off of equipment during periods of inactivity if they do occur, and a transport

EPA Export 06-01-2017:02:02:12

management plan as part of the CEMP as described above. No additional mitigation measures are considered necessary.

6.6 Predicted residual impacts of the development

6.6.1 Construction Phase

The effect of construction of the facility on air quality will not be significant following the implementation of the proposed mitigation measures. The main environmental nuisance associated with construction and operation activities is dust. Nevertheless, the trace metal content of the tailings is such that without adequate control of the moisture content, a minor impact may be experienced.

However, it is proposed to adhere to good working practices and dust mitigation measures to ensure that the levels of dust generated will be minimal and are unlikely to cause an environmental nuisance. A series of such good working practices and mitigation measures are outlined earlier in this section.

For inspection purposes only.
Consent of copyright owner required for any other use.

6.6.2 Operation Phase

The overall effect of raising the level of the tailings facility and at the same time reducing its surface area is difficult to model but the expectation is that the rate of deposition within the existing zone of deposition will reduce and the total rate of dust release from the surface will be virtually unchanged. The impact, therefore, will be insignificant as is the case with the existing Tailings Facility.

Current good tailings management practice as adopted by Tara Mines will be continued. This will include:

- The maintenance of adequate moisture content on exposed tailings beaches using sprinkler system where necessary.
- The rapid establishment of a temporary vegetation cover on tailings after the cessation of operations.
- The application of suitable binding agents to the tailings surface to minimise the effects of wind erosion on the surface.

6.6.3 "Worst Case" Scenario

For dust emissions, the "worst case" scenario consists of the failure to implement dust management and mitigation measures resulting in nuisance conditions downwind of the facility. This will not occur and the currently implemented high level dust management and mitigation procedures will be maintained at the existing and proposed facility operations.

EPA Export 06-01-2017:02:02:12

6.6.4 Decommissioning

(BTML) have prepared this Closure Reclamation and Aftercare Management Plan (CRAMP) in accordance with Condition 10.2.1 of its industrial Emissions Licence, P0 516-01, to facilitate meeting the financial provision requirements under Condition 12.3.1 and to ensure compliance with Regulation 14 and 21 of SI No. 566 of 2009 Waste Management (Management of Waste From the Extractive Industries) Regulations.

It is proposed to install an inert soil cap cover over the tailings facility; the purpose of which is to

- Provide a productive land asset that could be used for agriculture; managed sheep farming and/or wildlife conservation purposes;
- Minimise the possibility of long term exposure of tailings and therefore tailings dusting;
- Minimise contaminant runoff from the surface;
- Reduce the migration of contaminants upwards to the surface and;
- Reduce the time frame between the post closure active phase, passive phase and finally the stable phase.

Consent of copyright owner required for any other use. For inspection purposes only.

It is envisaged that the decommissioning and restoration of the existing tailing facility will be undertaken on a phased basis in advance of the permanent cessation of mining activity in Navan.

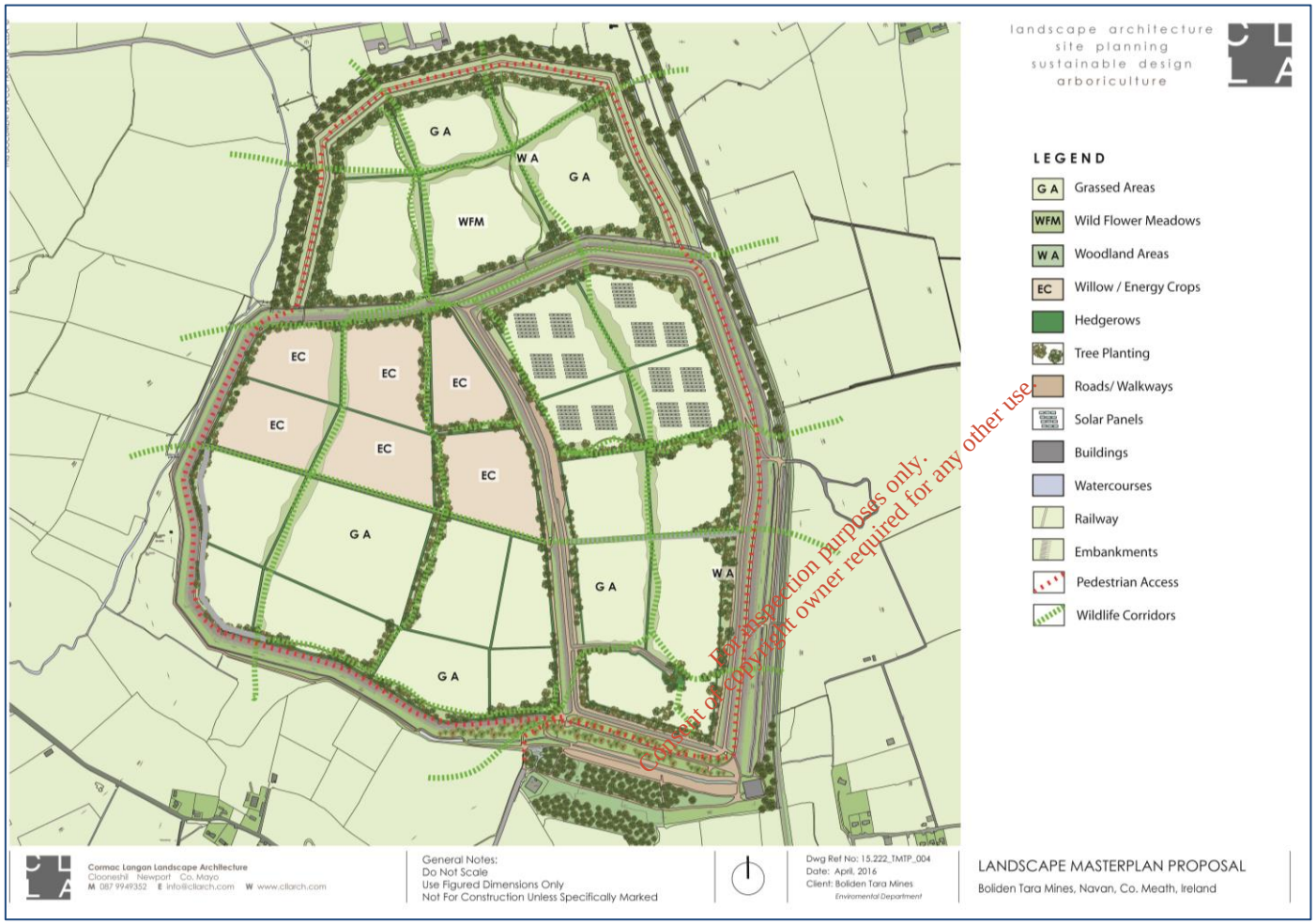
Stage 5A will reach it final storage capacity in 2016. After a defined period, to allow for consolidation and settlement, the first phase of the capping process will begin.

It is envisage that by the time the proposed Stage 6 is constructed and fully operational a significant portion of the existing tailings surface will be rehabilitated.

Figure 6.3 indicates what the tailings facility will look like post decommissioning.

One of the principle objectives of the permanent soil cap is the removal of the risk of wind-blown erosion of the tailings surface.

EPA Export 06-01-2017:02:02:12



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 6.3 Landscape plan for the tailing facility; including the proposed stage 6 extension.

EPA Export 06-01-2017:02:02:12

6.7 Monitoring

6.7.1 Construction Phase

It is envisaged that the proposed facility development will not have a significant impact on the surrounding air quality. However, as discussed previously a number of dust mitigation measures have been suggested. If the level of dust is found to exceed 350mg/m^{2}day in the vicinity of the site, further mitigation measures will be incorporated into the construction of the proposed site.

The current programme of dust monitoring around the tailings facility will be continued.

6.7.2 Operational Phase

The current programme of dust monitoring around the tailings dam will be continued.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

Section 7 Roads and Traffic

7.1 Introduction

TOBIN Consulting Engineers Ltd. has been appointed by Boliden Tara Mines Limited (BTML) to carry out a Traffic Impact Assessment (TIA) as part of the Environmental Impact Assessment for the Randalstown Tailings Management Facility Stage 6 Dam extension near Navan, Co. Meath. This traffic assessment focuses on the construction stage of the Tailings Management Facility (TMF) extension as the operational phase will not generate significant traffic.

In preparing this report, TOBIN Consulting Engineers has made reference to

- The NRA 'Traffic and Transport Assessment Guidelines, May 2014'
- The NRA 'Future Traffic Forecasts 2002 to 2040'
- NRA DMRB TD 41-42/11;
- NRA DMRB TD 9/12;
- NRA DMRB TD 16/09;
- RT180 Geometric Design Guidelines;
- DoT's Traffic Signs Manual.

For inspection purposes only.
Consent of copyright owner required for any other use.

7.1.1 Objectives

The objective is to assess the impact the proposed development will have on the existing road network during the construction period of the proposed facility.

This report determines the expected volume of vehicles that will be generated by the proposed development and assesses the impact that these vehicles will have on the operational capacity of the road network in the vicinity of the development. In this case the junctions assessed are:

- The priority junction between the L74141 and the private access road leading to the tailings management facility;
- The crossroads between the R163, the L74141 Local Road and a minor private laneway;
- The staggered crossroads between the R163 and the R162 (Kilberry Cross);
- The roundabout connecting a link to the N3, the N51 and the R163 ('The Round O').

This report also considers the safety directly related to construction traffic that this development will have on the surrounding environment.

EPA Export 06-01-2017:02:02:12

7.1.2 Report Structure

This report is divided into seven Sections:

- Section 7.1 includes this introduction;
- Section 7.2 describes the proposed development, and its location.
- Section 7.3 provides an overview of the existing and proposed traffic conditions, explaining how this information was obtained.
    - Section 7.3.4 outlines the assumptions that have been made in the calculation of traffic generated by the development and the factors used to forecast the future road network traffic.
    - Section 7.3.5 explains the methodology used and the results of the analysis performed on the proposed site access junction. An investigation into link capacity is also dealt with in this Section.
- Section 7.4 addresses potential impacts associated with traffic
- Section 7.5 concludes the report.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

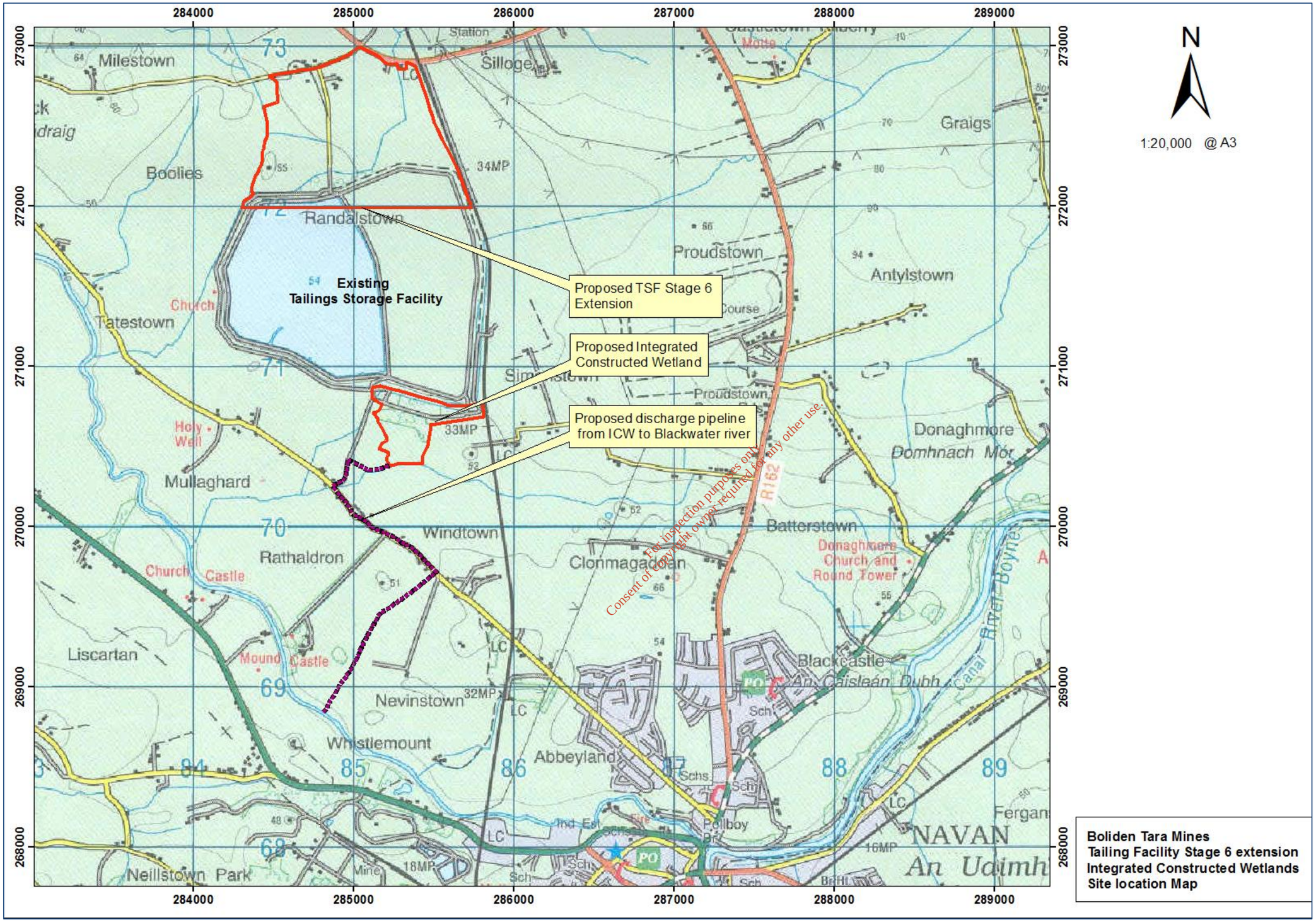


Figure 7.1 Site location map

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:12

7.2 Proposed development

7.2.1 Site Location

The Randalstown Tailings Management Facility is located approximately 3km to the northwest of Navan, Co. Meath. Access to the facility is via an access road that connects with the L74141 local road. Figure 7.2 shown below illustrates the location of the proposed development.

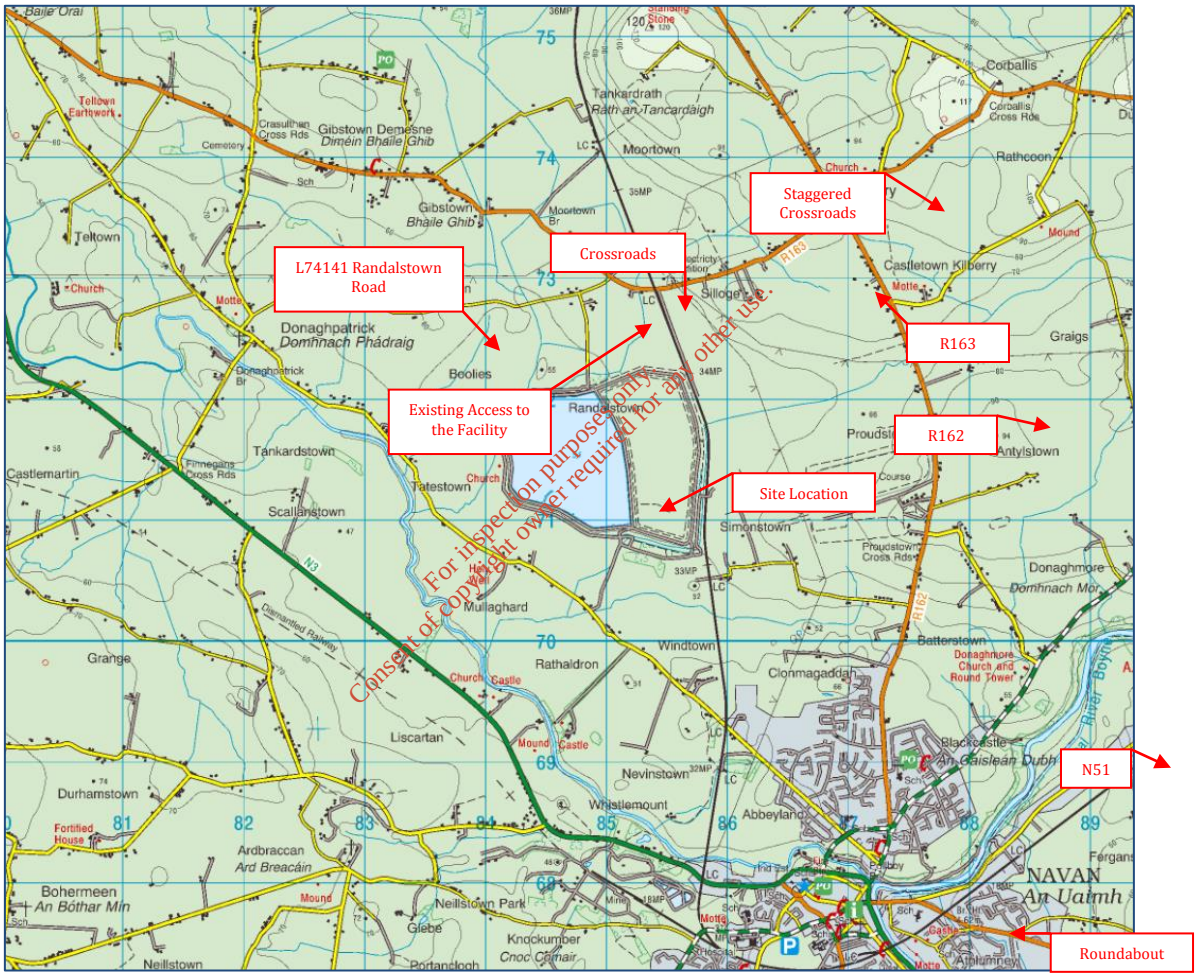


Figure 7.2 - Site Location and road network

EPA Export 06-01-2017:02:02:12

7.2.2 Existing and Proposed development

Boliden Tara Mines Limited operates one of Europe's largest zinc lead mines at Knockumber, 2 km west of Navan in County Meath. After target minerals have been extracted in the processing plant the tailings stream is cycloned to separate the coarse sand fraction from the finer slimes fraction. The coarse fraction of tailings is pumped, to the underground mined out areas. In so doing, approximately 50% of the tailings are used underground to backfill mined voids. The tailings used for backfilling is stabilised, chemically and physically, by mixing with Portland cement.

The remaining fines fraction tailings is pumped as an aqueous slime to the Tailings Storage Facility (TSF) located some 2.5 km north of the processing plant in the townland of Randalstown. On an annual basis approximately 1.1 million tonnes of tailings are deposited for permanent storage in the TSF.

Since its inception the tailings facility has been constructed and operated in seven stages, Stages 1, 2, 3 (lateral extensions) and the more recent Stage 4A, 4B, 5A and 5B (upstream vertical extensions), using combinations of temporary and permanent embankment walls.
The existing TSF, enclosing a footprint area of approximately 171 ha, serves as containment for tailings to settle and consolidate, as well as a storage area for water that is circulated back to the processing plant at Knockumber for reuse in the processing plant or for eventual discharge to the *River Boyne*.

Consent of copyright owner required for any other use. For inspection purposes only.

- **It is proposed to extend the existing TSF laterally in a northerly direction.**
    - **Here after the proposed facility will be referred to as *TSF Stage 6*.**
    - **The proposal facility will cover an area of c. 58 hectares, extend to a height of 22 m above ground level and will provide a potential a storage volume of approximately 9.6 million cubic metres [13.6 million tonnes].**

- **The second part of the proposed development is the construction of an Integrated Constructed wetland (ICW). The function of the wetland is to provide a passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle.**

The proposed Stage 6 development will be located along the northern part of the site. The proposed facility potentially provides for a struck storage volume of 940,000m^3. The development would cater for a possible 10 years storage based on current production rates and projections.

A planning search was carried out which revealed some committed development in the area. These other developments, however, are limited to one of housing type developments. These developments are considered to be accounted for in the yearly growth figures.

EPA Export 06-01-2017:02:02:12

7.3 Existing and proposed traffic conditions

7.3.1 Traffic Survey

In order to determine the magnitude of the existing traffic flows, TOBIN used the results of Manual Classified Traffic Surveys that were carried out by Abacus Transportation Surveys Ltd. on the 3rd September 2015 at the following locations:
the crossroads between the R163, the L74141 Randalstown Road and a minor road;
the staggered crossroads between the R163 and the R162; and
the roundabout connecting a link to the N3, the N51 and the R163.

These surveys were carried out between the hours of 07.00 to 19.00 and distinguished between cars, buses, light good vehicles and heavy good vehicles (HGV). Details of the results of these surveys are provided in Appendix 7.1 to this report.

In order to calculate the peak flows of traffic using the junctions, it was necessary first to convert the raw traffic survey data, which consisted of cars and heavy vehicles, into a common index known as passenger car units (PCU's). This was undertaken by applying a factor to all surveyed traffic movements to take account of the composition of the different types of vehicle. This factoring calculation assumes 1 bicycle = 0.2 PCU, 1 motorcycle = 0.4 PCU, 1 car / light vehicle = 1 PCU, 1 heavy vehicle = 2.3 PCU's and 1 bus = 2 PCU's.

From the survey results the peak traffic levels through the junctions were calculated. The survey results were also used to calculate the percentage of HGVs that use the junctions. The times of the peak flows and the percentage HGVs are shown in table 7.1 below:

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 7.1 Existing Junction Peak Flows and HGV Percentage

Junction Peak Flows and HGV Percentage					
Junction	**AM Peak Hour**	**AM Peak Hour (pcu)**	**PM Peak Hour**	**PM Peak Hour (pcu)**	**% HGVs**
Junction 1 – Site A : Crossroads between the R163, the L74141 Local Road and a minor road	07:45 – 08:45	153	17.30 – 18.30	187	10.5
Junction 2 – Site B: Staggered crossroads between the R163 and the R162	08.15 – 09.15	691	17.15 – 18.15	504	8.5
Junction 3 – Site C: Roundabout connecting a link to the N3, the N51 and the R163	08.00 – 09.00	1957	17.00 – 18.00	2045	5.4

EPA Export 06-01-2017:02:02:12

7.3.2 Existing Road Network

Access to the development will be by means of a private local road which connects the TMF to the L-74141. The road is subject to a 20km/hr speed limit and has a carriageway width of approximately 6.7m with a grass verge on both sides. The junction between this road and the L-74141 local road is situated on a straight section of road however visibility on the approach to the junction is restricted by vegetation on both sides.

The L-74141 has a carriageway width that varies between approximately 4m and 5m and has grass verge on both sides. The section of this road being used by traffic generated by the TMF is in an 80km/hr zone. This road meets the R163 at a crossroads with a private entrance making up the fourth arm of the junction. Visibility for traffic on the L-74141 at this junction is partially restricted to the right by a vertical crest curve which limits visibility to the right to 120m. Advanced quarry site entrance warning signage is present on the approaches to the existing site entrance to warn motorists of the quarry location.

The R163 is a regional road linking Kells to Slane. This road has a carriageway width of approximately 6m and grass verges on both sides within the section that the traffic from the TMF will use. This road is subject to a speed limit of 80km/hr but this reduces to 60km/hr where the R163 meets the R162 at a staggered crossroads. For the traffic waiting on the R163 at this junction, the required visibility splay of 4.5x90m is achievable.

For inspection purposes only.
Consent of copyright owner required for any other use.

The R162 is a regional road linking Navan to Kingscourt. This road has a carriageway width of approximately 6m along 4km of the section that the traffic from the TMF will use although this width varies somewhat. For the remaining 1.5km leading to the junction with the N51 it widens to approximately 8m. This road is subject to a speed limit of 50km/hr within the 8m wide section and varies between 60km/hr and 80km/hr over the remaining stretch. Forward visibility along the road is adequate to accommodate these speeds. The R162 meets the N51 and a link to the N3 at a 4 arm roundabout.

Thereafter, traffic generated by the TMF is expected to operate on national roads which are designed to accommodate such traffic without producing any additional adverse environmental effects. As such, these are not considered in this report.

EPA Export 06-01-2017:02:02:12

7.3.2.1 Proposed network improvements

Currently, there are no proposed improvements to the road network in the region.

7.3.3 Trip generation and distribution

7.3.3.1 Trip generation

Construction materials will be sourced for a number of potential sources, including:

- On site 'borrow pits'
- Onsite stockpiles
- Third party licenced facilities
- The main mine site at Knockumber (surplus mine rock)

The Stage 6 extension will be implemented in two phases.

- The first phase would be the construction of the Stage 6A wall to an elevation of 59.29 m AOD,
- The second phase would be the construction of the Stage 6B wall to an elevation of 67.29m AOD.

The construction phase will be implemented in a staged approach over three construction years.

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 7.2 - Details of Stage 6 Construction Phases

Details of Stage 6 Construction Phases				
Description	Units	Phase 1 Crest Elevation 59.29 m AOD	Phase 2 Crest Elevation 67.29 m AOD	Total Qty
Total Dam Fill Volumes	m3	529,683	1,173,586	1,703,269
Type A1/A2 Upstream Wall Construction	m3	123,671	110,617	234,288
Type A 2 Downstream Wall Construction	m3	113,658	111,893	225,550
Type B Road Surfacing	m3	4,902	5,056	9,958
Type C Protection Material	m3	52,926	7,426	60,352
Type D1 Drainage	m3	5,000		5,000
Type D2 Dam Footprint Drainage	m3	110,064	98,918	208,982
Random Fill	m3	182,290	852,159	1,034,449
Type E Coarse Drainage	m3	5,000		5,000
Total Construction Volumes	**m3**	**597,511**	**1,186,067**	**1,783,578**

It is envisaged that the proposed extension will be constructed over three consecutive years. Due to the nature of the construction work (i.e. construction using natural materials clay/soil/stone) the construction season will be restricted to the 36 week period March to October of each year.

EPA Export 06-01-2017:02:02:13

It is estimated that c. 1.1 million cubic metres of material will need to be imported to the site to complete the proposed development.

The 1,100,000m^3 of material imported to site will generate heavy vehicular traffic.

It is envisaged pending the successful outcome of the planning process that construction of the proposed Stage 6 extension would commence.

- For the purposed of this traffic assessment it is assumed tah the construction would run over three consecutive years.
- The duration of each year is based on 36 weeks (March to October inc.)

To reduce the impacts that the proposed development may have in terms of construction generated traffic, it is proposed that the deliveries, extraction and stockpiling of materials be undertaken such that generated traffic is evenly distributed over the proposed 3 year construction period, and within the 36 week construction period per year.

The preliminary programme estimates the two-way daily traffic over the proposed stage 6 construction activities and also the volume of materials required for each sub-stage.

For inspection purposes only.
Consent of copyright owner required for any other use.

In order to provide a robust assessment of the construction generated traffic, and provide a realistic assessment of construction related traffic, average generated traffic volumes as outlined in table 7.2 above have been adjusted to account for daily production-hour losses:

- 0.5 hour production in the first AM hour,
- 1 Hour loss of production during lunch hour and
- 0.5 hour production in the last PM hour.

Working on the basis of a working day from 08:00 to 18:00 this give a potential working day of 10 hours minus production-hour losses resulting in 8 hours per day.

This allows for peak site generated traffic to be identified for each of the scenarios outlined above and equates to the following:

- 5.0 day working week, 40 hours per week; and
- 5.0 day working week, 35 hours per week.

In addition to the HGV's generated during the construction stages, approximately 50 employees are expected to be required to carry out the work.

It is been assumed that these employees will all travel to / from the TMF site by car and will arrive during the AM peak hour and leave during the PM peak hour. The level of employees is envisaged to be the same as that associated with *Stage 5* construction activities.

As such, traffic counts undertaken as part of the stage 6 assessment already include for this level of construction employee traffic. In order to provide a robust

EPA Export 06-01-2017:02:02:13

calculation, traffic related to construction employees, and stage 5 HGV traffic, have not been extracted from the traffic count and has been subject to both seasonal and traffic growth adjustment.

It has been assumed that the rate of import of this material will remain constant over the construction period. The import of material will not be directly related to construction activities being undertaken on site.

The estimated peak generated traffic for the peak generation traffic scenarios are summarised in Table 7.3 below.

Table 7.3 Total Trips Generated

TOTAL TRIPS GENERATED		
Junction	Arriving	Departing
AM Peak (5.0 Day Working Week/ 40 Hour)		
HGV	18	18
PM Peak (5.0 Day Working Week/ 40 Hour)		
HGV	18	18
AM Peak (5.0 Day Working Week/ 35 Hour)		
HGV	21	21
AM Peak (5.0 Day Working Week/ 35 Hour)		
HGV	21	21

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:13

7.3.3.2 Trip Distribution

The following two route options have been considered for this assessment.

- Route1: Between the existing tailings management facility and Navan; and
- Route 2: Between the existing tailings management facility and Slane

Route 1: TMF to Navan

HGV traffic arriving and departing from the site will

- Turn right onto the L74141 and travel towards the R163.
- Upon reaching the junction with the R163 traffic will turn right and travel towards the R162.
- Upon arriving at the junction with the R162, HGV traffic will once again turn right, travelling in the direction of Navan.
- Upon reaching the roundabout between the N51, N3 Link and the R162 traffic will join the N3 link and subsequently join the N3.

Car traffic generated by the facility is expected to distribute in a manner that mirrors existing traffic flows.

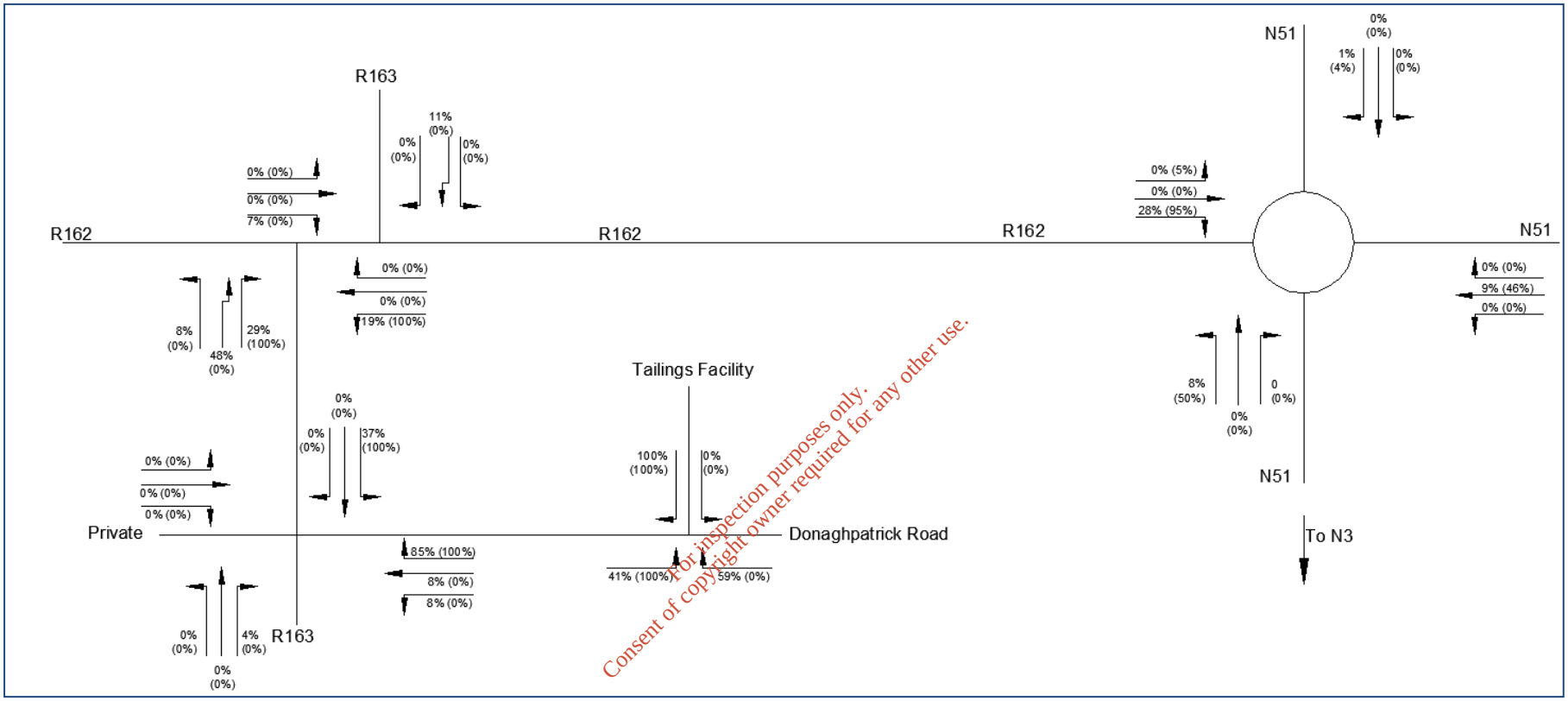
Figures 7.3 and 7.4 show the expected distribution of traffic generated by the TMF construction project.

HGV distributions are shown in brackets.

It has been assumed that HGV will pass through the roundabout junction.

For inspection purposes only.
Consent of copyright owner required for any other use.

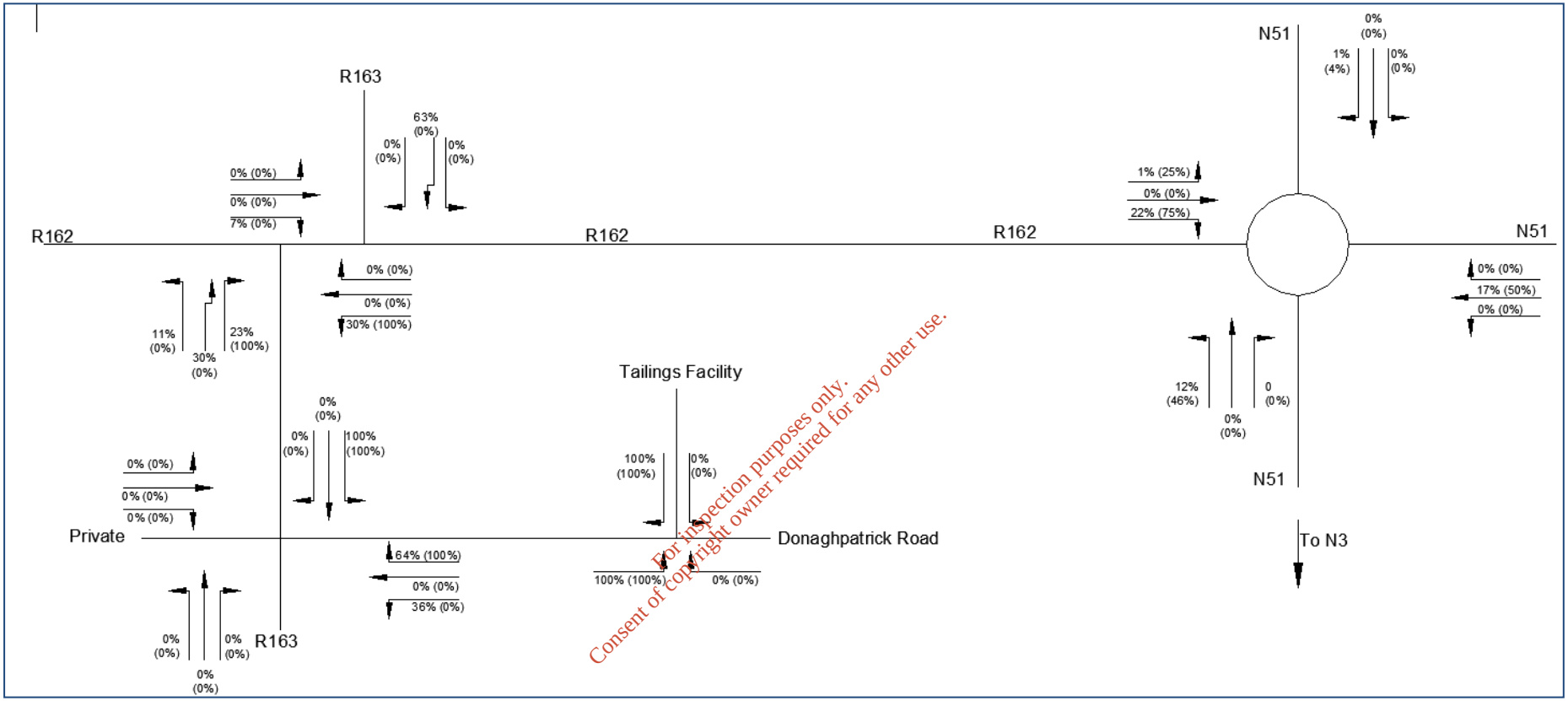
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.3 Distribution of Generated Traffic AM Peak

EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.4 Distribution of Generated Traffic PM Peak

It has been assumed that HGV distribution from Arm B to Arm A (and Arm A to Arm B) of the proposed site access junction, in the PM assessments, equate to 100% for the purpose of a robust analysis as actual HGV traffic movements on the day of the traffic count were zero. This indicates that HGV traffic associated with construction activities were parked during the PM network peak.

EPA Export 06-01-2017:02:02:13

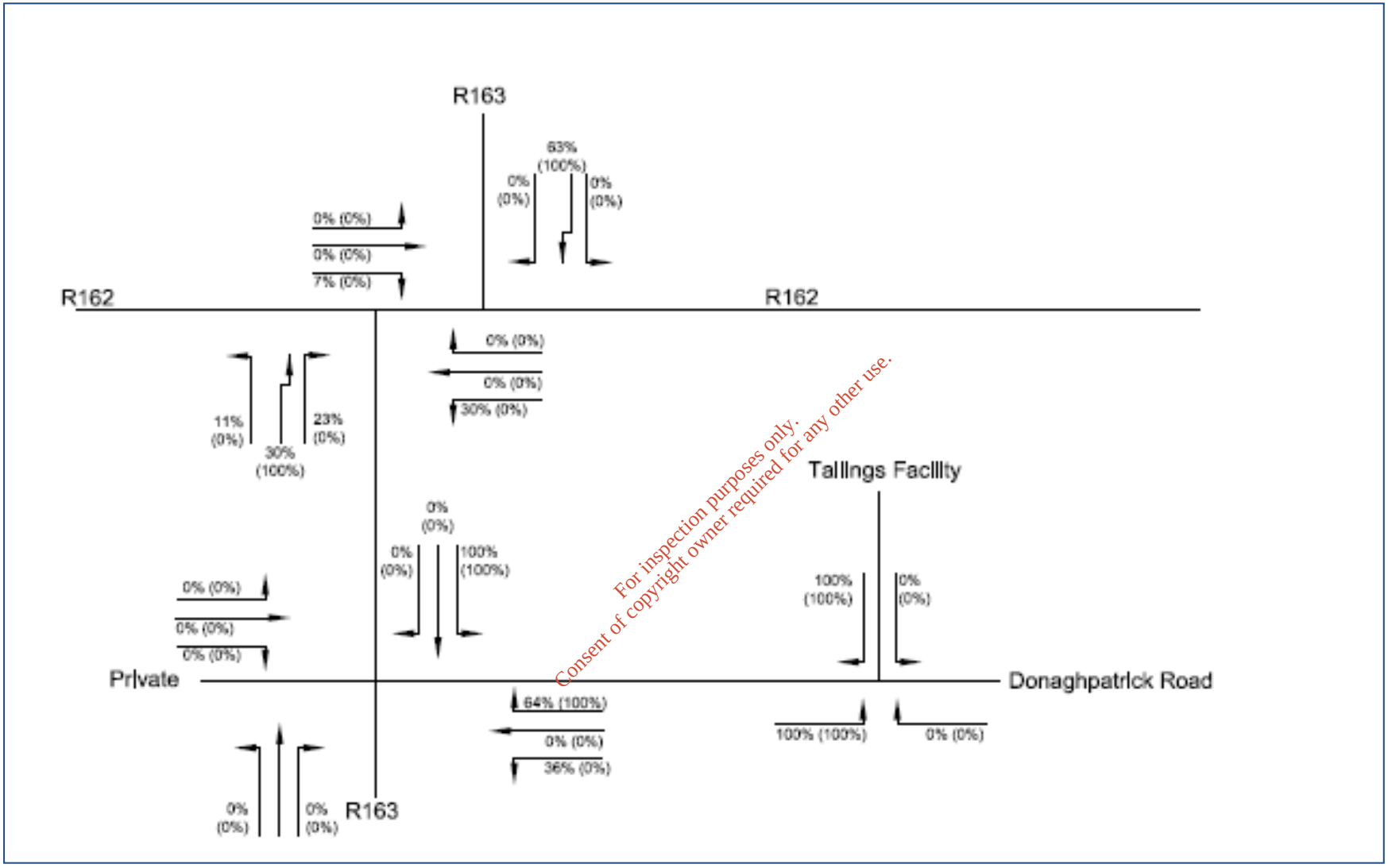
Route 2:

HGV traffic arriving and departing from the site is envisaged to turn right onto the L74141 Road and travel towards the R163. Upon reaching the junction with the R163 traffic will turn right and travel towards the R162. Upon arriving at the junction with the R162, HGV traffic will once again turn right, and immediately turn left to re-joining the R163.

HGV traffic will travel this route to and from the quarry located at Slane. Car traffic generated by the facility is expected to distribute in a manner that mirrors existing traffic flows. Figures 7.5 and 7.6 show the expected distribution of traffic generated by the TMF. HGV distributions are shown in brackets.

For inspection purposes only.
Consent of copyright owner required for any other use.

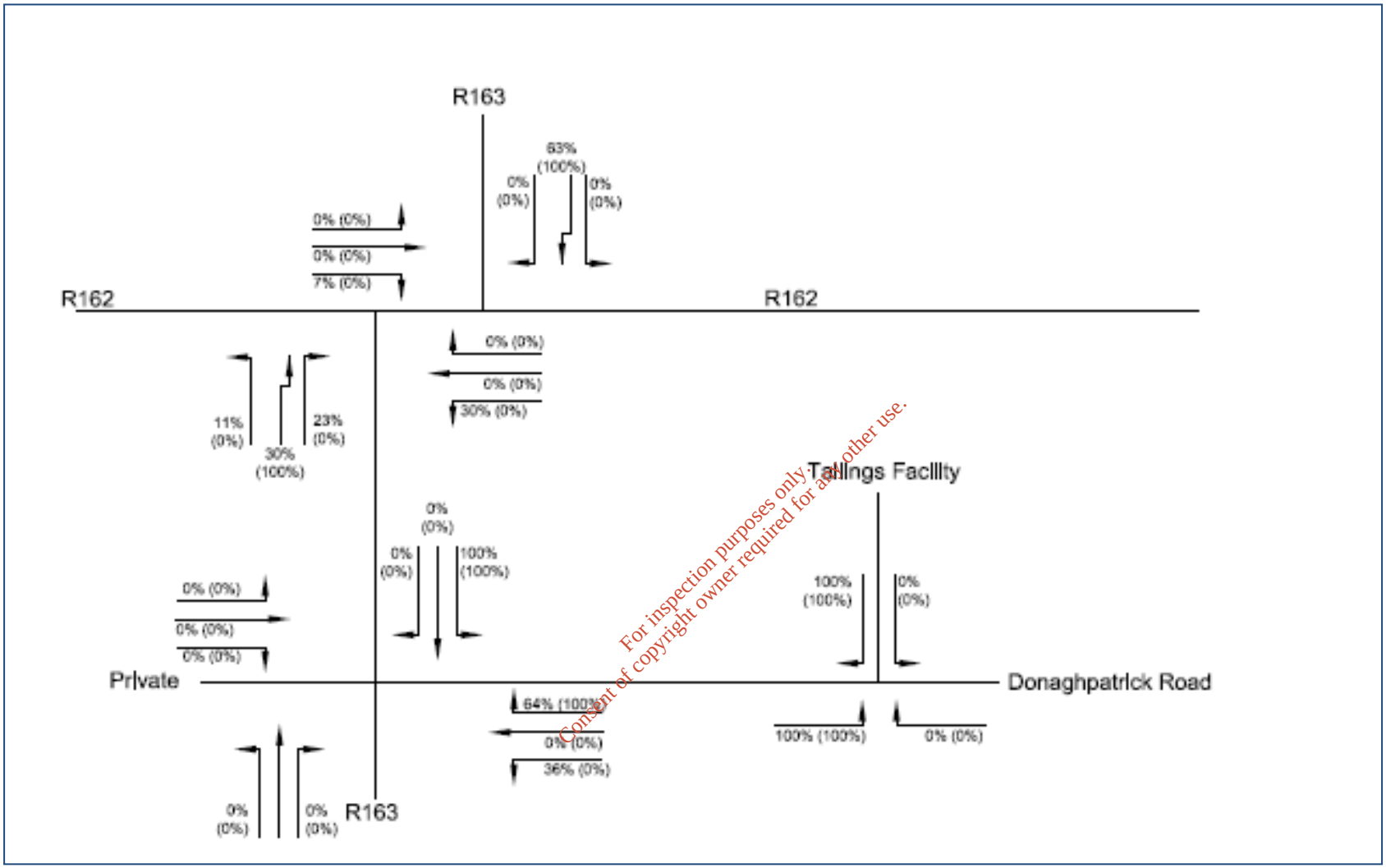
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.5 Distribution of Generated Traffic AM Peak

EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.6 Distribution of Generated Traffic PM Peak

It has been assumed that HGV distribution from Arm B to Arm A (and Arm A to Arm B) of the proposed site access junction, in the PM assessments, equate to 100% for the purpose of a robust analysis as actual HGV traffic movements on the day of the traffic count were zero. This indicates that HGV traffic associated with construction activities were parked during the PM network peak.

EPA Export 06-01-2017:02:02:13

7.3.4 Seasonal Adjustment

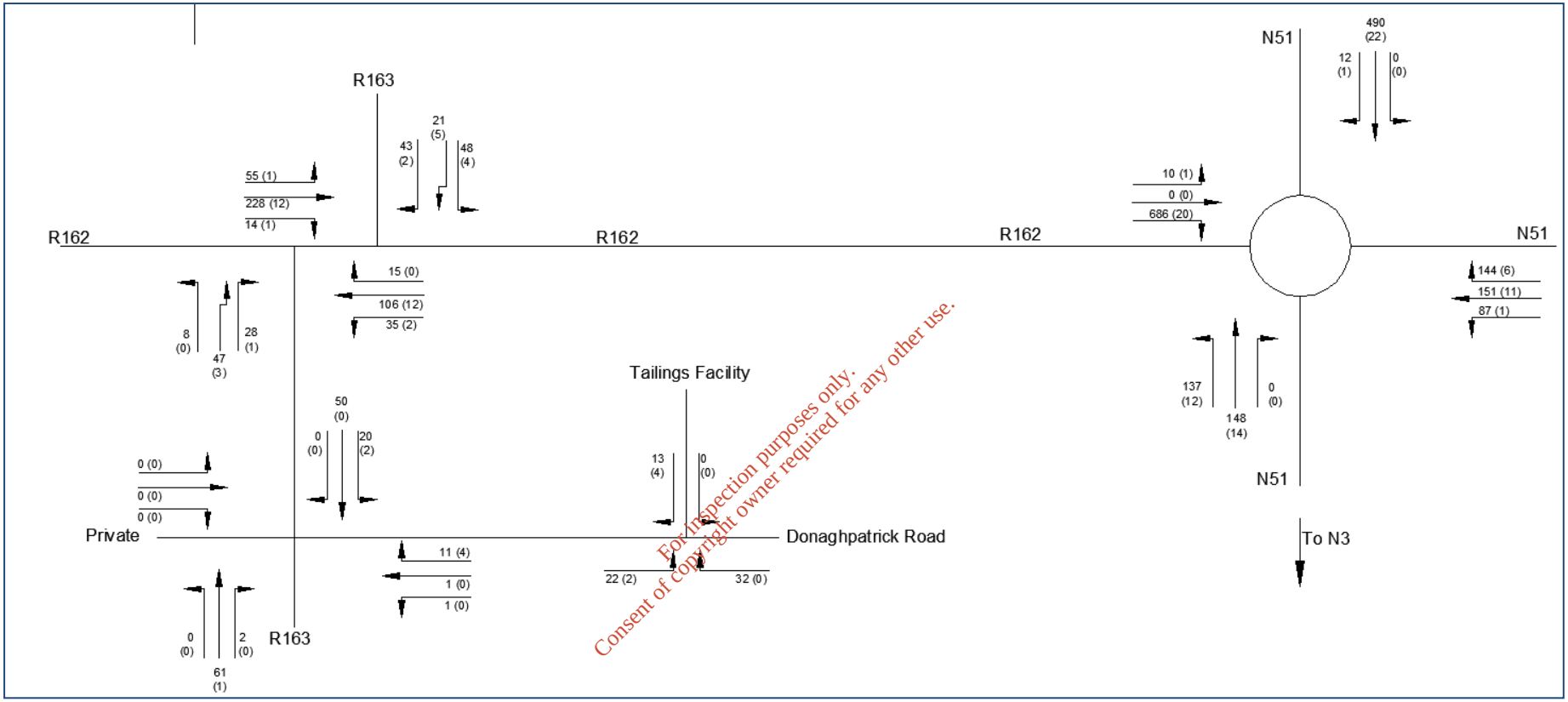
In order to undertake an analysis of the junctions, it may be necessary to apply a correction factor to convert the surveyed PCU values into seasonally adjusted traffic flows to take account of the seasonal variation that is experienced with traffic surveys.

These seasonally adjusted conversion factors were calculated using data taken from a fixed automatic traffic counter located on the N51 between Navan and Slane to the west of Slane over a 12-month period in 2014. It was found that traffic volumes for both the AM and PM peaks in September are above the average peak traffic flows during the other months of that year.

In order for a robust assessment, no seasonal adjustment has been made for this reason. Figures 7.7 and 7.8 below depict the seasonally adjusted traffic flows for the junctions during 2015 AM and PM peak hours.

For inspection purposes only.
Consent of copyright owner required for any other use.

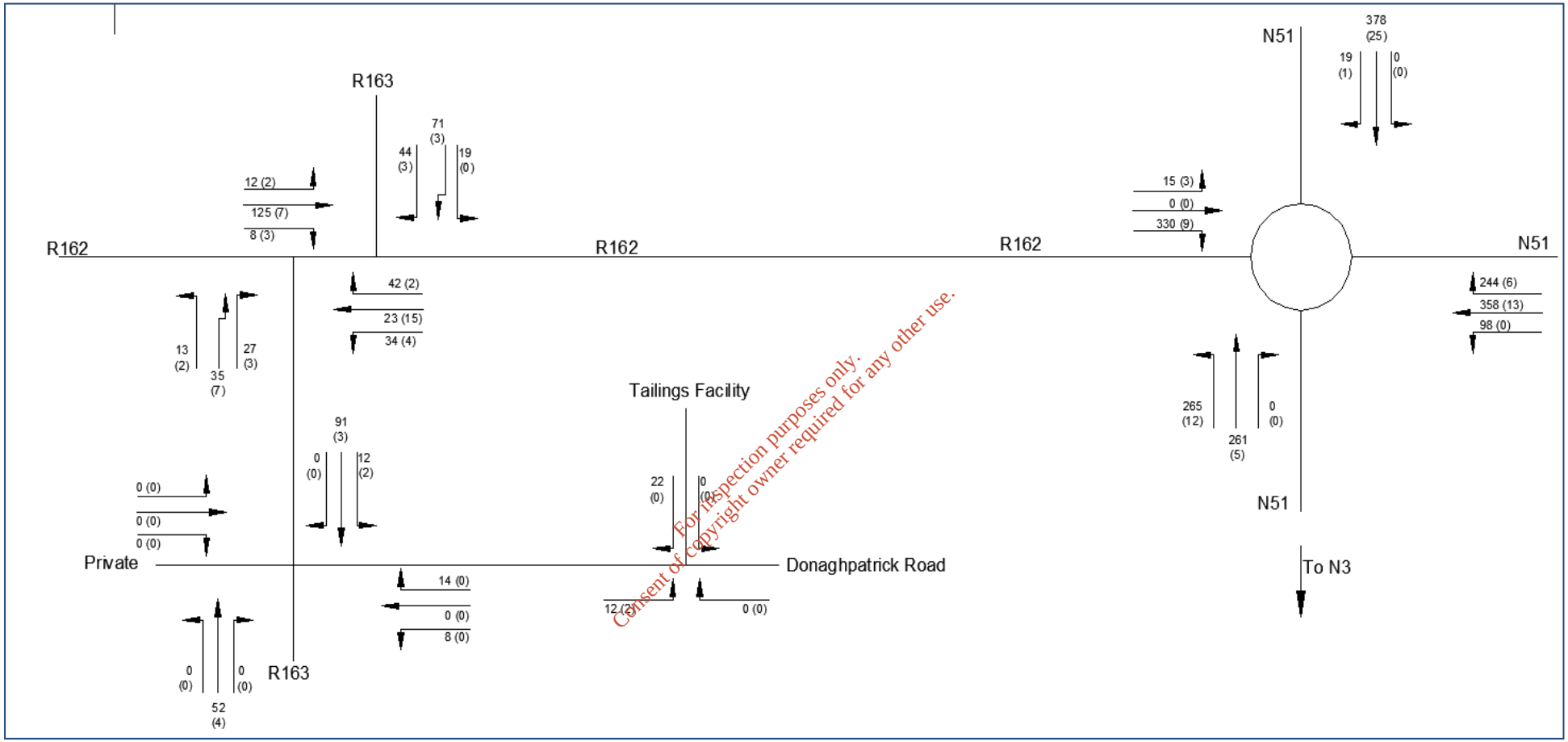
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.7 Seasonally adjusted traffic flows 2015 AM Peak

EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.8 Seasonally adjusted traffic flows 2015 PM Peak

EPA Export 06-01-2017:02:02:13

7.3.5 Traffic growth

Background traffic on the road network is expected to grow in future years and as such analysis has been carried out on the traffic flows over the duration of the construction period.

The peak trip generation for each construction scenario (average and peak trip generations) have been assessed based on the preliminary construction programme and the existing network AM and PM peak traffic.

The background traffic growth factors used in the analysis in this report are those provided by the NRA (Published August 2003 for years 2002 – 2040) for the non-national road network.

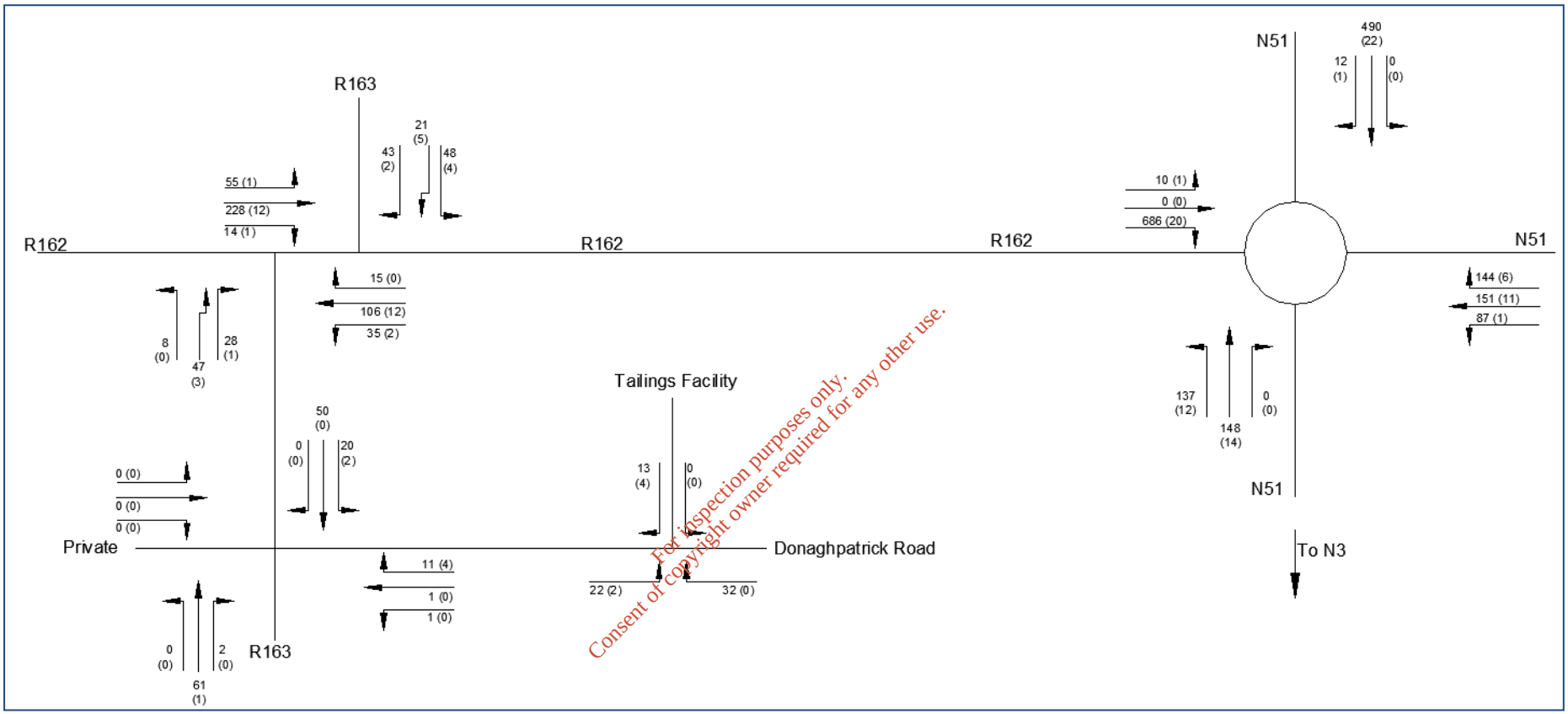
These are:

- Cars 1.011 medium growth (Region 3) factor from 2015 to 2016
- 1.008 medium growth (Region 3) factor from 2015 to 2016
- HGV 1.045 medium growth (Region 3) factor from 2015 to 2019
- 1.032 medium growth (Region 3) factor from 2015 to 2019

Figures 7.9 – 7.14 below show the 2015 base traffic flows for AM and PM peaks, 2016 traffic growth base traffic flows for AM and PM peaks and 2019 traffic growth base traffic flows for AM and PM peaks.

For inspection purposes only.
Consent of copyright owner required for any other use.

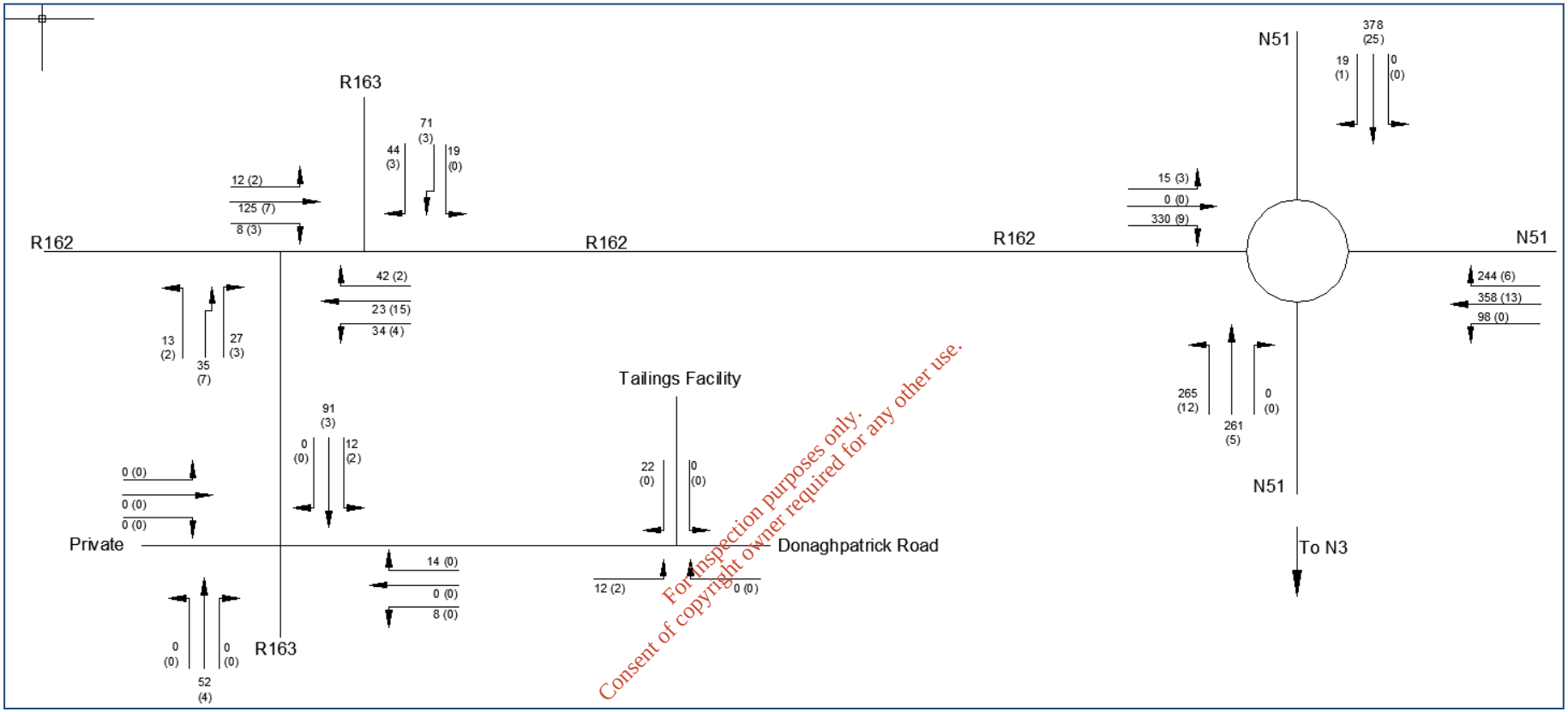
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.9 2015 Base-flow AM Peak

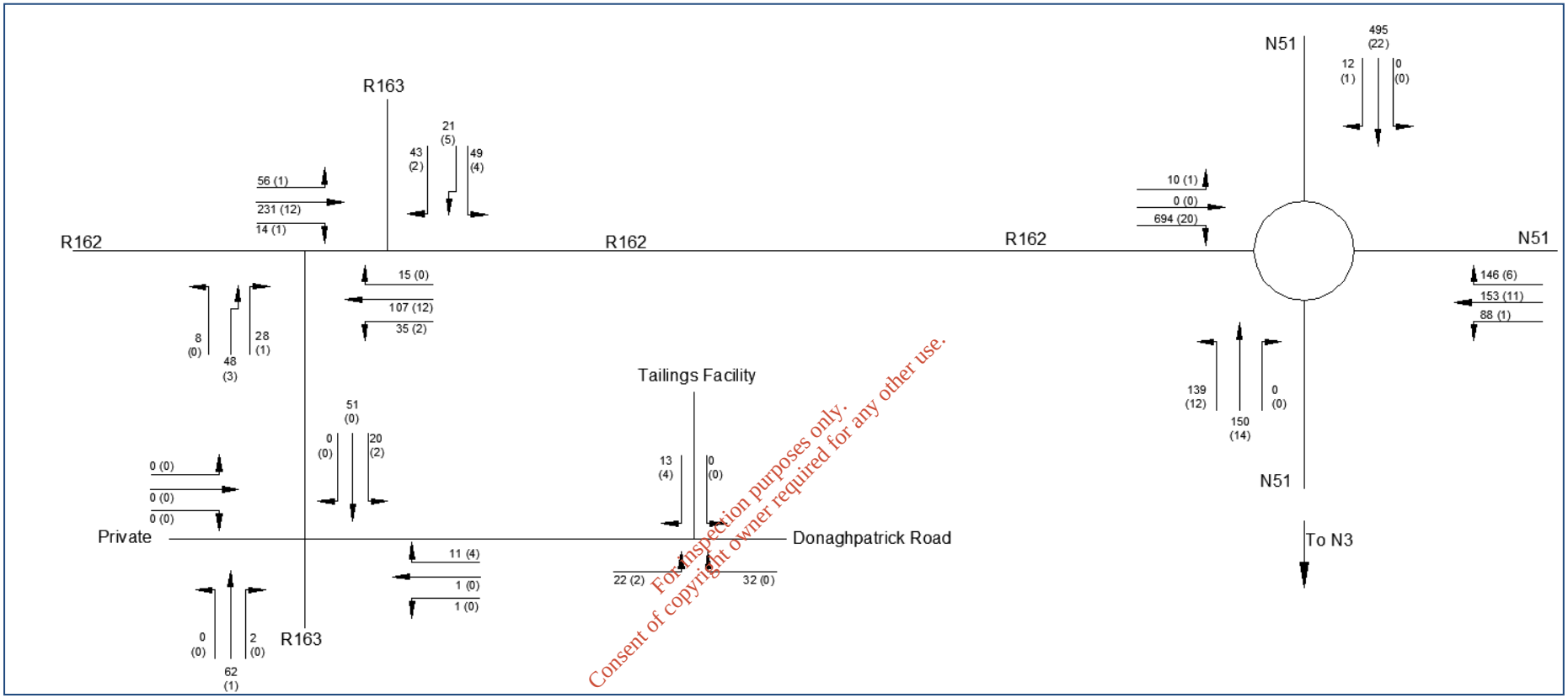
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.10 2015 Base-flow PM Peak

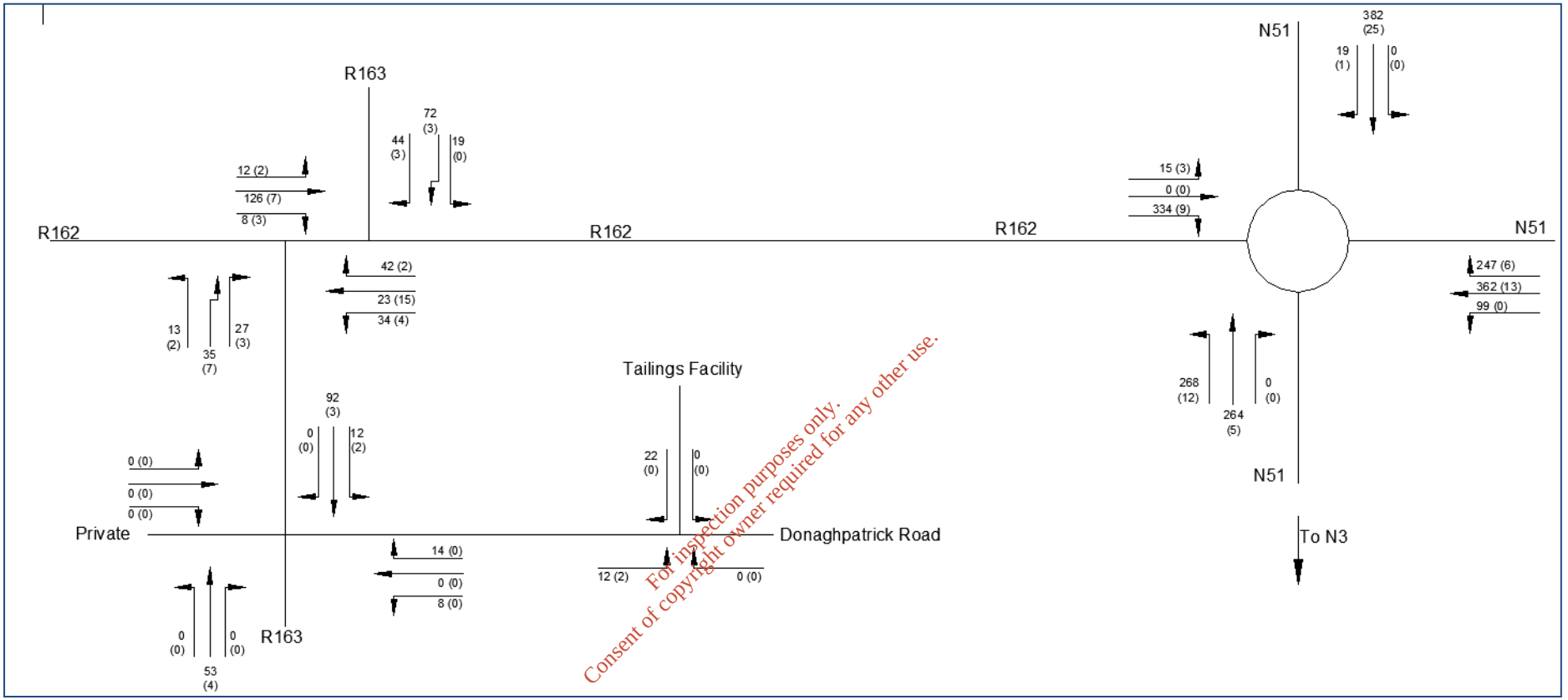
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.11 2016 Base-flow AM Peak

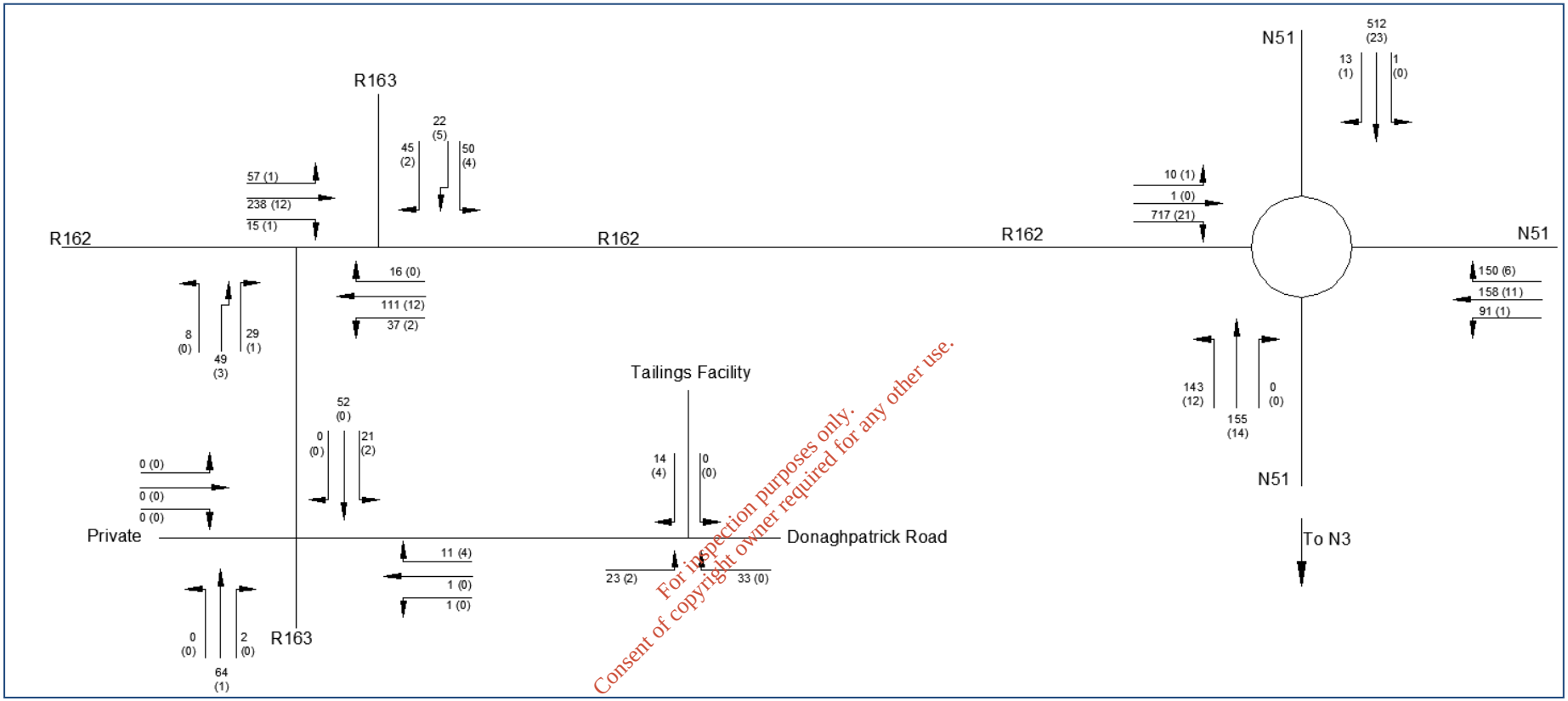
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.12 2016 Base-flow PM Peak

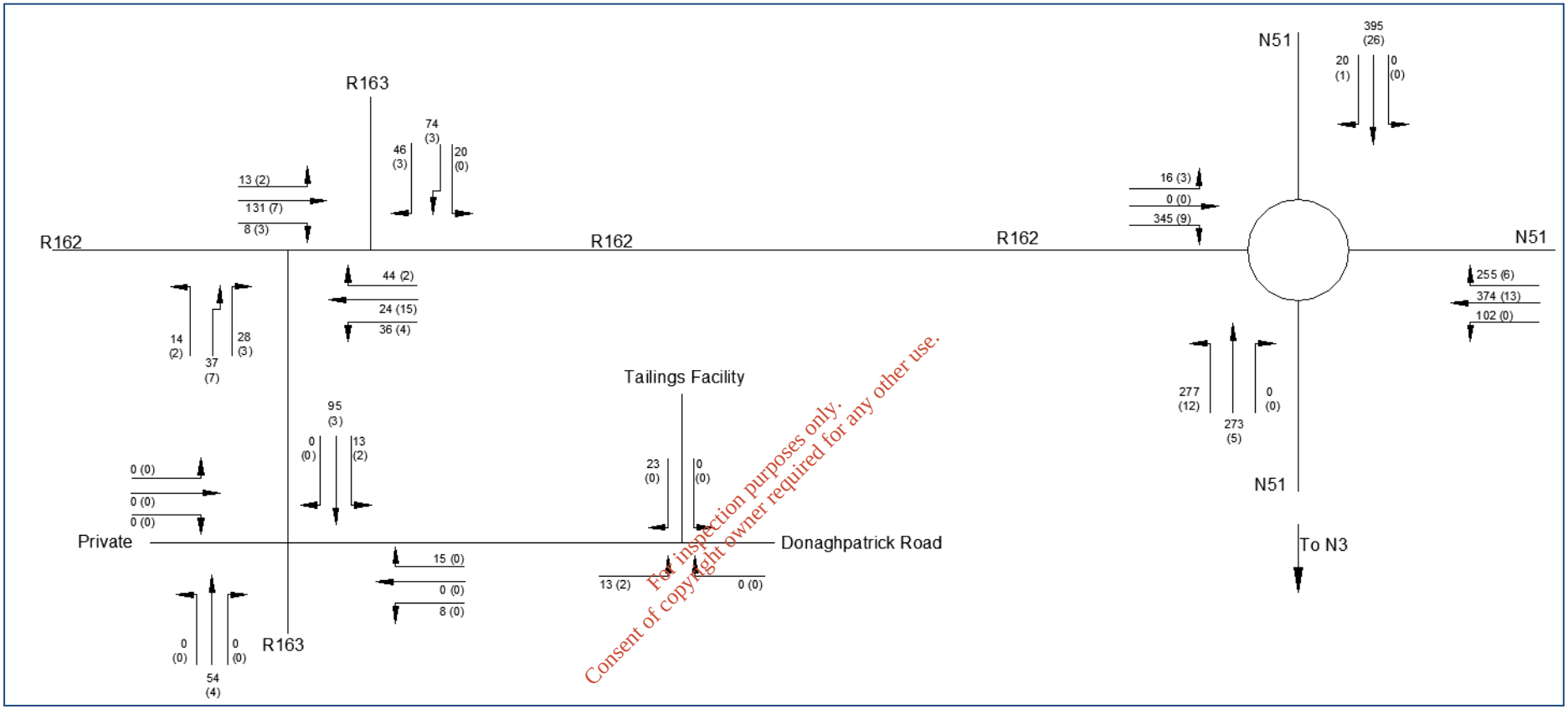
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.13 2019 Base-flow AM Peak

EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.14 2019 Base-flow PM Peak

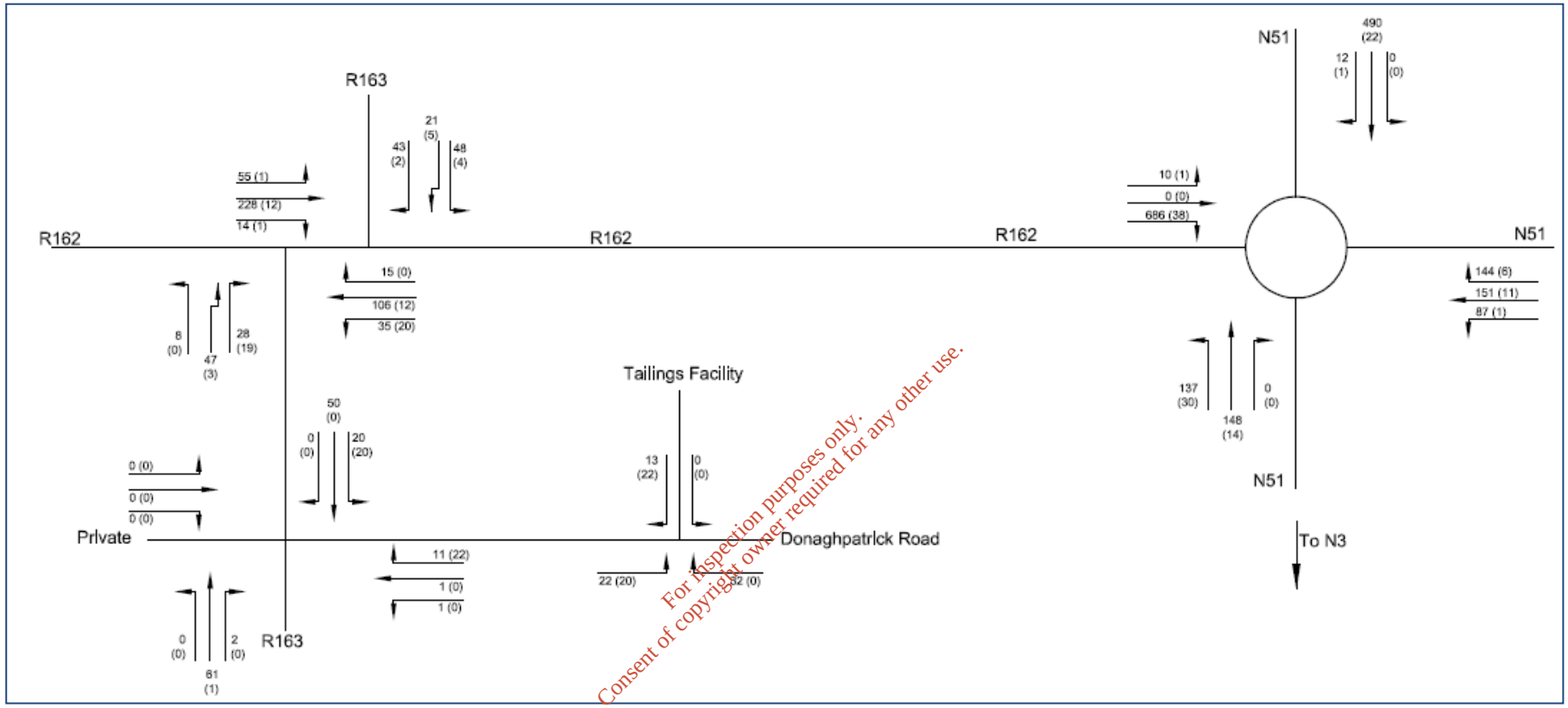
EPA Export 06-01-2017:02:02:13

Figures 7.15 – 7.26 below show the base-flow plus TMF stage 6 generated traffic for 2015, 2016 and 2019 AM and PM peaks for each of the following scenarios for route 1:

- 5.0 day working week, 40 hours per week; and
- 5.0 day working week, 35 hours per week.

For inspection purposes only.
Consent of copyright owner required for any other use.

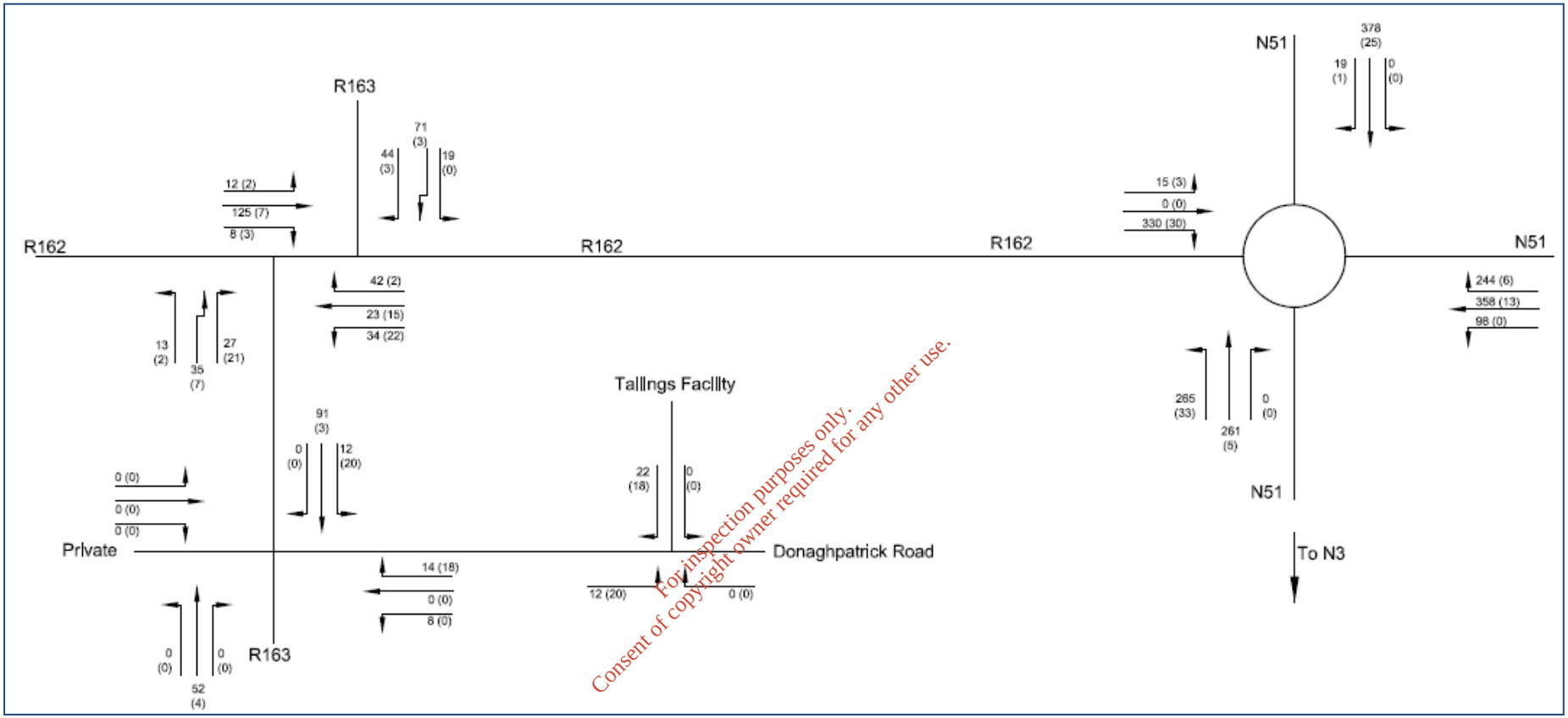
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.15 2015Base-flowwith generated traffic AM Peak (5.0 day working week, 40 Hours per Week)

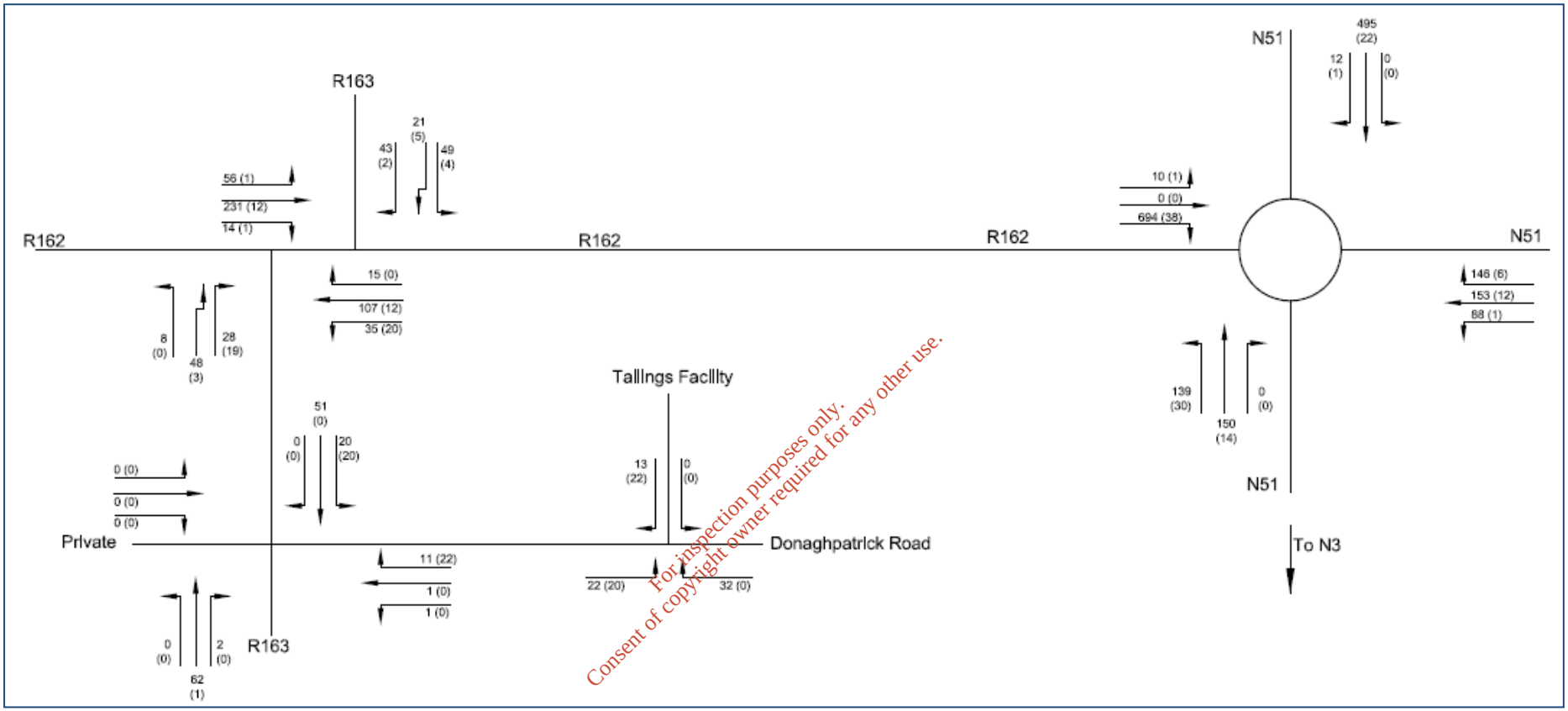
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.16 2015Base-flowwith generated traffic PM Peak (5.0 day working week, 40 Hours per Week)

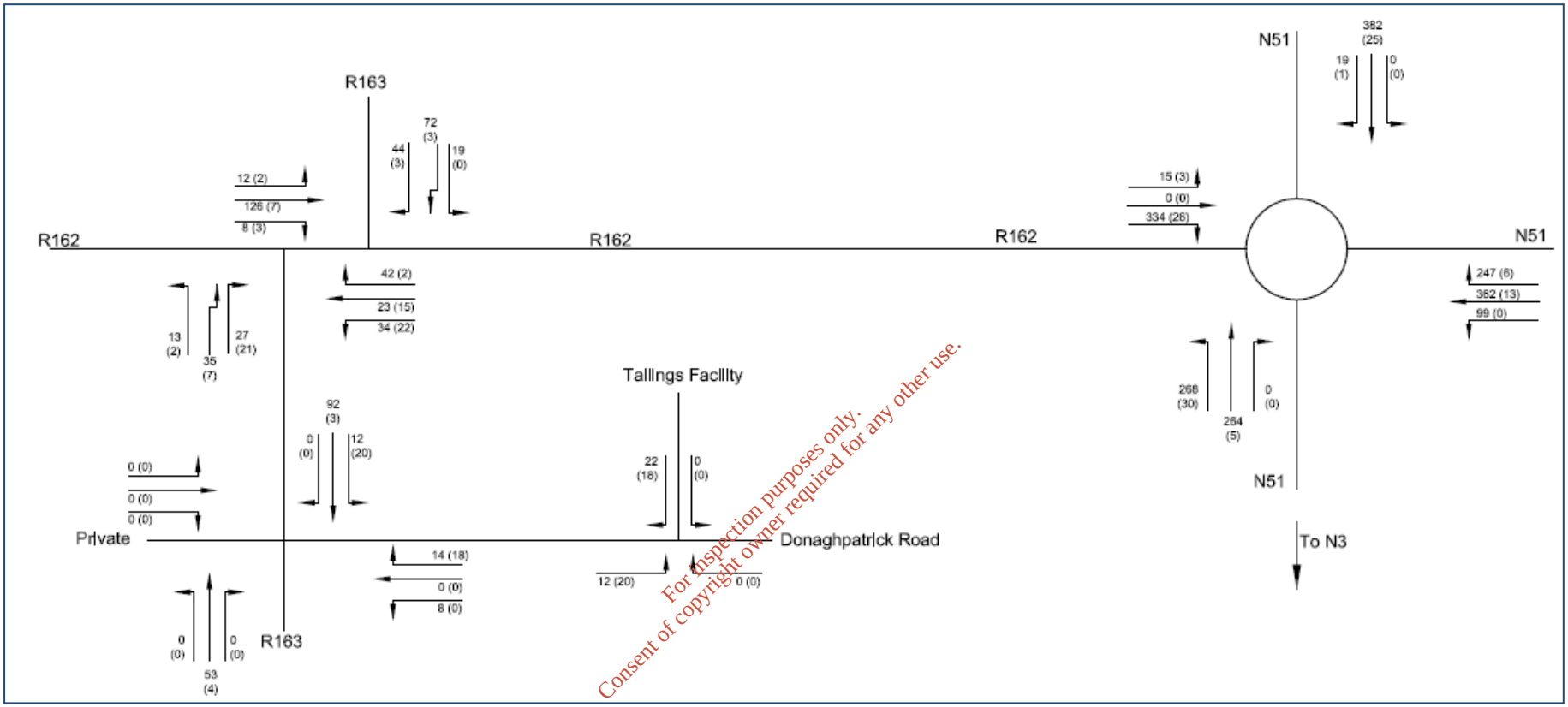
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.17 2016Base-flowwith generated traffic AM Peak (5.0 day working week, 40 Hours per Week)

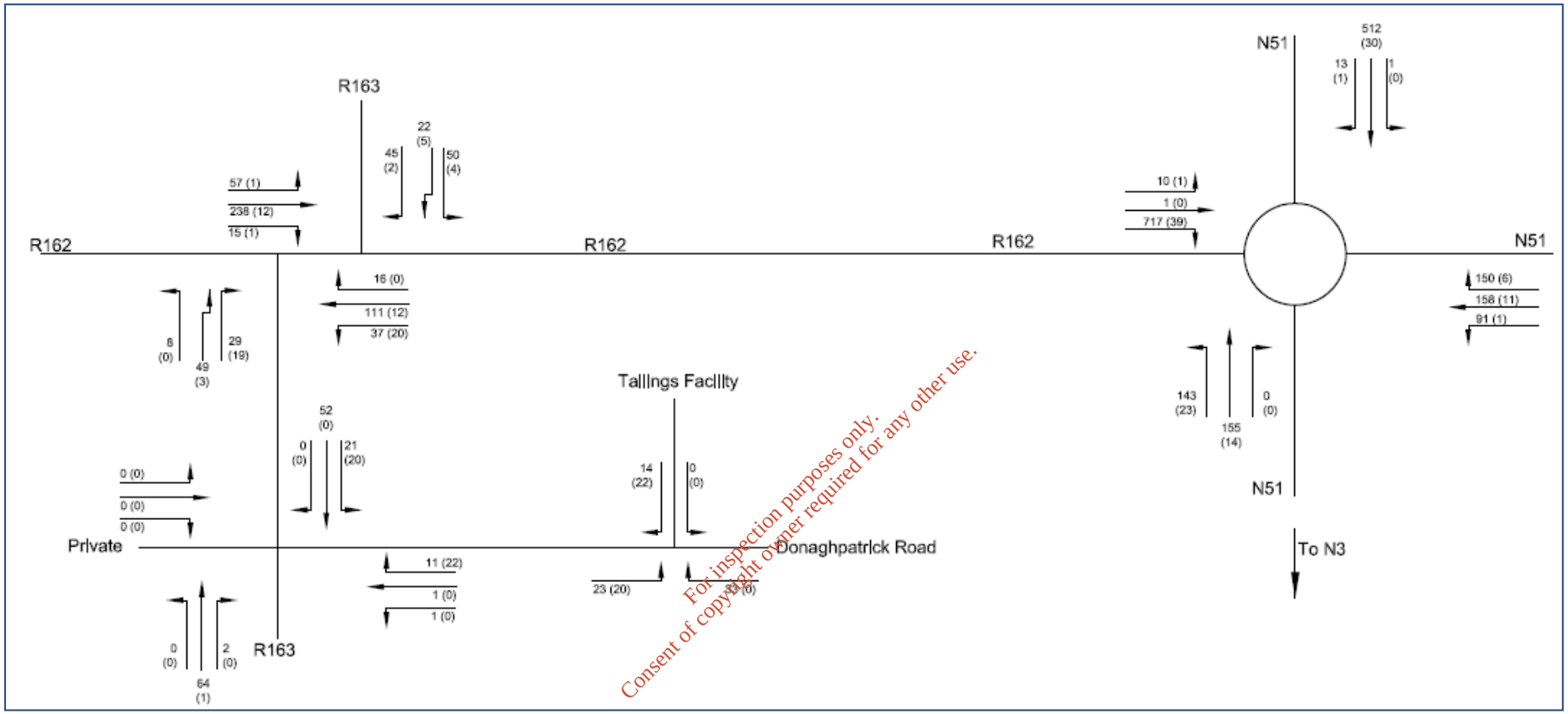
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.18 2016Base-flowwith generated traffic PM Peak (5.0 day working week, 40 Hours per Week)

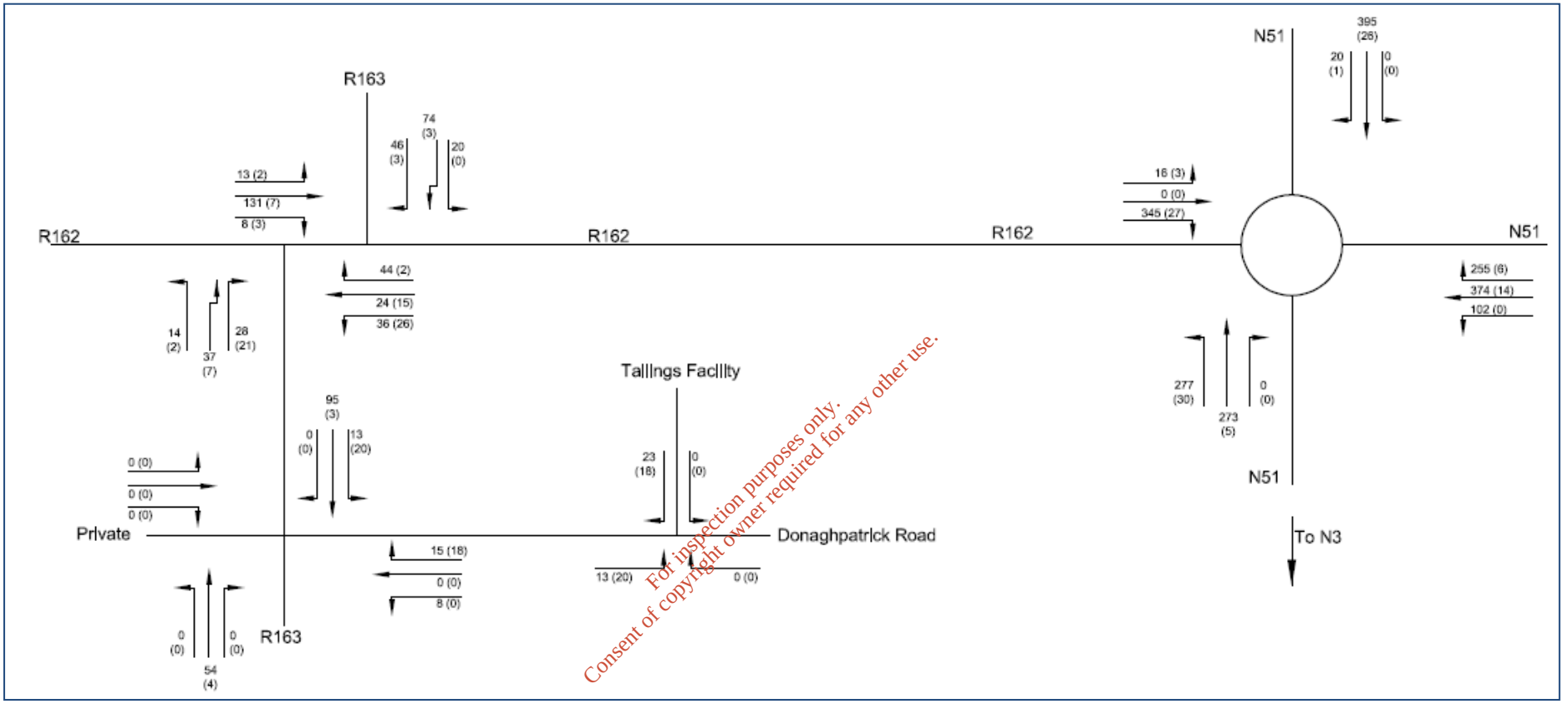
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.19 2019Base-flowwith generated traffic AM Peak (5.0 day working week, 40 Hours per Week)

EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.20 2019Base-flowwith generated traffic PM Peak (5.0 day working week, 35 Hours per Week)

EPA Export 06-01-2017:02:02:13

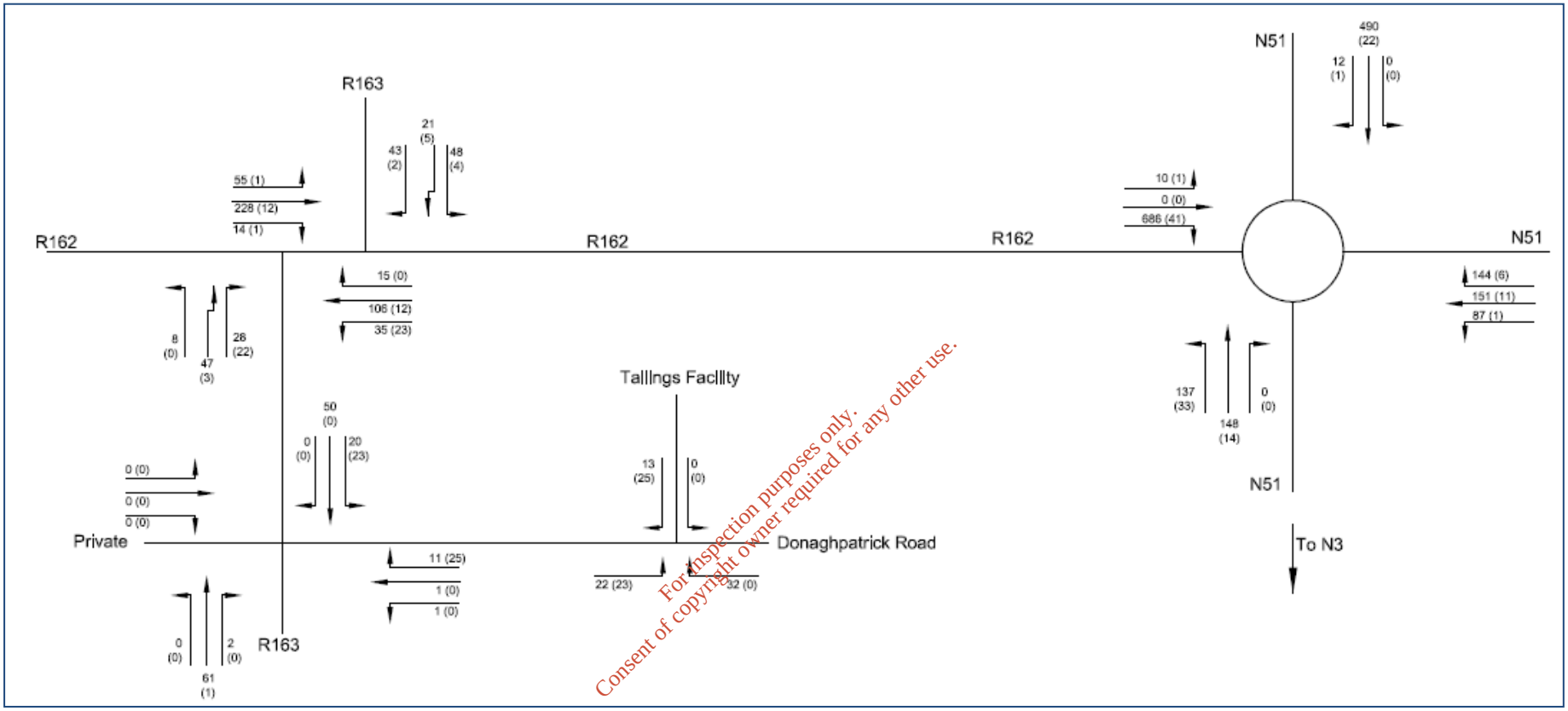
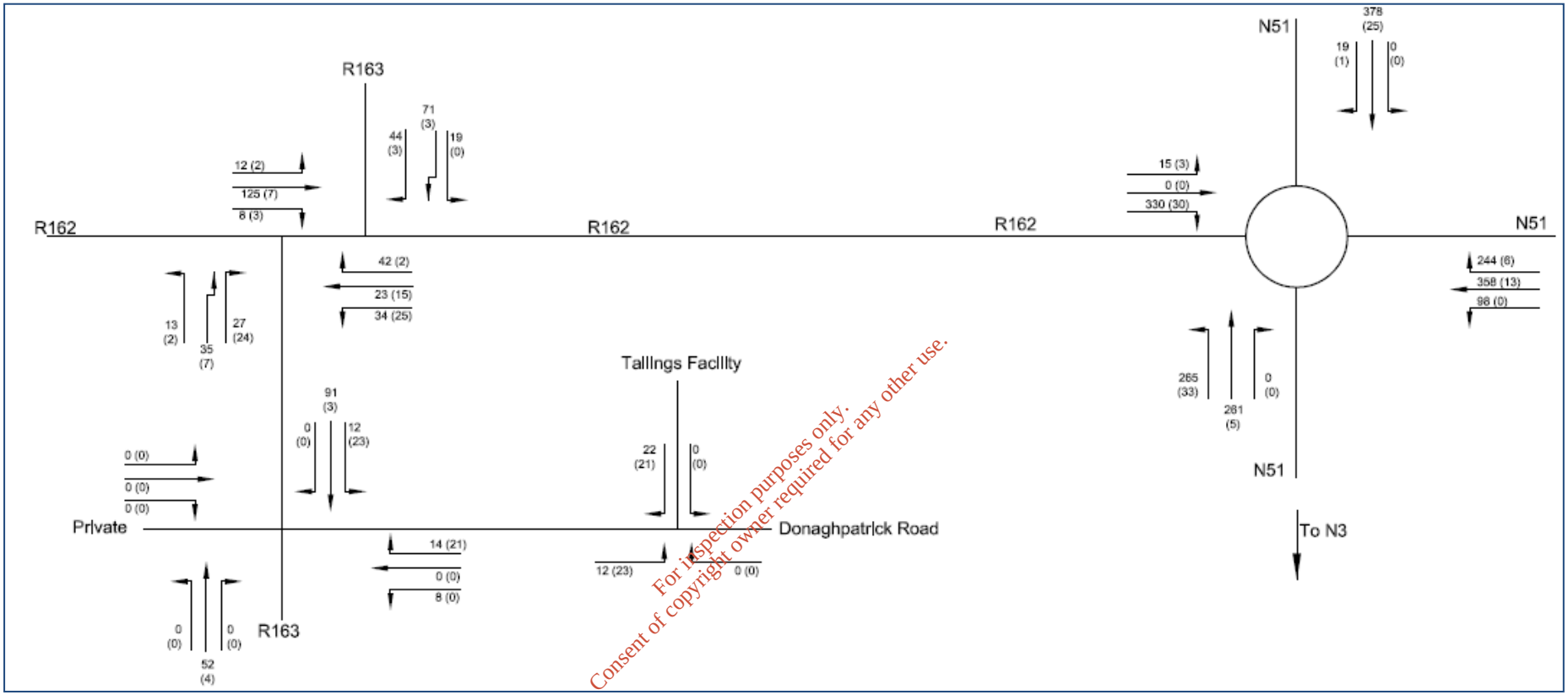


Figure 7.21 2015Base-flowwith generated traffic AM Peak (5.0 day working week, 35 Hours per Week)

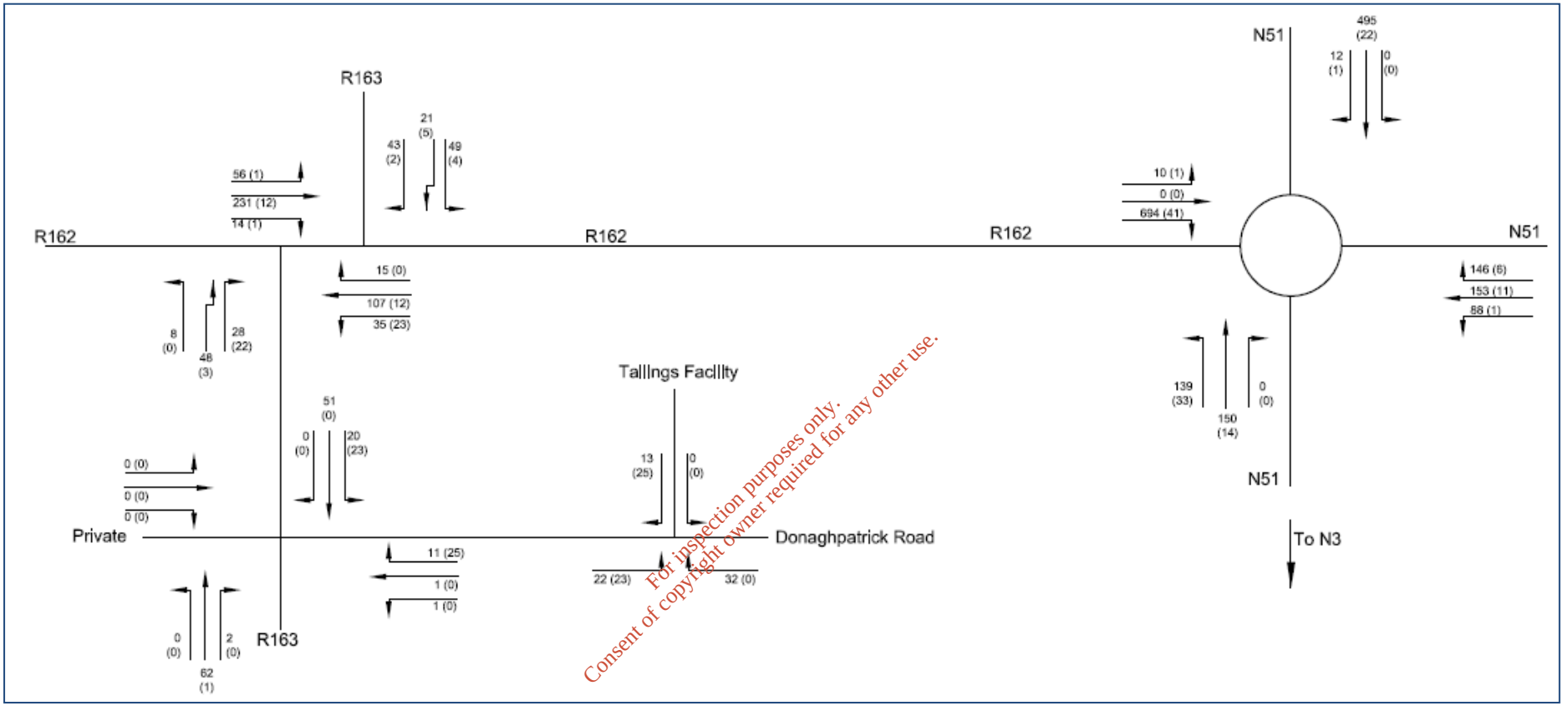
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.22 2015Base-flowwith generated traffic PM Peak (5.0 day working week, 35 Hours per Week)

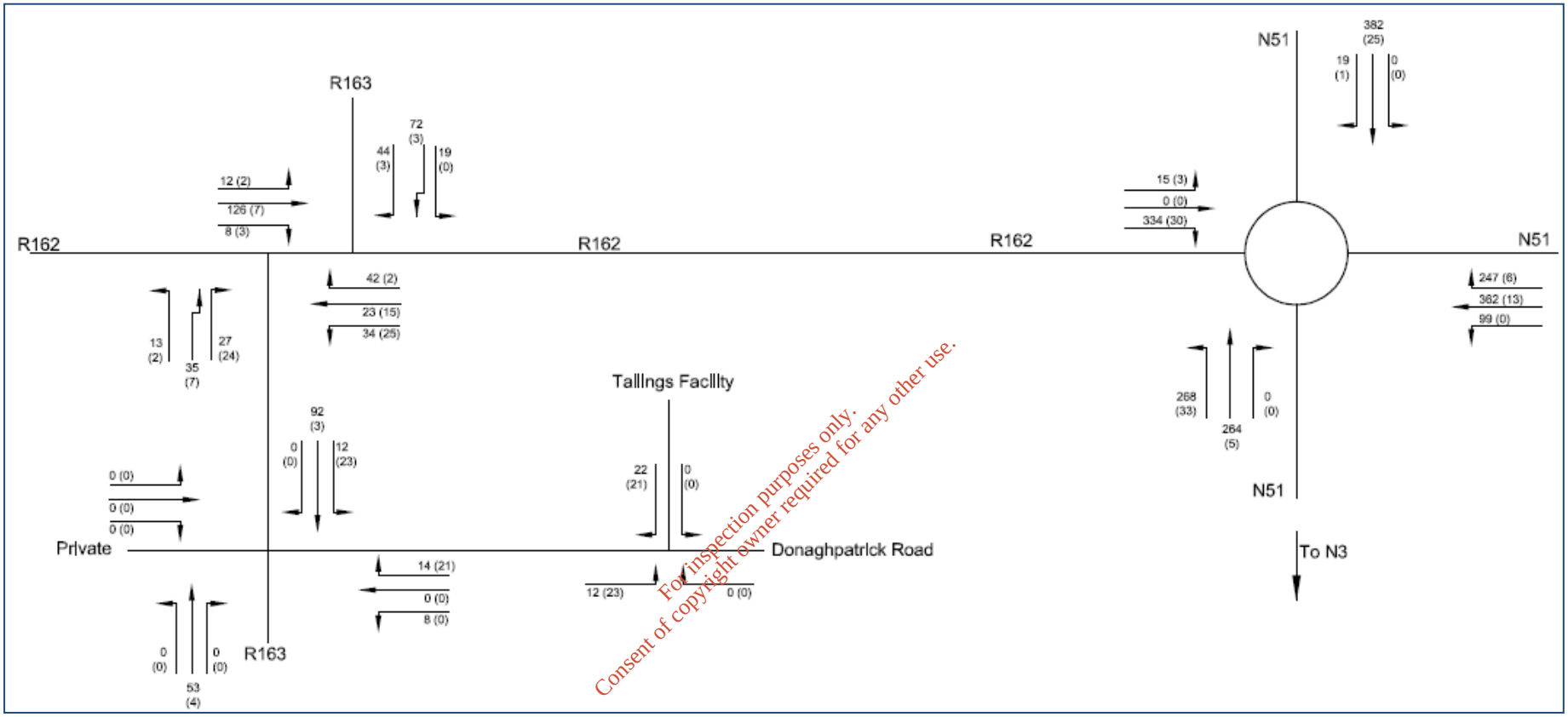
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.23 2016Base-flowwith generated traffic AM Peak (5.0 day working week, 35 Hours per Week)

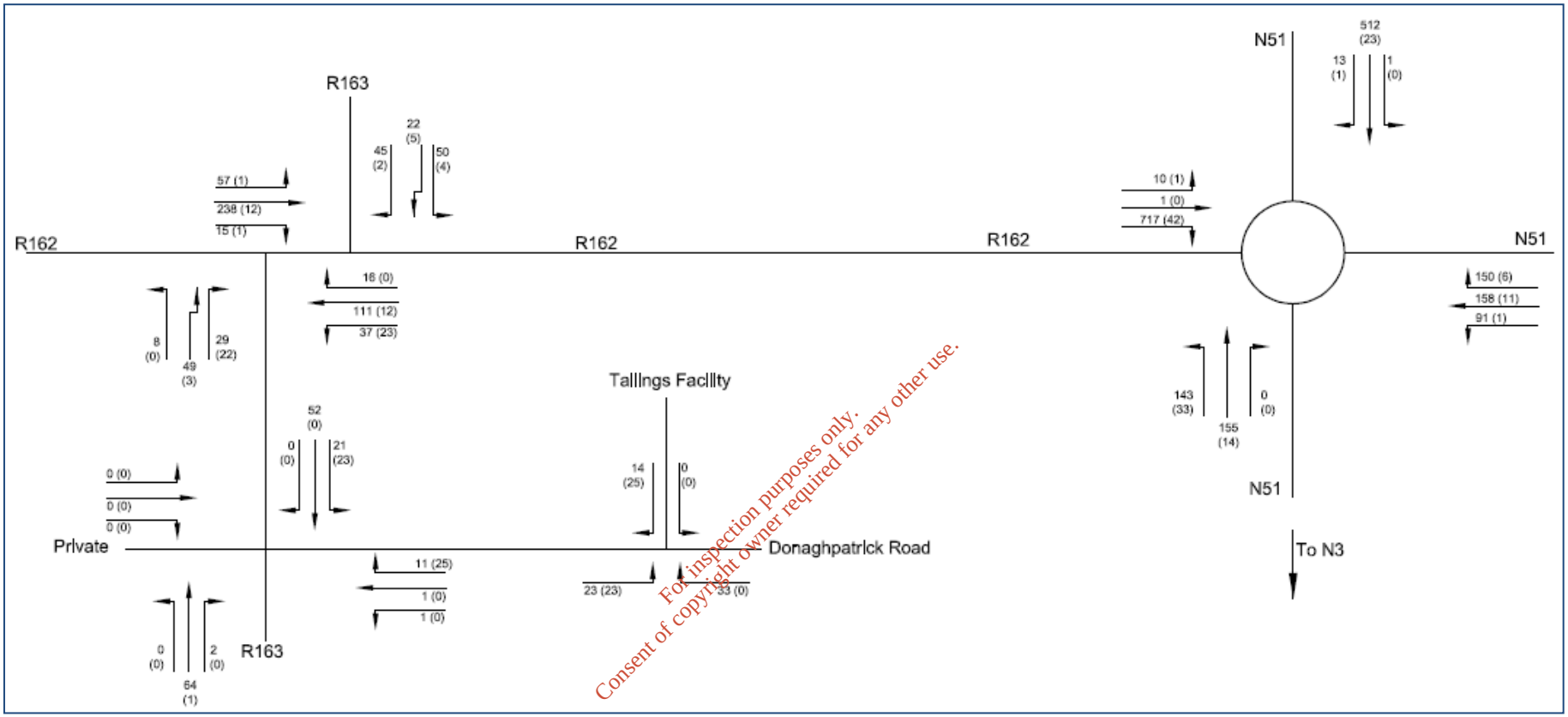
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.24 2016Base-flowwith generated traffic PM Peak (5.0 day working week, 35 Hours per Week)

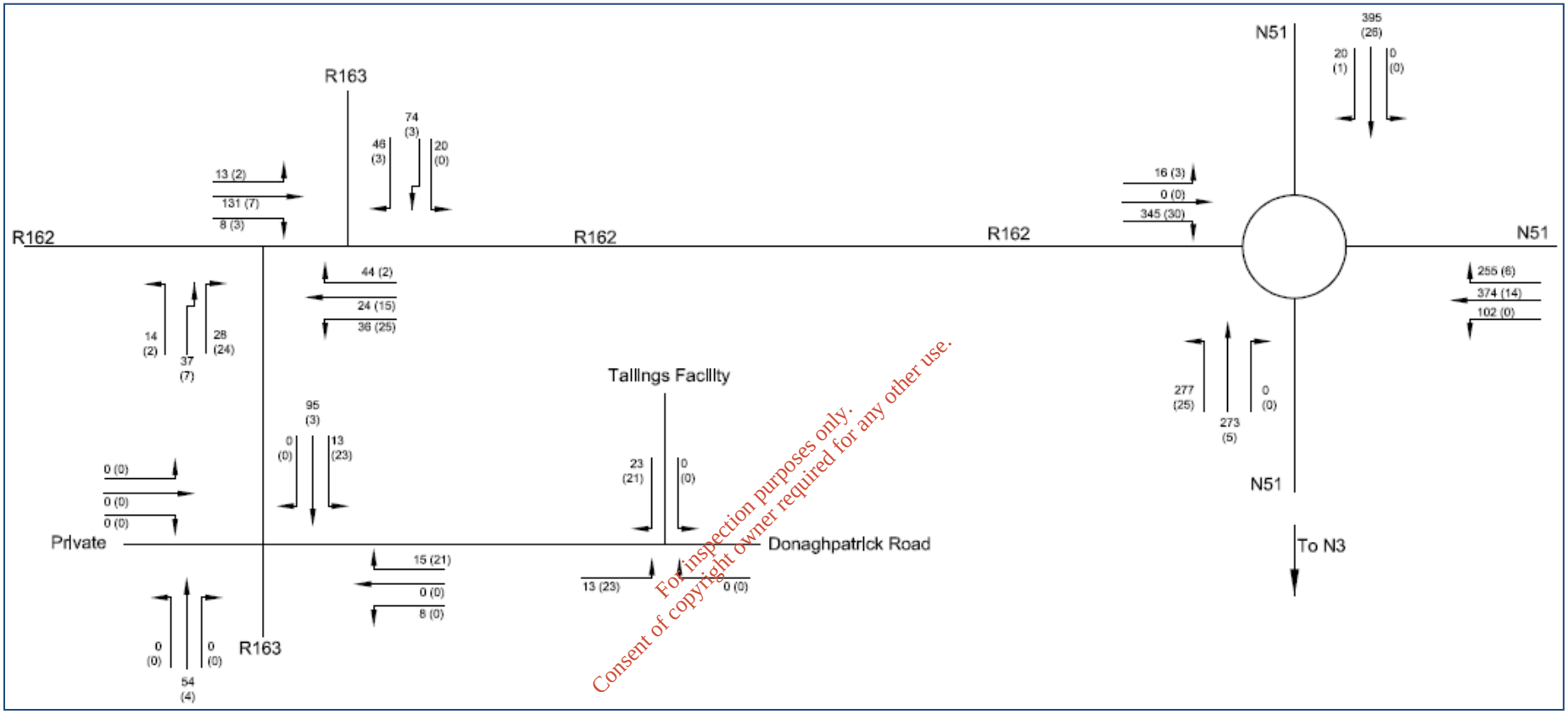
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.25 2019Base-flowwith generated traffic AM Peak (5.0 day working week, 35 Hours per Week)

EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.26 2019Base-flowwith generated traffic PM Peak (5.0 day working week, 35 Hours per Week)

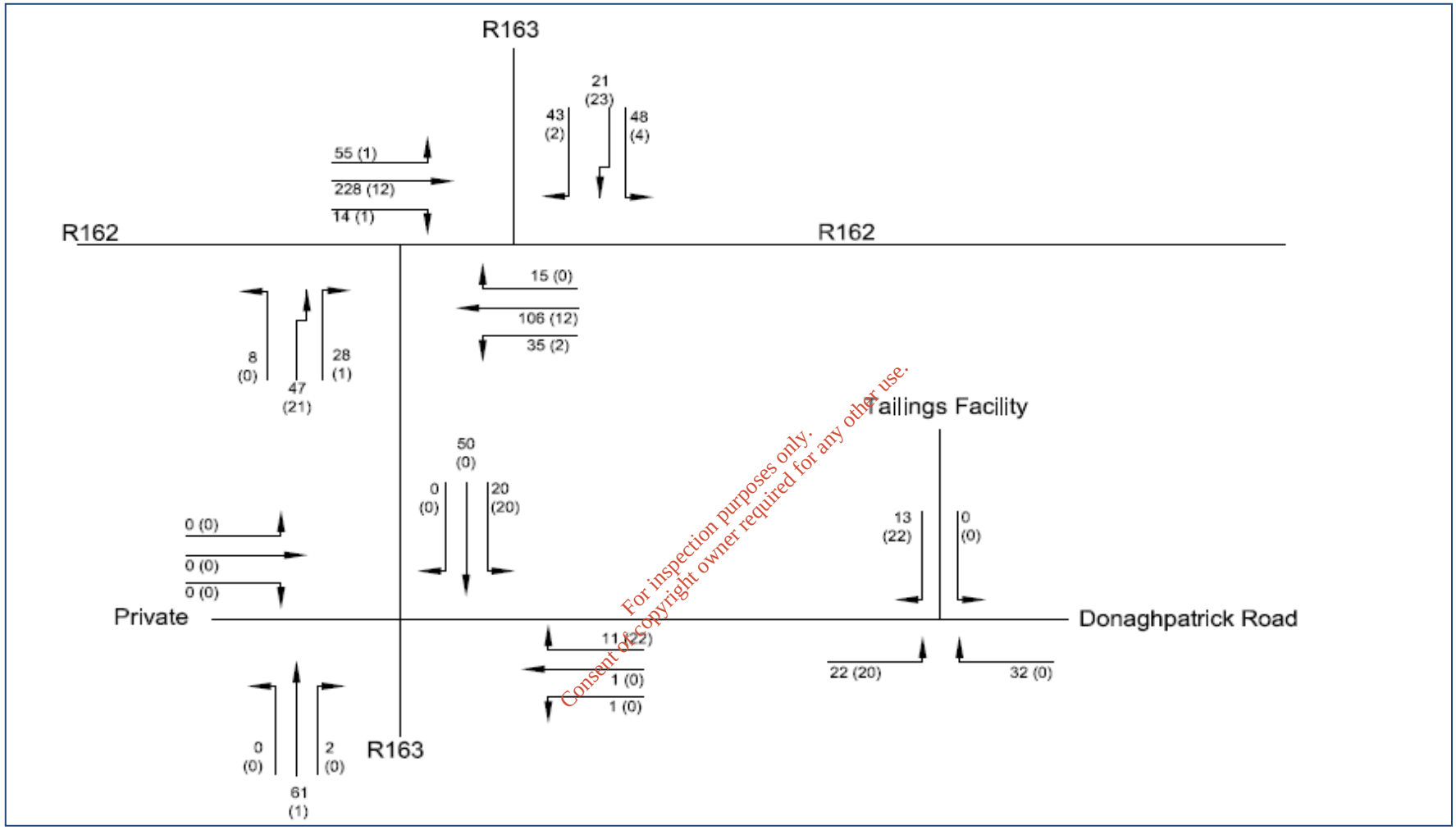
EPA Export 06-01-2017:02:02:13

Figures 7.27 – 7.38 below show the Base-flow plus the proposed TMF stage 6 generated traffic for 2015, 2016 and 2019 AM and PM peaks for each of the following scenarios for route 2:

- 5.0 day working week, 40 hours per week; and
- 5.0 day working week, 35 hours per week.

For inspection purposes only.
Consent of copyright owner required for any other use.

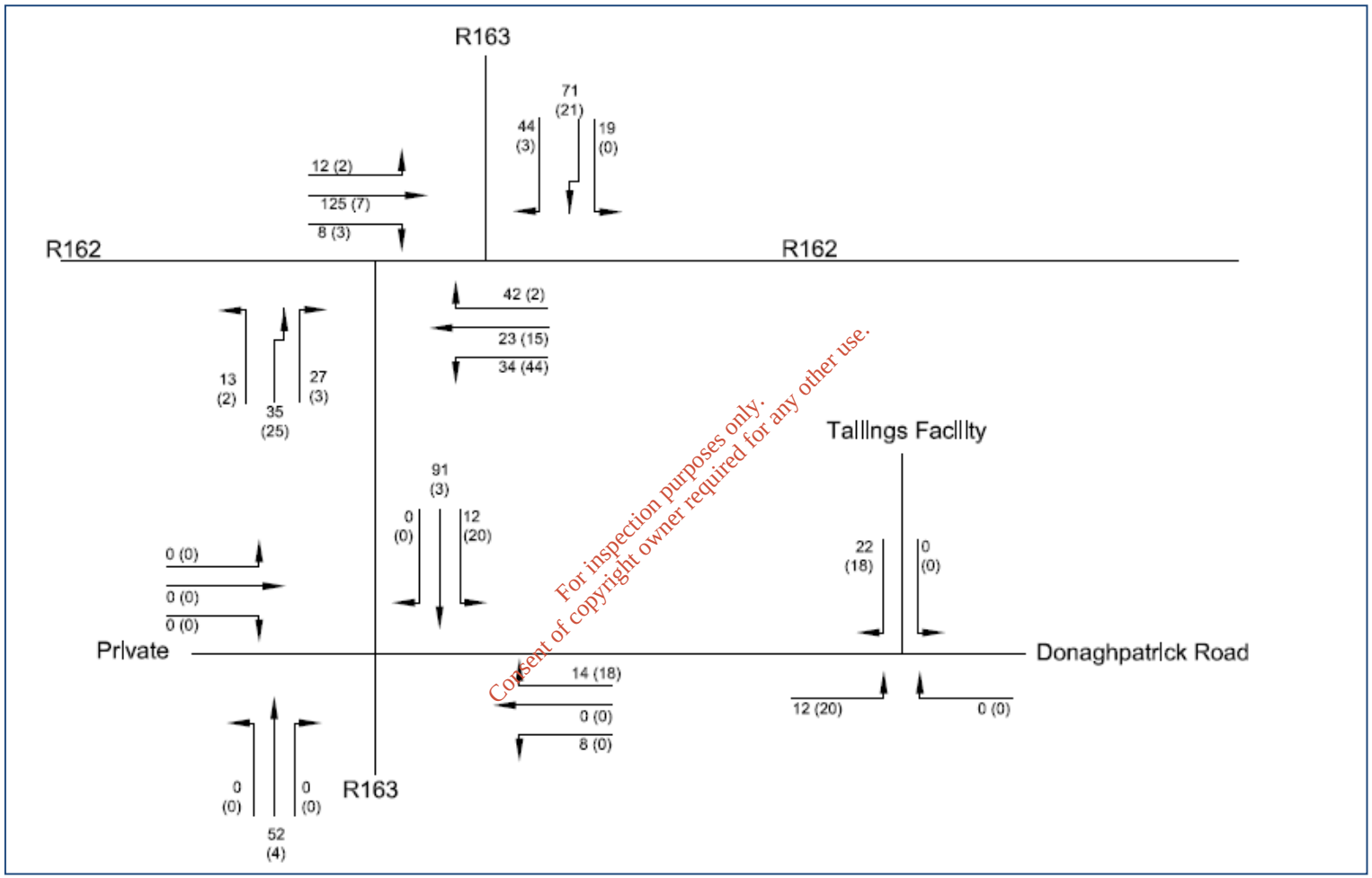
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.27 2015 Base-flow with generated traffic AM Peak (5.0 day working week, 40 Hours per Week)

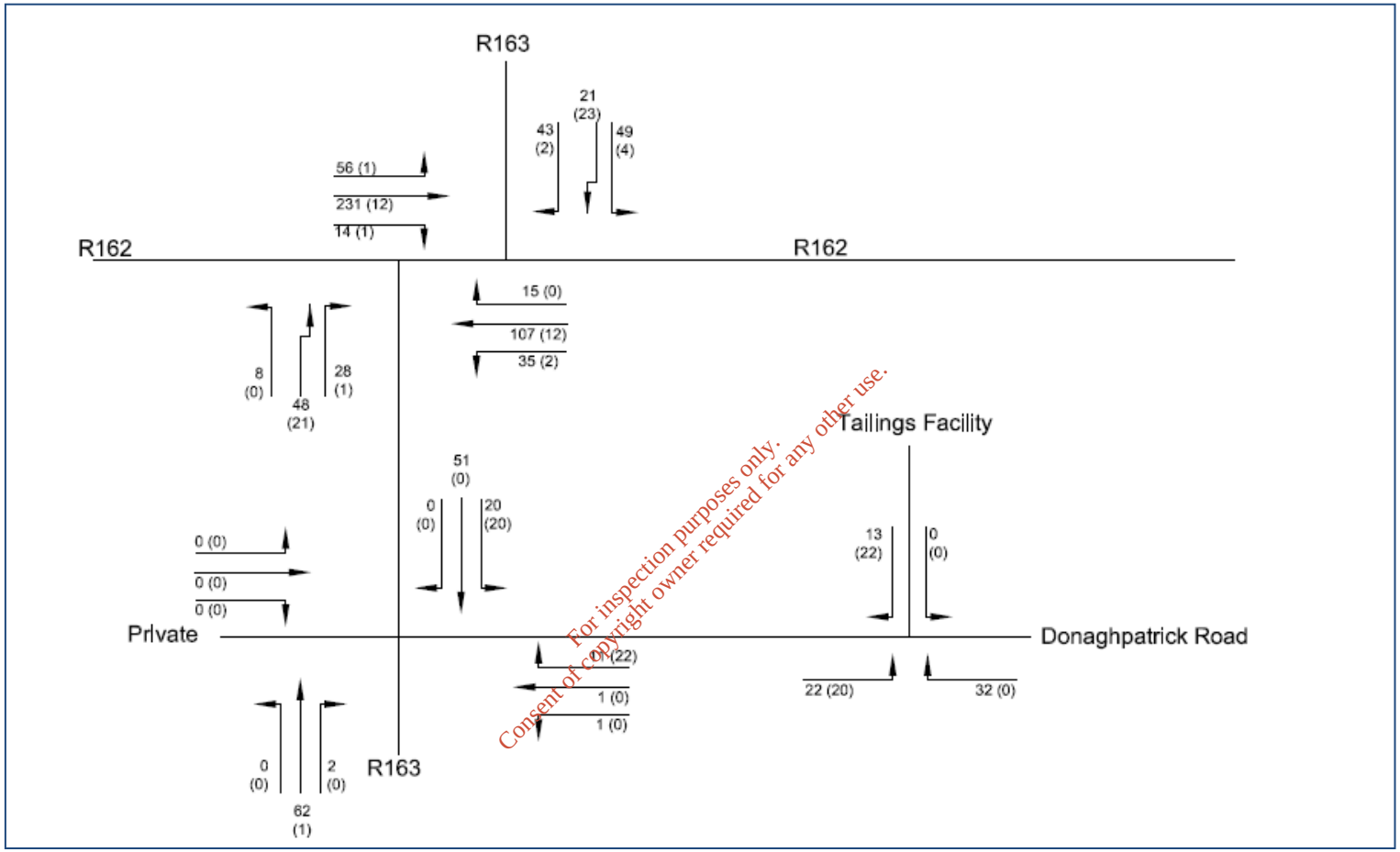
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.28 2015 Base-flow with generated traffic PM Peak (5.0 day working week, 40 Hours per Week)

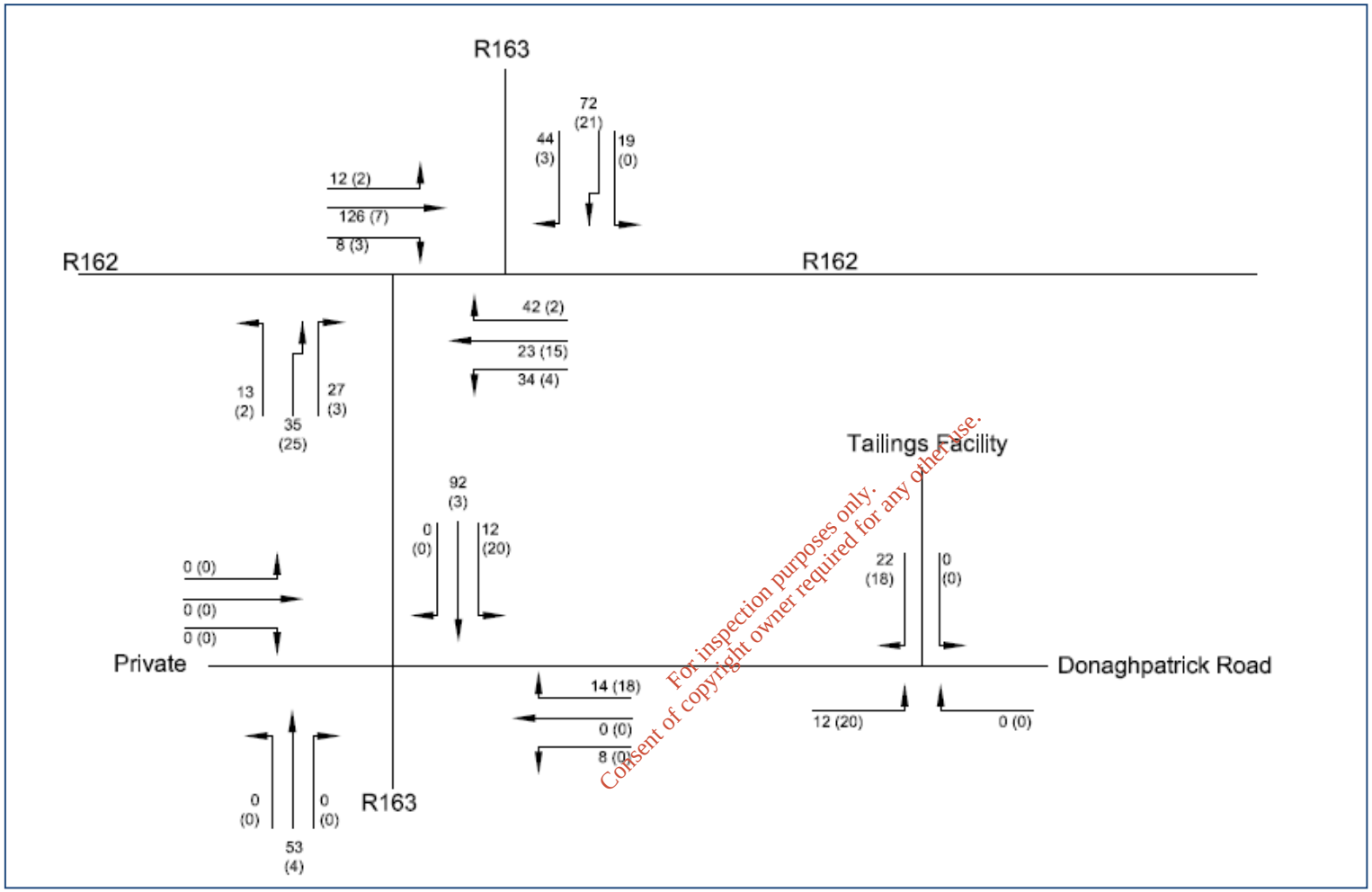
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.29 2016 Base-flow with generated traffic AM Peak (5.0 day working week, 40 Hours per Week)

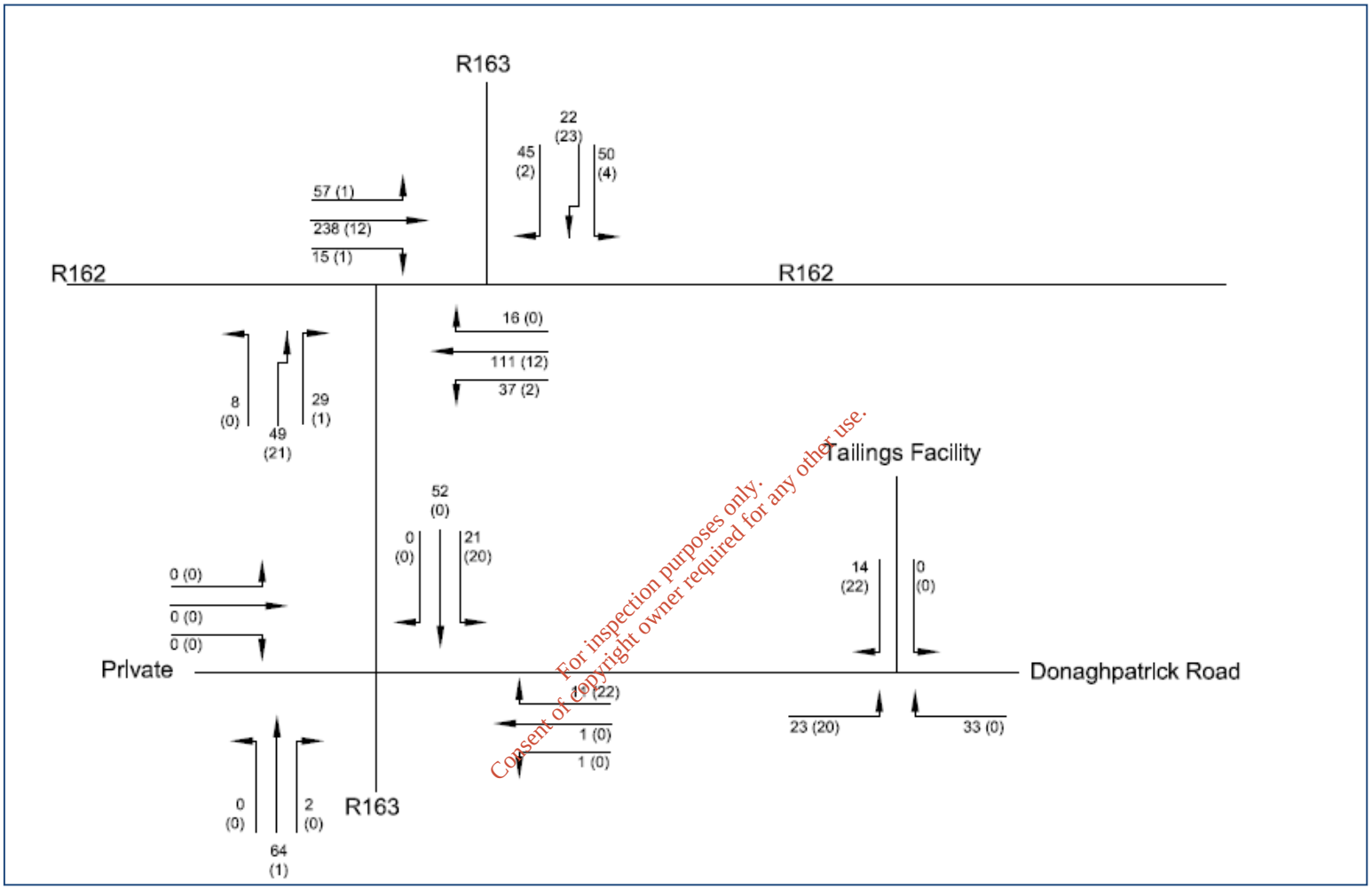
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.30 2016 Base-flow with generated traffic PM Peak (5.0 day working week, 40 Hours per Week)

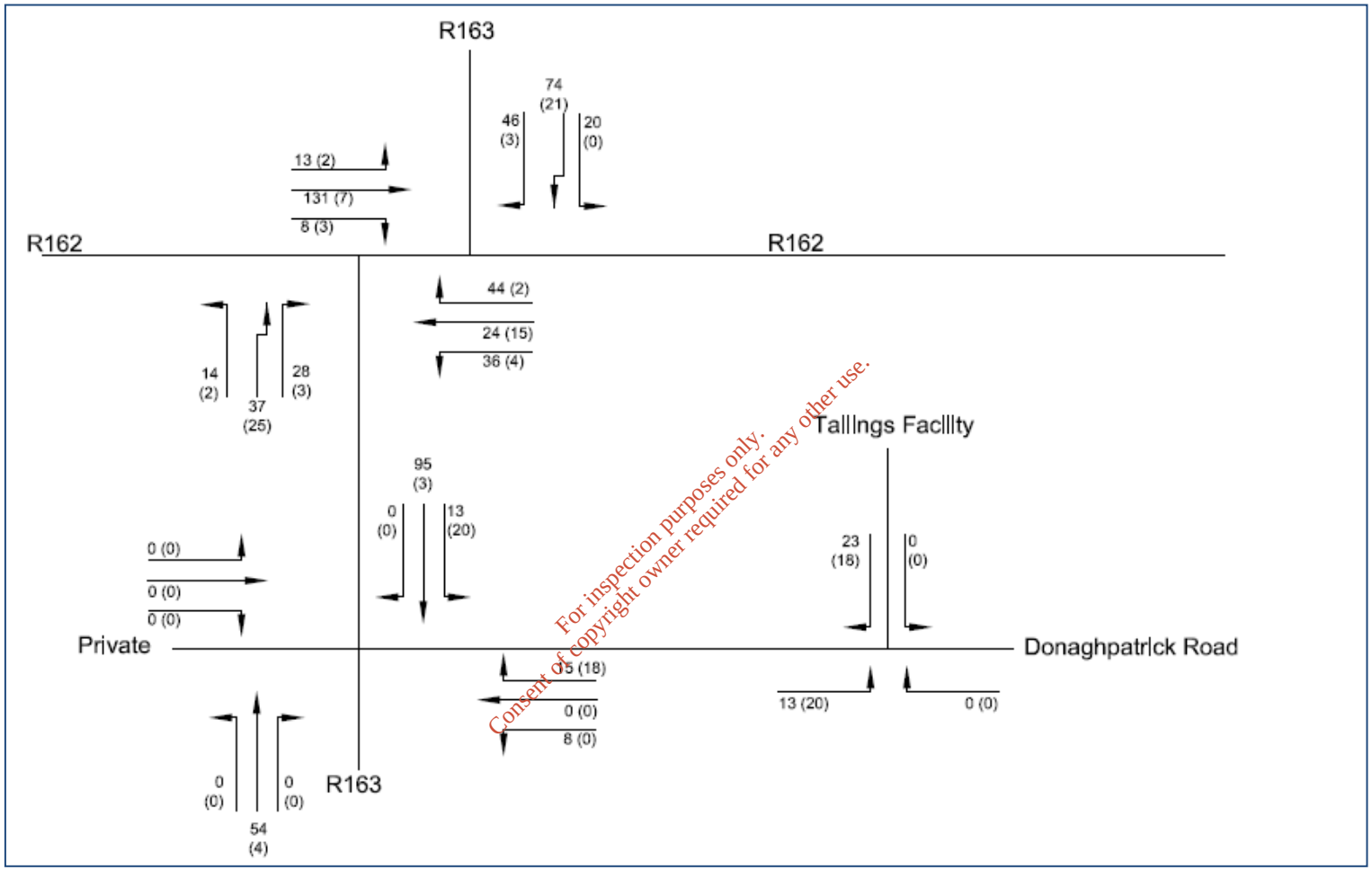
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.31 2019 Base-flow with generated traffic AM Peak (5.0 day working week, 40 Hours per Week)

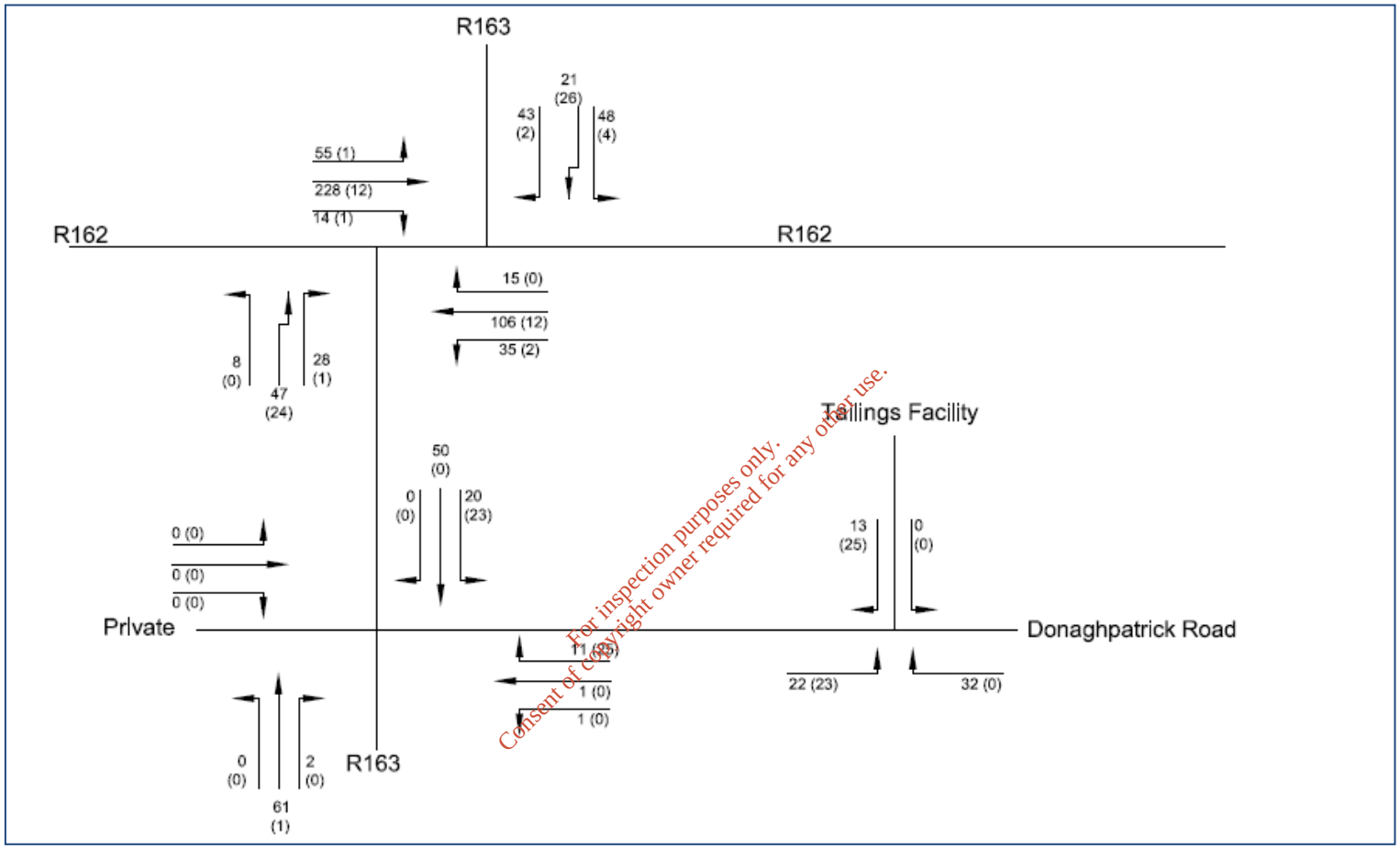
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.32 2019 Base-flow with generated traffic PM Peak (5.0 day working week, 40 Hours per Week)

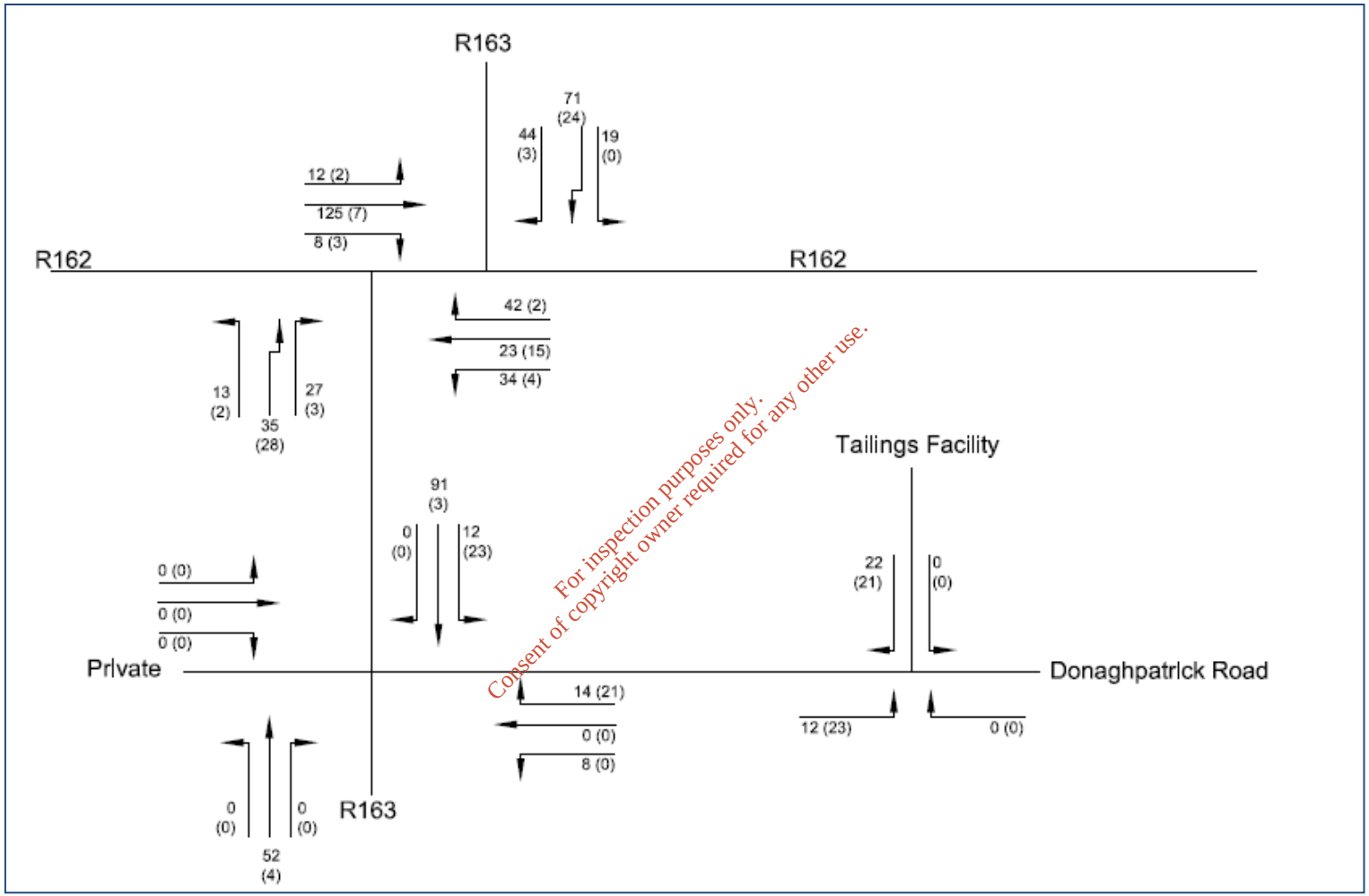
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.33 2015 Base-flow with generated traffic AM Peak (5.0 day working week, 35 Hours per Week)

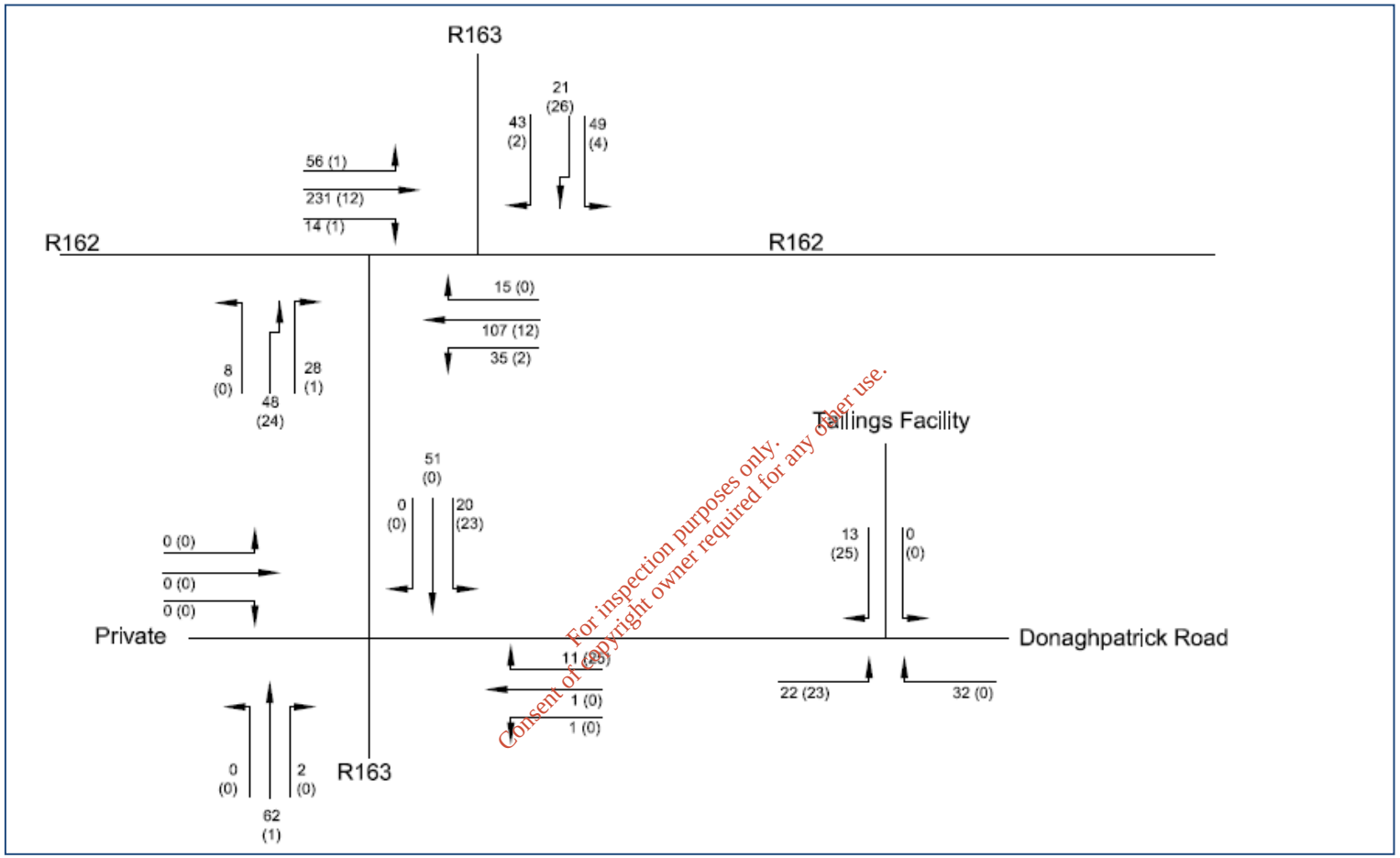
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.34 2015 Base-flow with generated traffic PM Peak (5.0 day working week, 35 Hours per Week)

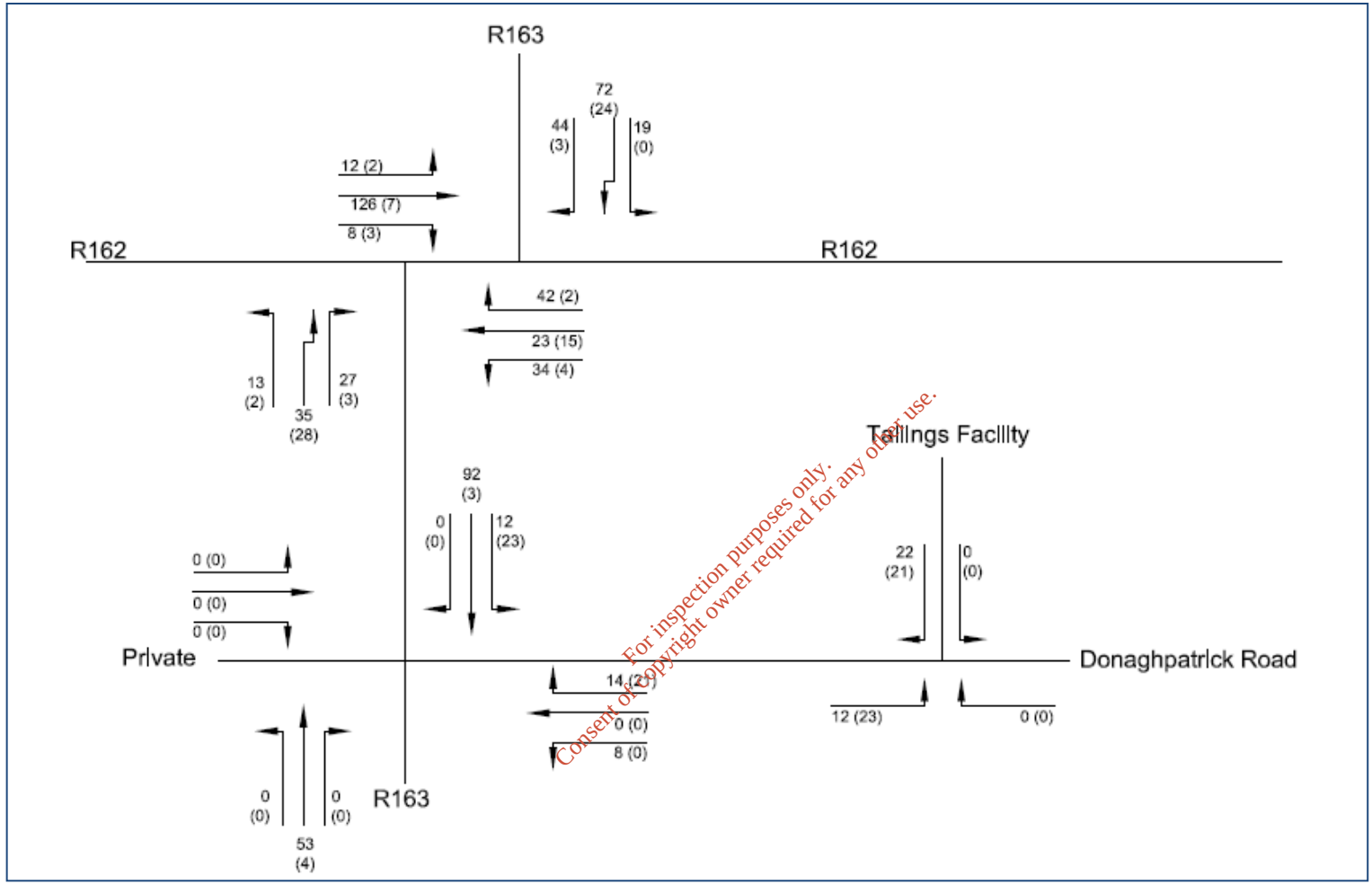
EPA Export 06-01-2017:02:02:13



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.35 2016 Base-flow with generated traffic AM Peak (5.0 day working week, 35 Hours per Week)

EPA Export 06-01-2017:02:02:13

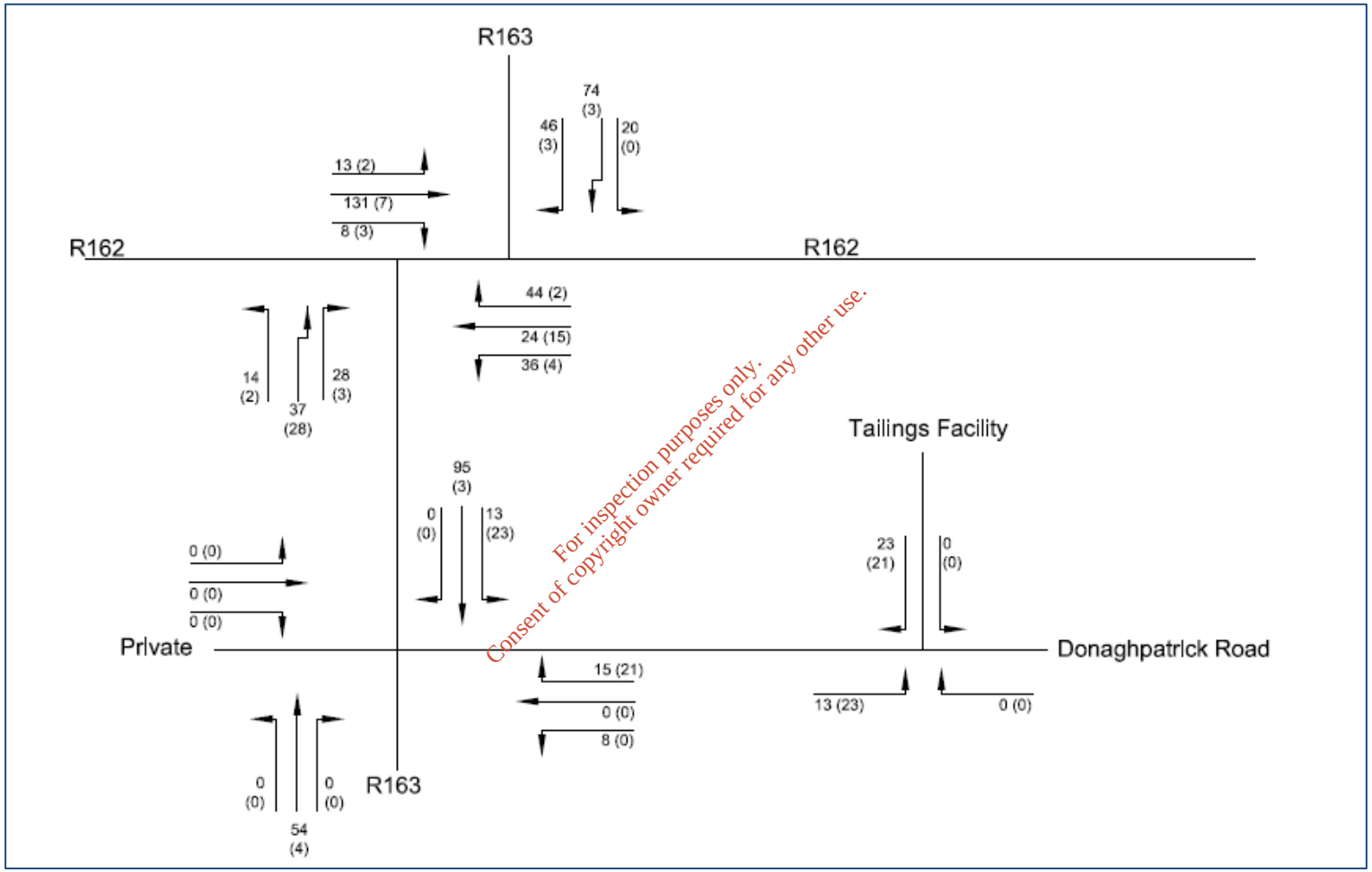


For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.36 2016 Base-flow with generated traffic PM Peak (5.0 day working week, 35 Hours per Week)

EPA Export 06-01-2017:02:02:13

Figure 7.37 – indicates the 2019Base-flowwith generated traffic AM Peak (5.0 day working week, 35 Hours per Week)



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 7.37 – 2019 Base-flow with generated traffic PM Peak (5.0 day working week, 35 Hours per Week)

EPA Export 06-01-2017:02:02:13

7.4 Road Impacts

7.4.1 Junction Analysis

7.4.1.1 Introduction and Methodology

The existing site access junction has been analysed using the Transport Research Laboratory (TRL) computer program PICADY, a widely accepted tool used for the analysis of priority junctions. This program has also been used to analyse the crossroads between the R163, L74141 Local Road and a private entrance and the staggered crossroads between the R163 and the R162.

The roundabout connecting the R162, N51 and the N3 link have been analysed using the Transport Research Laboratory (TRL) computer program ARCADY, which is widely used for the analysis of roundabouts.

The key parameters examined in the results of the analysis are the Ratio of Flow to Capacity Value (RFC value – desirable value should be no greater than 0.85 for PICADY or ARCADY, values over 1.00 indicate the approach arm is over capacity), the maximum queue length on any approach to the junction and the average delay for each vehicle passing through the junction during the modelled period.

Consent of copyright owner required for any other use. For inspection purposes only.

PICADY and ARCADY require the following input data:

- Basic modelling parameters (usually peak hour traffic counts synthesised over a 90 minute model period)
- Geometric parameters (including lane numbers & widths, visibility, storage provision etc)
- Traffic demand data (usually peak hour origin/destination table with composition of heavy goods vehicles input).

The results of the PICADY and ARCADY analysis are presented in section 7.5. The origin/destination traffic demand tables for all the different scenarios tested for the analysed junction are provided in Appendix 7.2.

7.4.1.2 Assessment Years

The performance of the junctions being assessed have been analysed for the critical AM and PM peak hours (see table 7.4) for the following peak scenarios:

- 5.0 day working week, 40 hours per week; and
- 5.0 day working week, 35 hours per week.

The years assessed have been determined based on the preliminary construction programme detailed as follows:

- Base Year 2015;
- On-going import of earthworks materials and start of sub-stage construction works in 2016; and
- Completion of construction activities in 2019.

EPA Export 06-01-2017:02:02:13

7.5 Analysis Results

The analysis results of the existing site access priority junction along the L74141 Local Road for the AM and PM peak hours are provided below in Table 7.4 Full outputs from PICADY are available upon request. This analysis has not been carried out for the non-construction periods as traffic using the access during these periods is low.

Table 7.4 PICADY Results: Proposed L74141 Priority Junction

PICADY RESULTS: JUNCTION 5 – SITE E - PROPOSED SITE ACCESS							
Year & Time	Arm A – L74141 Road East		Arm B – Site Access		Arm C – L74141 Road West		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2015 AM Peak - Baseline	0.00	0.0	0.05	0.0	0.06	0.1	9.63
2015 PM Peak - Baseline	0.00	0.0	0.05	0.1	0.00	0.0	7.57
2016 AM Peak - Baseline	0.00	0.0	0.05	0.1	0.06	0.1	9.54
2016 PM Peak - Baseline	0.00	0.0	0.05	0.1	0.00	0.0	7.57
2019 AM Peak - Baseline	0.00	0.0	0.05	0.1	0.06	0.1	9.58
2019 PM Peak - Baseline	0.00	0.0	0.05	0.1	0.00	0.0	7.59
2015							
2015 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.13	0.1	0.06	0.1	13.95
2015 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.13	0.1	0.00	0.0	12.08
2015 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.14	0.2	0.06	0.1	14.46
2015 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.14	0.2	0.00	0.0	12.62
2016							
2016 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.13	0.1	0.06	0.1	13.95
2016 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.13	0.1	0.00	0.0	12.08
2016 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.14	0.2	6.54	0.1	14.46

For inspection purposes only. Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:13

PICADY RESULTS: JUNCTION 5 – SITE E - PROPOSED SITE ACCESS							
Year & Time	Arm A – L74141 Road East		Arm B – Site Access		Arm C – L74141 Road West		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2016 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.14	0.2	0.00	0.0	12.62
2019							
2019 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.13	0.2	0.06	0.1	13.93
2019 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.13	0.1	0.00	0.0	12.03
2019 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.15	0.2	6.56	0.1	14.44
2019 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.14	0.2	0.00	0.0	12.52

The above results indicate that the site access will operate below its capacity during the construction phase of the project.

The analysis results of the crossroads between the R163, the L74141 Road and private access for the AM and PM peak hours are provided below in Table 7.5 Full outputs from PICADY are available upon request.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:13

Table 7.5 - PICADY Results: Crossroads between R163, L74141 Road and Private access

PICADY RESULTS: JUNCTION 1 – SITE A - CROSSROADS BETWEEN THE R163, L74141 ROAD AND A PRIVATE ACCESS									
Year & Time	Arm A –R163 East		Arm B – L74141 Road		Arm C – R163 West		Arm D – Private Access		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2015 AM Peak - Baseline	0.00	0.0	0.06	0.1	0.00	0.0	0.00	0.0	11.16
2015 PM Peak - Baseline	0.00	0.0	0.05	0.1	0.00	0.0	0.00	0.0	8.45
2016 AM Peak - Baseline	0.00	0.0	0.06	0.1	0.00	0.0	0.00	0.0	11.17
2016 PM Peak - Baseline	0.00	0.0	0.05	0.1	0.00	0.0	0.00	0.0	8.45
2019 AM Peak - Baseline	0.00	0.0	0.06	0.1	0.00	0.0	0.00	0.0	11.10
2019 PM Peak - Baseline	0.00	0.0	0.06	0.1	0.00	0.0	0.00	0.0	8.53
2015									
2015 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.15	0.2	0.00	0.0	0.00	0.0	16.62
2015 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.15	0.2	0.00	0.0	0.00	0.0	14.63
2015 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.17	0.2	0.00	0.0	0.00	0.0	17.19

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:13

PICADY RESULTS: JUNCTION 1 – SITE A - CROSSROADS BETWEEN THE R163, L74141 ROAD AND A PRIVATE ACCESS									
Year & Time	Arm A –R163 East		Arm B – L74141 Road		Arm C – R163 West		Arm D – Private Access		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2015 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.17	0.2	0.00	0.0	0.00	0.0	15.39
2016									
2016 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.15	0.2	0.00	0.0	0.00	0.0	16.53
2016 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.15	0.2	0.00	0.0	0.00	0.0	14.65
2016 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.17	0.2	0.00	0.0	0.00	0.0	17.21
2016 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.17	0.2	0.00	0.0	0.00	0.0	15.39
2019									

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:13

PICADY RESULTS: JUNCTION 1 – SITE A - CROSSROADS BETWEEN THE R163, L74141 ROAD AND A PRIVATE ACCESS									
Year & Time	Arm A –R163 East		Arm B – L74141 Road		Arm C – R163 West		Arm D – Private Access		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2019 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.15	0.2	0.00	0.0	0.00	0.0	16.56
2019 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.00	0.0	0.16	0.2	0.00	0.0	0.00	0.0	14.68
2019 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.17	0.3	0.00	0.0	0.00	0.0	17.24
2019 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.00	0.0	0.17	0.3	0.00	0.0	0.00	0.0	15.46

For inspection purposes only.
Consent of copyright owner required for any other use.

- **The above results indicate that where the junction will operate below capacity throughout the construction of the TMF.**

The analysis results for the Staggered Crossroads between the R162 and R163 for the AM and PM peak hours are provided below in Table 7.6 Full outputs from PICADY are available upon request.

EPA Export 06-01-2017:02:02:13

Table 7.6 - PICADY Results: Staggered Crossroads between R163 and R162 (Route 1)

PICADY RESULTS: JUNCTION 2 – SITE B - STAGGERED CROSSROADS BETWEEN THE R162 AND R163									
Year & Time	Arm A – R162 South		Arm B – R163 West		Arm C – R162 North		Arm D – R163 East		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2015 AM Peak - Baseline	0.03	0.0	0.21	0.3	0.04	0.0	0.30	0.4	11.63
2015 PM Peak - Baseline	0.09	0.1	0.21	0.3	0.03	0.0	0.34	0.5	11.99
2016 AM Peak - Baseline	0.03	0.0	0.21	0.3	0.04	0.0	0.31	0.4	11.68
2016 PM Peak - Baseline	0.09	0.1	0.21	0.3	0.03	0.0	0.34	0.5	12.04
2019 AM Peak - Baseline	0.03	0.0	0.30	0.4	0.04	0.0	0.31	0.5	13.60
2019 PM Peak - Baseline	0.09	0.1	0.22	0.3	0.03	0.0	0.36	0.5	12.38
2015									
2015 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.03	0.0	0.3	0.4	0.04	0.0	0.31	0.5	13.60
2015 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.09	0.1	0.29	0.4	0.03	0.0	0.35	0.5	12.57
2015 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.03	0.0	0.32	0.5	0.04	0.0	0.32	0.5	14.22
2015 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.09	0.1	0.31	0.4	0.03	0.0	0.35	0.5	13.43
2016									

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:13

PICADY RESULTS: JUNCTION 2 – SITE B - STAGGERED CROSSROADS BETWEEN THE R162 AND R163									
Year & Time	Arm A – R162 South		Arm B – R163 West		Arm C – R162 North		Arm D – R163 East		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2016 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.03	0.0	0.30	0.4	0.04	0.0	0.32	0.5	13.57
2016 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.09	0.1	0.29	0.4	0.03	0.0	0.35	0.5	12.80
2016 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.03	0.0	0.32	0.5	0.04	0.0	0.32	0.5	14.31
2016 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.09	0.1	0.30	0.4	0.03	0.0	0.35	0.5	13.27
2019									
2019 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.04	0.0	0.31	0.5	0.04	0.1	0.33	0.5	13.82

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:13

PICADY RESULTS: JUNCTION 2 – SITE B - STAGGERED CROSSROADS BETWEEN THE R162 AND R163									
Year & Time	Arm A – R162 South		Arm B – R163 West		Arm C – R162 North		Arm D – R163 East		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2019 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.10	0.1	0.30	0.4	0.03	0.0	0.37	0.6	13.00
2019 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.04	0.0	0.33	0.5	0.04	0.1	0.33	0.5	14.53
2019 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.10	0.1	0.31	0.4	0.03	0.0	0.37	0.6	13.32

For inspection purposes only.
Consent of copyright owner required for any other use.

- **The above results indicate that the staggered crossroads will operate below capacity throughout the construction stage for route 1.**

EPA Export 06-01-2017:02:02:13

Table 7.7 - PICADY Results: Staggered Crossroads between R163 and R162 (Route 2)

PICADY RESULTS: JUNCTION 2 – SITE B - STAGGERED CROSSROADS BETWEEN THE R162 AND R163									
Year & Time	Arm A – R162 South		Arm B – R163 West		Arm C – R162 North		Arm D – R163 East		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2015 AM Peak - Baseline	0.03	0.0	0.21	0.3	0.04	0.0	0.30	0.3	10.13
2015 PM Peak - Baseline	0.09	0.1	0.21	0.3	0.03	0.0	0.34	0.5	11.99
2016 AM Peak - Baseline	0.03	0.0	0.21	0.3	0.04	0.0	0.31	0.3	10.19
2016 PM Peak - Baseline	0.09	0.1	0.21	0.3	0.03	0.0	0.34	0.5	12.04
2019 AM Peak - Baseline	0.03	0.0	0.22	0.3	0.04	0.0	0.32	0.3	12.04
2019 PM Peak - Baseline	0.09	0.1	0.22	0.3	0.03	0.0	0.36	0.5	12.38
2015									
2015 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.03	0.0	0.3	0.4	0.04	0.0	0.40	0.7	15.53
2015 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.09	0.1	0.29	0.4	0.03	0.0	0.43	0.7	15.61
2015 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.03	0.0	0.32	0.5	0.04	0.0	0.42	0.7	16.26

For inspection purposes only. Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:13

PICADY RESULTS: JUNCTION 2 – SITE B - STAGGERED CROSSROADS BETWEEN THE R162 AND R163									
Year & Time	Arm A – R162 South		Arm B – R163 West		Arm C – R162 North		Arm D – R163 East		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2015 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.09	0.1	0.30	0.4	0.03	0.0	0.44	0.8	16.22
2016									
2016 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.03	0.0	0.31	0.4	0.04	0.0	0.40	0.7	15.61
2016 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.09	0.1	0.29	0.4	0.03	0.0	0.43	0.8	15.71
2016 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.03	0.0	0.32	0.5	0.04	0.0	0.42	0.7	15.58
2016 PM Peak + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.09	0.1	0.30	0.4	0.03	0.0	0.45	0.8	16.33
2019									

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:13

PICADY RESULTS: JUNCTION 2 – SITE B - STAGGERED CROSSROADS BETWEEN THE R162 AND R163									
Year & Time	Arm A – R162 South		Arm B – R163 West		Arm C – R162 North		Arm D – R163 East		Maximum Delay (s)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2019 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.04	0.0	0.27	0.4	0.04	0.1	0.42	0.7	15.92
2019 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.09	0.1	0.30	0.4	0.03	0.0	0.45	0.8	16.23
2019 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.04	0.0	0.33	0.5	0.04	0.0	0.43	0.8	16.16
2019 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.09	0.1	0.32	0.5	0.03	0.0	0.46	0.8	16.90

For inspection purposes only.
Consent of copyright owner required for any other use.

- ***The above results indicate that the staggered crossroads will operate below capacity throughout the construction stage for route 2.***

EPA Export 06-01-2017:02:02:13

The analysis results of the Roundabout connecting the R162, N51 and N3 link for the AM and PM peak hours are provided below in Table 7.8 Full outputs from ARCADY are available upon request.

Table 7.8 - ARCADY Results: Roundabout connecting R162, N51 and N3 Link

ARCADY RESULTS: JUNCTION 3 – SITE C -EXISTING ROUNDABOUT BETWEEN THE N3 LINK, N51 AND R162									
Year & Time	Arm A – N51 West (N3 Link)		Arm B – R162		Arm C – N51 North		Arm D – N51 South		Average Delay (min/veh)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2015 AM Peak - Baseline	0.41	0.7	0.78	3.4	0.75	2.9	0.40	0.7	18.69
2015 PM Peak - Baseline	0.83	4.4	0.43	0.8	0.48	0.9	0.51	1.0	27.58
2016 AM Peak - Baseline	0.41	0.7	0.79	3.6	0.77	3.1	0.41	0.7	19.83
2016 PM Peak - Baseline	0.85	5.1	0.45	0.8	0.48	0.9	0.53	1.1	31.94
2019 AM Peak - Baseline	0.43	0.7	0.82	4.4	0.81	3.9	0.43	0.8	24.21
2019 PM Peak - Baseline	0.89	6.9	0.47	0.9	0.50	1.0	0.55	1.2	42.38
2015									
2015 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.45	0.8	0.82	4.2	0.77	3.2	0.41	0.7	20.70
2015 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.89	7.0	0.48	0.9	0.49	0.9	0.53	1.1	43.23

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:13

ARCADY RESULTS: JUNCTION 3 – SITE C -EXISTING ROUNDABOUT BETWEEN THE N3 LINK, N51 AND R162									
Year & Time	Arm A – N51 West (N3 Link)		Arm B – R162		Arm C – N51 North		Arm D – N51 South		Average Delay (min/veh)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2015 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.45	0.8	0.83	4.5	0.78	3.3	0.41	0.7	21.42
2015 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.90	7.4	0.49	0.9	0.49	1.0	0.53	1.1	45.73
2016									
2016 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.46	0.8	0.83	4.5	0.78	3.4	0.41	0.7	21.96
2016 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.90	7.5	0.49	1.0	0.49	1.0	0.54	1.2	46.46
2016 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.42	0.8	0.84	4.8	0.79	3.5	0.42	0.7	22.77

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:13

ARCADY RESULTS: JUNCTION 3 – SITE C -EXISTING ROUNDABOUT BETWEEN THE N3 LINK, N51 AND R162									
Year & Time	Arm A – N51 West (N3 Link)		Arm B – R162		Arm C – N51 North		Arm D – N51 South		Average Delay (min/veh)
	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	RFC Value	Max Queue Length	
2016 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.91	8.1	0.49	1.0	0.50	1.0	0.54	1.2	49.88
2019									
2019 AM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.47	0.9	0.86	5.5	0.83	4.4	0.44	0.8	27.58
2019 PM + Construction (5.0 Day Working Week, 40 Hours Per Week)	0.95	11.1	0.51	1.0	0.51	1.0	0.56	1.3	65.32
2019 AM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.48	0.9	0.86	5.6	0.83	4.4	0.44	0.8	27.82
2019 PM + Construction (5.0 Day Working Week, 35 Hours Per Week)	0.96	12.2	0.51	1.0	0.52	1.1	0.56	1.3	71.11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

The above results indicate that this roundabout is currently operating above the desirable minimum RFC value of 0.85, but below capacity during the PM peak hour. This will remain the case during the periods where construction traffic generated relating to the TMF is at its heaviest. The AM peak hour flows are currently below the desirable minimum RFC value.

Traffic attributable to the TMF makes up a very small percentage of the total volume of traffic using this roundabout and by comparing the Base-flow figures it can be seen that main reason the roundabout approaches capacity is due to the expected growth in traffic added by means of the growth factors identified in section 4.4. Traffic generated by the TMF is also temporary in nature and subsequent to the completion of the peak construction period for stage 6 in 2019, there will be little traffic attributable to the TMF using the roundabout.

7.6 Link Capacity

A link capacity assessment for the TMF Access Road, L74141 Local Road, R163 and the R162 were undertaken. RT180 Geometric Design Guidelines were gives a means of estimating the link capacity of rural roads.

Consent of copyright owner required for any other use. For inspection purposes only.

For the purposes of classification of Road Type, the Access Road to the TMF has a carriageway width of approximately 6.7m wide with 0% visibility greater than 460m and obstructions on one side.

This gives a two way capacity of 560 vehicles per hour. The maximum flow expected to be experienced during the construction is 209 PCU per hour which will be experienced during the AM peak hour in 2019 (5.0 Day Working Week, 43 Hour Week). This would indicate that the access road has sufficient capacity to cater for the increase in traffic generated during the construction period.

For the purposes of classification of Road Type, the section of the L74141 Local Road has a carriageway width of 5m wide with 0% visibility greater than 460m and obstructions on both sides. This gives a two way capacity of 495 PCU per hour. The maximum flow expected to be experienced during the construction is 209 PCU per hour which will be experienced during the AM peak hour in 2019 (5.0 Day Working Week, 43 Hour Week). This would indicate that the L74141 Local Road has sufficient capacity to cater for the increase in traffic generated during the construction period.

For the purposes of classification of Road Type, the R163 has been classified as a 6m wide road with 0% forward sight distance greater than 460m and no obstructions. This gives a two way capacity of 600 PCU per hour. The maximum flow expected to be experienced during the construction is 331 PCU which will be experienced during the PM peak hour in 2019 (5.0 Day Working Week, 43 Hour Week). This would indicate that the R163 has sufficient capacity to cater for the increase in traffic generated by the construction.

For the purposes of classification of Road Type, the R162 from the junction with the R163 for approximately 4km in the direction of Navan has been classified as a 7m

EPA Export 06-01-2017:02:02:14

wide road with 60% forward sight distance greater than 460m and no obstructions. This gives a two way capacity of 1025 vehicles per hour. The maximum flow expected to be experienced during the construction is 903 PCU which will be experienced during the AM peak hour in 2019 (5.0 Day Working Week, 43 Hour Week). This would indicate that this section of the R162 has sufficient capacity to cater for the increase in traffic generated by the construction.

For the purposes of classification of Road Type, the remaining 1.5km of the R162 travelling to the roundabout has been classified as a 7.5m wide road with 20% forward sight distance greater than 460m and no obstructions. Due to the proximity to Navan it is assumed that Level of Service D is to be provided. This gives a two way capacity of 1500 vehicles per hour. The maximum flow expected to be experienced during the construction is 1181 PCU which will be experienced during the AM peak hour in 2019 (5.0 Day Working Week, 43 Hour Week). This would indicate that this section of the R162 has sufficient capacity to cater for the increase in traffic generated by the construction.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

7.7 Impacts related to traffic

7.7.1 Road Safety

As stated in section 3.2, visibility at the site access is restricted by existing vegetation. It is recommended that vegetation be cut back to provide a visibility splay of 3.0 x 160m in accordance with the NRA DMRB. As previously noted, advanced signage has been erected in accordance with Section 8 of the DoT's 'Traffic Signs Manual' to warn motorists of an entrance to a construction site is in operation.

7.7.2 Pedestrians

In general, there is little provision of pedestrian facilities along routes that will be used by construction traffic associated with the development until the approach to Navan where the streetscape is more urban in nature. The increase in traffic will not have effect on these facilities other than a slight potential increase in delay for pedestrians wishing to cross the road. Any increase in delay for pedestrians wishing to cross would be quite minor.

Consent of copyright owner required for any other use. For inspection purposes only.

7.7.3 Sensitive Locations

It should be noted that an existing National School is situated along the R163. Construction traffic travelling along this section of carriageway will be subject to the same speed limit of 50 km/h. In addition, construction related traffic will be restricted from travelling along this route during peak school times in order to facilitate drop offs and pick-ups at the school.

EPA Export 06-01-2017:02:02:14

7.8 Conclusions and recommendations

The conclusions to this report are as follows:

- Traffic generated by the construction of stage 6 of the TMF are temporary in nature and will occurring between 2016 and 2019. Traffic generated by the proposed works will be consistent throughout the construction of stage 6;
- A significant amount of HGV traffic will be generated by the TMF extension. The amount of employee traffic generated is low and will contribute less than 10% of flows at the junctions analysed other than the access to the TMF;
- The above assessments are deemed worst case scenario as base traffic utilised in this assessment includes for existing construction traffic of stage 5 of the facility;
- During the assessment years the site access will operate below capacity;
- During the assessment years the crossroad junction between the R163, L74141 Road and a private access will operate below capacity;
- During the assessment years the staggered crossroads between the R162 and R163 will operate below capacity.
- During the assessment years the roundabout between the N3 Link, the N51 and the R162 will operate above capacity in both the AM and PM time periods. It should be noted that this roundabout is currently operating above the desirable minimum RFC value and while the addition of construction traffic will contribute to the roundabout further exceeding this value, expected background traffic growth will have a larger impact.

Consent of copyright owner required for any other use. For inspection purposes only.

It is recommended that:

- Vegetation at the entrance to the site be cut back to ensure sufficient sight lines are available to traffic using the access.
- Appropriate signage informing traffic of the presence of the site entrance should be installed and maintained throughout the construction period.
- A Construction Stage Traffic Management Plan be prepared by the appointed contractor in conjunction with the local authority to address construction related traffic issues including pavement condition surveys, sensitive locations and working times.

EPA Export 06-01-2017:02:02:14

Section 8 Water

8.1 Introduction

This hydrological and hydrogeological section of the EIS relates to the proposed development:

- It is proposed to extend the existing TSF laterally in a northerly direction.
  - Here after the proposed facility will be referred to as *TSF Stage 6*.
  - The proposal facility will cover a footprint area of c. 58 hectares, extend to a height of 22 m above ground level and will provide a potential a storage volume of approximately 9.6 million cubic metres [13.6 million tonnes].
- The second part of the proposed development is the construction of an Integrated Constructed wetland (ICW). The proposal facility will cover a footprint area of c. 12 hectares. The function of the wetland is to provide a passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle. Treated water will discharge from the ICW to the river Blackwater via a buried HDPE pipeline.

For inspection purposes only. Consent of copyright owner required for any other use.

The walls and foundations are constructed from the Quaternary glacial till (which underlies the site) to reduce the potential amount of seepage from the overburden material (tailings) into groundwater and adjacent surface watercourses.

An interceptor channel close to the base of the dam captures vertical and horizontal seepage. Seepage water collected in the interceptor channel is then pumped back up to the TMF (tailings pond) from pumps with automated level controls, located at intervals around the interceptor channel. By returning seepage back to the TMF, a closed water cycle system operates which helps to protect the local water environment.

The proposed Stage 6 extension is similar in design to the previous Stages and therefore many of the potential hydrological and hydrogeological issues remain the same.

Two main differences are that Stage 6 is a lateral extension so would affect surface water hydrology and secondly the facility would be lined which would minimise seepage.

Since the previous EISs were produced in 1996 and 2009 and the Stage 4 and Stage 5 raises approved, a water monitoring programme had been in place at the TMF. An annual water quality monitoring review is undertaken independently and submitted for approval in accordance with the IE licence. The data collected as part of the

EPA Export 06-01-2017:02:02:14

monitoring programme provides a baseline against which the likely environmental impact of the Stage 6 extension is assessed.

8.1Scope of the Assessment

This Environmental Impact Assessment (EIA) assesses the potential impacts of the proposed developments and the combined effects of the proposed and the existing facility on the water environment.

The scope of the assessment is outlined below:

- A baseline assessment of hydrology and hydrogeology;
- A hydrological and hydrogeological impact assessment covering construction, operation and closure phases;
- Residual effects and mitigation;
- Monitoring recommendations;
- A preliminary flood risk assessment; and
- A Water Framework Directive (WFD) assessment.

8.1.2Policy and Legislative Context

For inspection purposes only.
Consent of copyright owner required for any other use.

An Environmental Impact Assessment (EIA) is required under the European Communities Directive 85/337/EEC (as amended by Directive 97/11/EC and Article 3 of 2003/35/EC), to ensure that projects which are likely to have significant effects on the environment are subject to a comprehensive assessment of environmental effects prior to development consent being given. An EIA is the overall process for anticipating and assessing the effects on the environment caused by a particular development. An EIA is subsequently produced and constitutes the main documentary output of the EIA process. Where environmental effects are identified that are unacceptable, these can then be avoided or reduced during the design process.

8.1.3Assessment Methodology

The methodology adopted for undertaking this EIA is based on the requirements of the EC Directive (85/337/EEC), as amended by Directives 97/11/EC and Article 3 of 2003/35/EC, known as the EIA Directive.

The approach uses a source – pathway - receptor methodology. This identifies the potential sources or 'causes' of effect as well as the receptors (water resources) that could potentially be affected. The presence of a potential effect and a potential receptor does not always infer an effect; there needs to be a clear mechanism or 'pathway' via which the source can have an effect on the receptor.

The causes or 'sources' of potential impact have been identified through a review of the design details for the Stage 6 extension, including the size and nature of the development, potential construction methodologies and timescales. This has been

EPA Export 06-01-2017:02:02:14

undertaken in the context of local conditions relative to water resources near the site, such as topography, geology, climatic conditions and potential sources of contamination.
The identification of potential water receptors has been undertaken through a review of the baseline data, site walkovers and previous EIAs.
The significance of effect depends on the sensitivity of the receptor and the magnitude of effect. Once significance is established, mitigation measures can be developed to counteract significant adverse effects.

8.2 Description of the Proposed Development

8.2.1 Stage 6 Design

The proposed Stage 6 extension to the TMF would be an extension of the existing facility northwards into the borrow areas (Figure 1-1). The conceptual design for the Stage 6 TMF has been carried out by Golder Associates and is described in detail in the design report (Golder Associates, 2015).

A composite lining system would be in place which consists of a high density polyethylene (HDPE) geomembrane over a geosynthetic clay liner (GCL). The lining system would be placed on the upstream slopes of the dam wall and basin area.
Drainage System

The existing drainage system within the TMF would be modified to accommodate the extra storage capacity provided by Stage 6, but the previous system would still operate as designed for the Stage 5 raise.
No chimney drainage system is provided for this structure, but a downstream drainage blanket (Type D1), 1 m thick, would be incorporated in the downstream dam sector and at the base of the dam wall and a sector of the downstream toe would be constructed from Type D2 (downstream fill) material.
In the Stage 6 footprint the existing drainage systems in the borrow area would be backfilled with Type D1 material to prevent ponding during placement of the lining system. Over this period the area would be drained by channels and discharged after settlement into the Yellow River. The existing northern dam wall interceptor channel would also be backfilled after a 300 mm diameter perforated pipe is installed into the base of the perimeter interceptor channel on a bedding of Type C material (Protection material). Blake's stream would be diverted to the west to the north of the Stage 6 footprint within a new interceptor channel that will discharge to the Yellow River around 380 m upstream of the existing discharge location.

Following the current arrangements, once operational, a closed water system would operate for Stage6, as shown in fiure 8.2.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:14

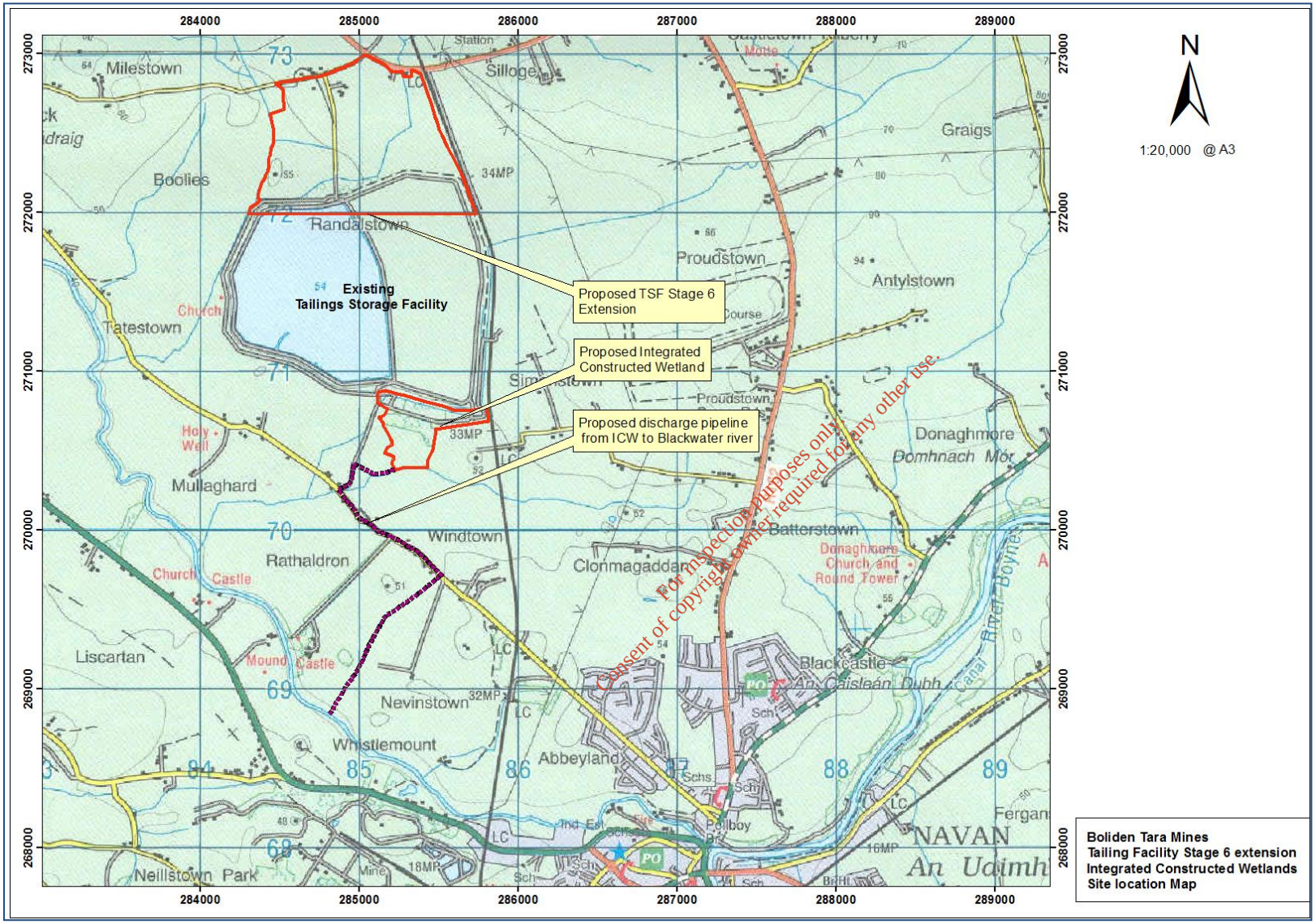


Figure 8.1 Site location map

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

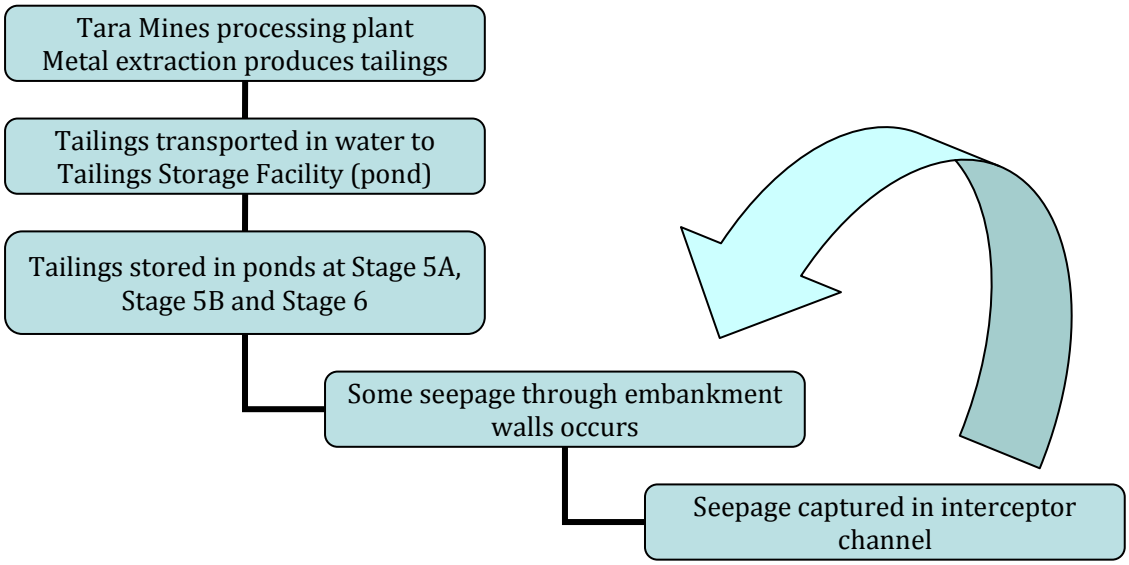


Figure 8.2 TSF Water management cycle

The TMF perimeter dam used for tailings storage is operated without spillways. At closure, Stage 6 closure spillways would be required to control water levels and discharges. The proposed design for water management would be similar to that proposed for Stage 5 closure which involves the use of a spillway system connected to the interceptor channel. This would divert water to a wetland area for water treatment prior to discharge into the local river system as described in the Scott Wilson EIS (Scott Wilson, 2009). The spillway would be located and designed in detail closer to the end of the life of the Stage 6 facility.

For inspection purposes only.
Consent of copyright owner required for any other use.

8.3 Hydrology and Hydrogeology Baseline Assessment

8.3.1 Hydrology

There is a long term record of rainfall from the rain gauge at Tara Mines which has daily rainfall data from 1987 to 2014. As of 1st October 2013, rainfall data has been sourced from an automatic meteorological station recording from midnight to midnight. The average annual rainfall recorded between 1987 and 2014 is 880.9 mm. The probable maximum precipitation (PMP) for the TMF area would be in the order of 250 mm over 24 hours (Golder Associates, 2015).

Surface Watercourses

The Tailings Management Facility (TMF) is bounded by the Yellow River to the west, the Simonstown Stream to the east and the Blackwater River to the south. There are also two smaller streams, the Duog to the south east and Blake's stream to the north (Figure 8-3-1). These surface water courses are tributaries in the Boyne catchment, which lies within Ireland's Eastern River Basin District (ERBD), as designated under

EPA Export 06-01-2017:02:02:14

the European WFD. The ERBD incorporates the majority of County Meath and all or part of 12 other counties, covering approximately 6,300 km^2 and equal to a tenth of Ireland's land mass.

The Boyne catchment area constitutes Hydrological Area 07 within the ERBD and is made up of 89% agricultural land use, with the majority as pasture. The rivers and streams surrounding the TMF at Randalstown have been classified overall as 'at risk' of pollution from various sources, along with most of the Boyne catchment.
The current TMF area is approximately 1.6 km^2, with Stage 6 the total area would be approximately 2 km^2 making up around 10% of the Simonstown Stream catchment area and 2% of the Yellow River sub-catchment areas. The Yellow River flows southwards towards the Blackwater River draining an area of 38.1 km^2 north and north-west of the dam. Blake's Stream, to the north of the dam, is a tributary of the Yellow River.

The Yellow River has an overall status as poor due to macroinvertebrate and ecological status. The general physic-chemical status of the river is good. The Yellow River is at risk due to diffuse sources and channelisation. The WFD objective for this river is to achieve a 'good status' by 2021.

The Simonstown stream, to the east, has a smaller catchment area of 9.7 km^2 and used to flow beneath what is now the Stage 1 and 2 embankments. In 1977 the stream was diverted into a trapezoidal channel which runs parallel to the interceptor channel around the south eastern corner of the TMF.

Consent of copyright owner required for any other use. For inspection purposes only.

The Simonstown Stream returns to its original course near the TMF access road to the south before combining with the Duog and continuing westward toward the confluence with the Blackwater River.

The Blackwater River at Liscartan, downstream of inflow from the Yellow River and Randalstown stream, drains a total catchment area of 717 km^2 and follows a meandering south easterly course towards the confluence with the River Boyne east of Navan.

The Blackwater River in this area has a moderate status due to ecological and general physico-chemical status. The macroinvertebrate status is classed as good. This river is at risk due to channelisation. The WFD objective for this river is to restore the protected areas to a 'good status' by 2021.

EPA Export 06-01-2017:02:02:14

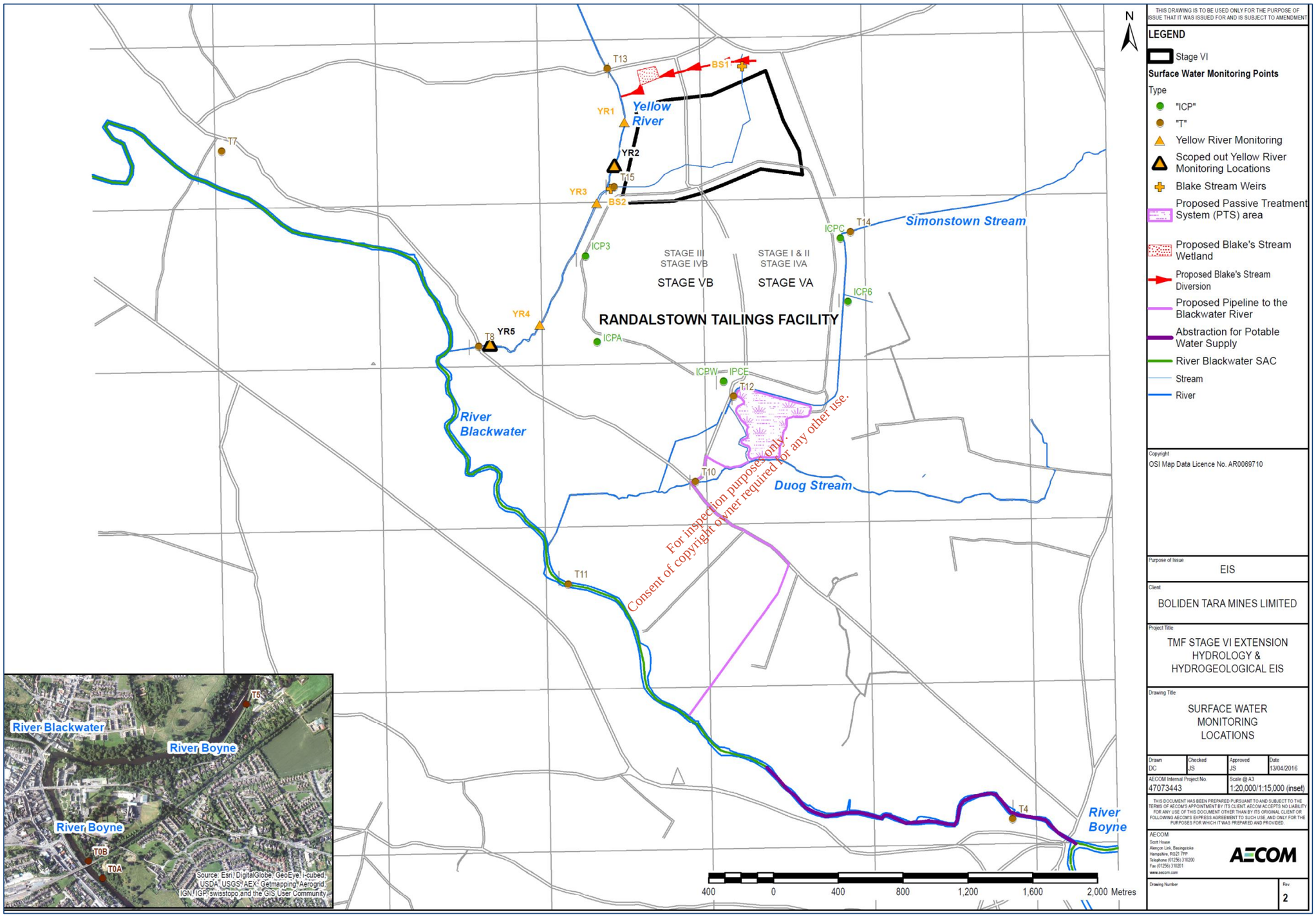


Figure 8.3 Surface water network

EPA Export 06-01-2017:02:02:14

8.3.2 Geology and Hydrogeology

Bedrock

The bedrock of the local area comprises Carboniferous strata incorporating the Pale Beds (Meath Formation) , Mixed Beds (Liscarton Formation) and Red Beds (Old Red Sandstone) underlain unconformably by the Lower Palaeozoic sequence (Rathkenny Formation). The TMF and the surrounding areas to the north and east are dominated by the Pale Beds and Lower Palaeozoic sequence. To the south and east the Shaley Pales (Moathill Formation) appear along with the Upper Dark Limestone (Ballysteen Formation).
The TMF is located in an area of major faults as shown on the bedrock geology map (Figure 8.4), mainly trending north-east to south-west. There is another fault that runs perpendicular to the major faults (north-west to south-east) and a smaller one in the north that trends east-west. Other bedrock in the area is made up of the Argillaceous Bioclastic Limestone to the east and some Mixed Beds in the south-east and south-west of the TMF.

Superficial Deposits

There are approximately 10 m of superficial deposits overlying the Bedrock however this thickness varies across the region. The superficial deposits are made up mainly of Boulder Clays and Boulder Silts (Glacial Till) to the north, east and south-east of the tailings pond.

Consent of copyright owner required for any other use. For inspection purposes only.

To the south and west of the TMF the superficial deposits constitute some Boulder Clays and Silts but also some poor to moderately well sorted sands and gravels. The thickness of these deposits can vary from 5 m to more than 10 m (Figure 8.5).

Aquifer Properties

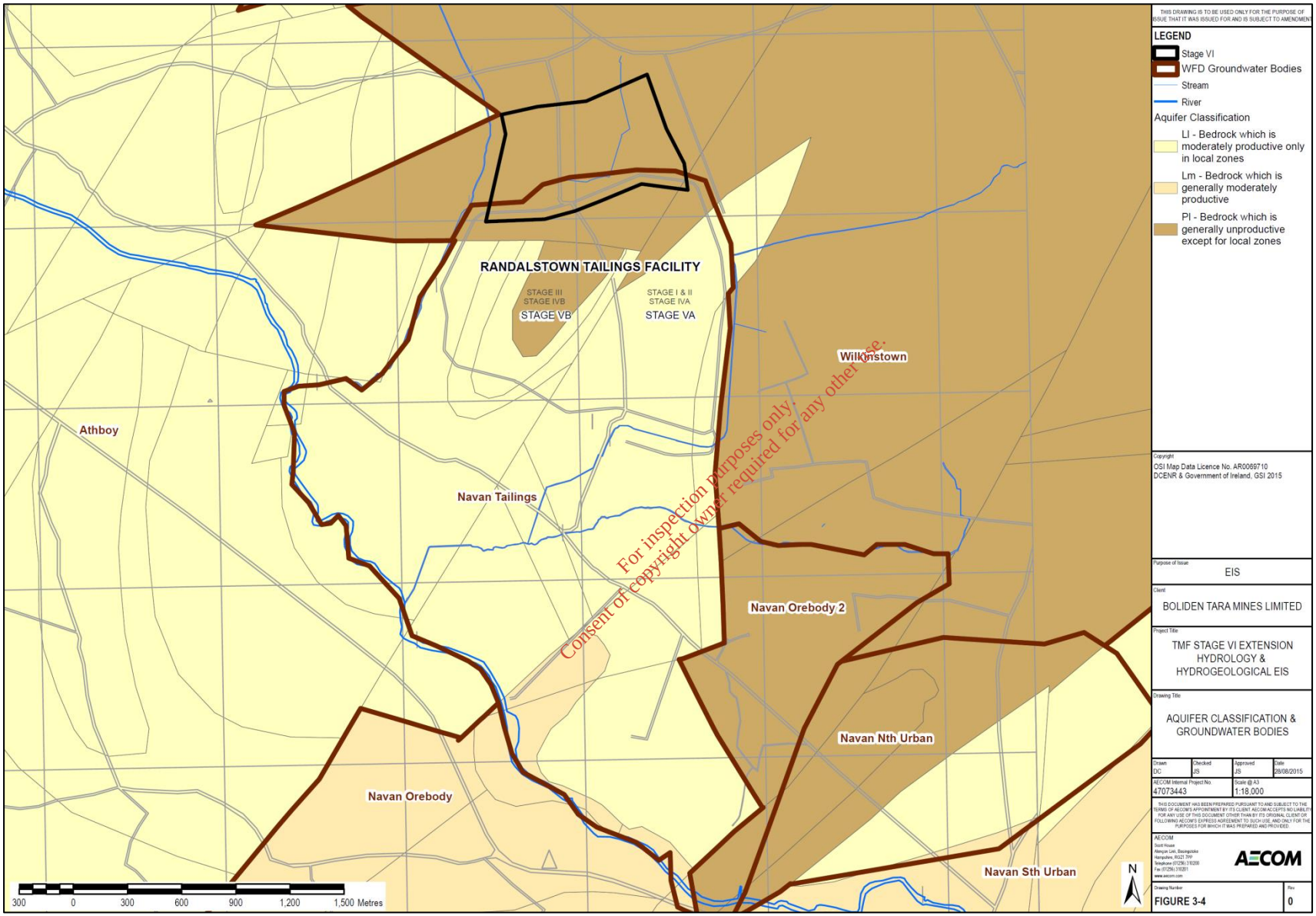
All groundwater bodies within Ireland have been mapped as part of WFD Implementation and classified as one of two overall types: bedrock or (unconfined) sands and gravels. Groundwater within County Meath is entirely hosted by bedrock, in keeping with most of the Eastern River Basin District (ERBD).
The aquifer in the vicinity of Tara mines and the TMF is classified as 'poorly productive' (Phillips, 2005).

There are no superficial deposit aquifers defined at or within the immediate area of the TMF.

According to the Geological Survey of Ireland (GSI) online groundwater mapping tool, the Meath, Liscarton and Old Red Sandstone formations, which underlie part of the TMF and the area to the south and west, are classified as locally important aquifers, described as bedrock which is moderately productive only in local zones.

The Rathkenny Formation, which underlies part of the TMF and the area to the north, is classified as a poor aquifer, described as bedrock which is generally unproductive except for local zones. Aquifer classifications and groundwater bodies are shown on Figure 8.4 and groundwater vulnerability is shown on Figure 8.5.

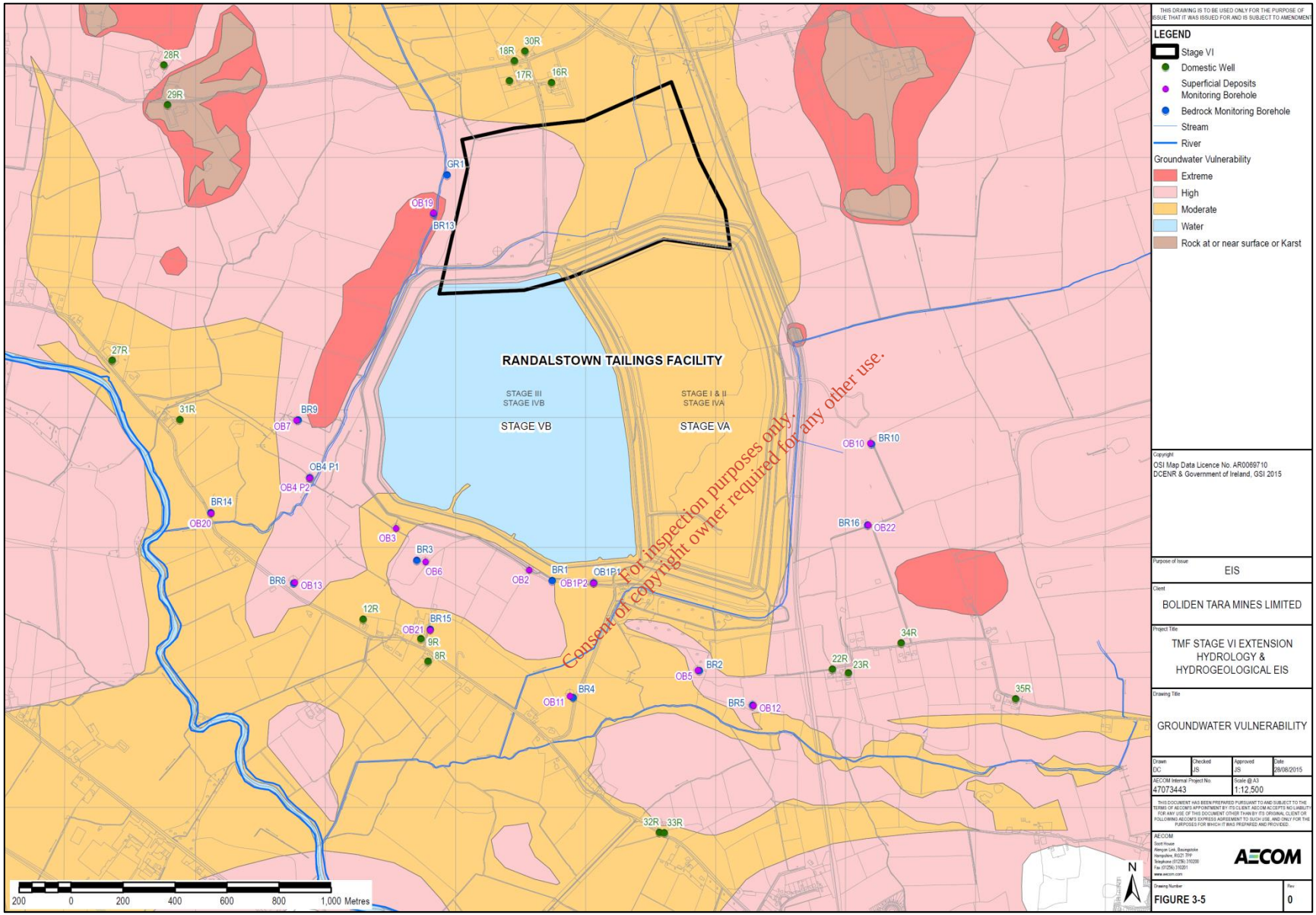
EPA Export 06-01-2017:02:02:14



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 8.4 Aquifer classification

EPA Export 06-01-2017:02:02:14



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 8.5 Groundwater vulnerability

EPA Export 06-01-2017:02:02:14

The permeability of the Pale Beds can be highly variable, lying in the range 10^{-2} to 10^{-9} m/s, depending on the extent of fracturing. Areas of sands and gravels within the superficial deposits are also water-bearing and may constitute aquifers of local importance.

The permeability of the superficial deposits is also variable ranging between 10^{-4} to 10^{-6} m/s in areas of sandy deposits and between 10^{-8} to 10^{-10} m/s in areas of clayey deposits (Knight Piésold, 1996). Potential recharge is approximately 400 mm/year, but up to 50% of this may be rejected resulting in actual recharge being nearer to 200 mm/year or less where permeability is lower (Knight Piésold, 1996).

GSI recharge zones published for this area describe moderate permeability subsoil overlain by poorly drained gley soil with an indicative recharge of 100 mm/year.

Groundwater Piezometry

Groundwater levels around the TMF are monitored by monthly manual dips at overburden and bedrock boreholes.

The locations of boreholes and wells are shown on Figure 8.6 and Figure 8.7.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

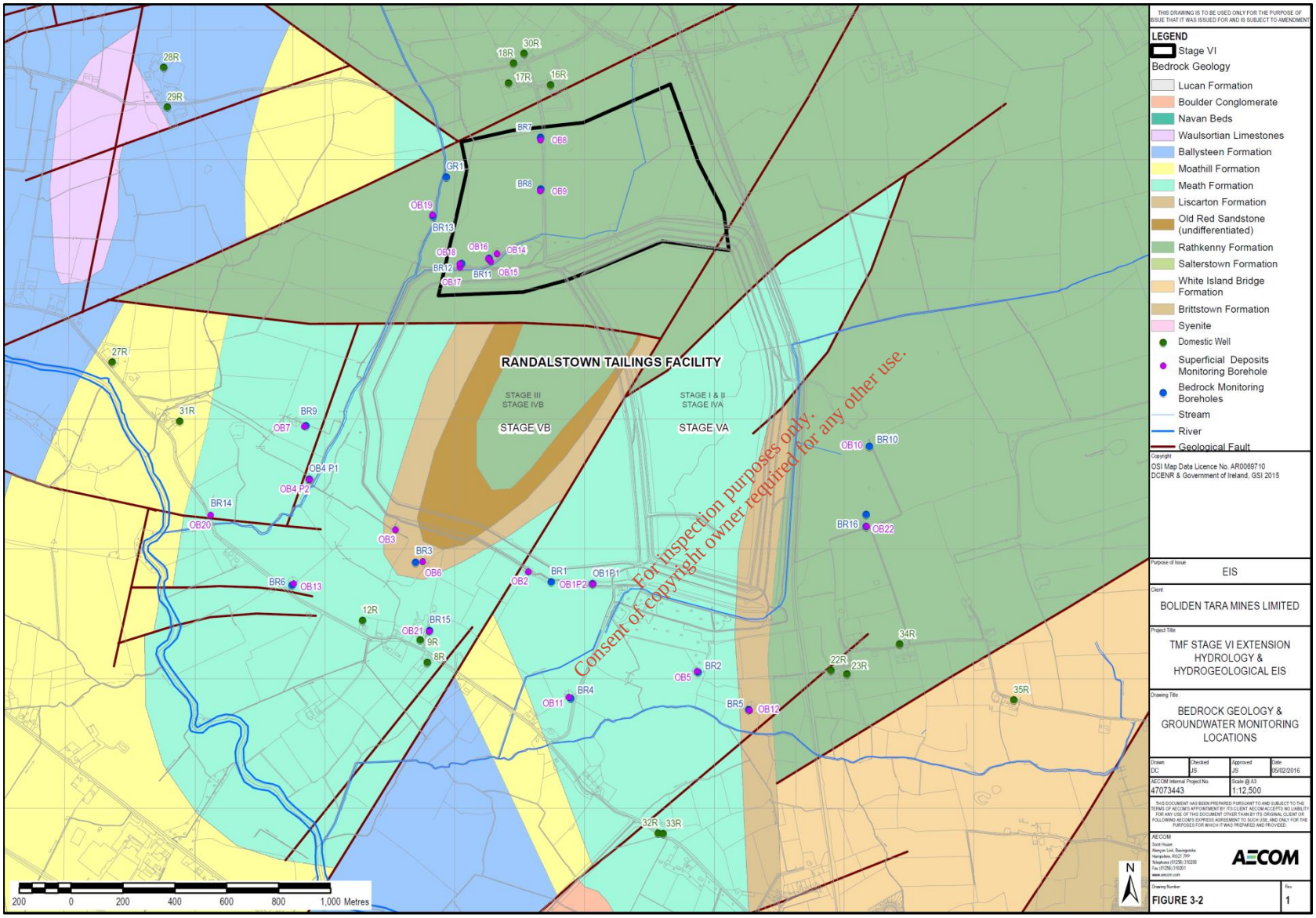


Figure 8.6 Bedrock geology and groundwater monitoring locations

EPA Export 06-01-2017:02:02:14

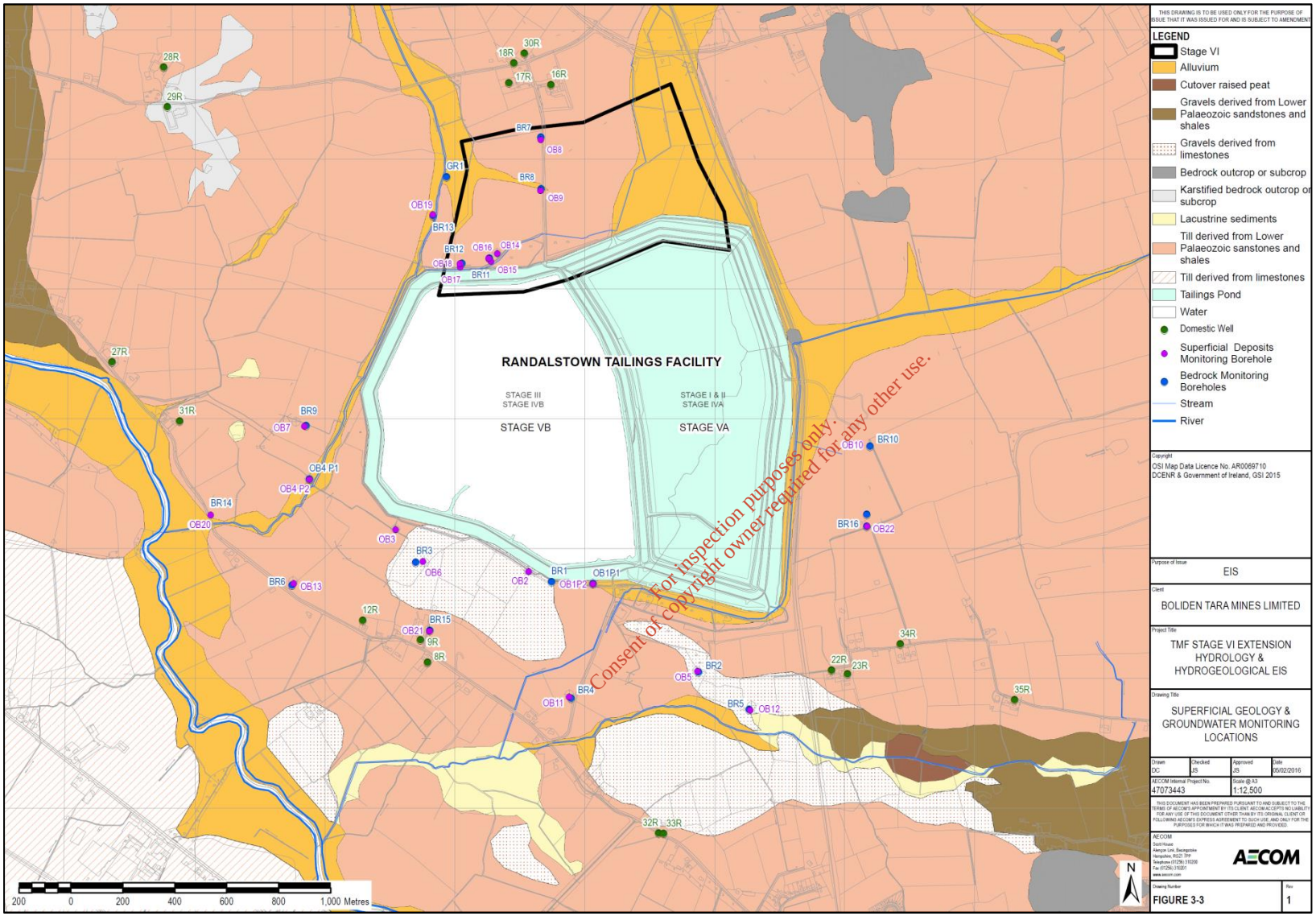


Figure 8.7 Superficial deposits

EPA Export 06-01-2017:02:02:14

Bedrock water levels
Water levels range from approximately 52.29 metres above ordance datum at BR16, to 23.29 metres above ordance datum at BR1.

The hydraulic head within the bedrock aquifer is generally higher than the top of the bedrock, indicating the bedrock aquifer to be confined and limiting the potential for the movement of seepage water from the superficial deposits into the bedrock (Knight Piésold, 1996).

Groundwater levels in the bedrock in the south and south west of the TMF appear to have been influenced by the mine dewatering (see hydrographs in Figure 8.8), particularly BR1 which is influenced by a likely connection with the Randalstown Fault The groundwater levels to the north of the TMF are less affected by the mine dewatering and show seasonal fluctuations of between 1 to 2 metres.

Overburden Water Levels
Water levels range from 52.29 metres above ordance datum at OB22, to 33.29 m above ordance datum at OB11.
To the south and southwest of the TMF superficial groundwater levels are generally either higher than or similar to groundwater levels in bedrock, suggesting that there is a downward head gradient here with some head reversal due to seasonal change. Groundwater levels in the superficial deposits in this area also appear to be slightly influenced by the dewatering of the mine, with a reduction in groundwater levels observed in OB1-P2 and OB11 (see hydrographs in Figure 8.9). To the north of the TMF, in the proposed extension area the levels are generally lower than those in the bedrock, suggesting that there is an upward head gradient. Water levels in OB8 have been reducing since 2005, likely due to excavation in the borrow pit area.

Consent of copyright owner required for any other use. For inspection purposes only.

Groundwater flow
Groundwater flow is in a south-westerly direction towards the River Blackwater, with the smaller streams and ditches, such as the Yellow River and Simonstown Stream, exerting a local influence. Hydraulic gradients in the superficial deposits range from 0.001 to 0.01.

EPA Export 06-01-2017:02:02:14

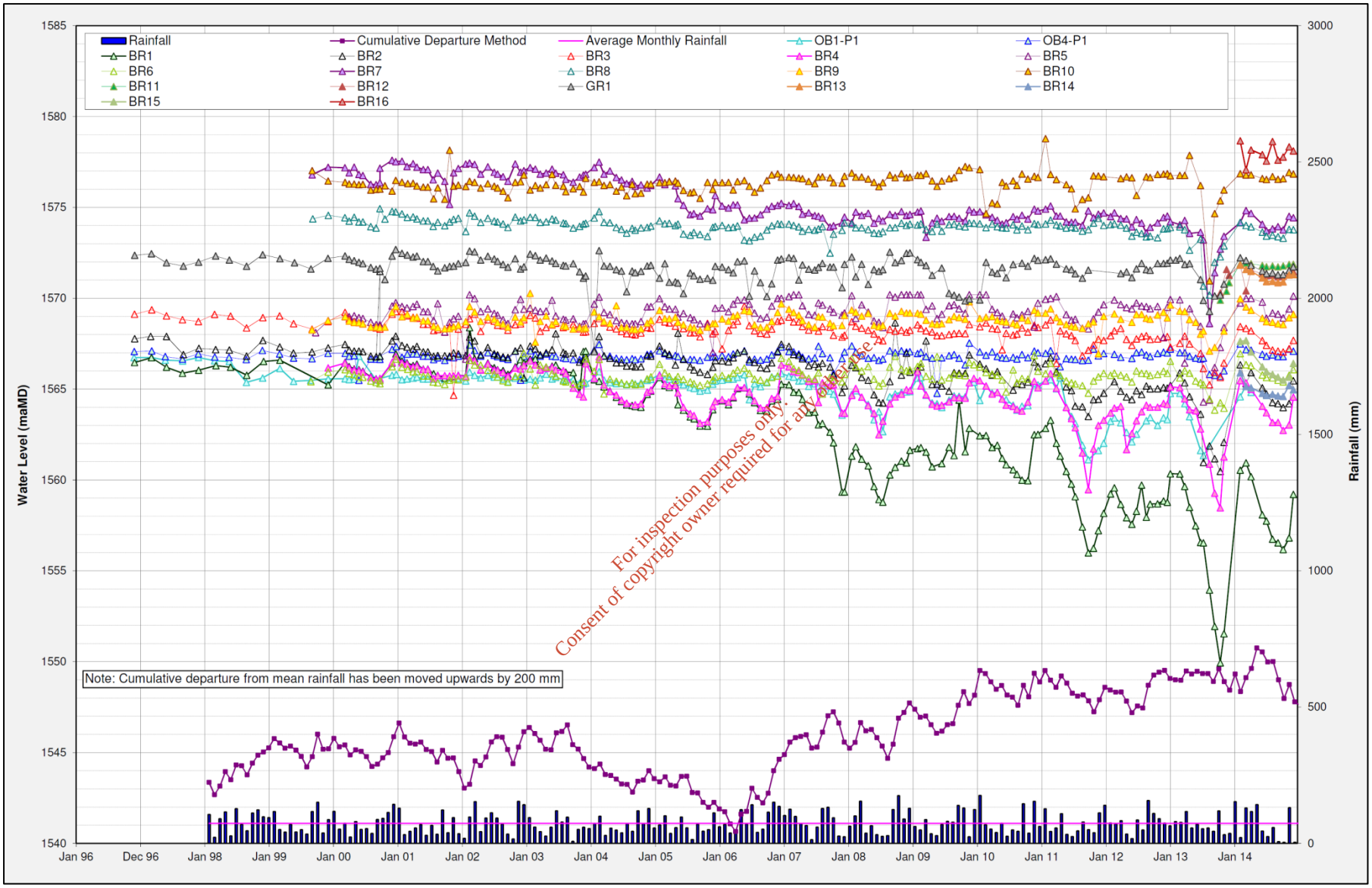
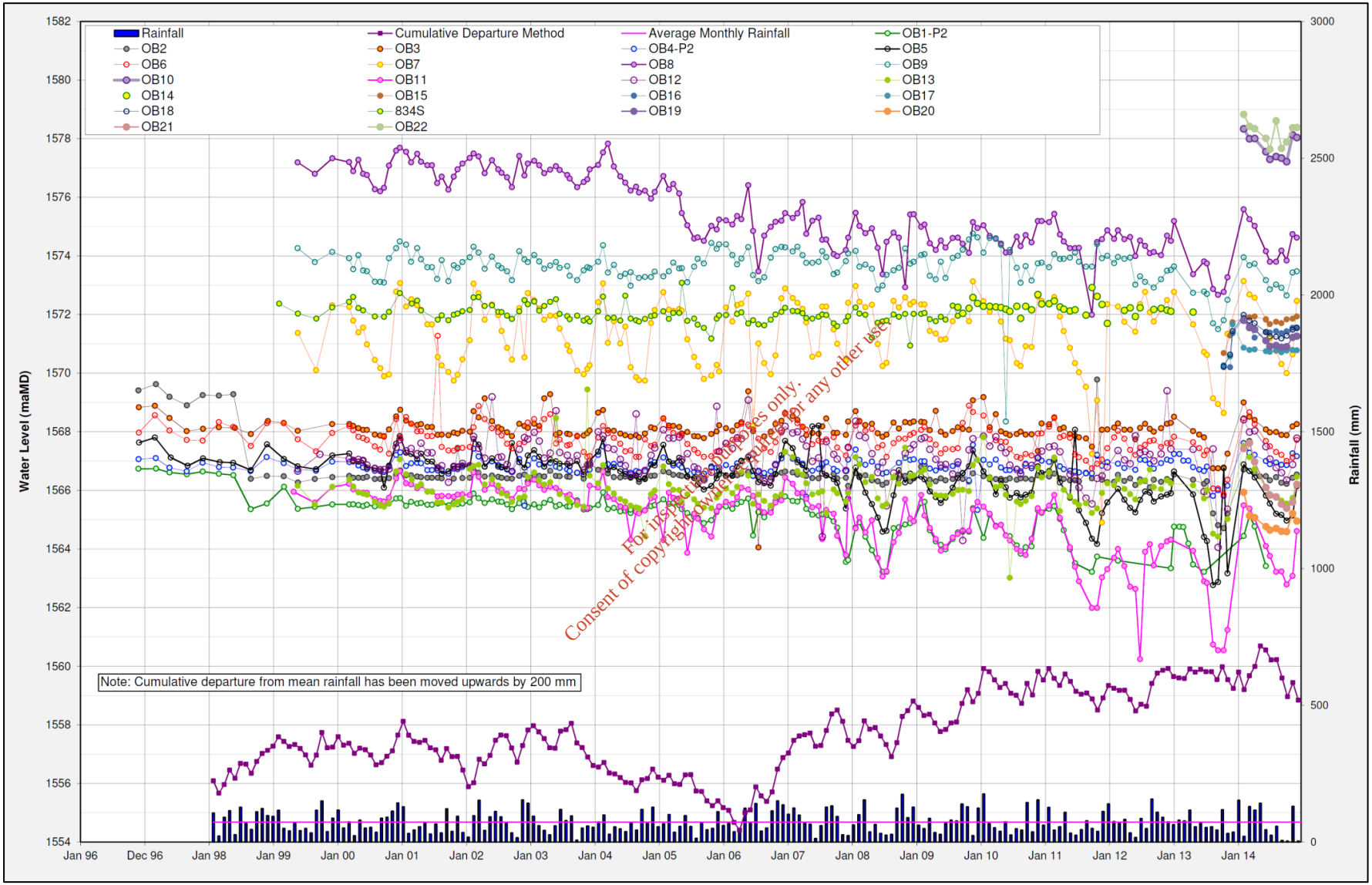


Figure 8.8 Bedrock boreholes water level hydrographs.

EPA Export 06-01-2017:02:02:14



Consent of copyright owner required for any other use.
For inspection purposes only.

Figure 8.9 Overburden (superficial) boreholes water level hydrographs.

EPA Export 06-01-2017:02:02:14

Groundwater dependent terrestrial ecosystems

A number of groundwater dependent terrestrial ecosystems have been identified within the Eastern River Basin District (ERBD), including the River Boyne and River Blackwater Special Area of Conservation (SAC). A small section of the River Blackwater at Boyne Island and Newtown Lough is classified as sensitive to changes in groundwater quantity and high sensitivity to changes in groundwater quality (Phillips, 2005). This SAC is located some distance upstream of the TMF and is not considered further in the hydrological assessment.

Groundwater Bodies

Groundwater bodies are the management unit for groundwater under the WFD. The TMF is located within the Navan Tailings groundwater body (Figure 8.4). This appears to be delineated on the basis of the likely area of influence of the TMF, bound to the west and southwest by the Yellow River and River Blackwater respectively, by the boundary of the TMF to the north and east and by geological boundaries to the southeast.

The adjoining groundwater bodies are the Athboy body to the west and the Wilkinstown body to the east. The proposed extension lies partially within the Navan Tailings, Wilkinstown and in a small area the Athboy (to the west) bodies. According to the groundwater body descriptions, groundwater flow in these bodies will be predominantly in the upper weathered zone, described as rapid throughflow, and some deeper flow along fractures and faults (ERBD,2010). Groundwater flow pathways in these bodies will tend to be relatively short, in general between 30 and 300 m, with groundwater discharging to streams and rivers across the aquifer.

Table 8.1 summarises the current (2009-2015) WFD status of these groundwater bodies and the expected status in 2015.

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 8.1 Groundwater Body Status

Water Body	Status 2009-2015	WFD Risk Score
Navan Tailings	Good	Expected to achieve good status by 2015
Athboy		
Navan Orebody		
Navan Orebody 2		
Navan North Urban		
Navan South Urban		
Wilkinstown		At risk of not achieving good status by 2015

EPA Export 06-01-2017:02:02:14

Groundwater Protection
The implementation of groundwater protection schemes in Ireland is the overall responsibility of the Environmental Protection Agency (EPA) and local government authorities. Aquifer vulnerability mapping undertaken by the Geological Survey of Ireland indicates that the general area surrounding the TMF has an interim classification of 'moderate' to 'high' vulnerability .

Land directly to the north, west and south of the TMF is classified as having 'high' vulnerability, with a hotspot of 'extreme' vulnerability also to the west. Land to the east of the TMF is classified as having 'moderate' aquifer vulnerability. There are no Source Protection Zones (Inner or Outer) currently identified in the locality, however the implementation of groundwater protection schemes is still underway

8.3.3 Water Use around Tara Mines and the TMF

Surface Water Use
The River Blackwater is used for abstraction of water which (with augmentation from the River Boyne and after treatment) is used to supply potable water to Navan and environs. The abstraction is from the River Blackwater at Liscarton approximately 2.4 km to the south of the TMF.

The River Blackwater and River Boyne watercourses have been designated as Special Areas of Conservation (SAC) and as Special Protected Areas (SPA). In addition, the Boyne has been designated as a salmonid river, capable of supporting salmon, and a nutrient sensitive river.

For inspection purposes only.
Consent of copyright owner required for any other use.

Groundwater Use
According to the GSI online mapping tool and the network of domestic wells sampled by Tara Mines, there are no groundwater abstractions in use within 200 m of the TMF. The closest domestic well to the TMF which is in use is 23R; this is located across gradient from the TMF and on the opposite bank of the Simonstown Stream (Figure 8.6 and Figure 8.7). The nearest Source Protection Zone (SPZ) is Slane which is over 9 km from the TMF site.

8.3.3.1 Water Quality

Monitoring Programme
The Tara Mines water quality monitoring system has been developed since 1996 to collect relevant data at strategic locations in the immediate area. The system aims to provide sufficient factual data to confirm previous (Stage 5) EIS predictions and act as an advance warning system for any potential pollution incidents to local landowners or water users.
The potential for localised groundwater contamination of the immediate environment from the TMF has been consistently monitored through collection and analysis of spot samples from an extensive network of sampling points. Independent annual monitoring reviews have been undertaken to evaluate monitoring data in the context of relevant legislation.

EPA Export 06-01-2017:02:02:14

Water Quality is currently monitored at Tara Mines in several key locations, from the carrying water leaving the mine processing plant and on to the tailings pond, dam seepage, interceptor channel and the wider environment (Table 8.3.2). By including a comprehensive range of groundwater and surface water locations outside of the TMF, water quality in the wider environment can be monitored.

Table 8.2 Summary of Water Quality Monitoring Locations

Water Body	Monitoring Type	Number of Monitoring Points
TMF	Carrying Water	1
Tailings Dam Seepage	Interceptor Channel	4
Groundwater Monitoring	Overburden Boreholes	24
	Bedrock Boreholes	17
	Domestic Wells	11
Surface Water Monitoring	Local Rivers and Streams	13

Figure 8.3, Figure 8.6 and Figure 8.7 show the locations of individual groundwater and surface water monitoring points in relation to the TMF.

Water quality samples are analysed for a range of physical and chemical parameters as required by the IE licence no. P0516-03.

The sampling frequency of groundwater and surface water is summarised in Table 8.2.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:14

Table 8.3 Summary of Analysed Parameter and Frequency

Parameters	Units	Groundwater			Surface Water	
		Overburden Boreholes (OB)	Bedrock Boreholes (BR)	Domestic Wells (R)	Interceptor Channel	Rivers & Streams
pH		Monthly	Monthly	Monthly	Monthly	Monthly
Temperature	Degrees Celsius	Monthly	Monthly	Monthly	Monthly	Monthly
Electrical Conductivity	(µS/cm)	Monthly	Monthly	Monthly	Monthly	Monthly
Total Hardness as $CaCO_3$	mg/l	-	-	-	-	Monthly
Alkalinity as $CaCO_3$	mg/l	-	-	-	-	Monthly
Suspended Solids	mg/l	-	-	-	Monthly	Monthly
Dissolved Oxygen	mg/l	Monthly	Monthly	Monthly	-	Monthly
Total Ammonia as NH_4	mg/l	Quarterly	Quarterly	Quarterly	-	Monthly
Chloride as Cl	mg/l	Quarterly	Quarterly	Quarterly	-	Quarterly
Nitrate as NO_3	mg/l	Quarterly	Quarterly	Quarterly	-	Monthly
Nitrite as N	mg/l	Quarterly	Quarterly	Quarterly	-	-
Phosphate as P	mg/l	Quarterly	Quarterly	Quarterly	-	Quarterly
Aluminium	mg/l	Monthly	Monthly	Monthly	Quarterly	Quarterly
Antimony	mg/l	-	-	-	-	Quarterly
Arsenic	mg/l	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Cadmium	mg/l	-	-	-	Quarterly	Quarterly
Chromium	mg/l	-	-	-	-	Quarterly
Copper	mg/l	-	-	-	Quarterly	Quarterly
Cobalt	mg/l	-	-	-	Quarterly	Quarterly
Cyanide	mg/l	-	-	-	Quarterly	Quarterly
Iron	mg/l	Monthly	Monthly	Monthly	Quarterly	Quarterly
Lead	mg/l	Monthly	Monthly	Monthly	Quarterly	Monthly
Manganese	mg/l	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Magnesium	mg/l	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Mercury	mg/l	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Nickel	mg/l	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Potassium	mg/l	Quarterly	Quarterly	Quarterly	-	-
Sodium	mg/l	Quarterly	Quarterly	Quarterly	-	Quarterly
Sulphate	mg/l	Monthly	Monthly	Monthly	Monthly	Monthly
Zinc	mg/l	Monthly	Monthly	Monthly	Quarterly	Monthly

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

8.3.3.2 Water Quality Standards

Water quality is evaluated in the context of current legislative requirements for Ireland, in particular the WFD. As part of the WFD implementation process, EU Member States are required to set or review their national water quality standards, taking into account groundwater-surface water interaction and potential ecological impacts. The Competent Authority responsible for reviewing water quality standards in Ireland is the Environmental Protection Agency (EPA).

Between 2009 and late 2012, the following regulations came into force to give effect to the Water Framework Directive in Ireland:
EC Environmental Objectives (Surface Waters) Regulations S.I. No. 272 of 2009, which came into operation on 30 July 2009 to give effect to the Water Framework Directive including the environmental quality standards of Directive 2008/105/EC and further effect to the Dangerous Substances Directive (2006/11/EC);
EC Environmental Objectives (Surface Waters) (Amendment) Regulations S.I. No. 327 of 2012, which came into operation on 4 September 2012 to amend the EC Environmental Objectives (Surface Waters) Regulations S.I. No. 272 of 2009; and
EC Environmental Objectives (Groundwater) Regulations S.I. No. 9 of 2010, which came into operation on 27 January 2010 to give effect to the Water Framework Directive and Groundwater Directive (2006/118/EC).

The groundwater threshold values set by the EC Environmental Objectives (Groundwater) Regulations are now the most stringent guideline values and therefore these values were included in the assessment of the monitoring data for 2010 onwards. Although these guideline values were established for the protection of groundwater, they are considered appropriate for the protection of surface waters influenced by groundwater, such as at the TMF.

Where there is no threshold value the most stringent alternative is used as summarised in Table 3-4. The most stringent alternatives for all monitored parameters are the Interim Guideline Values (IGV) with the exception of antimony for which the EU (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014) value is used, and for total ammonia as N for which the EC Environmental Objectives (Groundwater) Regulations value for ammonium as N is used. Throughout the remainder of the assessment, the applicable groundwater threshold values or the IGV's are referred to as 'guideline values'.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

Table 8.4. Guideline Values for Groundwater

Water Quality Parameter	Threshold Value*	IGV**	Drinking Water Regulations***
Aluminium (mg/l)	0.15	-	-
Ammonium as N (mg/l)	0.065	-	-
Antimony (mg/l)	-	-	0.005
Arsenic (mg/l)	0.0075	-	0.01
Cadmium (mg/l)	0.00375	-	-
Calcium (mg/l)	-	200	-
Chromium (mg/l)	0.0375	-	-
Cobalt (mg/l)	-	-	-
Copper (mg/l)	1.5	-	2
Chloride (mg/l)	24	250	250
Cyanide (mg/l)	0.0375	-	0.05
Electrical Conductivity (µS/cm)	800	-	2500
Iron (mg/l)	-	0.2	0.2
Lead (mg/l)	0.01875	-	0.01
Magnesium (mg/l)	-	50	-
Manganese (mg/l)	-	0.05	-
Mercury (mg/l)	0.00075	-	0.001
Nickel (mg/l)	0.015	-	0.02^
Nitrate as N (mg/l)	8.47	25	-50
Nitrite as N (mg/l)	0.114	-	-0.5
Orthophosphate (mg/l)	-	0.03	-
pH (pH units)	-	6.5-9.5	-
Potassium (mg/l)	-	5	-
Sodium (mg/l)	150	150	200
Sulphate (mg/l)	187.5	200^^	250
Sulphide (mg/l)	-	-	-
Temperature (˚C)	-	25	-
Total hardness ($CaCO_3$)	-	200	-
Zinc (mg/l)	-	0.1	-

For inspection purposes only.
Consent of copyright owner required for any other use.

* Threshold Value: EC Environmental Objectives (Groundwater) Regulations Threshold Value, 2010 (S.I. No. 9 of 2010)
** Interim Guideline Values: Towards Setting Guideline Values for the Protection of Groundwater in Ireland
*** EU (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014)
^ http://www.irishstatutebook.ie/eli/2014/si/122/made/en/pdf

EPA Export 06-01-2017:02:02:14

^^https://www.epa.ie/pubs/reports/water/ground/EPA_ground_water_guideline_values_interim_report.pdf
Note: All values are for hardness >100 mg/l

Baseline Water Quality
Water quality records since 1996 are used to define the baseline. Seepage from the TMF has elevated concentrations of sulphate which is used as a proxy for assessing water quality. The guideline value for sulphate is 187.5 mg/l.
Seepage is intercepted by the interceptor channel so concentrations are expected to be elevated in the channel. Measurement of water quality in surface water and groundwater demonstrates that seepage to the environment is being controlled. The results of monitoring the interceptor channel, surface water and groundwater are discussed below.

Interceptor Channel
Monitoring was undertaken at 4 locations in the interceptor channel. Monthly sulphate concentrations for all monitoring points in the interceptor channel are presented in Figure 3-8 which demonstrates that concentrations tend to be highest in the summer and early autumn.

Table 8-5 summarises mean annual sulphate concentrations at the sampling points for 1998-2010, 2011, 2012, 2013 and 2014. Concentrations in the channel generally have not met the guideline value (187.5 mg/l), which is as expected, given the nature of the intercepted waters. The interceptor channel collects water from the internal drainage system within the embankment of the TMF, horizontal seepage from the TMF, local runoff and groundwater

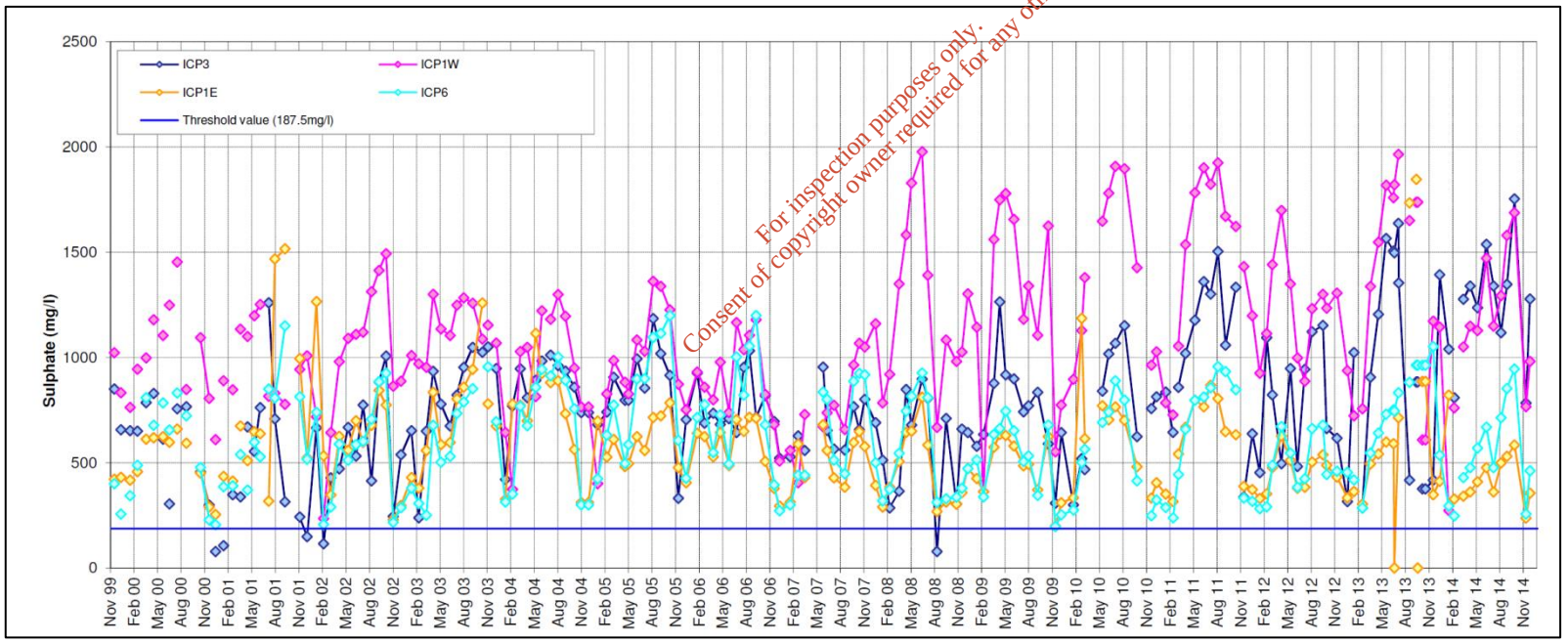
For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

Table 8.5. Average Sulphate Concentrations in the Interceptor Channel

	Sulphate Concentration (mg/l)				
	Average 1998*-2010	Average 2011	Average 2012	Average 2013	Average 2014
ICP1.E	594	597	446	648	442
ICP1.W	1054	1455	1202	1359	1108
ICP3	692	1006	759	983	1238
ICP6	612	623	482	752	533
All Samples	738	920	722	936	830

*Start of record



For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

All of the water quality data since 1996 has been reviewed and compared with the relevant guidelines on a yearly basis. Manganese, ammonia, magnesium and zinc exceed the guideline values on most occasions. Nickel has remained below the guideline value since 2009 and aluminium has remained below since 2012. Given the nature of the intercepted water, it would be expected that elevated concentrations are detected at times.

8.3.3.3 Surface Water Quality in the area of the TMF

Sulphate is also the key parameter used for evaluating surface water quality trends at the TMF and within the surrounding environment. The results of monitoring are also compared with the groundwater threshold value (GTV) of 187.5 mg/l as defined by the Groundwater Regulations (S.I. No. 9 of 2010). This is considered appropriate for surface water where influenced by groundwater. The following points summarise the results of the sulphate monitoring in surface water:

Figure 3-9 illustrates the overall trend of annual average sulphate concentrations for surface water bodies close to the TMF since 1998; and concentrations have not exceeded the GTV at the surface water monitoring points since monitoring began in 1996.

Additionally annual average concentrations in the Yellow River, Simonstown Stream, River Blackwater, Duog Stream and River Boyne do not show a sustained upward rising trend and have remained relatively stable.

Consent of copyright owner required for any other use.
For inspection purposes only.

Magnesium is also monitored at surface water monitoring points. The results of monitoring are compared with the IGV of 50 mg/l as defined by the EPA's publication Towards Setting Guideline Values for the Protection of Groundwater in Ireland. This is considered appropriate for surface water where influenced by groundwater. The following points summarise the results of the magnesium monitoring:
Concentrations generally exceed the IGV in the interceptor channel, due to the nature of the intercepted water, but have not exceeded the IGV at the surface water monitoring points since monitoring began in 1996.

Concentrations in the Yellow River, Simonstown Stream, River Blackwater, Duog Stream and River Boyne do not show a sustained upward rising trend and have remained relatively stable. however naturally occurring evaporites have not been identified in the immediate vicinity of the TMF (Knight Piésold, 1996);
Concentrations in the superficial deposits are elevated above natural background conditions to the south of the TMF as far east as OB12, as far west as OB20 and as far south as OB11. The area corresponds approximately with a continuous band of more permeable superficial deposits identified during drilling (Knight Piésold, 1996). There is no apparent continuous band of more permeable superficial deposits to the north of the TMF;

Concentrations in bedrock are elevated above natural background concentrations to the south of the TMF at least as far as east as BR2, as far west as OB4-P1 and as far

EPA Export 06-01-2017:02:02:14

south as BR4. This area corresponds approximately with the extent of the Meath Formation in the direction of regional groundwater flow;

The highest exceedances for sulphate within the superficial deposits occur at locations where the annual average concentrations in bedrock are elevated above the GTV (OB1-P1 to the south, BR11 and BR12 to the north and BR14 to the southwest). At all of these locations, the more permeable superficial deposits directly overlie bedrock, suggesting that there is hydraulic continuity between these horizons at these locations; and
Concentrations at the domestic well monitoring locations have generally remained below the GTV, with only six exceedances occurring between 1996 and 2012.

Conceptual Understanding of Water Quality in and around the TMF
Potential Source Areas

The current and historic site operations do not include the delivery, storage or usage of hazardous chemicals or raw materials, or non-hazardous chemicals, nor the generation, storage or disposal of hazardous waste. The mine tailings are classified as non-hazardous, EWC 01 03 06.

The chemicals of potential concern (COPC's) at the TMF site are sulphate and magnesium. The tailings water is known to be naturally high in sulphate, and to a lesser extent magnesium, and elevated concentrations of these substances have been recorded in groundwater in the immediate vicinity of the TMF and documented for many years;

Consent of copyright owner required for any other use. For inspection purposes only.

Concentrations of manganese, potassium, nickel, aluminium, ammonia and zinc in surface water have also exceeded the relevant water quality standards on occasions. These exceedances are not considered to be significant.
Of the parameters monitored at the TMF, all are classified as non-hazardous substances, with the exception of arsenic, cadmium and mercury. Concentrations have not exceeded the minimum reporting values (MRV) since monitoring began in 2013.

Groundwater Quality in the area of the TMF

Sulphate is the key parameter used for evaluating groundwater quality trends at the TMF and within the surrounding environment. The results of monitoring are compared with the groundwater threshold value (GTV) of 187.5mg/l as defined by the Groundwater Regulations (S.I. No. 9 of 2010). This is the most stringent guideline value for the protection of groundwater in Ireland and is expressed as an annual arithmetic mean concentration. The following points summarise the results of the sulphate monitoring in groundwater:
Figure 3-10 illustrates the overall trend of annual average sulphate concentrations in groundwater close to the TMF since 1996 when monitoring began;
Concentrations exceed the GTV at several superficial deposit and bedrock monitoring points, primarily to the south of the TMF. Annual average concentrations in the superficial deposits are consistently higher than in bedrock;

EPA Export 06-01-2017:02:02:14

Concentrations in OB7 and OB9 are likely to represent natural background concentrations in the superficial deposits and in BR8 and BR10 in bedrock. These boreholes are located up gradient of the TMF. The range of annual average concentrations measured between 1999 and 2013 at these boreholes is 10 to 73 mg/l and 10 to 40 mg/l respectively, which remain below the GTV. The range in bedrock corresponds well with the median Natural Background Level (NBL) reported for sulphate of 11 mg/l (EPA, 2008);

Natural background concentrations may be additionally influenced by the dissolution and oxidation of naturally occurring evaporites or pyrite minerals known to occur in the underlying Pale Beds (S.I. No. 9 of 2010), as a result of dewatering at the Tara Mines; The source of elevated sulphate and magnesium in groundwater is the current and historic seepage of tailings water from the TMF and the surrounding interceptor channel. The occurrence of elevated sulphate concentrations in groundwater in the immediate vicinity of the TMF suggests that there is a small amount of seepage occurring from the tailings into groundwater. The interceptor channel is likely to be an intermittent source, with seepage occurring when adjacent groundwater levels drop below the base of the interceptor channel.

Potential Pathways

There are a number of key potential pathways for sulphate and magnesium to reach the receptors in the area of the TMF. The potential receptors are the groundwater resource in the locally important bedrock aquifer, taking account of its existing and future use, the Yellow River and the River Blackwater. There are no groundwater abstractions for potable water supply within the bedrock aquifer itself between the TMF and the River Blackwater. However the River Blackwater is used for potable supplies at approximately 2.4 km from the TMF in the direction of regional groundwater flow. It is likely that the bedrock aquifer contributes to this water body and therefore the River Blackwater has been identified as the sensitive receptor for the groundwater flow pathway in bedrock. The potential pathways are listed below:

There is a pathway for seepage to enter shallow groundwater where the more permeable superficial deposits directly underlie or are adjacent to the TMF and the interceptor channel and when the vertical or lateral hydraulic gradients allow. On reaching groundwater, there is a pathway for seepage to move laterally in the direction of local groundwater flow, i.e. towards the Yellow River and River Blackwater to the southwest. There is no continuous band of more permeable superficial deposits to the north or east of the TMF;

There is a pathway for seepage to enter the Yellow River and River Blackwater as baseflow. In addition, there is a pathway for seepage to move laterally as groundwater flow within the channel of more permeable superficial deposits associated with the river as indicated from the high concentrations detected at OB20;

There is a pathway for shallow groundwater to move vertically downwards entering bedrock, where the more permeable superficial deposits directly overlie permeable bedrock and when the vertical hydraulic gradients allow. This is shown by concentrations elevated above natural background conditions in bedrock to the south of the TMF, immediately to the north of the TMF and at OB4-P1 adjacent to the Yellow River; and

Within bedrock, there is a pathway for deep groundwater to move laterally via fractures and fissures in the direction of regional groundwater flow, i.e. to the south and the River Blackwater, where it is used for potable water supply.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:14

Risk Screening for TMF

There is a general decrease in sulphate concentration with increasing distance from the TMF. Sulphate concentrations have been mapped on a regular basis as part of the annual monitoring reviews and show that sulphate concentrations are generally highest to the south-west of the TMF, linked to the direction of groundwater flow and are focused in small plumes to the south.

Although elevated concentrations of other parameters have been noted in the immediate environment of the TMF, the TMF itself is not thought to be a significant source of contamination to local hydrological and hydrogeological systems. For example, there is evidence from historical data that manganese occurs naturally in groundwater in the area (Knight Piésold, 1996) and ammonia is potentially derived from local agricultural fertiliser use.

Continued monitoring of the TMF since operation of the Stage 5 extension has shown that the interceptor channel is effectively capturing almost all seepage from the tailings storage facility through the embankment walls. As this water is then recycled back to the TMF, a closed water cycle system is operating.

AECOM carried out a risk screening exercise on the TMF in March 2015 (AECOM, 2015). Modelling was undertaken to assess the risk to the receptors in the area. For the purposes of the modelling the worst case scenario was assumed.

Two model scenarios were used. Scenario A assumed direct seepage from the TMF into the Yellow River and scenario B assumed seepage was entering the Yellow River indirectly as baseflow from shallow groundwater in the more permeable superficial deposits. It was assumed that there is a continuous band of more permeable superficial deposits between OB3, OB13 and the River Blackwater and between OB5, OB4-P2 and the Yellow River.

It is likely that scenario A and B occur simultaneously; however as the average sulphate concentrations in the Yellow River are in the region of 50 mg/l, it is likely that the seepage input to the Yellow River is predominantly indirect, via shallow groundwater. It also suggests that sulphate concentrations may be subject to attenuation in the superficial deposits before groundwater reaches the Yellow River.

The seepage element to the Yellow River has been investigated (AECOM, 2016) utilising flow and concentration monitoring undertaken on the Yellow River and the Blake's Stream in September and October 2015. This has shown that the Yellow River is losing water to the shallow groundwater in the section to the west of the existing TMF, and sulphate input from seepage is occurring. Volumetric rates of infiltrating water from seepage alone have been assessed in the water balance and these are small in comparison to the dilution provided by the Yellow River upstream flow (0.064% to 0.58%), indicating that the flow in the river is sufficient to dilute any seepage.

A summary of the findings of the risk modelling is listed below and provides the baseline against which the proposed Stage 6 extension is assessed:

The risk screening suggests that seepage inputs from the TMF and interceptor channel pose a moderate risk to the surrounding environment, specifically groundwater quality;

The exceedances with regard to sulphate concentrations within the superficial deposits may pose a risk to the future WFD status of the Navan Tailings groundwater body and associated surface water bodies;

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:14

A technical assessment, carried out using a mass balance approach, suggests that sulphate-rich seepage inputs to groundwater pose a low risk to the Yellow River. A mass balance predicts that an annual average sulphate concentration of 2,200 mg/l in seeps from the western bank of the TMF would result in non-compliance in groundwater immediately adjacent to the Yellow River, under exceptionally dry conditions;
A technical assessment, carried out using a remedial targets assessment, suggests that sulphate-rich seepage inputs to the superficial deposits pose a low risk to the River Blackwater. A remedial targets assessment predicts that an annual average sulphate concentration of 2,750 mg/l at monitoring borehole OB13 would result in non-compliance in groundwater immediately adjacent to the River Blackwater; and
The TMF site is considered to be compliant with the "prevent" and "limit" objectives of the WFD.

8.4 Hydrological and Hydrogeological Impacts

8.4.1 Impact Assessment Methodology

The impact assessment uses receptor sensitivity and magnitude of impacts to determine the significance of effect.

For inspection purposes only.
Consent of copyright owner required for any other use.

8.4.2 Receptor Sensitivity

The sensitivity or importance of each water resource (the receptor) is based on its considered value, for example its value as an ecological habitat, as a source of drinking water or as a recreational resource (see Table 8.1).

Table 8.6 Sensitivity of Water Receptors

Importance	Criteria	Examples
Very high	Water resource with an importance and rarity at an international level with limited potential for substitution.	- A water resource making up a vital component of a protected Special Area of Conservation (SAC) or Special Protection Area (SPA) under the European Commission (EC) Habitats Directive - Principal aquifer providing potable water to a large population - EC designated Salmonid fishery
High	Water resource with a high quality and rarity at a national or regional level and limited potential for substitution.	- A water resource designated or directly linked to a Site of Special Scientific Interest (SSSI). - Principal aquifer providing potable water to a small population - A water body used for national sporting events such as regattas or sailing events - EC designated Cyprinid fishery

EPA Export 06-01-2017:02:02:14

Importance	Criteria	Examples
Medium	Water resource with a high quality and rarity at a local scale; or Water resource with a medium quality and rarity at a regional or national scale.	- Secondary aquifer providing potable water to a small population - An aquifer providing abstraction water for agricultural and industrial use
Low	Water resource with a low quality and rarity at a local scale.	- A non 'main' river or stream or other water body without significant ecological habitat

8.4.3 Magnitude of Impact

The magnitude of a potential impact is then established based on the likely degree of impact relative to the nature and extent of the proposed development (see Table 8-4-2). It is important to consider at this stage that potential impacts can be beneficial as well as adverse and it is the purpose of an EIA to highlight the full spectrum of potential impacts from a proposed development. The derivation of magnitude is carried out independently of the importance of the water resource

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 8.7 Magnitude of Impact

Importance	Criteria	Examples
High	Impact results in a shift in a water bodies' potential attributes.	- Loss of European Union (EU) designated Salmonid fishery - Change in WFD classification of a water body or prevention of future good status. - Compromise employment source - Loss of flood storage/increased flood risk - Pollution of potable source of abstraction
Medium	Results in impact on integrity of attribute or loss of part of attribute.	- Loss / gain in productivity of a fishery. - Contribution / reduction of a significant proportion of the effluent in a receiving river, but insufficient to change its WFD classification - Reduction / increase in the economic value of the feature.
Low	Results in minor impact on water bodies attribute.	- Measurable changes in attribute, but of limited size and / or proportion.
Very Low	Results in an impact on attribute but of insignificant magnitude to affect the use / integrity.	- Physical impact to a water resource, but no measurable reduction / increase in quality, productivity or biodiversity. - No significant impact on the economic value of the feature. - No increase in flood risk

EPA Export 06-01-2017:02:02:14

8.4.4 Significance of Effect

An assessment of the significance of each effect takes into account the sensitivity of the receptor and impact magnitude as summarised in 8-4-3. Effects can range from high to negligible and can be adverse or beneficial.
Effects that are assessed to be high or moderate are considered to be significant; those that are low or negligible are not considered to be significant.

Table 8.8 Significance of Effect

Sensitivity of Receptor	**Impact Magnitude**			
	High	Medium	Low	Very Low
Very High	High	High	Moderate	Low
High	High	Moderate	Moderate	Low
Medium	Moderate	Moderate	Low	Negligible
Low	Moderate	Low	Negligible	Negligible

8.4.5 Potential Impacts

A description of the proposed extension as it relates to the water environment is provided in Section 8.2.

Potential impacts may arise as a result of dewatering, excavation, the lining system, associated diversions, and restoration plans.
Dewatering would be temporary, during the construction of the TMF. Operation and closure plans are permanent.
The main potential impacts of the proposed development on the water environment include:

- Dewatering and lowering of the water table during extraction;
- Excavating overburden material from the borrow area increasing the vulnerability of the underlying bedrock;
- Diverting Blake's Stream;
- Change in groundwater levels and flows due to the presence of a low permeability liner;
- Seepage from TSF during operation;
- Increasing the interceptor channel length and backfilling the channel on the existing northern dam wall; and
- The installation of spillways and a passive treatment system during closure.

Table 8.9 summarises the potential impacts.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:14

Table 8.9. Potential Impacts

Aspect	Dewatering	Excavation	Seepage	Lining System	Diversions	Interceptor Channel	Spillways	Passive Treatment System
Project Life Cycle	Construction	Construction	Operation	Operation	Construction, Operation and Closure	Construction, Operation and Closure	Closure	Closure
Temporary or Permanent	Temporary	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

8.4.6 Receptors

The baseline assessment has identified surface water and groundwater receptors. These are summarised in Table 8-4-5. The sensitivity or value of the receptors is determined by the identification and analysis of attributes.

Table 8.10. Sensitivity of Water Receptors

Receptor	Sensitivity	Reasons for classification
The Meath, Liscarton and Old Red Sandstone formations (Bedrock aquifers)	High	They are classified as locally important aquifers, described as bedrock which is moderately productive in local zones.
Groundwater Users	High	Groundwater supply for domestic use.
Yellow River and Blackwater River	High	Water bodies classified under the WFD.
Blake's, Simonstown and Doug Stream	Medium to Low	A water body not classified under the WFD, but discharge into WFD classified waterbodies.

Consent of copyright owner required for any other use.
For inspection purposes only.

8.4.6.1 During Construction of Stage 6 Extension

During construction of the Stage 6 extension material would be needed from the Northern Borrow Area and the adjacent Seven Fields Borrow Area. The design for the Stage 6 extension is based on a base elevation of 1572 maMD. Site drainage ditches would be required to keep the borrow area relatively dry during construction. Groundwater levels in the superficial deposits and bedrock in the area have shown that levels are above 1572 maMD all year round at some of the boreholes (Figure 8-4-1 and Figure 8-4-2) meaning drainage ditches may not be sufficient and dewatering would be required.

8.4.6.2 Impacts on Groundwater Hydrology

During construction, dewatering would be needed to place a lining system at a base elevation of 1572 maMD. This will lower groundwater levels in the area of Stage 6 temporarily while the lining is put in place. The potential impact from dewatering would be on the base flow to the Yellow River and any groundwater users in the area. The significance of the impact is considered to be low given that dewatering would be temporary and a maximum of 4 m.

The closest domestic well to the TMF which is in use is 23R; this is located across gradient from the TMF and on the opposite bank of the Simonstown Stream and not likely to be impacted by dewatering. The nearest Source Protection Zone (SPZ) is at over 9 km from the TMF site.

EPA Export 06-01-2017:02:02:14

8.4.6.3 Impacts on Groundwater Quality

The impacts on groundwater quality during construction are listed below:
Dewatering during construction may cause contamination of groundwater as the water table is lowered. Contaminated water may enter groundwater from the interceptor channel and TMF. The significance of the impact is considered to be low if the dewatered groundwater level is not taken below the interceptor channel water level creating a downward head gradient out of the interceptor channel and potentially causing vertical seepage downwards into the superficial deposits in this location.

Contamination may also occur to groundwater if accidents or spillages occur during the removal of materials from the borrow areas. The significance of this impact would be high because of the shallow groundwater level and the likely spillages containing hydrocarbons.
The interceptor channel would be backfilled on the existing northern dam wall with type E material and a 300 mm diameter perforated pipe installed in the base of the channel on a bedding of type C material. The new interceptor channel around the Stage 6 would be connected to the existing east and west channels. If not constructed properly the contaminated water from the interceptor channel could enter groundwater. The significance of the impact is considered to be low given that mitigation has been put in place in the design; a perforated pipe in the existing northern channel would continue to capture seepage draining vertically through the existing TMF.

For inspection purposes only.
Consent of copyright owner required for any other use.

8.4.6.4 Impacts on Groundwater Vulnerability

The removal of impermeable till materials from the borrow areas would act to increase the vulnerability of the underlying bedrock. The potential increase in the localised vulnerability of the bedrock aquifer is considered to be medium given that all of the available material would be removed.

8.4.6.5 Impacts on Surface Water Hydrology

It is proposed to divert Blake's Stream to the west as it enters the site (Figure 8-3-1) and into a new interceptor channel to discharge to the Yellow River further upstream of the current discharge. The diversion of Blake's Stream may have an impact on the ecological value of the stream, or on the Yellow River due to the change in the discharge location. The diversion could reduce the flow entering the Yellow River, the significance of the impact would depend on the base flow from Blake's Stream entering the Yellow River and whether this is a significant amount of water. Flow measurements have been taken on the Blake's Stream and Yellow River between September and November 2015 at the five monitoring points (BS1, BS2, YR1, YR3, and YR4) shown on Figure 3-1. Flow in the Blake's Stream before discharging to the Yellow River (BS2) has been reported to be between 720 m^3/d and 5350 m^3/d equating to between 7 % and 17 % of the Yellow River flow directly downstream (YR3) (9650 m^3/d to 32170 m^3/d. Given these recorded flows, should the diversion

EPA Export 06-01-2017:02:02:14

result in a reduction of contributing flow from the Blake's Stream to the Yellow River, it is not considered that this reduction in flow would be significant.

8.4.6.6 Impacts on Surface Water Quality

Impacts on surface water quality may arise from surface run-off from the borrow areas which, during the construction period, is likely to contain elevated concentrations of suspended solids. In the event of accidents or spillages, surface run-off may also contain concentrations of hydrocarbons. The predicted temporary increase in concentrations of suspended solids, and the possible occurrence of hydrocarbons, in surface run-off, unless mitigated, could affect the quality of the receiving watercourses (the Simonstown Stream, Blake's Stream and the Yellow River). Drainage ditches excavated during construction may create pathways to these watercourses.

8.5 During Operation of Stage 6

8.5.1 Impacts on Groundwater Hydrology and Quality

A potential impact on groundwater quality is the increased seepage entering groundwater from the Stage 6 extension. The significance of this impact is considered to be low because it is proposed to place a low permeability composite lining system on the upstream dam slopes and basin area of Stage 6. This is an embedded mitigation to prevent further seepage entering groundwater. The lining material would have 2 and 5 leaks per hectare less than 10 mm² in size. It has been calculated that at the final condition of Stage 6 the seepage rate would range between less than (<) 2 m^3/day to <3 m^3/day. After 30 years of deterioration it would be expected to increase to <5 m^3/day through the total area of Stage 6 (Golder Associates, 2015).

Consent of copyright owner required for any other use. For inspection purposes only.

The chemistry of the seepage during Stage 6 operation would not differ from that observed during Stage 5, since the nature of the deposited tailings would be similar. The interceptor channel would also be in place to create a closed water cycle system.
There is a potential impact on groundwater hydrology from the placement of the new lining system. The lining system will create a barrier to groundwater flow in both the superficial and bedrock aquifers. Groundwater levels in the bedrock would be prevented from rising above the lining system due to the low permeability liner and groundwater in the superficial deposits would be prevented from flowing south west across the borrow area towards the Yellow River. This barrier may cause groundwater levels to rise on the northern and north eastern sections of the Stage 6 extension. The significance of this impact is considered to be low for the bedrock aquifer in Stage 6 because most of the area is overlain by superficial deposits with low permeability in some areas and also because an interceptor channel will be excavated around the extension area and will intercept groundwater if it rises above the base of the ditch.. The significance of this impact on shallow groundwater levels in the superficial deposits is considered to be low because a small depth of impermeable superficial deposits have already been removed from the borrow area for the Stage 5 raise and no significant impact has occurred.

EPA Export 06-01-2017:02:02:14

8.5.2 Impacts on Surface Water Hydrology and Quality

During operation there would be no direct discharge to surface water from the TSF, although surplus supernatant water would continue to be treated at the mine site and discharged to the River Boyne. Potential impacts, therefore, would be confined to the contribution of seepage to groundwater which may pass as base flow to surface watercourses.

There is no clear evidence that there is an expanding plume at the TMF site. The extent of groundwater contamination surrounding the TMF with regard to sulphate fluctuates, depending on rainfall and mine dewatering operations, and is estimated at 0.7 km^2. The extent of groundwater contamination directly underneath the TMF, with regard to sulphate, is estimated at 1.9 km^2. The extent of groundwater contamination surrounding the TMF with regard to magnesium is fragmented and is estimated to be significantly less.

Compliance points and trigger values at the TMF have been put in place (AECOM, 2015). The compliance points have been put in place to protect the Yellow River and Blackwater River. OB13 would be used as a compliance point in the superficial deposits to help protect the Yellow River and OB4-P2 and BR4 would be used in the superficial deposits and bedrock respectively to help protect the Blackwater River. Trigger values have been set at these compliance points for sulphate and magnesium at 1000 mg/l and 50 mg/l respectively.

For inspection purposes only.
Consent of copyright owner required for any other use.

These concentrations would be used as an alert of a potential future non-compliance at the compliance points and hence at the receptors. The section of the River Blackwater used for potable water supply is at approximately 2.4 km south of the TMF and forms the southernmost boundary of the groundwater body. It is unlikely that there is a pathway between the TMF and this section of the River Blackwater, but a compliance point has still been set.

The contribution of groundwater from the area characterised by elevated sulphate concentrations to base flow in surface watercourses is generally low, since the affected area constitutes only a small proportion of the total catchment. The Yellow River has been receiving base flow with elevated sulphate concentrations for some time, however the impact on the Yellow River, and the River Blackwater downstream of the confluence, has been insignificant.

8.5.3 Closure of TMF

Before the Stage 6 is closed the Stage 5 raise would be closed and capped. For the Stage 5 closure Boliden Tara Mines Ltd propose to cover the TMF with a 350 mm thick layer of soil placed on top of the tailings and drained using a combination of rockfill access roads, perforated pipe and geosynthetic drains. The surface would be profiled so that water decants from a structure at the south east corner of Stage 5B into a receiving area. Pumps would cease at closure and water in the interceptor channel would pass by gravity to the south east of the channel. It would then discharge through a passive treatment system (PTS), consisting of a retention pond,

EPA Export 06-01-2017:02:02:14

sulphate reducing bioreactor, and Free Water Cell (integrated constructed wetland (ICW)), to the Blackwater River (via a pipeline) downstream of the Liscartan water treatment works. There would be an overflow route to the Simonstown Stream at times of high flow when dilution is adequate for discharge without treatment (Golder Associates, 2009).

The completion of Stage 5 is predicted to be by the middle of 2019. This Stage would be capped but the arrangement of drainage and the shape of the cap would need to be detailed once the location of the sand line and reclaim pumps are determined by Boliden Tara Mines Ltd. A spillway would also be put in place before closure of Stage 6 to control water levels and discharges, but it would be engineered once the facility is approaching closure. It is assumed that the closure of Stage 6 would use the PTS already put in place for the Stage 5 closure.

8.6 Impacts on Groundwater Hydrology and Quality

The potential impact on groundwater during closure would be seepage bypassing the interceptor channel. As mentioned above seepage would increase to <5 m^3/day after 30 years of deterioration. The significance of impact is considered to be low assuming appropriate operation and maintenance of the interceptor channel making sure levels in the interceptor channel remain below groundwater levels which would contain seepage close to the TMF. The 2009 closure plan states that the hydraulic design of the treatment system would ensure that levels are low within the interceptor channel. The interceptor channel would be regularly maintained to prevent water backing up and to ensure effective operation, pumping may be necessary to maintain low levels in the channel. Re-profiling of the channel invert and off-takes from more than one location would also be considered (Golder Associates, 2009).

Consent of copyright owner required for any other use.
For inspection purposes only.

8.6.1 Impacts on Surface Water Flow and Quality

As mentioned above during closure of Stage 5 seepage would continue to be captured in the interceptor channel before passing by gravity to a passive treatment system, consisting of a retention pond, a sulphate reducing bioreactor (SRBR) and a free water cell or integrated constructed wetland (ICW). Stage 6 will follow this closure plan. The system is to be located to the south of the existing TMF, in the area indicated on Figure 8-3-1.

The current design for the ICW consists of 5 ponds planted with a mixture of sedges, reeds, rushes and cattalls. The ponds will be constructed into low permeability material with any sand and gravel material encountered removed and replaced with glacial till.

Further research (testing and onsite trials) will be carried out once the mine water has been fully characterised on completion of Stage 5A to demonstrate the effectiveness of the treatment (Golder Associates, 2009) and to finalise the ICW design.

EPA Export 06-01-2017:02:02:14

The proposed ICW system will not discharge to the River until discharge parameters are met, until such a time the water will be recycled to the mine site for reuse or discharged to the river Boyne under the conditions of the current site licence.

The current ICW design allows for the discharge of a maximum of 7,000 m^3/hour into the River Blackwater (with a 95th percentile flow of 31,000 m^3/hour). Boliden have also provided calculations that have been used to assess the concentrations that could be discharged to the River Blackwater, utilising the dilution potential of the river.
The discharge concentrations and resulting diluted concentrations are also provided in Table 8-4-6.

The significance of the closure plan on the surface water is considered to be low as a result of the treatment and dilution put in place. Maintenance and monitoring of the interceptor channel and PTS would be required to keep the significance of impacts low.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

Table 8.11 Evaluation of Treatment Potential

	Pollutants (mg/l)						
	SO_4	Mn	Ni	Al	NH_4 (as N)	Mg	Zn
Inputs (maximum values from Interceptor channel)	1977	2.25	0.035	2.8	0.967	218	0.83
Threshold Values or IGV	187.5	0.05	0.015	0.15	0.065	50	0.1
Stage 1 - Retention pond	1977	2.25	0.035	2.8	0.967	218	0.83
Stage 2 - SRBR (assume 90% removal for metals and sulphate)	197.7	0.225	0.0035	0.28	TBC	21.8	0.083
Stage 3 - ICW cell[a,b] (assuming 80% removal of metals and 70% for sulphate)	59.3	0.045	0.0007	0.056	TBC	4.4	0.02
Effluent Quality Expected	59.3	0.045	0.0007	0.056	TBC	4.4	0.02
% removal (Total)	97	98	98	98	98	98	98
Compliance expected with Threshold Value or IGV	✓	✓	✓	✓	TBC	✓	✓
Discharge Concentrations from ICW provided by Boliden	500	0.06	TBC	0.10	0.75	55	0.035
Diluted concentrations within the Blackwater River	113.1	0.035	TBC	0.092	0.236	17.5	0.023
Upstream Yellow River quality (mean 2014 at T13)	40	0.033	<0.003	<0.1	<0.08	12.5	0.001
Downstream Blackwater River quality (mean 2014 at T11)	29	0.02	<0.003	0.1	<0.08	11.2	0.003

* TBC = To Be Considered

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

8.6.2 Summary of Impacts and Significance of Effects

Table 8.12 provides a summary of potential impacts and significance of effects arising from the proposed Stage 6 extension.

Table 8.12 Summary of Potential Impacts

Aspect	Receptor	Sensitivity of Receptor	Magnitude of Potential Impacts	Significance of Effect
Dewatering (construction)	Bedrock aquifers	High	Low	Moderate
	Groundwater Users	High	Very Low	Low
	Yellow River and Blackwater River	High	Low	Moderate
	Blake's, Simonstown and Doug Stream	Medium to Low	Low	Low
Excavation	Bedrock aquifers	High	High	High
	Yellow River and Blackwater River	High	High	High
	Blake's, Simonstown and Doug Stream	Medium to Low	High	Moderate
Lining System	Bedrock aquifers (contamination)	High	Very Low	Low
	Bedrock & Superficial Aquifer hydrology	High	Medium	Moderate
	Yellow River and Blackwater River	High	Medium	Moderate
Interceptor Channel	Bedrock and superficial aquifers	High	Very Low	Low
Diversions	Blake's, Simonstown and Doug Stream	Medium to Low	Low	Low
	Yellow River and Blackwater River	High	Low	Moderate
Spillways	Bedrock aquifer	High	Low	Moderate
	Yellow River and Blackwater River	High	Low	Moderate
Passive Treatment System	Bedrock aquifer	High	Low	Moderate
	Yellow River and Blackwater River	High	Low	Moderate

For inspection purposes only. Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

Residual Effects and Mitigation

Table 8.13 provides a summary of the mitigations in place or recommended to reduce the overall impacts on hydrology, hydrogeology and water quality.

Table 8.13 Summary of Residual Impacts on Hydrology, Hydrogeology and Water Quality

Aspect	Receptor	Impact	Embedded Mitigation	Significance of Effect	Proposed Mitigation	Residual Impact and additional mitigation required
Dewatering (construction)	Bedrock aquifers	Lowering the water table and increasing contamination.		Moderate	Groundwater levels would be kept above the interceptor channel water level during dewatering.	Low
	Groundwater Users			Low	None required.	Low
	Yellow River and Blackwater River			Moderate	Groundwater levels would be kept above the interceptor channel water level during dewatering and prevent contamination reaching the Yellow River and Blackwater River. Dewatering would be temporary and reduce water levels by a few metres having a low impact on surface water.	Low

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

Aspect	Receptor	Impact	Embedded Mitigation	Significance of Effect	Proposed Mitigation	Residual Impact and additional mitigation required
	Blake's, Simonstown and Doug Stream			Low	None required. Blake's stream will be diverted.	Low
Excavation (construction)	Bedrock aquifers	Increasing the vulnerability of the Bedrock	The bedrock vulnerability would be protected by the lining system, which would consist of a HDPE geomembrane over a GCL. This composite lining overlies a 1000 g/m² geotextile which in turn overlies 100 mm layer of Type C protection material. Type A2, A3 and D2 material would also be used to level the basin area prior to placement and Terram 1000 would be placed in softer areas below the Type C layer.	High	A designated refuelling area will be provided and all refuelling will be within this area. The construction of bunds around the fuel/oil storage facility located within the compound and the use of double skinned fuel tanks. Any spillage would be contained within this bunded area, which would also have a compacted till floor to prevent infiltration of spilt liquids. An oil absorbent boom would be installed at the discharge from the temporary settling pond to remove oil contaminants in the surface run-off which might arise from normal operation of the mechanical plant. Spill kits will be provided. A water management	Low

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:14

Aspect	Receptor	Impact	Embedded Mitigation	Significance of Effect	Proposed Mitigation	Residual Impact and additional mitigation required
					system will be put in place to include oil interceptors and settlement lagoons. Discharge from the site will meet water quality standards.	
	Yellow River and Blackwater River	Contaminating surface watercourses		High	Surface run-off and dewatering discharges from the borrow areas would be routed through temporary settling ponds to promote the settling of suspended solids. The precise location and size of the settling ponds would vary in response to the changing extent of borrow area working and restoration. The possibility of significant quantities of fuel or oils entering	Low
	Blake's, Simonstown and Doug Stream			Moderate		Low

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

Aspect	Receptor	Impact	Embedded Mitigation	Significance of Effect	Proposed Mitigation	Residual Impact and additional mitigation required
					the surface run-off would be minimised by the construction of bunds around the fuel/oil storage facility located within the compound and the use of double skinned fuel tanks. Any spillage would be contained within this bund, which would also have a compacted till floor to prevent infiltration of spilt liquids. An oil absorbent boom and oil interceptor would be installed at the discharge from the temporary settling pond to remove oil contaminants in the surface run-off which might arise from normal operation of the mechanical plant.	
Lining System (operation)	Bedrock aquifers	Seepage from Liner	The lining system would be put in place to reduce seepage from the TMF.	Moderate	Groundwater monitoring would continue and compliance points and trigger values would be used to help protect the water bodies. The interceptor channel would also help create a closed water	Moderate / Low

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

Aspect	Receptor	Impact	Embedded Mitigation	Significance of Effect	Proposed Mitigation	Residual Impact and additional mitigation required
					cycle system. Operation and maintenance of the interceptor channel would need to continue.	
		Barrier to groundwater flow	Interceptor channel around perimeter will drain groundwater if levels rise.	Low	No further mitigation proposed.	Low
	Yellow River and Blackwater River	Seepage from Liner	The lining system would be put in place to reduce seepage from the TMF.	Moderate	Groundwater and surface water monitoring would continue to be carried out in accordance with permits.	Moderate / Low
Interceptor Channel (construction, operation and closure)	Bedrock and superficial aquifers	Seepage entering groundwater from the interceptor channel	The interceptor channel would be backfilled on the existing northern dam wall with type E material and a 300 mm diameter perforated pipe installed in the base of the channel on a bedding of type C material. This would continue to capture seepage draining	Moderate	Operation and maintenance of the interceptor channel would need to continue to prevent water backing up. Pumping may be necessary after closure to maintain low levels. Water levels in the interceptor channel would also continue to be monitored to check that they do not rise above groundwater levels	Low

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

Aspect	Receptor	Impact	Embedded Mitigation	Significance of Effect	Proposed Mitigation	Residual Impact and additional mitigation required
			vertically through the TMF.			
Diversions (construction, operation and closure)	Blake's, Simonstown and Doug Stream	Diverting Blake's Stream		Low	Baseline data would be collected to determine the quantities of flow in Blake's stream and the ecology present.	Low
	Yellow River	Diverting Blake's Stream		Moderate	Baseline data would be collected to determine flows in the Yellow River to determine the impact.	Low
Spillways (closure)	Bedrock aquifer	Spillways may increase water levels in the interceptor channel.	Spillways would be installed to control contaminated water levels in the TMF.	Moderate	The spillway discharge rate would be controlled to prevent too much water filling the channel.	Low
	Yellow River and Blackwater River			Moderate		

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:14

Aspect	Receptor	Impact	Embedded Mitigation	Significance of Effect	Proposed Mitigation	Residual Impact and additional mitigation required
Passive Treatment System (closure)	Bedrock aquifer	Water of an unacceptable standard is discharged to ground/river system.	A Passive Treatment System would be put in place to treat contaminated water before discharging to ground or River System. This system would already be in place for the closure of the previous stages and research would have been carried out to ensure the efficiency of the PTS and to make sure the discharge does not have a significant impact on the environment.	Moderate	Maintenance and monitoring of the interceptor channel and PTS would be required, so that an acceptable standard of water is discharged. Production and containment of toxic hydrogen sulphide gas in the SRBR would require safeguards and a sealed chamber to be put in place. Knowledge of volumetric loading rates, effect of intermittent flows (including optimisation of hydraulic retention time), temperature effects, manual operational inputs, and short-circuiting effects would need to be considered in the design. Removal of manganese, which has not been successfully removed in active or passive treatment and generally requires lime dosing or closed limestone drains would need to be considered.	Low

For inspection purposes only. Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

Aspect	Receptor	Impact	Embedded Mitigation	Significance of Effect	Proposed Mitigation	Residual Impact and additional mitigation required
					In the free water cell, treatment performance during winter may be lower; water must not pond or H_2S will be readily produced; a large surface area is required for all metal removals and information on volumetric loading will be required.	

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

8.7 Monitoring Recommendations

A number of monitoring boreholes would be decommissioned during the construction of Stage 6 because they are within the area of the extension. These include monitoring boreholes BR7, BR8, BR11, BR12, BR13, OB8, OB9, OB15, OB16, OB17, OB18 and OB19.The monitoring boreholes would be decommissioned to ensure that there is no direct pathway to groundwater from surface.
These monitoring boreholes in the northern section of the TMF would be replaced with boreholes around the perimeter. Figure 6-1 shows the locations of recommended boreholes.

Due to the backfilling of the existing northern interceptor channel, monitoring point 'ICPB' would also be decommissioned. Interceptor channel monitoring locations would be constructed in the new channel on the western, eastern and northern perimeter of Stage 6.

Following the drilling and installation of the recommended boreholes the conceptual model for the extension area should be updated as more geological and hydrogeological data is collected. Groundwater levels and quality will be monitored in these boreholes.
Conclusion

The groundwater and surface water impacts during construction and operation of Stage 6 will be very similar to those identified within previous Environmental Impact Assessments and are considered to be mostly minor or insignificant. The main potential risk to the water environment continues to be from seepage through the embankment walls and base of the TMF, and associated elevated concentrations of sulphate and other parameters in groundwater south west of the TMF. Embedded mitigation of a low permeability composite lining system will reduce the seepage rate from the Stage 6 extension to less than (<) 2 m^3/day to <3 m^3/day, increasing to <5 m^3/day through the total area of Stage 6 after 30 years of deterioration (Golder Associates, 2015). With effective operation and maintenance of the interceptor channel, seepage is contained close to the TMF and the chemical status of groundwater is expected to be maintained.

With ongoing operation and maintenance of the interceptor channel, residual impacts are expected to be minor.
Impacts post closure will depend on the effectiveness of the interceptor channel and the passive treatment system (PTS). Design work will be required following capping of Stage 5 when flows and water quality can be estimated with greater certainty. The proposed PTS will incorporate a retention pond, sulphate reducing bioreactor (SRBR) and integrated constructed wetland (ICW), which will reduce maintenance requirements and enable water to be stored until discharge is appropriate, thus avoiding significantly higher flows in the river.

Discharge from the PTS will be to the Blackwater River, downstream of Liscartan. An overflow system will operate during peak rainfall events, whereby diluted water is discharged to the Simonstown Stream and may subsequently be used by livestock.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:14

The ability of the proposed PTS to discharge water of an acceptable quality into the Blackwater River and Simonstown Stream cannot be guaranteed at this stage. The proposed PTS incorporates technology that is currently unproven, and the baseline environmental conditions in local river systems will need to be re-assessed at the time of Stage 5 closure, along with the exact nature of the wastewater quantity and quality .

Continued monitoring and further research into the suitability of the proposed PTS design will enable an informed decision to be made at Stage 5 closure. Of particular importance will be the dilution capacity of the Simonstown Stream, and whether it can deal with potentially high concentrations of sulphate during overflow storm discharges from the TMF that will bypass any form of water treatment.
Since approval in 1996 and 2009 of the Stage 4 and Stage 5 raises a water monitoring programme has been in place at the TMF. An annual water quality monitoring review is undertaken independently and submitted for approval in accordance with the IE licence. Monitoring would continue, with some changes to take into account the proposed Stage 6 development.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:14

8.8 References

AECOM, 2015. Risk Screening and Technical Assessment Report for Randalstown Tailings Management Facility at Tara Mines. For the Environmental Protection Agency. IE Licence No. P0516-03.

AECOM, 2016. Yellow River Mass Balance.

CDM, 2005. Eastern River Basin District Final Characterisation Report. Dublin City Council.

Eastern River Basin District, 2010. River Basin Management Plan 2009-2015. As adopted by Minister for Environment, Heritage and Local Government.

Environmental Protection Agency (2008), Water quality in Ireland 2004-2006.

European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) (Groundwater Regulations) - http://www.irishstatutebook.ie/2010/en/si/0009.html

Geological Survey of Ireland online mapping tool – www.gsi.ie/maps

Golder Associates, March 2009. The Reclamation and Closure Plan for the Randalstown Tailings Facility following Stage V Raise. 08514150063/A.4

Golder Associates, June 2015. Conceptual Design for the Stage 6 Tailings Management Facility. Boliden Tara Mines Tailings Management Facility. Report Number 1532091.500/B.O

Knight Piésold (1996), Randalstown Tailings Facility – Stage IV: Environmental Impact Statement

Scott Wilson, June 2009. Tara Mines Randalstown Tailings Management Facility Stage V Raise to Embankment. Environmental Impact Statement. Water Section: Hydrology & Hydrogeology. Project Number D121382.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:14

Section 9 Landscape and visual

9.1.1 Background

This section assesses the landscape and visual impacts arising from the proposed extension of the existing tailings management facility (TMF), which forms part of the Tara Mines development at Navan, Co. Meath.

The proposed extension site is located within an existing borrow pit, immediately to the north of the existing TMF, approximately 5km northwest of the centre of Navan, 1.5km to the west of the R162 and just south of the R163. The site will be accessed via the access road to the existing TSF.

The proposed TSF extension will cover an area of approximately 43 in total. It will be tied into the existing TMF, so that the existing northern dam wall will form the southern dam wall of the extension. The proposed western, northern and eastern dam walls, which will be built in 2 phases, will reach a height of up to 22m above ground level and will be level along the top at a height of 67.29AOD. Please refer to chapter 3 of this EIS for a detailed description of the proposed development.

Consent of copyright owner required for any other use. For inspection purposes only.

Landscape and visual effects are independent but related issues; landscape effects are changes in the landscape, its character and quality, while visual effects relate to the appearance of these changes and the resulting effect on visual amenity. Wherever possible, identified effects are quantified, however the nature of landscape and visual impact assessment requires interpretation by professional judgement. In order to provide a level of consistency to the assessment, the appraisal of the sensitivity of the landscape/visual receptors and the prediction of magnitude and assessment of significance of the residual landscape and visual effects have been based on pre-defined criteria, as described further preceding the relevant sections of this report.

9.1.2 Scope of Work

This landscape and visual impact assessment was undertaken in accordance with the Guidelines for Landscape and Visual Impact Assessment (Landscape Institute and Institute of Environmental Management & Assessment, Third Edition, 2013; hereafter referred to as GLVIA3) and is structured in the following manner:
Introduction – a brief description of the proposed development and the structure of this report, as well as an account of the relevant planning context (e.g. planning policies, designated landscapes, sites of nature conservation importance)
Receiving Environment – a description of the landscape and visual baseline
Impact Assessment – a description of the aspects of the proposed development which are likely to cause landscape and/or visual effects, including the methodology for and an assessment of landscape and visual receptor sensitivity, as well as the magnitude and significance of the landscape and visual effects;
Mitigation Measures – a description of the measures which will be incorporated to mitigate any landscape and visual effects of the proposed development; and

EPA Export 06-01-2017:02:02:14

Residual Impact Assessment – a summary of the degree of the residual landscape and visual impact.

The assessment is illustrated by:

- A Landscape Designations Map (including viewpoint locations),
- Two Zone of Theoretical Visibility (ZTV) Maps
- Six Viewpoint Sheets, refer to Figures 9-1 to 9-9. The viewpoint sheets include sketch photomontages of the proposed development for four of the chosen viewpoints.
    - **NOTE: All of the above are presented in Appendix 9.1**

A description of the restoration scheme can be found in the closure remediation and aftercare management plan for the site

9.1.3 Legislative Framework / Planning Policy

The Meath County Development Plan (CDP) 2013-2019 is the statutory plan detailing the development objectives/policies of the authority responsible for the development site. Those policies, with relevance to this assessment, are listed below. In addition, the National Parks and Wildlife Service (NPWS) website was checked for any protected sites in proximity to the application site.

For inspection purposes only.
Consent of copyright owner required for any other use.

Refer to Figure 9-1 – Landscape Designations and Viewpoint Locations for the location and extent of protected sites within the study area.

9.1.4 Views & Prospects

The Meath CDP places protection on a number of views & prospects. Objective LC OBJ 5 within Section 9.10 of the current Meath CDP states the following: *"To preserve the views and prospects and the amenity of places and features of natural beauty or interest listed in Appendix 12 and shown on Map 9.5.1 from development that would interfere with the character and visual amenity of the landscape."*

Refer to Figure 9-1 for those protected viewpoints located within the study area. It should be noted that, as per the description in Appendix 12 of the Meath CDP, none of these views are directed at the application site. Nevertheless, the protected viewpoint on Carn Hill, east of Navan (protected views & prospects no. 38), was checked and is included in the assessment as Viewpoint I on Figure 9-8.
Although outside the study area, the protected panoramic view on Tara Hill (protected views & prospects no. 44, approximately 14km south of the application site) was visited during the site survey, due to its importance. The existing TMF could not be clearly distinguished in any views from the Hill of Tara. Since the proposed extension will be located to the back of the existing TMF, when viewed from Tara, the visual impact on these views would be imperceptible to none. It was therefore decided that no further assessment of this view is required.

EPA Export 06-01-2017:02:02:14

Protected views & prospects no. 13, the Tower of Lloyd at Kells is another important viewpoint in County Meath. This is located 13km to the northwest of the applications site. Due to the distance to the application site, the likely visual impact on views from the tower would also be imperceptible to none. It was therefore decided that no further assessment of this view is required.

Extractive Industry and Building Materials Production

Section 10.12 of the current Meath County Development Plan lists a number of policies with regard to the Extractive Industry, which includes zinc mining. Those policies with relevance to the landscape and visual impact chapter are listed below:

Policy RD POL 22:*"To facilitate the exploitation of the county's natural resources and to exercise appropriate control over the types of development taking place in areas containing proven deposits, whilst also ensuring that such developments are carried out in a manner which would not unduly impinge on the visual amenity or environmental quality in the area."*

Policy RD POL 23:*"To support the extractive industry where it would not unduly compromise the environmental quality of the county and where detailed rehabilitation proposals are provided."*

Policy RD POL 24:*"To seek to ensure that the extraction of minerals and aggregates minimise the detraction from the visual quality of the landscape and do not adversely affect the environment or adjoining existing land uses."*

Policy RD POL 26:*"To ensure that all existing workings shall be rehabilitated to suitable land uses and that all future extraction activities will allow for the rehabilitation of pits and proper land use management. The biodiversity value of the site should be considered in the first instance when preparing restoration plans. Where land filling is proposed, inert material is the preferred method. Each planning application shall be considered on a case by case basis and where relevant will be dealt with under the relevant regional Waste Management Plan."*

Consent of copyright owner required for any other use. For inspection purposes only.

Policy RD POL 27:*"To ensure that development for aggregates / mineral extraction, processing and associated processes does not significantly impact in the following areas: … vii. Sensitive landscapes… ."* (note: the site is located within a Landscape Character Area classed as being of medium sensitivity, see summary of Meath Landscape Character Assessment below).

9.1.5 Protected Sites

One Special Areas of Conservation (SAC), one Special Protection Area (SPA), one Natural Heritage area and one proposed Natural Heritage Areas (pNHAs)are located within the wider study area surrounding the application site, refer to Figure 9.1).

EPA Export 06-01-2017:02:02:14

Table 9.1 Sites of Nature Conservation Importance

Type	Site Code	Site Name	Distance and Direction from application area
SAC	002299	River Boyne And River Blackwater	1.2km southwest
SPA	004232	River Boyne And River Blackwater	1.2km southwest
NHA	001324	Jamestown Bog	7.4km southwest
pNHA	001592	Boyne Woods	5.2km southeast

9.1.6 Consultations

Following a review of published development plans and a site inspection, it was considered that there was no requirement for a separate formal consultation to be carried out with regard to landscape and visual impact of the proposed development.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

9.2 Receiving Environment

9.2.1 Baseline Study Methodology

The landscape and visual baseline study has involved a desktop study, field work, data processing and analysis. The aim of the landscape baseline study *"is to provide an understanding of the landscape in the area that may be affected"* (Section 9.15 of GLVIA 3), including its constituent elements, landscape character and its geographic extent.

With regard to the visual baseline GLVIA 3 (Section 3.15) states that it is the aim *"to establish the area in which the development will be visible the different groups of people who may experience views of the development, the places where they will be affected and the nature of the views and visual amenity at those points."*

Representative and illustrative viewpoints were selected for inclusion in the detailed assessment in respect of the following parameters:

- types of receptor: to include settlements, roads, marked footpaths and cycle paths, marked viewpoints, picnic areas and beauty spots and outdoor passive recreational locations;
- different distances from the development;
- different directions from the development with the aim of achieving a distribution from different compass points around the site; and
- altitude.

For inspection purposes only.
Consent of copyright owner required for any other use.

Refer to Figures 9.4 to 9.9 for the nine chosen viewpoints (VP A-I). These represent typical views towards the application site and illustrate how large parts if not all of the of the existing TMF and application site are screened in views from the majority of locations surrounding the site.

The majority of the photographs used in this assessment were taken during the site survey on 14th October 2014, using a Canon EOS 1000D digital SLR camera. The weather conditions were overcast and misty at the beginning of the day. However, visibility was found to be sufficient to carry out the assessment. Some of the photos (i.e. VP A, B and D) were re-taken during the winter months, when deciduous trees are not in leaf, in order to demonstrate the 'worst-case' visibility of the application site.

The nature of the views was of relatively wide panoramas and it was therefore considered beneficial to present the photographs in this way. The panoramic views consist of two to four photographic frames merged together using computer software. It should be noted that photography is a tool to assist in the visualisation process and cannot be expected to replicate the actual view, which would be attained on the ground

EPA Export 06-01-2017:02:02:15

9.2.1.1 Study Area

A study area of approximately 8km surrounding the application site was identified following the desk top study, and the preparation of the zone of theoretical visibility (ZTV) mapping (refer to Figures 9.2 & 9.3). It should be noted that the visual envelope, i.e. the area from where the application site is actually visible, is much smaller than the study area, due to intervening vegetation and topography.

9.2.1.2 Sources of Information

The desktop study and field work was supported by, inter alia:

- the Meath County Development Plan 2013-2019,
- digital as well as paper (Ordnance Survey Ireland) mapping at different scales, and
- information available on the internet (such as information on recreational facilities and nature conservation sites).

For inspection purposes only.
Consent of copyright owner required for any other use.

9.2.1.3 Field Monitoring / Inspection

A detailed site survey was carried out on 14th October 2015. The visibility assessment has concentrated on the publicly accessible areas such as the road and public footpath networks, residential and outdoor recreational areas, with the exception of one viewpoint located within a private property to the east of the application site (i.e. Viewpoint A, Figure 9.4).

9.2.2 Landscape Baseline

9.2.2.1 Existing Landscape Appraisals

The Meath Landscape Character Assessment can be found in Appendix 7 of the current Meath Development Plan. The Assessment divides the county into 4 Landscape Character Types (LCT's), i.e. *"generic areas of distinctive character"* and further into 20 *"more geographically specific"* Landscape Character Areas (LCA's).

The development site is located within LCT 2 - 'Lowland Areas' and LCA 3 - 'North Navan Lowlands'. The nearest other LCAs are:

- LCA 20 – Blackwater Valley (approximately 1km southwest of the development site)
- LCA 16 – West Navan Lowlands (approximately 2.5km southwest of the development site)

EPA Export 06-01-2017:02:02:15

- LCA 5 – Boyne Valley (approximately 4km southeast of the development site)
- LCA 6 – Central Lowlands (approximately 5km southeast of the development site)

LCA3 is classed as being of 'Moderate' Landscape Value, i.e. '*Areas which retain a positive character and a sense of place, or are of local interest or importance*'. Despite this LCA 3 has been afforded 'Regional' Landscape Importance.

LCA 3is further classed as being of a 'Medium' Landscape Sensitivity, i.e. '*A landscape that can accommodate a certain amount of change without affecting the overall character. There are unlikely to be large numbers of people using or viewing this landscape*.'

The landscape description of LCA 3 includes the following: *"The landscape around the fringes of Navan is flat - an extension of the river plains to the east and west. It has a mix of land uses including ribbon housing development, retail units, a large quarry and a racecourse which are not well integrated into the landscape and which have caused the loss of traditional field boundaries, trees and vernacular field and road boundaries. The racecourse in particular has a visually detractive corrugated fence along the road corridor as has the Tara Mines Development. There are good views across this plain towards more undulating and well- treed farmland in the north and north east."*

For inspection purposes only. Consent of copyright owner required for any other use.

The key characteristics of LCA 3, as listed in the Meath Landscape Character Assessment, include the following:

- Geology: *"Complex geology of limestone, sandstone, shale and volcanic rock creating diverse landscape."*
- Geology: *"Due to the variety of geological parent material there are several quarries and pits in the area."*
- Geology: *"The Tara Mine north west of Navan was one of the largest lead-zinc mines in Europe."*
- Lands Use: *"Predominantly large agricultural fields, mix of pasture and arable crops."*
- Land Use: *"Field boundaries in degraded condition."*
- Land Use: *"Urban fringe landscape around Navan with mix of uses, degraded condition and visually detractive developments."*
- Tourism: *"Navan Racecourse attracts large numbers of spectators throughout the year with and extensive fixture list"*
- Tourism: *"Navan Golf course which is situated at the racecourse welcomes visitors and societies."*

EPA Export 06-01-2017:02:02:15

- Settlements and Built Structures: *"Mixed use development on urban fringe of Navan: commercial and light industrial, residential, quarrying and leisure (racecourse)."*
- Key Settlements: *Navan*: *"…Northern fringes of town which fall within this LCA are within flat plain surrounding river valley. A chaotic mix of uses including large quarry, racecourse, suburban housing and ribbon development. The railway line degrades landscape character here."*
- Key Settlements: *Kilberry*: *"a small graig on the busy R162 between Navan and Kingscourt that has expanded into an incoherent collection of buildings – a number of agri-industrial/ commercial units, a large palette yard, church, thatched pub and a few houses. There is little of the original character left and almost continuous residential ribbon development between it and Navan."*
- Forces for Change: *"Continued degradation of urban fringe and river plain around Navan."*

For inspection purposes only.
Consent of copyright owner required for any other use.

The recommendations for LCA 3 include:

> *"1. Provide incentives to landowners to improve condition of farmland, including management of hedgerows and trees in field boundaries. …*
> *3. Maintain the integrity of 18th Century farming landscape by encouraging the management of estate parkland, avenues of mature trees, boundary walls and clipped hedges. …*
> *5. Consolidate northern urban fringes of Navan. Favour location of development on infill sites rather than ribbon development extending along approaches to town. Use appropriate landscape treatment along edges of development to soften urban fringe.*
> *6. Compliment landscape enhancement of urban fringe with opportunities to increase amenity value of urban fringe of Navan for public access and recreation. …"*

The Landscape Character Assessment also includes an appraisal of the potential capacity of each of the LCA's to accommodate a number of *"likely forms of development"*. In the absence of an assessment of the potential capacity to accommodate mineral extraction facilities, the following was found to have some relevance to this assessment: LCA 3 is regarded as having a *"Medium potential capacity to accommodate the development of wind farms and individual turbines because there are few long range views except to the adjacent LCA. The number of viewers of such development would be relatively high but their proximity to several large urban areas is likely to lower their sensitivity"*. LCA 3 is further regarded as having a *"High potential capacity to accommodate biomass and forestry development except in the central sub-area of this LCA where large scale plantations are already and established feature of the landscape. …"*

9.2.2.2 Outdoor Recreational Facilities within the Study Area

EPA Export 06-01-2017:02:02:15

Navan Racecourse and Navan Golf Course are located just over 1km to the southeast of the TMF site. There are no other known outdoor recreational facilities with views of application site within the study area.

9.2.2.3 Site Specific Landscape Appraisal

The application site is located immediately north of the existing Tara Mines TMF, within and area that is currently used as a borrow pit to construct the dam walls of the TMF. Therefore the application site consists of large areas of disturbed ground. However, there are also some areas where grass and scrub vegetation has naturally recolonised the ground, as well as a number of rows of trees and two small woodland areas. The western, northern and eastern boundaries of the application site are marked with mature hedgerows.

Pasture fields and a small percentage of arable fields, bound by mature hedgerows, dominate the landscape surrounding the site. Small wooded areas are scattered throughout. Other elements in the landscape include a network of regional and local roads, with associated ribbon housing development, the rivers Boyne and Blackwater and associated river valleys, as well as Navan town.

The topography of the application site and immediately surrounding area is generally flat, at elevations of 50-60m AOD. Immediately south of the application site the ground levels were raised by 20-25m as part of the existing TMF.
Within 4km to the northwest, north and northeast of the site, the land is slightly undulating with a number of local highpoints between 80-120m AOD. Further northeast the land continues to rise until it reaches 159m AOD at Mullagha Hill, at a distance of approximately 6km.

For inspection purposes only.
Consent of copyright owner required for any other use.

Within 1.5km to the southwest and 4km to the southeast of the application site the land falls slightly towards the River Blackwater (below 50m AOD) and River Boyne (below 40m AOD), respectively. Beyond these the land continues to be generally flat at elevations around 70m AOD. The most significant highpoints in the wider landscape are Carn Hill (120m AOD), approximately 7km southeast of the site, the Hill of Tara (159m AOD) and Skryne (172m AOD), approximately 14km to the southeast , as well as the highpoint west of Kells (129m AOD), approximately 13km to the west.

The main transport routes through the study area are the R162, less than2km to the east of the site, the R162, immediately to the northeast and the R147, 2.5km to the southwest. The N51 from Navan to Drogheda is located 4km to the southeast of the site and the M3 motorway 4km to the southwest. There is further a comprehensive network of local roads interconnecting the regional and national roads.

As indicated above, there is extensive ribbon housing development along all roads within the study area. Navan, 5km to the southeast, is the largest settlement in the area.

The agricultural landscape surrounding the site is attractive, due to the abundance of mature hedgerows. However, the presence of the many manmade structure, including

EPA Export 06-01-2017:02:02:15

private properties, farm buildings, roads, electricity poles, as well as the existing TMF distract from the scenic rural character somewhat.

Due to the slightly undulating topography to the north of the site, as well as mature hedgerows throughout the study area, the landscape is enclosed somewhat, resulting in an overall medium scale. There are however a number of elevated locations where distant views open up and the scale of the landscape increases.

The undulating topography and abundant mature hedgerows provide good screening potential for low rise development.

9.2.2.4 Landscape Receptors

The landscape receptors affected by the works within the application site consist of the landscape elements (i.e. tree line, woodland areas and natural regeneration on disturbed ground), as well as the landscape character of the area surrounding the site (agricultural lowland - LCA 3).

9.2.3 Visual Baseline

9.2.3.1 General Visibility

Consent of copyright owner required for any other use. For inspection purposes only.

The visibility of the application site was initially assessed by a desktop study of OSI Discovery Maps (1:50,000) and available aerial photography. This was followed by 3D computer modelling and calculation of the zone of theoretical visibility (ZTV) of the existing TMF site, as well as the proposed TMF extension, using LSS (McCarthy Taylor) software.

The resulting ZTVs are depicted on Figures 9.2 & 9.3. They are based on a bare terrain; that is, the computer model does not include built structures or vegetation, with the exception of the trees along the western, northern and eastern boundary of the application site. These trees were picked up, during the aerial (drone) survey of the site and were included in the ZTV calculations, so that their screening potential was taken into account. However, in general, the illustrated extent of visibility can be regarded as a 'worst case' scenario, and visibility would be greatly reduced if all vegetation and buildings were included in the model.

Figure 9.2 – ZTV Map 1 shows the theoretical visibility of the proposed TMF extension, whereas Figure 9.3 – ZTV Map 2 that of the existing TMF. The two ZTVs are provided, in order to demonstrate the smaller visibility area of the proposed extension, compared with the existing TMF. In particular, the two ZTVs illustrate that the existing TMF will screen the proposed development in any views from a southern direction (also refer to Viewpoints G & H on Figure 9.8).

Figure 9.2 – ZTV Map 1 indicates that the proposed TMF extension will potentially be visible, within a 3km radius, from locations to the west, north and east of the application

EPA Export 06-01-2017:02:02:15

site. Outside the 3km radius the theoretical visibility is so low (i.e. areas shown in grey) that, from experience, it is likely that intervening vegetation will screen all views.

When compared with Figure 9.3 – ZTV Map 2, it is noticeable that apart from a small number of locations to the north, the TMF extension will not become visible in views from any locations that the existing TMF is not visible in already. Also, it will be visible from a significantly fewer locations than the existing TMF.

It should also be noted that the vast majority of the areas of theoretical visibility of the proposed TMF extension are located on private land and are therefore not publicly accessible. Only short sections of the R162 & R163, as well as some of the local roads are theoretically affected.

The site survey revealed that the actual area from where the application site is visible is almost reduced to none, due to roadside and intervening vegetation. This is particularly the case along the R163 and the local road immediately to the north of the site (refer to Viewpoints D & E on Figures 9.7).

9.2.3.2 Visual Receptors

The receptors with actual views of the application area consist of local residents and road users. Some of these experience similar views towards the application site and they were therefore grouped into 7 Visual Receptor Areas (VRAs). The location and extent of each of the VRAs is indicated on Figures 9.2 & 9.3 and described in Table 9.2 below. The table further lists the types of receptors present in each VRA and describes the nature of views/visual amenity within the areas. Those Viewpoints representing a typical view from within one of VRAs are also listed (refer to Figures 9.4 to 9.9).

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:15

Table 9.2 Visual Receptor Areas (VRA)

VRA No.	Approximate Location/Extent	Types of Receptors	Nature of Views/Visual Amenity
1	Private land south of the R163 and east of the site, as well as short stretch of the R163.	Residents of 1 property and road users.	Close distance views towards the existing TMF and the application site, both of which are partially screened by vegetation. Agricultural land in foreground, distant wooded hills visible in background. Medium visual amenity, due to presence of existing TMF and other manmade features, such as wooden poles. Viewpoint A represents typical view.
2	Parts of Navan Racecourse and approximately 200m long stretch along the R162.	Residents of 4 properties, visitors of Navan racecourse and golf club and road users.	Medium distance views towards the existing TMF and the application site, large parts of which are screened by vegetation. Racecourse and Golf course in foreground, distant wooded hills visible in background. Medium/high visual amenity, due to lush vegetation dominating the view. Viewpoint B represents typical view.
3	Approximately 200m long stretch of R163 to north of junction with the road to the site entrance.	Residents of 2 properties and road users.	Close distance views of the northern application site boundary, which is marked by a grassed screening berm in this area. Road and agricultural land in foreground, no distant views available (due to flat ground and height of screening berm). Low/Medium visual amenity, due to restriction of view by screening berm and road and wooden poles present in view. Viewpoint C represents typical view.
4	Approximately 1km long stretch of local road to west of the site entrance.	Road users	Close distance views towards the existing TMF and the application site, both of which are partially screened by vegetation. Agricultural land in foreground, no distant views available (due to flat ground and height of hedgerows/existing TMF). Medium visual amenity, due to presence of existing TMF and other manmade features, such as wooden poles. Viewpoint F represents typical view.
5	Approximately 30m long stretch along the R163 around highpoint in Gibstown	Residents of 10-12 properties and road users	Medium distance views towards the existing TMF the majority of which is screened by intervening vegetation and structures. The application site is fully screened. Vegetation and properties in foreground, distant lowlands barely visible in background. Medium visual amenity, due to lush vegetation in village location. Viewpoint E represents typical view.
6	Approximately 700m along local road to west of R162 and 2km north of the application site.	Residents of 5 properties and local road users.	Medium distance views towards the existing TMF and the proposed application site in the middle ground of these views. The existing TMF resembles a lake in this view. Sloping agricultural land in the foreground and distant lowlands visible in the background. Medium/high visual amenity, due to pleasantly sloping agricultural land and tree lined hedgerows in view. Viewpoint D represents typical view.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

VRA No.	Approximate Location/Extent	Types of Receptors	Nature of Views/Visual Amenity
7	Approximately 300m along the local road near the highpoint of Carn Hill.	Residents of 10-12 properties and road users.	Long distance views over Navan and surrounding agricultural lowland. The existing TMF is barely visible in the middle ground, the application site is imperceptible. Sloping agricultural land in foreground. Medium/high visual amenity, due to lush agricultural landscape dominating view. Viewpoint I represents typical view.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

9.3 Impact Assessment

9.3.1 Evaluation Methodology

In order to arrive at conclusions about the significance of landscape/visual effects, this LVIA links judgements about the sensitivity of a receptor with the magnitude of identified effects. According to GLVIA 3, section 3.26, the sensitivity (or 'nature') of a receptor is *"made up of judgements about:*

- *the susceptibility of the receptor to the type of change arising for the specific proposal; and*
- *the value attached to the receptor".*

The magnitude (or 'nature') of effects is *"made up of judgements about:*

- *the size and scale of the effect - for example whether there is complete loss of a particular element of the landscape or a minor change;*
- *the geographical extent of the area that will be affected; and*
- *the duration of the effect and its reversibility"* (GLVIA 3, section 3.26)

The judgements about the sensitivity and magnitude are supported by a number of pre-defined parameters, where possible, as described in more detail below. They are then summarised using word scales and combined using a matrix to arrive at the overall significance of the effects, also described in more detail below.

For inspection purposes only.
Consent of copyright owner required for any other use.

9.3.1.1 Landscape Sensitivity

The sensitivity of the landscape is made up from a combination of judgements about the susceptibility of the landscape to change and the value attached to the landscape.

Susceptibility to change means the degree to which a landscape type/area/element is able to accommodate change (arising from a particular development) without detrimental effects on its character. Depending on the type of development proposed, this varies, inter alia, with the existing land use, the pattern and scale of the landscape, the visual enclosure/openness of views and the scope for appropriate mitigation. The value attached to the landscape can be judged, inter alia, by way of existing designations, landscape/scenic quality, rarity, recreation value.

For the purpose of this report landscape sensitivity is defined as HIGH, MEDIUM, LOW or NEGLIGIBLE, based on professional interpretation of the findings with regard to the susceptibility and value.

EPA Export 06-01-2017:02:02:15

9.3.1.2 Viewpoint Sensitivity

Viewpoint sensitivity is made up from a combination of judgements about the susceptibility of visual receptors to changes in views/visual amenity and the value attached to views.

The susceptibility to change in relation to different receptor types is defined in terms of high, medium and low susceptibility in Table 9.3 below. The value attached to views is judged taking account of planning designations, such as protected views and other indicators of the values attached to views, e.g. in relation to heritage assets, views marked on maps or the provision of facilities for the enjoyment of views.

Table 9.3: Susceptibility to change in relation to receptor type

Susceptibility	Visual Receptor Types
High	Users of outdoor recreational facilities including strategic recreational footpaths, cycle routes or rights of way, whose attention may be focused on the landscape; important landscape features with physical, cultural or historic attributes; principal views from residential buildings, beauty spots or picnic areas; communities where views contribute to the landscape setting enjoyed by residents in the areas.
Medium	Other footpaths; secondary views from residential properties, people travelling through the landscape on roads, trains or other transport routes.
Low	People engaged in outdoor sports or recreation (other than appreciation of the landscape), commercial buildings, and other locations where people's attention may be focused on their work or activity.

For inspection purposes only.
Consent of copyright owner required for any other use.

The overall sensitivity of the visual receptors is summarised on a scale of HIGH, MEDIUM, LOW or NEGLIGIBLE based on professional interpretation of the findings with regard to the susceptibility and value.

9.3.1.3 Magnitude of Landscape/Visual Effects

The judgements of the size or scale, geographical extent and duration/reversibility of the changes in the landscape are based on information (based on GLVIA 3, sections 5.49-5.52) including:

- *"the extent of existing landscape elements that will be lost ...;*
- *the extent to which aesthetic or perceptual aspects of the landscape are altered ...;*
- *whether the effect changes the key characteristics of the landscape ...;*
- scale at which effects may have influence (e.g. site level, immediate setting, landscape type/character area);
- full/partial reversibility possible.

EPA Export 06-01-2017:02:02:15

Based on GLVIA 3, sections 5.39-5.41, the judgements of the size or scale, geographical extent and duration/reversibility of visual effects are based on information including:

- *"the scale of the change in the view with respect to the loss or addition of features in the view and changes in its composition ...;*
- *the degree of contrast or integration of any new features or changes in the landscape with the existing or remaining landscape elements and characteristics in terms of form, scale and mass, line, height, colour and texture;*
- *the nature of the view of the proposed development, in terms of the relative amount of time over which it will be experienced and whether views will be full, partial or glimpses;*
- *the angle of view in relation to main activity of the receptor;*
- *the distance of the viewpoint from the proposed development;*
- *the extent of the area over which the changes would be visible;*
- full/partial reversibility possible.

For inspection purposes only.
Consent of copyright owner required for any other use.

The overall magnitude of the landscape/visual effects is summarised on a scale of 'substantial', 'moderate', 'slight' or 'negligible' based on professional interpretation of the findings with regard to size or scale, geographical extent and duration/reversibility. In order to assist the assessment, brief definitions of each level of magnitude are provided in Table 9.4, below.

Table 9.4 Definition of Levels of Magnitude

Magnitude	Definition
Substantial	Total loss or major alteration of key elements/features/characteristics of the baseline conditions such that post development, landscape character or view composition attributes of the baseline will be fundamentally changed.
Moderate	Partial loss or alteration to one or more key elements/features/characteristics of the baseline conditions such that post development, landscape character or view composition attributes will be partially changed.
Slight	Minor loss or alteration to one or more key elements/features/characteristics of the baseline conditions. Change arising from the loss/alteration will be discernible, but the underlying landscape character or view composition attributes will be similar to the baseline.
Negligible	Very minor loss or alteration to one or more key elements/features/characteristics of the baseline conditions. Change will be barely distinguishable, approximating to 'no change'.

EPA Export 06-01-2017:02:02:15

9.3.1.4 Significance of Effects

The significance of any identified landscape or visual impact has been assessed in terms of 'major' 'moderate', 'minor' or 'none'. These categories have been based on combining the overall sensitivity of landscape/visual receptors and overall magnitude of effects, as shown in Table 9.5 below. This process is not a quantitative process; there is not an absolute scoring system. Instead, the correlation of the two factors, although reflecting recognised features and methods, is in the end a matter of professional judgement:

Table 9.5 Principles of Assessing Significance of Landscape and Visual Impacts

	Magnitude - Substantial-	**Magnitude - Moderate-**	**Magnitude - Minor-**	**Magnitude - Negligible-**
Sensitivity -High-	Major	Major/Moderate	Moderate	Moderate/Minor
Sensitivity -Medium-	Major/Moderate	Moderate	Moderate/Minor	Minor
Sensitivity -Low-	Moderate	Moderate/Minor	Minor	Minor/None
Sensitivity - Negligible -	Moderate/Minor	Minor	Minor/None	None

For inspection purposes only.
Consent of copyright owner required for any other use.

The above matrix is not used as a prescriptive tool and the methodology and analysis of potential effects at any particular location must allow for the exercise of professional judgement. Thus in some instances a particular parameter may be considered as having a determining effect on the analysis.

Table 9.6, below, provides a brief definition of the full range of significance criteria. For the purpose of this report, it is considered that Major and Major/Moderate Impacts are significant.

Table 9.6 Definition of Significance Criteria for Landscape and Visual Impact

Significance	**Definition**
None	The proposed scheme is appropriate in its context. It may be difficult to differentiate from its surroundings and would affect very few or no receptors.
Minor	The proposed scheme would cause a barely perceptible impact, and would affect few receptors.
Moderate	The proposed scheme would cause a noticeable difference to the landscape, and would affect several receptors.
Major	The proposed scheme would completely change the character and/or appearance of the landscape for a long period of time or permanently. It would affect many receptors.

EPA Export 06-01-2017:02:02:15

9.3.2 Landscape and Visual Impacts

9.3.2.1 Landscape Effects

The landscape effects that will take place, due to the construction of the proposed TMF extension, are the removal of approximately 3.6ha of woodland and 700m of treelines/hedgerows, as well as some small areas of scrub, which has naturally recolonised disturbed ground covering the majority of the application site. Another effect will be the introduction of a large linear feature into the landscape.

9.3.2.2 Landscape Sensitivity

The Meath Landscape Character Assessment describes the 'North Navan Lowlands' (LCA 3), within which the application site is located, as being of 'Medium' landscape sensitivity, moderate landscape value and regional importance.

The area near Navan is described in the landscape character assessment as having *"a mix of land uses including ribbon housing development, retail units, a large quarry and a racecourse which are not well integrated into the landscape and which have caused the loss of traditional field boundaries, trees and vernacular field and road boundaries."* Considering that the proposed development is an extension to an existing development, that it is located within the boundaries of an existing borrow pit and considering the existing mix of land uses, the susceptibility of LCA2 to the change associated with the proposed TMF extension is assessed as medium.

For inspection purposes only.
Consent of copyright owner required for any other use.

The affected landscape elements, i.e. tree lines, woodland areas and scrub are abundant in the landscape surrounding the application site. It is therefore considered that the removal of a minor percentage of these elements would not have undue consequences for the maintenance of the baseline conditions. The susceptibility of the affected landscape elements is therefore medium.

Apart from the River Boyne and River Blackwater SPA & SAC, just over 1km to the southwest (located within LCA 20), there are no other landscape designations in the vicinity of the application site. There are further no protected views & prospects directed at the application site. This indicates the moderate value of this part of LCA3.

Considering all of the above the sensitivity of LCA3 is assessed as MEDIUM. The sensitivity of the individual landscape elements affected by the works within the application site is assessed as MEDIUM.

9.3.2.3 Magnitude of Change to Landscape

Table 9.7 below describes the size and scale, geographical extent and duration/reversibility of the identified landscape effects and makes a judgement of their overall magnitude:

EPA Export 06-01-2017:02:02:15

Table 9.7 Magnitude of Landscape Effects

Parameter	Description
Size &Scale	Out of a total area of approximately 60.6ha of mostly disturbed ground, 3.6ha of woodland and approximately 700m of treelines/hedgerows would be removed, in order to facilitate the proposed TMF extension. The proposed development will be an extension to the existing TMF to the south of the site and will increase the area covered by the overall facility by approximately 30%. The existing TMF and proposed TMF extension area are the largest elements in the surrounding landscape. However, considering the often large size of agricultural fields and overall dominance of agricultural land in the wider landscape, the application site is not completely out of scale with the general landscape characteristics. While the proposed development will be a tall new element in the landscape, the perceptual and aesthetic aspects of the landscape will not be altered much, due to the generally flat topography and the partial screening of the development by tree-lined hedgerows. The key characteristics of the landscape surrounding the site will not be changed by the works within the application area, in particular since the proposed development is a continuation of an existing development and since all of the existing mature boundary vegetation will be retained.
Geographical Extent	The effects, due to the works within the application site will be perceived from a number of locations within a 3km radius to the west, north and east of the site. However, intervening topography and vegetation screens part if not all of the site in many locations. The size of the overall development only be perceived from a number of locations on private ground in the immediate vicinity of the site.
Duration/ Reversibility	The impact on the landform is permanent and not reversible. The loss of vegetation can be compensated somewhat and can therefore be seen as temporary and partially reversible. The loss of vegetation will be compensated by the capping and subsequent restoration of the application site to grassland, including a network of hedgerows – **Refer to Figure 9.9**
Overall magnitude	Although the proposed development will result in the insertion of a large element into the landscape, the changes within the site will not affect the landscape character and will be perceived from a relatively confined area only (considering the size). The loss of vegetation will be compensated by the restoration of the site to grassland with associated hedgerows. The overall magnitude of the landscape effects, due to the proposed works are therefore assessed as MODERATE.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:15

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 9.9 Landscape plan, post closure

EPA Export 06-01-2017:02:02:15

9.3.2.4 Significance of Landscape Impact

The sensitivity of both LCA3 and the individual landscape elements affected was assessed as MEDIUM. This combined with the assessed MODERATE magnitude of the landscape effects, results in a MODERATE level of landscape impact (refer to Table 9.5); i.e. a level of impact that is not considered to be significant.

9.3.2.5 Visual Effects

The visual effects caused by the proposed development will include the visibility of the construction works (including machinery used for the construction), as well as the visibility of the completed TMF structure, which will be approximately 22m in height compared to the surrounding ground levels.

Visual Receptor Sensitivity

Table 9.8 below judges the susceptibility of the visual receptors within each of the identified Visual Receptor Areas (VRAs), based on Table 9.2 above. The table further describes the value placed on views from within each of the VRAs and makes a judgement of the overall sensitivity of each VRA.

For inspection purposes only. Consent of copyright owner required for any other use.

Table 9.8 Visual Receptor Sensitivity

VRA No.	Susceptibility	Value	Overall Sensitivity
1	Receptors of MEDIUM susceptibility (road users); one private property with direct views and therefore of HIGH susceptibility	No protected views or scenic routes or other significant viewpoints present.	MEDIUM (private property HIGH)
2	Receptors of MEDIUM susceptibility (road users, visitors of racecourse and golf course); four private properties with direct views and therefore of HIGH susceptibility	No protected views or scenic routes or other significant viewpoints present.	MEDIUM (private properties HIGH)
3	Receptors of MEDIUM susceptibility (road users and secondary views from properties)	No protected views or scenic routes or other significant viewpoints present.	MEDIUM
4	Receptors of MEDIUM susceptibility (road users)	No protected views or scenic routes or other significant viewpoints present.	MEDIUM
5	Receptors of MEDIUM susceptibility (road users secondary views from properties); some private properties with direct views and therefore of HIGH susceptibility	No protected views or scenic routes or other significant viewpoints present.	MEDIUM (private properties HIGH)
6	Receptors of MEDIUM susceptibility (road users secondary views from properties); some private properties with direct views and therefore of HIGH susceptibility	No protected views or scenic routes or other significant viewpoints present.	MEDIUM (private properties HIGH)

EPA Export 06-01-2017:02:02:15

VRA No.	Susceptibility	Value	Overall Sensitivity
7	Receptors of MEDIUM susceptibility (road users secondary views from properties); some private properties with direct views and therefore of HIGH susceptibility	Views southwest from Carn Hill are protected in the current Meath County Development Plan	HIGH

9.3.2.6 Magnitude of Change to Viewpoints

Table 9.9 below describes the magnitude of change to views from within each of the VRAs, in terms of the size and scale, geographical extent and duration/reversibility of the visual effects. The table also contains a judgement of the overall magnitude of change.

The computer model of the proposed development, which was constructed for the production of the ZTV mapping was used to prepare sketch photomontages for four of the Viewpoints used as part of this assessment (refer to Viewpoints A-D on Figures 9.4 to 9.7), in order to help with the assessment of the magnitude of change.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

Table 9.9 Magnitude of Visual Effect

REFER TO APPENDIX 9

VRA No.	Description of Magnitude of change (VE01)	Overall Magnitude
1	Size & Scale: The proposed development will be visible in the middle ground of this view, partially screened by intervening vegetation. Parts of the early stages of the construction works will be fully screened by this vegetation (in particular during the summer months). Once completed, the TMF extension will be visible over a fairly wide horizontal area of the panoramic views available, however over only a small vertical area (as indicated by Viewpoint A on Figure 9.4). The development will not break the skyline and the views of distant hills will not be blocked. Due to the flat surrounding topography, the large linear shape of the existing TMF is not at odds with the landscape character. It has the appearance of a lake and is noticeable due to the lack of vegetation. The grassed dam embankments blend in with the surrounding vegetation. This will also be the case with the proposed extension. Geographical Extent: Similar views from within VRA 1 (refer to Figure 9.2), mostly from private land; Most views from R163 restricted by roadside vegetation; Viewpoints between 300-900m from the application site boundary. Duration/Reversibility: The proposed TMF extension would be constructed in 3 phases over a period of approximately 9 years and has an operational life of just over 11 years. While it will not be possible to reverse the changes to the landform, it is proposed to restore the entire TMF to grassland, including a network of hedgerows, similar to the surrounding field pattern, which will ensure that the site will further blend into the surrounding landscape.	MODERATE during construction and operation; reducing to MINOR on completion of the restoration works

Consent of copyright owner required for any other use. For inspection purpose only.

EPA Export 06-01-2017:02:02:15

VRA No.	Description of Magnitude of change (VE01)	Overall Magnitude
2	Size & Scale: The proposed development will be visible in the middle ground of this view, however largely screened by intervening vegetation. The early stages of the construction works will be fully screened by this vegetation. Once completed, the TMF extension will occupy a fairly small horizontal area of the panoramic views available, and only a minute vertical area (as indicated by Viewpoint B on Figure 9.5). The development will not break the skyline and views of distant hills will not be blocked. Due to the flat surrounding topography and the abundant screening vegetation, the large linear shape of the existing TMF is not very noticeable within the landscape, except for the lack of vegetation. This will also be the case with the proposed extension. Geographical Extent: Similar views from within VRA 2 (refer to Figure 9.2), many screened by intervening vegetation within the area; Viewpoints between 2,000-2,500m from the application site boundary. Duration/Reversibility: The proposed TMF extension would be constructed in 3 phases over a period of approximately 9 years and has an operational life of just over 11 years. While it will not be possible to reverse the changes to the landform, it is proposed to restore the entire TMF to grassland, including a network of hedgerows, similar to the surrounding field pattern, which will ensure that the site will further blend into the surrounding landscape.	MODERATE/MINOR during construction and operation; reducing to NEGLIGIBLE on completion of the restoration works

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:15

VRA No.	Description of Magnitude of change (VE01)	Overall Magnitude
3	Size & Scale: The proposed northern dam wall will become visible above an existing screening berm along the northern application boundary, as it reaches a certain height. The early stages of the construction works will be fully screened by this berm. Once completed, the TMF extension will be visible over almost the full width of the views from within VRA 3, and over a small percentage of the height (as indicated by Viewpoint C on Figure 9.6). The development will break the skyline, as does the existing screening berm and it will therefore be seen as an extension in height of such. The dam embankments, once grass seeded, will blend in with the surrounding vegetation. Geographical Extent: Similar views from within VRA 3 (refer to Figure 9.2); views from properties with the area obscured by boundary vegetation; Viewpoints between 50-300m from the application site boundary. Duration/Reversibility: The proposed TMF extension would be constructed in 2 phases over a period of approximately 9 years and has an operational life of just over 11 years. While it will not be possible to reverse the changes to the landform, it is proposed to restore the entire TMF to grassland, including a network of hedgerows, similar to the surrounding field pattern. The embankments will have to be kept clear of larger vegetation, so that the integrity of the dams can continue to the checked.	MODERATE during construction and operation; MODERATE on completion of the restoration works

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

VRA No.	Description of Magnitude of change (VE01)	Overall Magnitude
4	Size & Scale: The proposed development will be visible in the middle ground of this view, largely screened by intervening vegetation. Parts of the early stages of the construction works will be fully screened by this vegetation. Once completed, the TMF extension will be visible over approximately 50% of the width of the views available within this VRA, however only a small percentage of the height (refer to Viewpoint F on Figure 9.8). The development will break the skyline, as does the existing TMF and it will be seen as a continuation of such. Due to the flat surrounding topography, the large linear shape of the existing TMF is not at odds with the landscape character. The grassed dam embankments blend in with the surrounding vegetation. This will also be the case with the proposed extension. Geographical Extent: Similar views from within VRA 4 (refer to Figure 9.2), through gaps in the roadside hedgerow only; Viewpoints between 100-1,000m from the application site boundary. Duration/Reversibility: The proposed TMF extension would be constructed in 2 phases over a period of approximately 9 years and has an operational life of just over 11 years. While it will not be possible to reverse the changes to the landform, it is proposed to restore the entire TMF to grassland, including a network of hedgerows, similar to the surrounding field pattern. The embankments will have to be kept clear of larger vegetation, so that the integrity of the dams can continue to the checked.	MODERATE/MINOR during construction and operation; MODERATE/MINOR on completion of the restoration works

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

VRA No.	Description of Magnitude of change (VE01)	Overall Magnitude
5	Size & Scale: Some parts of the proposed development may be visible in the middle ground of some views from within VRA 5, however intervening vegetation screens the application site in most, and in particular in public, locations (refer to Viewpoint E on Figure 9.8). Where visible it will be distantly seen as an extension of the existing TMF and will only take up a minor percentage of the overall views available. The development will not break the skyline and distant views will not be blocked. Geographical Extent: Similar views from within VRA 5 (refer to Figure 9.2), many screened by intervening vegetation within the area; Viewpoints between 1,800-2,300m from the application site boundary. Duration/Reversibility: The proposed TMF extension would be constructed in 2 phases over a period of approximately 9 years and has an operational life of just over 11 years. While it will not be possible to reverse the changes to the landform, it is proposed to restore the entire TMF to grassland, including a network of hedgerows, similar to the surrounding field pattern, which will ensure that the site will further blend into the surrounding landscape.	MINOR during construction and operation; reducing to NEGLIBIBLE on completion of the restoration works
6	Size & Scale: Part of the proposed development will be visible in the middle ground of some views from within VRA 5, however intervening vegetation partially to fully screens the application site in many locations (in particular during the summer months, refer to Viewpoint D on Figure 9.7). Where visible it will be distantly seen as an extension of the existing TMF and will only take up a minor percentage of the overall views available. The development will not break the skyline and distant views will not be blocked. Geographical Extent: Similar views from within VRA 6 (refer to Figure 9.2), some screened by intervening vegetation within the area; Viewpoints between 1,700-2,000m from the application site boundary. Duration/Reversibility: The proposed TMF extension would be constructed in 2 phases over a period of approximately 9 years and has an operational life of just over 11 years. While it will not be possible to reverse the changes to the landform, it is proposed to restore the entire TMF to grassland, including a network of hedgerows, similar to the surrounding field pattern, which will ensure that the site will further blend into the surrounding landscape.	MINOR during construction and operation; reducing to NEGLIGIBLE on completion of the restoration works

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:15

VRA No.	Description of Magnitude of change (VE01)	Overall Magnitude
7	Size & Scale: The construction and operation of the proposed development will be imperceptible, due to the distance and due to its location behind the existing TMF (which is hardly discernible itself). Geographical Extent: Similar views from within VRA 7 (refer to Figure 9.2), many screened by intervening vegetation within the area; Viewpoints between 6,700-6,900m from the application site boundary. Duration/Reversibility: The proposed TMF extension would be constructed in 2 phases over a period of approximately 9 years and has an operational life of just over 11 years. While it will not be possible to reverse the changes to the landform, it is proposed to restore the entire TMF to grassland, including a network of hedgerows, similar to the surrounding field pattern, which will ensure that the site will further blend into the surrounding landscape.	NONE during construction and operation; NONE on completion of the restoration works

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

9.3.2.7 Significance of Visual Impact

Based on Table 9.5 above, the sensitivity of each visual receptor area was combined with the magnitude of the visual effects to arrive at the significance of the visual effects. As shown in Table 9.10 below the majority of impacts were found to be moderate, moderate/minor or minor, i.e. impacts not regarded as significant. Major/moderate and major/moderate to moderate impacts were predicted for a very small number of private properties within VRA1 & VRA 2. However it should be noted that the actual views from these properties, could not be assessed, due to their private nature and that it is likely that existing vegetation within the property boundaries will obscure views somewhat. Overall, the number of available views is small, due to the screening potential of existing vegetation and intervening topography:

Table 9.10 **Significance of Visual Effect**

VRA No.	Overall Sensitivity	Overall Magnitude	Significance
1	MEDIUM	MODERATE	MODERATE reducing to moderate/ minor when restoration complete
1	HIGH	MODERATE	MAJOR/MODERATE reducing to moderate when restoration complete
2	MEDIUM	MODERATE/MINOR	MODERATE to MODERATE/MINOR reducing to minor when restoration complete
2	HIGH	MODERATE/MINOR	MAJOR/MODERATE to MODERATE reducing to moderate/minor when restoration complete
3	MEDIUM	MODERATE	MODERATE
4	MEDIUM	MODERATE/MINOR	MODERATE to MODERATE/MINOR
5	MEDIUM	MINOR	MODERATE/MINOR reducing to minor when restoration complete
5	HIGH	MINOR	MODERATE reducing to moderate/minor when restoration complete
6	MEDIUM	MINOR	MODERATE/MINOR reducing to minor when restoration complete
6	HIGH	MINOR	MODERATE reducing to moderate/minor when restoration complete
7	HIGH	NONE	NONE

For inspection purposes only.
Consent of copyright owner required for any other use.

REFER TO APPENDIX 9

EPA Export 06-01-2017:02:02:15

9.3.3 Impacts on Landscape/Planning Designations

9.3.3.1 Views & Prospects

The site survey confirmed the application site is not visible in any of the views and prospects listed in the current Meath County Development Plan and the development will therefore have no landscape or visual impact on any of these views.

9.3.3.2 Extractive Industry and Building Materials Production

The above assessment has shown that the existing development does *"... not unduly impinge on the visual amenity or environmental quality in the area..."* and does not detract *"from the visual quality of the landscape".*

The CRAMP for the site detailed rehabilitation proposals and it is proposed to restore the TMF to a suitable land use (i.e. grassland). It is therefore considered that the development is in line with all policy provisions made within the current Meath county development plan with regard to the Extractive Industry.

9.3.3.3 Outdoor Recreational Facilities

The visual impact on views from Navan Racecourse and Golf Course was described, as part of VRA 2 in the above assessment.

For inspection purposes only.
Consent of copyright owner required for any other use.

9.3.3.4 Do-nothing Scenario

If the proposed development was not carried out, it is likely that the application site would continue to be used as a borrow pit for some time. On cessation of those works the site would continue to be slowly re-colonised with locally occurring grass and scrub species, similar to what is already happening in parts of the site that have not been disturbed in a while.

EPA Export 06-01-2017:02:02:15

9.4 Mitigation Measures

The Closure Restoration and aftercare Management Plan (CRAMP) for the overall TMF site and forms part of this EIS. The plan proposes to restore the capped TMF to grassland with a network of hedgerows, similar to the field pattern surrounding the facility.

In order to improve the appearance of the proposed facility in view from locations along the R163 to the immediate north of the site, it is proposed to plant a woodland belt on the existing screening berm along the northern boundary. Refer to figure 9.10

The planting would be carried out in a slightly wavy pattern on the northern embankment of the screening berm, in order to break the stark linear shapes of the berm and TMF extension somewhat.

This vegetation will soften and partially screen views of the TMF extension, as it becomes visible above the screening berm.

9.5 Residual Impact Assessment

The assessment has found that the proposed development will have moderate landscape impact on the affected individual landscape elements and on the general landscape character within the study area (i.e. a level of impact not considered to be significant). There will be no visual impact on the vast majority of views within the study area, due to the existing abundant intervening vegetation, as well as topography. In a small amount of locations, the visual impact will range from moderate/minor to major/moderate, most of which will reduce on completion of all restoration works.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:15

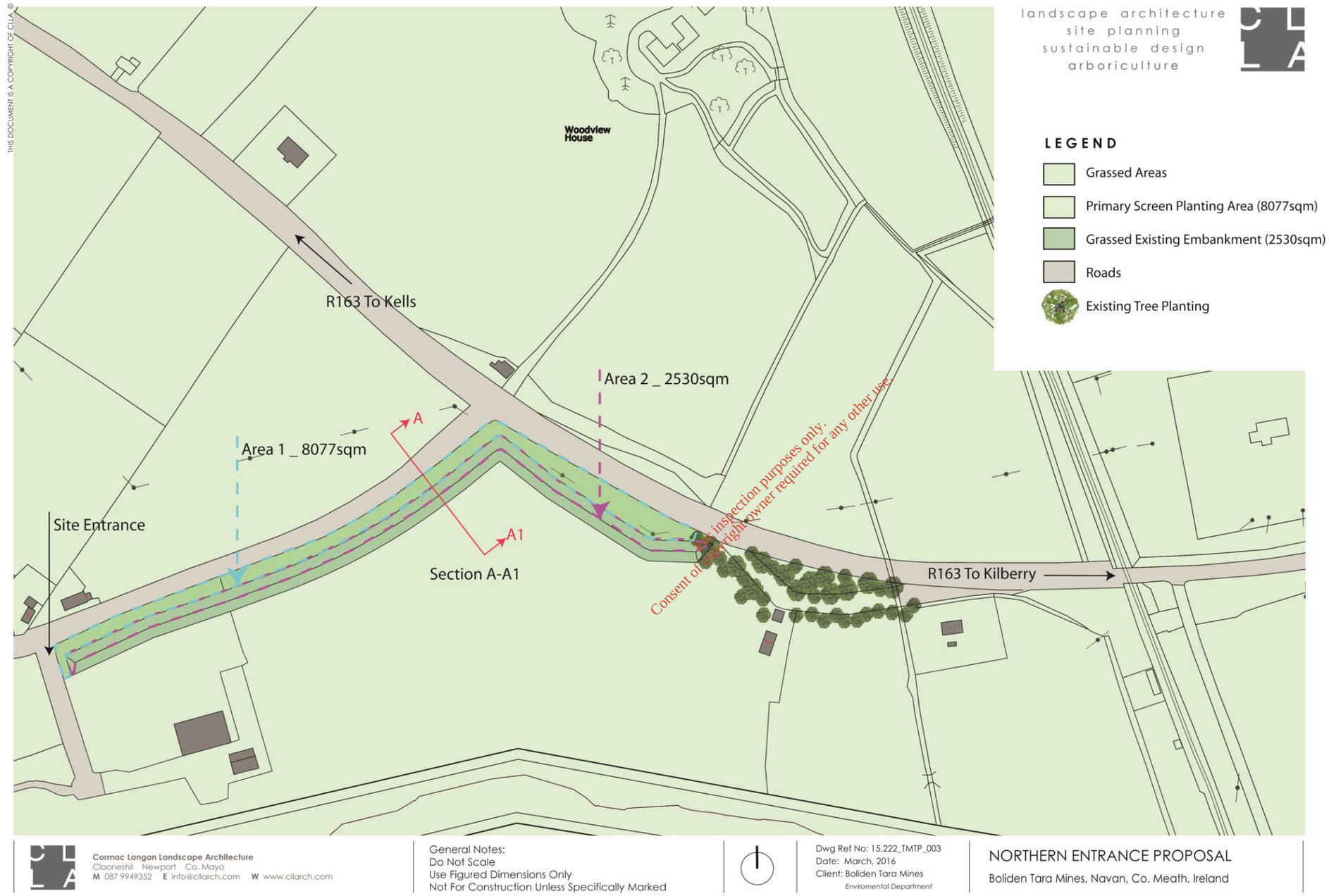
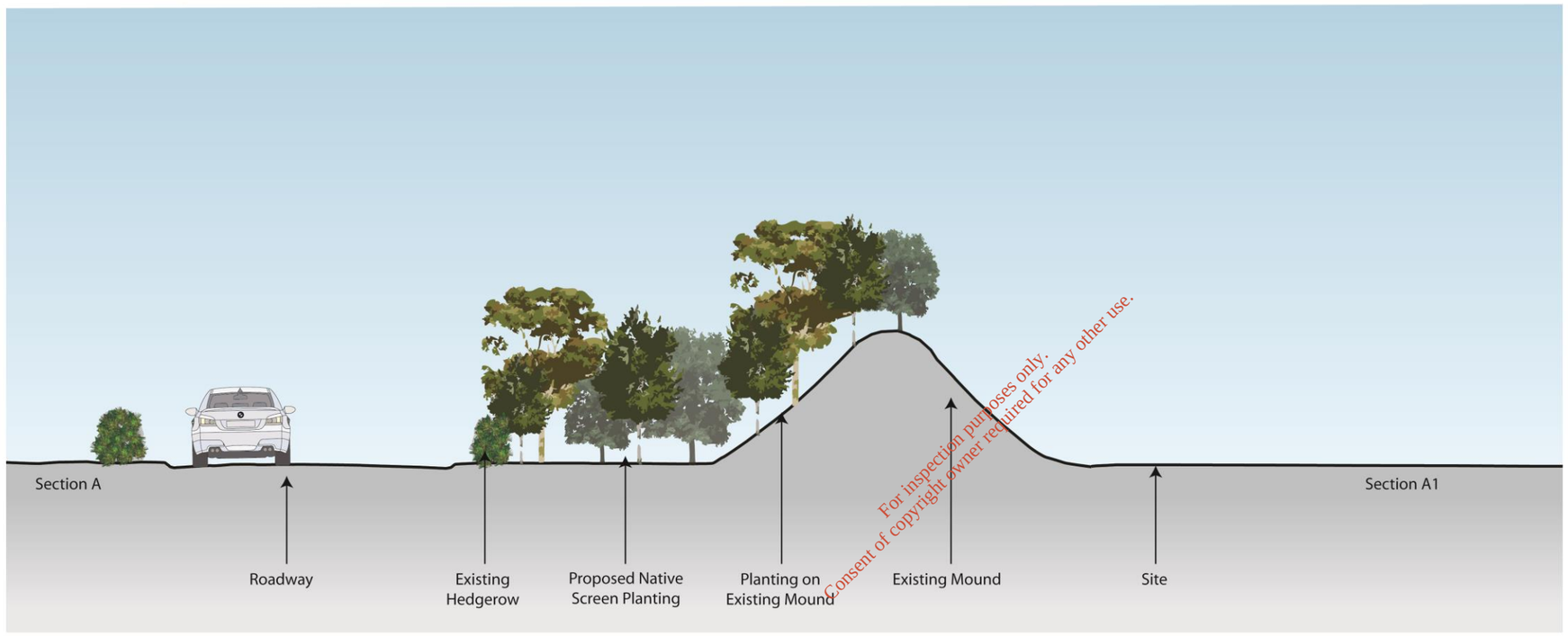


Figure 9.10 **View point A3** Approximately 200m long stretch of R163 to north of junction with the road to the site entrance.

EPA Export 06-01-2017:02:02:15

THIS DOCUMENT IS A COPYRIGHT OF CLLA ©

landscape architecture
site planning
sustainable design
arboriculture



For inspection purposes only.
Consent of copyright owner required for any other use.

Cormac Langan Landscape Architecture
Clooneshil Newport Co. Mayo
M 087 9949352 E info@cllarch.com W www.cllarch.com

This section drawing is to be read in conjunction with drawing number 15.222_TMTP_003

Dwg Ref No: 15.222_TMTP_004
Date: March, 2016
Client: Boliden Tara Mines
Enviromental Department

PROPOSED SECTION A-A1
Boliden Tara Mines, Navan, Co. Meath, Ireland

Figure 9.11 View point A3 Approximately 200m long stretch of R163 to north of junction with the road to the site entrance.

EPA Export 06-01-2017:02:02:15

REFERENCES

The Landscape Institute with the Institute of Environmental Management and Assessment (2013) Guidelines for Landscape and Visual Impact Assessment, Third Edition, Routledge

The Landscape Technical Committee (February 2009) Advice Note 01/09 – Use of photography and photomontage in landscape and visual assessment, The Landscape Institute

CAAS Environmental Services Limited on behalf of the Environmental Protection Agency (EPA) (March 2002) Guidelines on the Information to be contained in Environmental Impact Statements, EPA Ireland

CAAS Environmental Services Limited on behalf of the Environmental Protection Agency (EPA) (September 2003) Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), EPA Ireland

Guidelines for Landscape and Visual Impact Assessment, 3rd edition
The third edition of Guidelines for Landscape and Visual Impact Assessment (**GLVIA3)**

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

Note:Zone of Theoretical Visibility (ZTV) – Methodology

A Zone of Theoretical Visibility (ZTV) Study was conducted for the existing TMF and proposed TMF extension to help identify areas sensitive to visual impacts. This study used the measurement of the vertical subtended angle for its methodology. This method is explained below and illustrated by Figure A-1, below.

When a Target Area (red) is observed from a Viewpoint (A or B) its apparent height can be measured in the form of degrees, to give a Subtended Vertical Angle.

Figure A-1:

The use of the Subtended Vertical Angle in formulating a ZTV has the benefit of automatically reducing values to reflect the distance from the Target Area, and partial screening by intervening landforms. Generally the further the viewpoint is from the Target Area the smaller the Subtended Vertical Angle, reflecting the effect of distance on visual impacts.

Thus in the example section above Viewpoint A experiences a higher subtended angle due to proximity to the red target area. Viewpoint B has a lower subtended angle due to greater distance from the target area and partial screening by intervening landform.

If the Subtended Vertical Angle is measured from a series of grid points for a particular Target Area, the resultant data can then be used to generate contours. Each contour level representing a certain vertical angle, and thus potential level of visibility.

The subtended vertical angle method of calculating ZTVs using LSS digital terrain modelling software has been proven by field investigation on numerous sites to be an accurate method of predicting areas of potential visibility for on-site investigation.

However, the computer generated ZTV study is undertaken using a bare earth landform to give the worst case scenario. In reality any built structures (settlements, walls etc) or areas of vegetation (woodlands, scrub and hedgerows) will reduce the actual visibility of the target area. Therefore it is necessary to carry out fieldwork to validate the results of the ZTV.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

Section 10 Noise

10.1 Introduction

This section of the EIS evaluates the potential noise impacts arising from the construction and operation of the proposed Stage 6 extension to the existing Tailings Storage Facility (TSF). The Stage 6 extension adjoins the existing tailings facility to the north.

10.2 Aspects of the proposed development

- Construction of the Stage 6 extension to the existing TSF
  - Road traffic related noise (importation of construction materials)
- Construction of the proposed integrated wetland
- Operation of the proposed stage 6
- Operation of the proposed integrated wetland

10.3 Methodology

Criteria against which predicted noise levels are assessed have been derived from recognised national and international guidelines. Noise levels from similar type activity is taken from the author's own database. The projected road traffic flow is obtained from data provided by Tobin Consulting Engineers road traffic consultants for the project). Where noise predictions show a potential for significant impacts mitigation measures are detailed.

For inspection purposes only.
Consent of copyright owner required for any other use.

The assessment includes:

- A baseline noise survey, and description of the existing noise environment
- Prediction of noise levels for construction and operational phases
- An assessment of the effects of noise during both construction and operation
- Details of any necessary mitigation measures to be undertaken

10.4 Acoustic terminology

Sound is simply the pressure oscillations that reach our ears. These are characterised by their amplitude, measured in decibels (dB), and their frequency, measured in Hertz (Hz). Noise is unwanted or undesirable sound, it does not accumulate in the environment and is normally localised. Environmental noise is normally assessed in terms of A-weighted decibels, dB(A), where them A weighted filter in the measuring device elicits a response which provides a good correlation with the human ear. The criteria for environmental noise control are of annoyance or nuisance rather than damage. In general a noise level is liable to provoke a complaint whenever its level exceeds by a certain margin the pre-existing noise level or when it attains an absolute level. A change in noise level of 2 dB(A) is 'barely perceptible', while an

EPA Export 06-01-2017:02:02:15

increase in noise level of 10 dB(A) is perceived as a twofold increase in loudness.

Historically road traffic noise has been assessed using the L10 dB(A) parameter, the levels expressed as the arithmetic hourly mean value over an 18 hour period.

Recent draft guidelines by the National Roads Authority recommend the use of the equivalent continuous levels, L(Aeq). For construction or industrial noise sources the assessment is usually expressed in equivalent continuous levels, L(Aeq).

Table 10.1 gives comparative noise levels and sources in our environment.

Table 10.1 Comparison of Noise Levels in our Environment

Source/Activity	Indicative noise level dB
Threshold of hearing	0
Rural night-time background	20-50
Quiet bedroom	35
Wind farm at 350m	35-45
Busy road at 5km	35-45
Car at 65km/hr at 100m	55
Busy general office	60
Conversation	60
Truck at 50km/hr at 100m	65
Inside a typical shopping centre	70-75
Inside a modern car at around 90km/hr	75-80
Passenger cabin of jet aircraft	85
City Traffic	90
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

10.5 Existing Environment

10.5.1 Baseline Noise Survey

A baseline noise survey was carried out at three locations in the environs of the proposed development. Monitoring was undertaken over a period between 5th and 11th September'15 and 22nd September and 1st October'15. Weather was varied during the survey with very little rainfall. The monitoring locations are given in Figure 10.1.

The following conditions were adhered to in undertaking the survey:

- Measurement of ambient noise levels were taken during varied weather conditions using instruments of Type 1 specification
- Monitoring locations were selected to coincide with local residences
- Measurements were undertaken during weekday and weekend periods
- The survey was carried out in accordance with ISO 1996 Part 1 (Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures)

For inspection purposes only.
Consent of copyright owner required for any other use.

Instrumentation Used

The following instrumentation was used in the baseline survey:

- Three Larson Davis Precision Integrating Sound Level Analyser/Data logger with 900B Pre-amplifier and 1/2" Condenser Microphone Type 2541
- Wind Shields Type: Double skinned windscreens of outer diameter of 230mm
- Calibration Type: Larson Davis Precision Acoustic Calibrator Model CAL 200

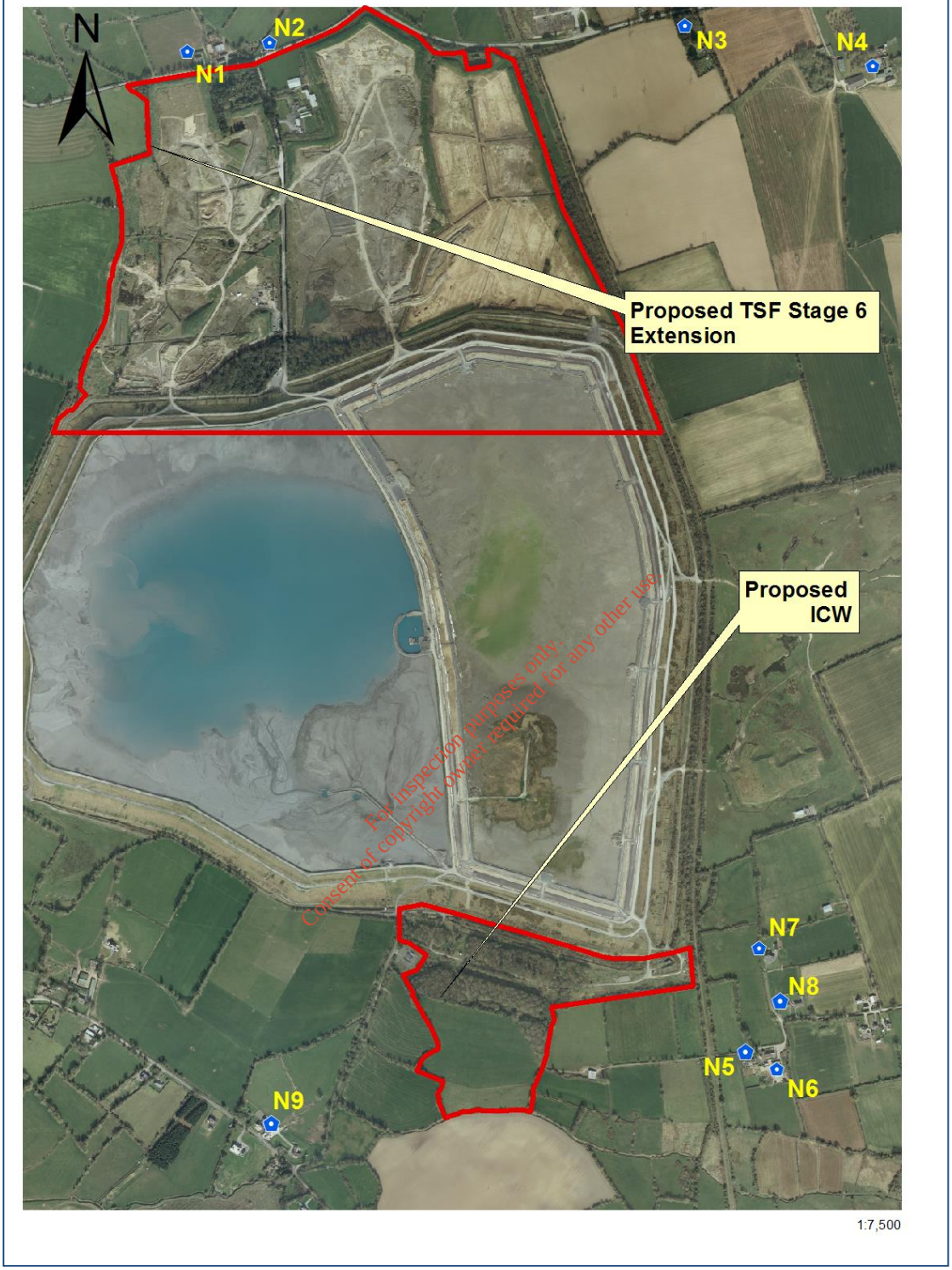
Measurement Procedure

Monitoring was carried out at three locations using environmental noise analysers with data logging facilities set on real time. See Figure 10.2 for locations.

At each monitoring location the microphone was located at 1.5m above ground level and away from reflecting surfaces. All acoustic instrumentation was calibrated before and after each survey and no drift of calibration was observed.

Table 10.2 gives details of calibration certification

EPA Export 06-01-2017:02:02:15



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 10.1 Noise monitoring locations

EPA Export 06-01-2017:02:02:15

Table 10.2 Details on Calibration Certification

Instrument/Model	Date of Calibration	Serial Number	Calibration By
L & D 812	17th August'14	0783	MTS, England
L & D 812	19th August'14	0762	MTS, England
L & D 831	22nd January'14	0001612	MTS, England
L & D CAL200	5th February' 15	5838	MTS, England

NB All instruments have been calibrated with pre-amp and microphone, with certificates available on request

Table 10.3 Baseline noise monitoring locations

Location id	*Description*
N2	Nearest dwelling north of the site, across the road in Tara property
N3	Nearest dwelling east of the site at entrance to property approx. 20m from R163
N5	Residential dwelling south east of the TSF site and east of the proposed ICW

For inspection purposes only. Consent of copyright owner required for any other use.

10.5.2 Site Description

The proposed lateral extension (Stage 6) to the tailings storage facility (TSF) is located to the Northwest of Navan town in a rural setting. The land surrounding the facility is used predominantly for intensive agricultural activity. Population density is low with ribbon development along the local road network .

The TSF is bounded on the east by the Navan-Kingscourt railway line, to the west by the Yellow river, to the south by the Windtown road and to the north by the L74141road. The primary access route to the facility is from the north off the L74141 road via the R163 Kilberry road (Kells to Slane road).

EPA Export 06-01-2017:02:02:15

10.5.3 Results of Noise Survey

The existing ambient noise levels were established during a period of continuous monitoring at representative locations in the environs of the proposed development.

- The results of this survey, which contain the total noise is typical of a rural environment.
- The complete dataset from the baseline study is given in the Appendix 10.1.
- A summary of the hourly intervals (mean values) measurements is given in Table 10.4 following.

Table 10.4 Day time noise levels mean values – One hour interval data dBA

Location id	Period	Leq	Lmin	Lmax	L10	L50	L90
N2	22nd Sept - 1st Oct'15	46.9	29	72	45.1	37.2	33.1
N3	22nd Sept - 1st Oct'15	54.6	33.4	70	58.4	50.1	42.4
N5	5th Sept - 11th Sep'15	40.2	30.2	57.4	41.7	36.4	32.8

Note: Day time is 08.00 to 22.00hrs
Leq is the equivalent continuous noise level or ambient level.
L10 is the noise level exceeded or equalled for 10% of the interval.
L90 (background) is the noise level equalled or exceeded for 90% of a sample interval

For inspection purposes only.
Consent of copyright owner required for any other use.

10.6 Characteristics of Proposal

Stage 6 extension proposal

After target minerals have been extracted in the processing plant the tailings stream is cycloned to separate the coarse sand fraction from the finer slimes fraction. The coarse fraction of tailings is pumped, to the underground mined out areas. In so doing, approximately 50% of the tailings are used underground to backfill mined voids. The tailings used for backfilling is stabilised, chemically and physically, by mixing with Portland cement.

The remaining fines fraction tailings is pumped as an aqueous slime to the Tailings Storage Facility (TSF) located some 2.5 km north of the processing plant in the townland of Randalstown. On an annual basis approximately 1.1 million tonnes of tailings are deposited for permanent storage in the TSF.

Since its inception the tailings facility has been constructed and operated in seven stages, Stages 1, 2, 3 (lateral extensions) and the more recent Stage 4A, 4B, 5A and 5B (upstream vertical extensions), using combinations of temporary and permanent embankment walls.

EPA Export 06-01-2017:02:02:15

The existing TSF, enclosing a footprint area of approximately 171 ha, serves as containment for tailings to settle and consolidate, as well as a storage area for water that is circulated back to the processing plant at Knockumber for reuse in the processing plant or for eventual discharge to the *River Boyne*.

- **It is proposed to extend the existing TSF laterally in a northerly direction.**
    - **Here after the proposed facility will be referred to as ***TSF Stage 6*****.**
    - **The proposal facility will cover an area of c. 58 hectares, extend to a height of 22 m above ground level and will provide a potential a storage volume of approximately 9.6 million cubic metres [13.6 million tonnes].**

- **The second part of the proposed development is the construction of an Integrated Constructed wetland (ICW). The function of the wetland is to provide a passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle.**

For inspection purposes only.
Consent of copyright owner required for any other use.

The Stage 6 construction will be implemented in 2 phases. Construction work will be seasonal (March to October) to coincide with best weather conditions and will be carried out over approximately three consecutive years.

Increased traffic flow will be generated on the local road network by arrival and departure of construction workers and by road haulage traffic delivering construction material to the site.

During the construction of the embankment of Stage 6, glacial till and rock will be excavated from the borrow areas. Imported material will also be used for construction.

Construction materials will be sourced for a number of potential sources, including:

- On site 'borrow pits'
- Onsite stockpiles
- Third party licenced facilities
- The main mine site at Knockumber (surplus mine rock)

Construction activity will not be centred in any one particular area rather will be dispersed over a number of sections of the borrow area.

EPA Export 06-01-2017:02:02:15

Wetland Proposal

The construction of the wetland area / pond will involve excavation of the area and construction of a berm around the perimeter. Construction will be carried out in a single phase over a 7 month period.

Excess material from the site will be transported on site to either the construction of Stage 6 or for capping and restoration and closure of Stage 5.

10.6.1 Construction details

Details of the construction phases are taken from the Golders Associates, 'Design for Stage 6 Tailings Management Facility'.

The Stage 6 extension will be implemented in two phases.

- The first phase would be the construction of the Stage 6A wall to an elevation of 59.29 m AOD,
- the second phase would be the construction of the Stage 6B wall to an elevation of 67.29m AOD.

The construction phase will be implemented in a staged approach over three construction years.

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 10.5: Details of Stage 6 Construction Phases

Details of Stage 6 Construction Phases				
Description	**Units**	**Phase 1 Crest Elevation 59.29 m AOD**	**Phase 2 Crest Elevation 67.29 m AOD**	**Total Qty**
Total Dam Fill Volumes	m3	529,683	1,173,586	1,703,269
Type A1/A2 Upstream Wall Construction	m3	123,671	110,617	234,288
Type A 2 Downstream Wall Construction	m3	113,658	111,893	225,550
Type B Road Surfacing	m3	4,902	5,056	9,958
Type C Protection Material	m3	52,926	7,426	60,352
Type D1 Drainage	m3	5,000		5,000
Type D2 Dam Footprint Drainage	m3	110,064	98,918	208,982
Random Fill	m3	182,290	852,159	1,034,449
Type E Coarse Drainage	m3	5,000		5,000
Total Construction Volumes	**m3**	**597,511**	**1,186,067**	**1,783,578**

EPA Export 06-01-2017:02:02:15

It is envisaged that the proposed extension will be constructed over three consecutive years. Due to the nature of the construction work (i.e. construction using natural materials clay/soil/stone) the construction season will be restricted to the 36 week period March to October of each year.

It is estimated that c. 1.1 million cubic metres of material will need to be imported to the site to complete the proposed development.

The 1,100,000m^3 of material imported to site will generate heavy vehicular traffic.

It is envisaged pending the successful outcome of the planning process that construction of the proposed Stage 6 extension would commence.

- For the purposed of this traffic assessment it is assumed tah the construction would run over three consecutive years.
- The duration of each year is based on 36 weeks (March to October inc.)

To reduce the impacts that the proposed development may have in terms of construction generated traffic, it is proposed that the deliveries, extraction and stockpiling of materials be undertaken such that generated traffic is evenly distributed over the proposed 3 year construction period, and within the 36 week construction period per year.

For inspection purposes only.
Consent of copyright owner required for any other use.

The preliminary programme estimates the two-way daily traffic over the proposed stage 6 construction activities and also the volume of materials required for each sub-stage.

In order to provide a robust assessment of the construction generated traffic, and provide a realistic assessment of construction related traffic, average generated traffic volumes as outlined in table 10.5 above have been adjusted to account for daily production-hour losses:

- 0.5 hour production in the first AM hour,
- 1 Hour loss of production during lunch hour and
- 0.5 hour production in the last PM hour.

Working on the basis of a working day from 08:00 to 18:00 this give a potential working day of 10 hours minus production-hour losses resulting in 8 hours per day.

This allows for peak site generated traffic to be identified for each of the scenarios outlined above and equates to the following:

- 5.0 day working week, 40 hours per week; and
- 5.0 day working week, 35 hours per week.

EPA Export 06-01-2017:02:02:15

In addition to the HGV's generated during the construction stages, approximately 50 employees are expected to be required to carry out the work.

It is been assumed that these employees will all travel to / from the TMF site by car and will arrive during the AM peak hour and leave during the PM peak hour. The level of employees is envisaged to be the same as that associated with *Stage 5* construction activities.

As such, traffic counts undertaken as part of the stage 6 assessment already include for this level of construction employee traffic. In order to provide a robust calculation, traffic related to construction employees, and stage 5 HGV traffic, have not been extracted from the traffic count and has been subject to both seasonal and traffic growth adjustment.

It has been assumed that the rate of import of this material will remain constant over the construction period. The import of material will not be directly related to construction activities being undertaken on site.

The estimated peak generated traffic for the peak generation traffic scenarios are summarised in Table 10.6 below.

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 10.6 Total Trips Generated

Daily trips generated		
	Arriving	**Departing**
AM Peak (5.0 Day Working Week/ 40 Hour)		
HGV	18	18
PM Peak (5.0 Day Working Week/ 40 Hour)		
HGV	18	18
AM Peak (5.0 Day Working Week/ 35 Hour)		
HGV	21	21
AM Peak (5.0 Day Working Week/ 35 Hour)		
HGV	21	21

The following two route options have been considered for this assessment.

Route1: Between the existing tailings management facility and Navan; and
Route 2: Between the existing tailings management facility and Slane

EPA Export 06-01-2017:02:02:15

10.7 Noise Impact

The noise impact of the proposal consists of:

- Construction activity which includes removal of topsoil, construction of acoustic berms and removal of till material for development of tailings facility embankment
- Road traffic movements to and from the site
- Construction of wetlands
- Operation of the TSF and wetland

10.7.1 Target Criterion and Noise Limits

Noise during operation of TSF

Boliden Tara Mines Limited operate within an EPA license for their operation. Noise limits are already in place in condition 8 of the IE licence which state that: subject to condition 3.4, activities on-site shall not give rise to noise levels off-site, at any noise sensitive location which exceed the following sound pressure limits:

For inspection purposes only. Consent of copyright owner required for any other use.

Daytime 55dB(A) expressed as L_{eq}, 1 hour
Night-time 45dB(A) expressed as L_{eq}, 1 hour

Daytime is 08.00 hrs to 22.00 hrs and Night-time is 22.00 hrs to 08.00 hrs

'There shall be no clearly audible tonal component in the noise emission from any activity at any noise sensitive location'.

These limits are similar line to the EPA's 'Guidance Note for Noise in Relation to Scheduled'.

Noise Limits during Construction

There are no mandatory noise limits for construction noise in Ireland.

The National Roads Authority (NRA) has published construction noise limits in a 2004 publication entitled "Guidelines for the Treatment of Noise and Vibration in National Roads Schemes". These limits, which are presented in Table 10.7 below, represent a reasonable compromise between the practical limitations in a construction project, and the need to ensure an acceptable ambient noise level for the residents and nearby sensitive areas.

EPA Export 06-01-2017:02:02:15

While they have been developed for roads projects, it is also considered best practice to apply them to other construction projects, as the limits are similar to typical construction noise limits that have been used elsewhere for numerous projects within the country.

Table 10.7 Construction Noise Limits

Days & Time	$L_{Aeq\ (1hr)}$ dB	$L_{AMax\ (1hr)}$ dB
Monday to Friday 07:00 to 19:00	70	80
Monday to Friday 19:00 to 22:00	60	65
Saturday 08:00 to 16:30	65	75
Sunday and Bank Holidays 08:00 to 16:30	60	65

Note:
Maximum permissible noise levels at the façade of dwellings during construction. Source: "Guidelines for the Treatment of Noise & Vibration in National Road Schemes", NRA, 2004

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

10.7.2 Construction Impacts

TSF Stage 6 - Typical Construction Noise Levels

It is not possible to specify the precise noise level emissions from construction equipment until such time as a contractor is chosen and construction plant has been selected however, Table 10.8 gives typical construction related noise levels and typical mobile plant for this type of activity. These noise levels have been sourced from measurements of noise sources at other construction sites within the country. The levels are based on measurements taken at 20m from the geometric centre of activity when the equipment was in continuous operating mode.

It is predicted that the maximum noise levels will exist during the site preparation phase of the development of the stage 6 footprint and will extend over a period no longer than one week equivalent (40 hours). During this phase topsoil will be stripped from the borrow areas in front of houses N1 and N2 and placed on the perimeter of the site forming an acoustic berm measuring up to 4 meters high. These berms will form an effective acoustic barrier between the nearest residents and the nearest borrow pit excavation zones.

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 10.8 List of typical construction plant and associated noise levels

Type	Noise level* dB(A) Leq @ 20 meters
Dump truck	72
Excavator- Wheeled	72
Large Excavator – Tracked	75
Large Bulldozer	80
Excavator ripping rock	81
Vibrating Roller	68
Grader	73
Tractor/Bowser	70
Tracked Excavator rock breaking	83

Note: *Compiled from own database

EPA Export 06-01-2017:02:02:15

The predicted noise levels generated by construction activity at a particular location can be calculated according to the following formula:

$$Lp2 = Lp1 + \Delta L\psi - \Sigma\Delta L \text{ where,}$$

Lp2 = Sound Pressure level in decibels at Residence.
Lp1 = Sound pressure level in decibels at 20 metres.
$\Delta L\psi$ = correction for direction effects in a horizontal plane,
$\Sigma\Delta L = \Delta Ld + \Delta La + \Delta Lr + \Delta Ls + \Delta Lv + \Delta Lg + \Delta Lw$, and where,
ΔLd = geometric spreading (spherical radiation) and is calculated according to:
$\Delta Ld = 20 \log_{10} (d1/d2)$, where, d1 is the residence distance in metres, while d2 is 20 metres.
ΔLa = air absorption
ΔLr = reflection and diffraction
ΔLs = screening
ΔLv = vegetation
ΔLg = ground absorption
ΔLw = wind gradients

An allowance of 3dBA attenuation has been made due to effects of air absorption and ground absorption with no allowance made for attenuation due to any other factors.

The predicted noise levels at key locations (potential noise sensitive locations) are given in Table 10.9 and 10.11.

The maximum noise levels at N1 and N2 will be due to construction of the acoustic berm in front of the respective houses and will persist for no longer than 1 week equivalent (40 hours). To control noise levels in these sections of berms only one excavator will work on the berm in front the respective houses at any point in time.

The noise levels at N4 and N5 are predicted with no acoustic berm attenuation because of the difference between elevation sources and receiver location. An acoustic berm attenuation of 7dBA has been applied to the predicted noise levels at Location N3.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:15

Table 10.9 Predicted noise levels at key locations from Stage 6 construction activity

Location id (NSL)	Predicted Maximum Levels LAeqT - 1 hour dB(A)	Predicted Typical Levels LAeqT - 1 hour dB(A)[1]
N1	66.6 (due to construction of berm)	<55.0
N2	72.0 (due to construction of berm)	<55.0
N3	55.7	<50.0
N4	51.0	<50.0

[1]Typical noise levels are for a period in excess of 50% of the total construction period.

The predicted noise levels at all locations assume that the noise sources listed in Table 10.5 are operating together in the same small area of the site, a situation that will not happen in practice.

Consent of copyright owner required for any other use. For inspection purposes only.

Wetlands

Table 10.10 gives typical construction related noise levels and typical mobile plant for this type of activity. These noise levels have been sourced from measurements of noise sources at other construction sites within the country. The levels are based on measurements taken at 20m from the geometric centre of activity when the equipment was in continuous operating mode. The construction of the wetlands will take approximately 6 months. Excess material from the site will be transported on site to either the construction of Stage 6 or for capping and restoration and closure of Stage 5A. There will be no road traffic impacts associated with material movement.

Table 10.10 List of typical construction plant and associated noise levels

Type	Noise level* dB(A) Leq @ 20 meters
Dump truck	72
Large Excavator – Tracked	75
Large Bulldozer	80
Vibrating Roller	68
Tractor/Bowser	70

Note: *Compiled from own database

EPA Export 06-01-2017:02:02:15

The predicted noise impact of this construction is given in Table 10.11. There has been no allowance made for a berm effects and 3dBA attenuation has been applied for ground absorption and air attenuation.

Table 10.11 Predicted noise levels at key locations from wetland construction activity

Location id (NSL)	Predicted Maximum Levels LAeqT - 1 hour dB(A)[14]	Predicted Typical Levels LAeqT - 1 hour dB(A)[15]
N5	51.6	<50
N6	52.1	<50
N7	50.8	<50
N8	50.8	<50
N9	54.9	<50

The predicted noise levels at all locations assume that the noise sources listed in Table 10.11 are operating together in the same small area of the site, a situation that will not happen in practice.
Accordingly the predicted noise levels will be lower than that those presented.

For inspection purposes only.
Consent of copyright owner required for any other use.

10.8 Road Traffic Noise Generated by Development

Road traffic will be generated by materials for construction which will be sourced outside the site via the local road network.

10.8.1 Road Traffic

Road traffic details are taken from the 'Traffic Impact Assessment Report' By Tobin Consulting Engineers

Material deliveries (HGV's) to the site will travel along the R163 Kilberry road and access the site via a 300m stretch of the Donaghpatrick road (L74141) from the east. The workforce movements are predicted to be along the same route. Figure 10.2 shows the layout of the local road network.

[14] The maximum Leq noise levels will pertain for short periods (less than two-week equivalent at any location for the entire project)
[15] Typical noise levels are for a period in excess of 50% of the total construction period.

EPA Export 06-01-2017:02:02:15

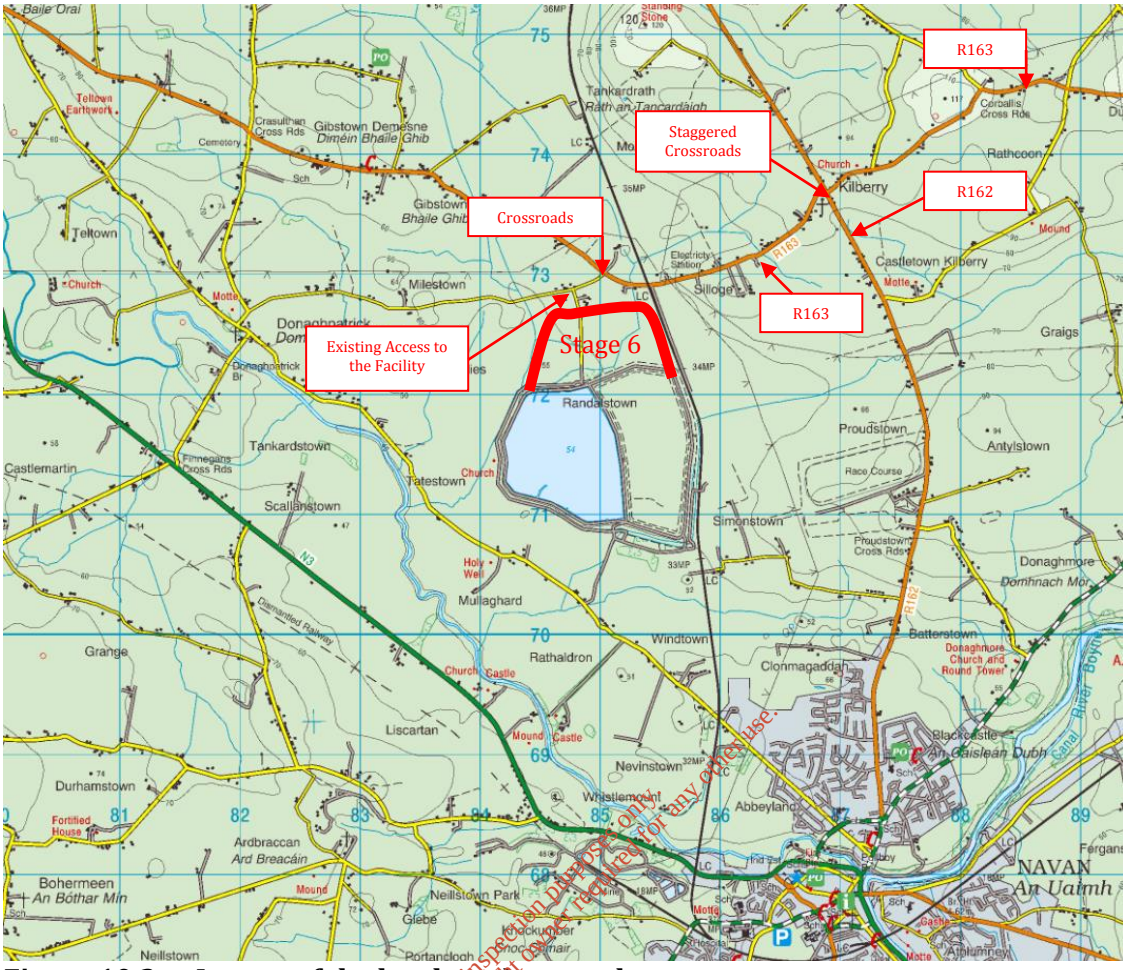


Figure 10.2 Layout of the local road network

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

Tables 10.12, 10.13, 10.14 and 10.15 give peak morning and evening 'background' traffic flows and peak 'with development' traffic flows for base 2015, predicted 2016 and 2019 flows for route 1 and route 2. HCV's are also shown in brackets (Data taken from Tobin Traffic Impact Report)

Table 10.12 Background and "with development", 2016 and 2019, AM peak hour (08:00 to 09:00)

Junction	Arm	2015	2016	2016	2016	2019	2019	2019	2019
		Background	Dev	With dev	% increase	Background	Dev	With dev	% increase
Route 1		traffic	traffic	traffic	due to dev	traffic	traffic	traffic	due to dev
Crossroads	L74141 to R163	35(6)	42	35(48)	88.0%	36(7)	42	36(49)	86.0%
Donaghpatrick	R163 to R162 (Kilberry)	142(7)	42	144(49)	86.0%	146(7)	42	148(49)	86.0%
(L74141)									
Staggered crossroads	R162 to Navan	592(43)	42	598(85)	49.0%	619(45)	42	619(87)	48.0%
Crossroads (Kilberry)									

Table 10.13 Background and "with development", 2016 and 2019, AM peak hour (08.00 to 09.00)

Junction	Arm	2015	2016	2016	2016	2019	2019	2019	2019
		Background	Dev	With dev	% increase	Background	Dev	With dev	% increase
Route 2		traffic	traffic	traffic	due to dev	traffic	traffic	traffic	due to dev
Staggered crossroads	R162 NE to Slane	68(8)	42	69(50)	84.0%	71(8)	42	71(50)	84.0%
Crossroads (Kilberry)									

Table 10.14 Background and "with development", 2016 and 2019, PM peak hour (17:00 to 18:00)

Junction	Arm	2015	2016	2016	2016	2019	2019	2019	2019
		Background	Dev	With dev	% increase	Background	Dev	With dev	% increase
Route 1		traffic	traffic	traffic	due to dev	traffic	traffic	traffic	due to dev
Crossroads	L74141 to R163	34(6)	42	34(48)	88.0%	36(6)	42	36(48)	88.0%
Donaghpatrick	R163 to R162 (Kilberry)	170(9)	42	172(51)	82.0%	177(9)	42	177(51)	82.0%
(L74141)									
Staggered crossroads	R162 to Navan	700(27)	42	708(69)	61.0%	732(28)	42	732(70)	60.0%
Crossroads (Kilberry)									

Consent of copyright owner required for any other use. For inspection purposes only.

Table 10.15 Background and "with development", 2016 and 2019, PM peak hour (17:00 to 18:00)

Junction	Arm	2015	2016	2016	2016	2019	2019	2019	2019
		Background	Dev	With dev	% increase	Background	Dev	With dev	% increase
Route 2		traffic	traffic	traffic	due to dev	traffic	traffic	traffic	due to dev
Staggered crossroads	R162 NE to Slane	106(10)	42	107(52)	81.0%	111(10)	42	111(52)	81.0%
Crossroads (Kilberry)									

EPA Export 06-01-2017:02:02:15

10.8.3 Road Traffic Noise

Increases in noise levels can be calculated when the percentage increase in traffic flow is known (Ref. HMSO Calculation of Road Traffic Noise, 1988). There is a logarithmic relationship between noise levels and traffic volume and the higher the existing traffic volume the greater the traffic increase required to produce a perceptible noise change. Typically, doubling the traffic flow produces a 3dB(A) change in noise level along a route.

HCV's on the road will give higher noise levels than cars on the same road and to allow for this the increase in noise levels along the routes, a calculation using a conversion factor is used where 1 HCV is equivalent to 2.3 CPU's (CPU = passenger car units). Tables 10.16, 10.17, 10.18 and 10.19 give traffic figures converted to CPU's and resulting percentage increase for calculating noise level increases.

Table 10.16 Background and "with development", 2016 and 2019, AM peak hour (08:00 to 09:00) converted to CPU's

Junction	Arm	2015	2016	2016	2016	2019	2019	2019	2019
Route 1		Background traffic	Dev traffic	With dev traffic	% increase due to dev	Background traffic	Dev traffic	With dev traffic	% increase due to dev
Crossroads	L74141 to R163	49	97	145	198.0%	52	97	113	187.0%
Donaghpatrick	R163 to R162 (Kilberry)	158	97	257	61.0%	162	97	261	60.0%
(L74141)									
Staggered crossroads	R162 to Navan	691	97	616	14.0%	723	97	819	13.0%
Crossroads (Kilberry)									

For inspection purposes only. Consent of copyright owner required for any other use.

Table 10.17 Background and "with development", 2016 and 2019, AM peak hour (08.00 to 09.00) converted to CPU's

Junction	Arm	2015	2016	2016	2016	2019	2019	2019	2019
Route 2		Background traffic	Dev traffic	With dev traffic	% increase due to dev	Background traffic	Dev traffic	With dev traffic	% increase due to dev
Staggered crossroads	R162 NE to Slane	86	97	184	113.0%	89	97	186	109.0%
Crossroads (Kilberry)									

EPA Export 06-01-2017:02:02:15

Table 10.18 Background and "with development", 2016 and 2019, PM peak hour (17:00 to 18:00) converted to CPU's

Junction	Arm	2015	2016	2016	2016	2019	2019	2019	2019
		Background	Dev	With dev	% increase	Background	Dev	With dev	% increase
Route 1		traffic	traffic	traffic	due to dev	traffic	traffic	traffic	due to dev
Crossroads	L74141 to R163	48	97	144	202.0%	50	97	146	194.0%
Donaghpatrick	R163 to R162 (Kilberry)	191	97	289	51.0%	198	97	294	49.0%
(L74141)									
Staggered crossroads	R162 to Navan	762	97	867	13.0%	796	97	893	13.0%
Crossroads (Kilberry)									

Table 10.19 Background and "with development", 2016 and 2019, PM peak hour (17:00 to 18:00) converted to CPU's

Junction	Arm	2015	2016	2016	2016	2019	2019	2019	2019
		Background	Dev	With dev	% increase	Background	Dev	With dev	% increase
Route 2		traffic	traffic	traffic	due to dev	traffic	traffic	traffic	due to dev
Staggered crossroads	R162 NE to Slane	129	97	227	75.0%	134	97	231	72.0%
Crossroads (Kilberry)									

Noise level increase at peak flows generated from development road traffic

The maximum noise levels will be generated at peak road traffic flows (AM and PM). Tables 10.20, 10.21, 10.22 and 10.23 gives the percentage increase calculated to CPU's and the resulting noise increase calculated to the nearest 0.5dBA.

Consent of copyright owner required for any other use. For inspection purposes only.

Table 10.20 Background and "with development", 2016 and 2019, AM peak hour (08:00 to 09:00) to nearest 0.5dBA

Junction	Arm	2016	2016	2019	2019
		% increase	Noise level	% increase	Noise level
Route 1		due to dev in CPU's	increase dBA	due to dev in CPU's	increase dBA
Crossroads	L74141 to R163	198.0%	6dBA	187.0%	6dBA
Donaghpatrick	R163 to R162 (Kilberry)	61.0%	2dBA	60.0%	2dBA
(L74141)					
Staggered crossroads	R162 to Navan	14.0%	0.5dBA	13.0%	0.5dBA
Crossroads (Kilberry)					

Table 10.21 Background and "with development", 2016 and 2019, AM peak hour (08.00 to 09.00) to nearest 0.5dBA

Junction	Arm	2016	2016	2019	2019
		% increase	Noise level	% increase	Noise level
Route 2		due to dev in CPU's	increase dBA	due to dev in CPU's	increase dBA
Staggered crossroads	R162 NE to Slane	113.0%	3dBA	109.0%	3dBA
Crossroads (Kilberry)					

EPA Export 06-01-2017:02:02:15

Table 10.22 Background and "with development", 2016 and 2019, PM peak hour (17:00 to 18:00) to nearest 0.5dBA

Junction	Arm	2016	2016	2019	2019
		% increase	Noise level	% increase	Noise level
Route 1		due to dev in CPU's	increase dBA	due to dev in CPU's	increase dBA
Crossroads	L74141 to R163	202.0%	6dBA	194.0%	6dBA
Donaghpatrick	R163 to R162 (Kilberry)	51.0%	2dBA	49.0%	2dBA
(L74141)					
Staggered crossroads	R162 to Navan	13.0%	0.5dBA	13.0%	0.5dBA
Crossroads (Kilberry)					

Table 10.23 Background and "with development", 2016 and 2019, PM peak hour (17:00 to 18:00) to nearest 0.5dBA

Junction	Arm	2016	2016	2019	2019
		% increase	Noise level	% increase	Noise level
Route 2		due to dev in CPU's	increase dBA	due to dev in CPU's	increase dBA
Staggered crossroads	R162 NE to Slane	75.0%	2.5dBA	72.0%	2.5dBA
Crossroads (Kilberry)					

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

Assessment of noise levels due to development traffic

The maximum noise level due to road traffic noise will be at the peak road traffic flows (AM and PM) periods.

The most significant impact will be on the L74141 from the T junction with the R163 and the entrance to the development site. The maximum increase in noise levels along this route will be in the order of 6dBA. An increase in noise levels at this residence would be just above what is termed a marginal impact (an increase between 1 and 5dBA would be considered marginal).

At the peak flow periods (PM and AM) the noise levels at all other locations will be increased by between 0.5 and 3dBA. A noise level increase between 1 and 5dba is considered marginal resulting in a negligible to marginal impact.

10.9 Ground Vibration

Ground vibration will be generated by truck movement on the roads; however, the levels generated will be below the level of sensitivity at less than 0.15mm/s peak particle velocity at 5 m from the road edge.

The impact from ground vibration will be negligible on all structures.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:15

10.10 Mitigation measures

The following mitigation measures are proposed for the development

An acoustic berm of topsoil (minimum height of 4m) will be constructed between the nearest residents and the nearest zone of excavation activity giving a minimum attenuation of 7dBA due North along the L74141.

Acoustic silencers/mufflers will be fitted to all rock breakers and where deemed necessary a barrier will be constructed close to rock-breaker between the source and receiver. The barrier could be a series of acoustic blankets of minimum height of 2m extended around the area of rock breaking.

'Operational sirens and similar, in routine use on-site shall be modified and maintained so as not to be audible at any noise sensitive location'. A compromise must be met to adhere to health and safety regulations.

All machinery on site will have directional flashing lights fitted to replace reversing horns (or alternative designated by health and Safety). No construction machinery with active reversing horns should be allowed to operate on site.

For inspection purposes only.
Consent of copyright owner required for any other use.

Operators of all mobile equipment will be instructed to avoid unnecessary revving of machinery and instructed to throttle down or turn off equipment / plant when not in use

Where possible the contractor will be advised to use the least noisy piece of equipment and especially when activity is close to a residence

All construction traffic to be used on site should have effective well-maintained silencers

Construction work will not be carried out past 19.00hrs on any day with Saturday work to stop at 16.00hrs with no Sunday work allowed.

10.11 Commentary

The maximum noise levels predicted due to construction activity are will exist for a short duration during removal of topsoil from the borrow areas to construct acoustic barriers.

As the project develops noise emission sources will retreat to greater distances from the receiver positions and the resulting noise levels will be considerable

EPA Export 06-01-2017:02:02:15

lowered. All construction will be carried out in accordance with BS 5228: Noise Control on Construction and Open Sites Part 1: 2009. Accordingly all construction traffic to be used on site should have effective well-maintained silencers. Operators of all mobile equipment will be instructed to avoid unnecessary revving of machinery and limiting the hours of site activities that are likely to give high noise level emissions. Where possible the contractor will be instructed to use the least noisy equipment. With efficient use of well-maintained mobile equipment considerably lower noise levels (3-6dB(A)) than those predicted can be attained. The Project Engineer will closely supervise all construction activity. Construction activity due to its nature is a temporary activity and thus any impacts will be short term. All construction works will be carried out during daytime periods.
Road traffic noise resulting from the proposed development will be of a temporary nature and of total duration of no more than 36 weeks per year over a 3 year period.

During the operational phase of the development there will be no audible noise emissions from offsite locations.

Consent of copyright owner required for any other use. For inspection purposes only.

10.12 Monitoring

It is proposed that continuous noise monitoring be carried out during construction at either location N4.

Furthermore this monitoring will be supplemented by additional periods of continuous monitoring for short periods (ranging from 1 week to 1 month) at representative locations to demonstrate compliance the noise level guidelines detailed in section 10.7 above .

EPA Export 06-01-2017:02:02:15

10.13 Conclusion

The maximum noise levels predicted will occur during the construction phase of the development and will pertain for short periods only during development of the acoustic berms. Construction noise by nature is a temporary activity and will have no long-term negative effects. Furthermore, there were no noise complaints from the stage 5A and 5B construction, which was of similar intensity as that planned for the Stage 5 construction. The author of this report carried out noise impact reports for previous extensions to the TSF and in all cases monitoring demonstrated that the noise levels were well the guideline limits and below the predicted level in the impact reports. Any impacts associated with noise generated from road traffic will be short term and of marginal impact.

During normal operation of the TSF including Stage 6 and Wetlands (when construction has ceased) there will no significant noise sources consequently there will be a negligible noise impact at all residents with no audible noise outside the boundary of the site.

For inspection purposes only.
Consent of copyright owner required for any other use.

10.14 References

(1) Noise Control on Construction and Open Sites - Part 1. Code of Practice for Basic Information and Procedures for Noise Control)
(2) BS 5228: Part 1: 2009, Noise and Vibration Control on Construction and Open Sites
(3) ISO 1996/1Acoustics – Description and Measurement of environmental noise- Part 1: Basic quantities and procedures
(4) ISO 1996-2: Acoustics – Description and Measurement of environmental noise Part 2: Acquisition of data pertinent to land use
(5) ISO 1996-3: Acoustics- Description and Measurement of environmental noise Part 3: Application to noise limits
(6) Calculation of Road Traffic Noise, Department of Welsh Office, 1988 HMSO
(7) EPA guidance Note for Noise in Relation to Scheduled Activities (1995)
(8) The National Roads Authority (NRA), Guidelines for the Treatment of Noise and Vibration in National Roads Schemes (2004)
(9) BS 5228: Noise Control on Construction and Open Sites Part 1: Code of Practice for Basic Information and Procedures for Noise Control (2009)

EPA Export 06-01-2017:02:02:16

Section 11 Human beings – Socio & Economic

11.1 Introduction

Human beings and their socio-economic environment are a vital element to be considered in an Environmental Impact Assessment (EIA). This section of the Environmental Impact Statement (EIS) examines the existing environment and the potential impact the proposed development may have on human being and the mitigating measures to address any likely impacts.

Boliden Tara Mines Limited (BTML) is Europe's largest zinc and lead mine and currently produces between 2.3 and 2.6 million tonnes of ore per annum and 0.4 Mt of zinc and lead concentrate. Based on current ore reserves, BTML needs to increase the storage capacity of the TSF to allow the processing of ore beyond the year 2020. The proposed development will extend the Life of Mine Plan beyond 2020

This section will focus on population, employment, tourism and amenities and economic opportunities.

For inspection purposes only.
Consent of copyright owner required for any other use.

11.2 Methodology

A desk study was carried out in order to examine all relevant information.

The following were consulted:

- National and Regional Planning Policy (NSS, NDP, RPGs);
- Meath County Development Plan 2013-2019;
- Navan Development Plan 2009-2015;
- Central Statistics Office (CSO) online database;
- National Monuments Service *Map Viewer* ;
- Failte Ireland website; and
- Ordnance Survey maps and satellite imagery

11.3 Existing Environment

Randalstown Tailings Storage Facility (TSF) is located approximately 2.5 km to the northwest of Navan, Co. Meath.

The proposed development consists of a lateral extension to the existing tailings storage facility (TSF) and the construction of an Integrated Constructed Wetlands (ICW) system in the townlands of Randalstown and Simonstown, Navan, Co Meath.

EPA Export 06-01-2017:02:02:16

The area surrounding the site is comprised of farmland, farm dwellings and residential dwellings. Navan racecourse is located to the east of the facility. A quarry and a waste disposal company are located to the southeast and a chemical manufacturing plant is located to the southwest of the facility. Access to the facility is via an access road that connects with the Donaghpatrick Local Road, L74141. The Tara mine facility is located 2.5 kilometers to the south of the Randalstown TSF.

The effects of noise, dust, traffic, air and water quality on the surrounding environment will be dealt with individually in those relevant sections of the EIS.

11.3.1 Land-Use

Navan is identified as a large growth town in the Meath. Land use zoning objectives to the south of Tara Mines include General Enterprise & Employment (E2), to the north Community Infrastructure (G1) and White Lands (WL) and to the east Existing Residential(A1).

According to the Meath Landscape Character Assessment, Tara Mines is located in the Blackwater Valley Landscape Character Area, which is marked as an area of very high value and high sensitivity. The topography of the Black river corridor is described as relatively flat around Navan to low undulating drumlins beyond Kells. It is described as a pleasant and balanced pastoral landscape with agricultural land, river corridor and small areas of settlement and woodland. Agricultural land consists of open farmland which is characterised by a loss of internal field boundaries. The urban fringe of Navan is characterised by some warehouse development, which has encroached into the edge of the flat river plain

For inspection purposes only.
Consent of copyright owner required for any other use.

11.3.2 Population

Navan is identified as a large growth town in the Meath CDP. It has grown significantly over each census with unprecedented growth between 2002 and 2011 which was amongst the highest experienced by any urban centre in the country. The population of Navan and Environs increased by almost 15% between Census 2006 and 2011, to its current population of 28,559.

The Meath County Development Plan 2013-2019 states that the county has had unprecedented growth within the residential sector, unparalleled by any other county, even those within the Greater Dublin Area or Mid-East Region. There has been significant growth in Meath's population. It is predicted that Navan will grow in the longer term (2022) to a population of 50,000 persons. However, growth in the employment sector and economic development generally has remained low, unable to keep pace with increases in residential population.
The County Managers Foreword in the Meath CDP states that

> '*with this expansion comes the need for a new economic configuration of the county to create the necessary conditions for significant generation of high quality employment to sustain our existing and new communities'.*

EPA Export 06-01-2017:02:02:16

11.3.3 Employment

Employment is an important indicator of the economic standing of an area. This section examines unemployment levels, employment status and industrial groups within the state and region.

The Quarterly National Household Survey (QNHS), published by the Central Statistics Office, provides details of unemployment at a regional level. The recent survey, *as of February 2015,* is for Quarter 2, 2015. Navan is located in the Mid East Region, which had an unemployment rate of *11.2%* and a participation rate of *61.6%* in the second quarter of 2015, demonstrating slightly higher employment figures than the State overall. The unemployment rate is the number of unemployed persons expressesed as a percentage of the total labour force. The participation rate is the number of persons in the labour force expressed as a percentage of the total population (over the age of 15 years). Table 11.1 illustrates the findings from the QNHS Quarter 2 2015.

Table 11.1 Quarterly National Household Survey, Q2 2015

	Unemployment Rate	***Participation Rate***
State	*9.8%*	*60.2%*
Mid East Region	*11.2%*	*61.6%*

Source CSO, 2015

For inspection purposes only. Consent of copyright owner required for any other use.

The CSO also publishes Live Register figures. These figures are not strictly a measure of unemployment as they include persons who are legitimately working part-time. However, they can be used comparatively to provide an overall trend within an area. The June 2014 and June 2015 Live Register figures (seasonally unadjusted) are shown in Table 11.2 below:

Table 11.2 Live Register (published October 2015)

	June 2014	***June 2015***	***% Change***
State	*398,813*	*356,520*	*-10.6*
Mid East Region	*39,017*	*35,124*	*-10*
County Meath	*9,807*	*8,625*	*-8.6*

Source CSO, 2015

EPA Export 06-01-2017:02:02:16

These figures show that County Meath and the Mid-East Region are consistent with current national trends in that there has been a slight decrease in people signing on between 2014 and 2015. However, the unemployment crisis remains at record levels. The slight decrease in the Live Register *for June 2015 accords with the overall trend of 'movements within a small range', according to the CSO (2013).*

BTML, one of the largest employers in the Navan area, provides significant employment, both directly and indirectly, in the locality and wider region (currently 572 direct employees). It is estimated that there are 3 to 4 additional jobs indirectly supporting each Tara job.

11.3.4 Socio-Economic Profile of the Locality

It is valuable to compare the employment numbers (by industrial group) for the State, Meath and Navan.

Table 11.3 Industrial Groups (Employment Numbers)

Occupational Group	*State*	*Meath*	*Navan*
Agriculture, Forestry and Fishing	*5.06%*	*4.96%*	*1.65%*
Manufacturing industries	*11.60%*	*11.8%*	*13.61%*
Building & Construction	*4.83%*	*6.28%*	*5.33%*
Transport & communications	*8.10%*	*9.36%*	*8.87%*
Commerce & Trade	*25.25%*	*26.02%*	*26.21%*
Public administration	*6.30%*	*6.71%*	*6.35%*
Professional Services	*23.53%*	*21.50%*	*23.60%*
Industry not stated	*15.3%*	*13.34%*	*14.35%*

Source: CSO, 2014

For inspection purposes only. Consent of copyright owner required for any other use.

Table 11.3 illustrates the industrial groups of persons living in the State, Meath and Navan. However these statistics do not convey the percentage of workers in the mining or quarrying sector nor do they convey other industrial groups that benefit from operations at Tara Mines such as construction, manufacturing etc.

EPA Export 06-01-2017:02:02:16

11.3.5 Tourism and Amenities

According to the Meath County Development Plan (CDP), 2013-2019,

'Tourism makes an important contribution to the economy of County Meath with income derived from tourist activity being distributed across a wide range of economic sectors'.

Meath, according to Fáilte Ireland, is located in the East & Midlands Tourist Region and consists of Counties Kildare, Laois, Longford, Louth, Meath, Wicklow, Offaly East and Westmeath. According to the latest available statistics from Fáilte Ireland (year ending December 2014) Meath received over 115 thousand overseas visitors in 2014 generating revenue of €38 million for this year

Table 11.4 Overseas Tourism to Meath 2014

	Britain	***M. Europe***	***N. America***	***Other***	***Total***
Number of Visitors (000s)	*49.5*	*38*	*18*	*10*	*115*
Revenue Generated (€m)	*15*	*13*	*7*	*3*	*38*

Source: Fáilte Ireland 2014

For inspection purposes only. Consent of copyright owner required for any other use.

Views and Prospects

The Meath County Development Plan (CDP) 2013 - 2019 places protection on a number of views & prospects.

> Objective LC OBJ 5 within Section 9.10 of the current Meath CDP states the following: *"To preserve the views and prospects and the amenity of places and features of natural beauty or interest listed in Appendix 12 and shown on Map 9.5.1 from development that would interfere with the character and visual amenity of the landscape."*

It should be noted that, as per the description in Appendix 12 of the Meath CDP, none of these protected views are directed at the application site.

Nevertheless, the protected viewpoint on Carn Hill, east of Navan (protected views & prospects no. 38), the protected panoramic view on Tara Hill (protected views & prospects no. 44, approximately 14km south of the application site) and protected views & prospects no. 13 (the Tower of Lloyd at Kells, 13km to the northwest of the application site) were all visited as part of the Landscape and Visual Impact Assessment of this EIS (Chapter 6). The impact of the proposed development on each of these views would be imperceptible to none.

EPA Export 06-01-2017:02:02:16

Designated Areas:

One Special Areas of Conservation (SAC), one Special Protection Area (SPA), one Natural Heritage area and one proposed Natural Heritage Areas (pNHAs) are located within the wider study area surrounding the application site. Designated areas are illustrated in Table 11.5 and further detail is presented in the Ecology Chapter of this EIS (Chapter 5).

Table 11.5 Designated Area

Type	Site Code	Site Name	Distance and Direction from application area
SAC	*002299*	*River Boyne And River Blackwater*	*1.2km southwest*
SPA	*004232*	*River Boyne And River Blackwater*	*1.2km southwest*
NHA	*001324*	*Jamestown Bog*	*7.4km southwest*
pNHA	*001592*	*Boyne Woods*	*5.2km southeast*

Walking and Cycling Routes:

The Meath County Development Plan 2013-2019 recognises

> *'The important role that suitable cycle and pedestrian route have in the attraction of tourism to the County'*

and states that

> *'Public rights of way which contribute generally to the amenities of the county and local areas will be protected and maintained'.'*.

For inspection purposes only.
Consent of copyright owner required for any other use.

An application has been granted by Meath County Council (MCC) to develop a shared pedestrian and Cycle Greenway along the Navan to Kingscourt rail line which borders the proposed development site to the east.

Tourist Amenities:

Navan Race Course is located east of the existing Randalstown TSF. An 18-hole golf course and driving range is also located adjacent to the race course.

EPA Export 06-01-2017:02:02:16

11.3.6 Material Assets

Planning Permissions:

There are no live planning applications within the townlands of Randalstown and Simonstown as of the 5th April 2016. There are two applications with Meath County Council in the townland of Donaghpatrick; one for an entrance onto a public road and the second is to construct a cattle shed.

Settlement:

The existing Randalstown TSF is not located within a town or village and is therefore does not have any zoning objectives as set out in the Meath County Development Plan 2013-2019. However due to its proximity to Navan it has been identified as a *'Rural Area under Strong Urban Influence'.*

> *'This area exhibits the characteristics of proximity to the immediate environs or close commuting catchment of Dublin, with a rapidly rising population and evidence of considerable pressure for development of housing due to proximity to such urban areas'.*

Extractive Industry:

Section 10.2 of the Meath CDP *Extractive Industry and Building Materials Production* states that

> '*Meath contains a variety of natural resources such as building raw materials in the form of sand, gravel, stone reserves including high purity limestones and shale used in cement and magnesia manufacture and base metal deposits. The potential of these resources to underpin construction output and provide employment and economic growth in the local and regional economy is recognised as is the need to exploit these in an environmentally sound and sustainable manner'*

The development plan also provides policies in relation to extractive industries which include;

Policy RD POL 22:
"To facilitate the exploitation of the county's natural resources and to exercise appropriate control over the types of development taking place in areas containing proven deposits, whilst also ensuring that such developments are carried out in a manner which would not unduly impinge on the visual amenity or environmental quality in the area."

Policy RD POL 23:
"To support the extractive industry where it would not unduly compromise the environmental quality of the county and where detailed rehabilitation proposals are provided."

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:16

Policy RD POL 24:

"To seek to ensure that the extraction of minerals and aggregates minimise the detraction from the visual quality of the landscape and do not adversely affect the environment or adjoining existing land uses."

RD POL 27:

'To ensure that development for aggregates / mineral extraction, processing and associated concrete production does not significantly impact on the following areas:

i) Existing & Proposed Special Areas of Conservation (SACs);
ii) Special Protection Areas (SPAs);
iii) Existing & Proposed Natural Heritage Areas (pNHAs);
iv) Other areas of importance for the conservation of flora and fauna;
v) Areas of significant archaeological potential;
vi) In the vicinity of a recorded monument;
vii) Sensitive landscapes, and;
viii) World Heritage Sites

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

11.4 Significant Impacts

11.4.1 Effects on Population

The existing TSF is not located in an urban area and the proposed Stage 6 Extension will not negatively impact on any towns or villages. There are a number of dispersed dwellings in close proximity to the TSF. The TSF will therefore operate under rigid guidelines to assure residential amenity is maintained.

11.4.2 Effects on Health and Safety

Potential Impacts regarding the public health and safety of the TSF, relate primarily to concerns about those either straying or trespassing into the site, as well as the health and safety of workers and visitors to the site. The day-to-day operation of the TSF, including the workings associated with all machinery and on-site vehicles, and how visitors are to present and conduct themselves when undertaking visits to the site, will be in compliance with all health and safety laws and regulations pertaining to the location and the location's Safety Statement.

The existing mine currently operates under the relevant health and safety legislation, i.e. *The Safety, Health and Welfare at Work Act, 2005*, *The Mines and Quarries Act, 1965* and subsequent Regulations relating to health and safety, training, appropriate site management etc.
The Tara mine site and the TSF also operate under the conditions of its current Industrial Emissions (IE) Licence P0516-03. This proposal will require a revision of the Company's IEL by the Environmental Protection Agency (EPA).

For inspection purposes only.
Consent of copyright owner required for any other use.

11.4.3 Effects on Employment and Economy

Contribution to Employment

BTML currently employs a total of 572 employees directly. It is estimated that there are 3 to 4 additional jobs indirectly supporting each job. The proposed development at the TSF will underpin the future operation of Tara Mines. The design capacity of the proposed Stage 6 lateral extension will extend the Life of Mine Plan beyond 2020.

The proposed development at the TSF will help in safe guarding employment for:

- Construction of the Stage 6 lateral extension and Integrated Constructed Wetlands (ICW) system
- Operation of the facility
- Indirect employment such as suppliers for construction and operational phases
- Spin off employment such as service suppliers due to the economic activity surrounding

EPA Export 06-01-2017:02:02:16

Without the additional tailings storage capacity, the remaining operational life of the mine would be seriously curtailed.
The project will involve the provision of direct and indirect job both on and off site over the construction period.

Contribution to Local Economy

The effect of wages and salaries generated by Tara being spent in the local and greater Navan areas are considerable. Currently, between €65 - €70 million is generated into the local community annually, made up of €45 million in gross payroll costs, €10 million by way of contractor and indirect employee earnings and €10 - €15 million of local spend with local suppliers. In addition an average of €1.75million is paid, annually, to the local authority in rates, water rates and planning charges.

The Stage 6 development is essential to the sustainability of the mine, and will be of major economic importance at local and national level. The Navan-Drogheda-Dublin rail link currently serving Tara depends on the business for its survival. So long as the mine remains in operation the future of this valuable transportation link is assured.

Contributions to the National Economy

The national economy also benefits, substantially, from a fully operating mine in the form of payments to state enterprises (e.g. Iarnrod Eireann, Dublin Port Company) and to the Revenue Commissioners in the form of PAYE, PRSI, Corporation and other taxes. Approximately €55 million (inclusive of local purchases) is spent annually for the purchases of goods and services within the state.

For inspection purposes only.
Consent of copyright owner required for any other use.

A major contribution to the country's *Balance of Payments* arises from the sales of zinc and lead concentrates. The annual contribution to the Balance of Payments is in the region of €156- million.

11.4.4 Effect on Land use

The proposed Stage 6 extension will not require a change of land use or will not take land from the agricultural landscape in the vicinity of the TSF.

The proposed ICW system will replace c. 10 ha of grassland habitat (GA1-Improved agricultural grassland) and c. 2 ha of modified woodland (WD2) consisting of mixed broadleaved / conifer woodland).

11.4.5 Effects on Amenities and Tourism

An application has been granted by Meath County Council (MCC) to develop a shared pedestrian and Cycle Greenway along the Navan to Kingscourt rail line which borders the proposed development site to the east.

EPA Export 06-01-2017:02:02:16

The impact the proposed extension to the existing tailings facility will have minimal visual impacts and will not impact on tourist facilities in the area.

11.4.6 Effects on Material Assets

The proposed development will be constructed and operated in line with the policies of Meath County Council. The impacts of the proposed Stage 6 extension on the environment are addressed in the relevant sections of this EIS.

11.5 Mitigation Measures

11.5.1 Population

The proposed development will have limited effects on the local population, as the TSF is currently an active site. The TSF and its proposed activities will be managed in such a way as to limit the impact of its operation on the surrounding environment.

11.5.2 Health and Safety

All personnel will be appropriately trained and certified in the safe handling and transportation of tailings material. All personnel will be thoroughly trained on the properties of all materials and products being handled within the TSF, and will be trained to react in the unlikely event of an unplanned incident.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

11.5.3 Employment and Economy

The impact on employment and both the local and national economy is positive and therefore no mitigation measures are proposed.

11.5.4 Amenities and Tourism

Visual impacts on tourism and amenities can be mitigated by seeding the new embankment immediately after construction to ensure that it blends with the existing embankment vegetation (more detail is provided in Section 9 of this EIS).

11.6 Conclusion

This section has examined the prevailing socio-economic conditions relevant to Tara Mines.

In summary the continued operation and the proposed Stage 6 extension at the existing Randalstown TSF will have a positive impact in relation to the socio-economic standing of the surrounding area. This will take the form of retaining and providing direct and indirect jobs and will continue to assist in the economic recovery of the Mid-East region, with potential export benefits to the Irish economy in general.

All activities on site will be carried out with regard to strict environmental and safety guidelines. When all mitigation measures are complied with there should be no significant impacts arising from the continued use of the TSF. It is anticipated that the development will not have a negative impact on the everyday activities and lifestyles of local people and the surrounding environs.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:16

Section 12 Material Assets

12.0 Introduction

This chapter of the Environmental Impact Statement (EIS) presents an evaluation of the proposed development in relation to material assets.

It has been prepared in accordance with relevant EU and Irish Legislation and guidance, including the requirement of Annex IV of the Environmental Impact Assessment (EIA) Directive and in accordance with Schedule 6 of the Planning and Development Regulations 2001 (as amended) and conforms to the relevant requirement as specified therein.

This chapter specifically deals with

- Part A Culture and Heritage - Archaeology
- Part B Soil, Vegetation & Land Use
- Part C Animal Health

For inspection purposes only. Consent of copyright owner required for any other use.

PART A Cultural and Heritage - Archaeology

12.1 Introduction

This archaeological report was undertaken at the request of Boliden Tara Mines Limited (BTML) as part of the EIS for the proposed Stage 6 extension of the Randalstown Tailings Storage Facility (TSF) and the construction of an Integrated Constructed Wetlands (ICW) system.

The purpose of the study is to assess the impact of the proposed development on the receiving archaeological environment and to put forward remedial and mitigation measures to safeguard any archaeological material which may be present.

The development site is situated in the townlands of Randalstown and Simonstown, c 2.5km north-west of Navan town and 1.5km west of Kilberry.

The proposed Stage 6 site is bounded on:

- the east by a narrow strip of land, wooded at the south end, beside the closed Navan-Kingscourt railway line, all in Silloge townland;
- on the north by the R163 Kilberry-Kells road and L74141 leading to Donaghpatrick;
- on the west by farmland in the townland of Boolies;
- on the south by the existing Randalstown TSF.

EPA Export 06-01-2017:02:02:16

The proposed Stage 6 extension to the TSF will cover an area of c. 58 hectares (internal basin area of c. 43 hectares), of the existing 'Borrow Areas' north of the current facility. This area has been extensively excavated and the works for the removal of clay for use in construction of the tailings pond have been archaeologically monitored, over a period from 1975 to 2012 (see references at end of report).

Archaeological monitoring followed by excavations revealed some prehistoric materials especially Bronze Age sites such as *Fulachta Fiadh*. These sites were archaeologically resolved for the most part, before clay was removed for the previous Stage 5 extension of the tailings facility. Isolated areas not resolved initially were subsequently excavated and removed from 2010 to 2012 inclusive.

The proposed ICW will be constructed over an area of c. 12 ha and will be located on BTML property south of the existing TSF in the townland of Randalstown and Simonstown. Access to the ICW site will be from the TSF site.

12.2.2 The Stage 6 Development Site

The proposed stage 6 development site covers a sub-rectangular area c.1000m E-W by 600m N-S and is contained within the 'Northern Borrow Pit' and 'Seven Fields Borrow' Areas. It excludes the extreme N areas to the W and E of Blake's House and the house itself with its immediate surrounds. The house is probably of early to mid 19th century in date and is in a totally ruinous state. It is not a listed structure. It does not appear as a separate structure from the Randalstown House Complex on any editions of the OS 6" map between 1840 and 1911 but is clearly distinguishable as a separate entity on more recent editions.

For inspection purposes only.
Consent of copyright owner required for any other use.

The site of the proposed Stage 6 development consists of the Northern Borrow Pit area and the Seven Fields Borrow area. The Northern Borrow area is in the W portion of the site c. 2/3 of the proposed Stage 6 development site. There is a central N-S access road to the current tailings pond which divides the Northern Borrow almost exactly in half. Some of the W half has been reinstated but is not totally levelled-off and reinstated. There are hills and hollows. Electricity poles stand on a few of these mounds.

The Seven Fields Borrow Area is about 1/3 of the size of the Northern Borrow Area and lies at the E side of the Stage 6 proposed site. It is much as it was after the extraction of material for Stage 5 extension to the TSF and consists of humps and hollows of sub-soil in a much reduced ground level. There are a few small green mounds of soil and clay on which stand electricity poles.

Along the SSE edge of the proposed development site between the existing tailings pond and the borrow areas there is a narrow band of trees with an accessway running SSE of them. There are a greater number of trees immediately E and W of the N-S access road and there are virtually none in the SW portion of the Northern Borrow Pit area.

EPA Export 06-01-2017:02:02:16

The Stage 6 development site is located in an area which has proven to be rich in archaeological monuments ranging in date from the Neolithic to the Post-Medieval periods. The *Record of Monuments and Places: County Meath*, issued by the Department of the Environment, Heritage and Local Government, lists six Recorded Monuments within the application area (refer to Figure 12.2) , of which five are situated within the existing Northern Borrow Area and one, ME018:026 designated 'Earthwork site' is in the Seven Field Borrow Area. The Recorded Monuments in the Northern Borrow Area were uncovered during construction of the Stage 4 tailings facility extension.

A number were archaeologically excavated in 1999 and 2004 and are no longer extant.

Between 1975 and 2004, during earlier phases of the tailings dam development, extensive archaeological excavations were undertaken in Randalstown and in the neighbouring townlands of Simonstown and Nevinstown. These excavations dealt with previously-known monuments, such as Simonstown Ringfort and St. Anne's Church, and also with many significant archaeological sites which were uncovered during monitoring of the development.

12.2.3 The Proposed ICW Site

Consent of copyright owner required for any other use. For inspection purposes only.

The proposed ICW site is located south of the TSF with the *Doug Stream* to its Southern Boundary and Simonstown Stream to the west. The North section of the site comprises an area of c. 2 ha of modified woodland (WD2 consisting of mixed broadleaved / conifer woodland) while the Southern section comprises a single field, c 10 ha of grassland habitat (GA1 – Improved agricultural grassland) with hedgerow to the north, west and east boundaries of the field. Hedgerow comprised primarily hawthorn, Ash & Beech.

12.2.4 Methodology

This archaeological study comprises the results of desk-based research and a field survey of the proposed development site.
The principal documentary sources consulted for the study were as follows:

- *Record of Monuments and Places: County Meath* (RMP) issued by the National Monuments and Historic Properties Division, Department of the Environment, Heritage and Local Government (DEHLG), in accordance with Section 12 of the National Monuments (Amendment) Act 1994. Also, the files for the relevant sites in the archives of the DEHLG were consulted. Sites recorded on the Record of Monuments and Places have statutory protection under the National Monuments Act 1994. An extract from sheets 18 and 25 of the RMP is attached as Figure 12.1 below.
- Revisions and updates to the *Record of Monuments and Places: County Meath* available on the DEHLG website.

EPA Export 06-01-2017:02:02:16

- The 1st edition of the O.S. six-inch map (1:10560) Meath Sheet 18, 1837.
- Topographical files in National Museum of Ireland.
- Aerial photographs of the Geological Survey of Ireland.
- Relevant historical and archaeological books and journals (Bibliography attached).

Field inspections were carried out to assess the local topography and current land use and to identify any further features of possible archaeological or historical interest.

12.2.4.1 Archaeological and Historical Background

Evidence of settlement in Randalstown and adjoining districts from the Neolithic period onwards is present in the form of upstanding monuments and has been attested by the sites uncovered during development of the Randalstown tailings facility at Simonstown and Randalstown between 1974 and 2004 (see Figure 12.1). In 1977, excavations at Nevinstown by Mary Cahill, National Museum of Ireland, uncovered archaeological deposits dating to the Early Bronze Age, Early Christian, Medieval and Post-Medieval periods.

Prehistoric period

At Simonstown in 1975 E.P. Kelly, National Museum of Ireland, recorded pits and hearths of Neolithic date (*c.* 4500-2200 BC) under the banks of an Early Christian period ringfort (Kelly 1976). Also at Simonstown, in 1998, Ó Drisceoil partially excavated the remains of a large rectangular structure which may have been destroyed by fire. A Neolithic date, indicated by the finding of a leaf-shaped arrowhead on the site, was confirmed by radiocarbon dating (Ó Drisceoil 2000).

For inspection purposes only.
Consent of copyright owner required for any other use.

Material of Bronze Age date (*c.* 2200-500 BC) was found at Nevinstown Site 1, Cahill, where cremated human bone was contained in an Encrusted Urn and a Food Vessel Vase buried in a pit (Cahill 1987-8). Burnt mounds or *fulachta fiadh*, presumed communal cooking places typically Bronze Age in date, have been excavated in the borrow areas for the tailings facility at Simonstown (Ó Drisceoil 2000: Area 6). At Randalstown in 1999, archaeological monitoring of the topsoil stripping in the Northern Borrow Area for the Stage 4A tailings storage facility extension, uncovered four *Fulachta Fiadh*, comprising deposits of 'burnt mound' material and a number of pits and troughs (Murphy 2000).

In 2003 seven archaeological sites of prehistoric date, including two *fulachta fiadh*, were identified during monitoring of topsoil-stripping in the 'Northern Borrow Area' associated with Stage 4B TSF extension (Campbell 2006). Four of the sites were subsequently excavated by Murray, CRDS Ltd., in September-November 2004 and were dated to the Bronze Age and Iron Age (Murray 2008). The Bronze Age sites were a *fulachta fiadh*, Site 6, dated by radiocarbon to 2040-1890 BC, an area of prehistoric industrial activity, Site 4, dated to 1760-1600 BC and isolated pit features at Site 1 dated to 1440-1290 BC. A date in the Iron Age, 120 BC-60 AD, was obtained for a probable house structure at Site 7B.

EPA Export 06-01-2017:02:02:16

At Simonstown, Ó Drisceoil also uncovered 61 circular pits containing burnt stone, charcoal and occasional cremated bone, suggesting a Bronze Age date (Ó Drisceoil 2000). In Liscartan townland, a tumulus or earthen mound (RMP ME025:012) is likely to be of prehistoric date.

Early Christian Period

Large-scale excavations of settlement sites of the Early Christian period have taken place at Nevinstown, Simonstown and Randalstown. Kelly excavated a large ringfort, 75m diameter, at Simonstown in 1975 and an enclosure with a cemetery at St. Anne's Chapel (ME025:002), Randalstown, in 1975-6 and 1981-2. On this latter site, Iron Age settlement was indicated by the finding of a 1st century AD Roman brooch (Kelly 1976; Kelly 2002).

Souterrains, associated with unenclosed settlements, were excavated at Nevinstown and on two sites at Randalstown (Cahill 1987-8; Campbell 1986, Campbell 1987). There is a record of a souterrain with two beehive chambers at Ardbraccan (ME025:022) (Moore 1987, 50). There is annalistic and archaeological evidence for Early Christian period churches at Ardbraccan, Liscartan and Randalstown but no fabric survives of the actual buildings. Bradley considers that documentary evidence for the foundation of a house for Augustinian Canons at Navan, before the coming of the Anglo-Normans, supports the tradition of an Early Christian monastery on the site of the town (Bradley 1988-9).

For inspection purposes only.
Consent of copyright owner required for any other use.

Medieval Period

The town of Navan is an Anglo-Norman foundation of the late 12th century although the earliest documentary reference to the town as a borough is 1462, when Edward IV confirmed the right of the town to collect tolls, and its earliest charter dates to 1494. Hugh de Lacy granted Navan and Ardbraccan to Jocelin de Angulo (later Nangle) before 1186 and the town most likely owes its foundation to him or his son William. The motte (ME025:023) built by de Angulo at Moathill, marked "Navan Moat" on the O.S. map, is probably the earliest surviving vestige of the medieval town. It is situated to the west of the town on a ridge on the south bank of the Blackwater. The town was walled from the 15th century and a portion of the wall with a tower survives at Barrack Lane on the north side of the town. The Augustinian Priory of St. Mary lay between the north wall and the River Blackwater.

Rathaldron House (ME025:011) on the east bank of the River Blackwater was originally built as a four-storey tower house, possibly by the Cusacks in the 14th century. Another medieval tower house stands at Liscartan, "Liscartan Castle (in ruins)" in company with the ruins of a gatehouse and a later stone house, of 16th or 17th century date. West of the castle are the ruins of the medieval church, still in use into the 18th century. At Ardbraccan, a 15th century church tower (ME025:22) stands beside the church built in the 1770s. There was a castle of the Everards at Randalstown, presumably on the site later occupied by Randalstown

EPA Export 06-01-2017:02:02:16

House. The castle, probably a tower house, is listed among the possessions of Richard Everard in 1574-5 and was renovated not long before the building of Randalstown House (Murray 2008, 8, citing Everard 1993).

The late medieval cross at Nevinstown, marked "Old Cross" on the 1837 O.S. map, was erected by Michael de Cusack in 1588 and is believed to have functioned as a wayside cross on an old road from Navan to Rathaldron Castle (King 1984). The cross was moved to the County Library in Navan in recent times. The site of the cross was the subject of archaeological excavation by the National Museum in 1977 when the remains of 7-8 infants were uncovered around the plinth (Cahill 1987-8). St. Anne's Chapel at Randalstown (ME025:002) was a chapel of ease belonging to the chantry chapel at Kilberry, dedicated to St. John the Baptist, where the ruins of the medieval parish church (ME018:022) still survive (Cogan 1862, 349).

In addition to recognised medieval monuments in the area, material of medieval date has also been found in the excavations of several Early Christian settlement sites in the area, representing the later phases of use of the sites. Pottery and other domestic artifacts were found in Phase III at Nevinstown Site I. A medieval phase was also recognised on the ringfort excavated by Kelly at Randalstown.

Post-Medieval Period

For inspection purposes only.
Consent of copyright owner required for any other use.

In the *Civil Survey of County Meath*, compiled in 1654-6, it is recorded that John Everard, Irish papist, was in possession of 290 acres at 'Randalstowne' (Simington 1940, 295). Randalstown House, built c. 1710 by Mathias Everard, stood at the centre of the estate until its demolition in the 1970s for the development of the Tara Mines tailings facility (Bence-Jones 1978, 237). The field pattern of large rectilinear fields, probably dating to the 18th century, is today largely unchanged from the O.S. 1st edition map surveyed in 1836. The southernmost three fields in the proposed borrow-pit area are shown as part of the Randalstown demesne on the 1836 O.S. survey. The earliest phase of the Tara Mines tailings facility has encroached into the southern ends of these three fields. The Navan to Kingscourt railway line, which runs close to the eastern side of the development, was constructed in 1872 by the Dublin and Meath Railway Co. and later became part of the Great Southern Railway (Ellison 1983, 38).

Test excavations took place at Randalstown in 1996 to assess the nature of the Recorded Monument ME018:026, 'Earthwork site', which is situated within the proposed Seven Field Borrow Area. The site was identified from a cropmark on an aerial photograph (Moore 1987, 119). Two parallel gullies, up to 1.5m wide and 0.45m deep, set 3.3m apart, were interpreted as drainage channels by the side of a track or road and although no dating evidence was recovered it is likely, due to their orientation, that the gullies and track predate the existing field system.

There are four houses at the northern end of the development area, three of which are indicated on the 1837 O.S. six-inch map. All four will be excluded from the development.

EPA Export 06-01-2017:02:02:16

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

12.2.4.2 Recorded Monuments

The Recorded Monuments in Randalstown and adjacent townlands are listed below under three headings:

- Recorded Monuments in the proposed development area
- Recorded Monuments elsewhere in Randalstown townland
- Recorded Monuments in adjacent townlands

The lists are compiled from the *Record of Monuments and Places: County Meath* (RMP), issued by DEHLG in 1996, and from revisions on National Monuments website (Figs. 12.1.2). Where applicable, Inventory Nos. are given as published in the *Archaeological Inventory of County Meath* (Moore 1987).

Five Recorded Monuments in the Northern Borrow Area result from archaeological monitoring and excavation undertaken during the development of the Stage 4 tailings facility extension. There is not an exact concordance between the number of sites uncovered and the number listed in the RMP as several excavated sites have been included under one number in the RMP.

The details of each site are arranged in the order as follows: *Recorded Monuments in the proposed development area*

For inspection purposes only.
Consent of copyright owner required for any other use.

Inventory No. **RMP No.** Townland National Grid Ref	**Classification** Description
1227 **ME018:026** Randalstown 28543 27260	**Earthwork site** Cropmark of rectangular ditches covering area of *c.* 5 acres on an aerial photograph (CUCAP, AUF 96). Located in the Seven Field Borrow Area. Investigated by Campbell in 1996.
ME018:033 Randalstown	**Fulacht Fiadh** Site 6 uncovered 2003 during Stage 4B tailings facility extension. Fully excavated by Murray in 2004.
ME018:034 Randalstown	**Fulacht Fiadh** Site uncovered 1999 during Stage 4A tailings facility extension. Fully excavated by Murphy 1999
ME018:035 Randalstown	**Fulacht Fiadh** Site uncovered 1999 during Stage 4A tailings facility extension. Fully excavated by Murphy 1999
ME018:036	**Fulacht Fiadh** Site uncovered 2003 during Stage 4B tailings facility extension. Left *in situ* in the Northern Borrow Area

EPA Export 06-01-2017:02:02:16

Randalstown	
ME018:037 Randalstown	**Excavation – miscellaneous** Refers to five archaeological sites, of indeterminate function, uncovered in 2003 during the Stage 4B tailings facility extension. Two sites (Nos. 2, 5) remain *in situ* in the Northern Borrow Area; two sites (Nos. 1, 4) were partially excavated by Murray in 2004; one site (No. 7) was fully excavated by Murray in 2004 (see Fig. 12.3).

Recorded Monuments elsewhere in Randalstown Townland

447 **ME025:001** Randalstown 28421 27163	**Souterrain** Undifferentiated souterrain and associated occupation features. Excavated by Campbell 1985
448 **ME025:003** Randalstown 28503 27125	**Souterrain** Unroofed passage and beehive chamber; associated occupation levels. Excavated by Campbell 1986
1477, 1071 **ME025:002** Randalstown 28414 27145	**Church and enclosure** 'St. Anne's Chapel (in ruins)'. Foundations of rectangular building with crypt. Associated graveyard. Enclosure ditch predating church. Excavated by Kelly 1975-6 and 1980-1.
- **ME025:045** Randalstown 28407 27139	**Holy Well** Holy well associated with St. Anne's Chapel.

Recorded Monuments in Adjacent Townlands

880 **ME025:005** Simonstown 28541 227082	**Ringfort** Circular area, 59m diameter, defined by earthen bank with outer fosse. Excavated 1975 by Kelly.
1772 **025:011** Rathaldron 28458 26932	**Tower House** A four-storey medieval tower house, still inhabited. The castle has been extensively remodelled but retains some original features.
287 **025:043.2** Boolies 28384 27304	**Field System Site** Banks and ditches covering *c.* 7 acres, identified from aerial photographs. Now reclaimed.
- **025:046** Tatestown 28415 227059	**Holy Well** Marked 'Toberdoney' on O.S. six-inch map.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

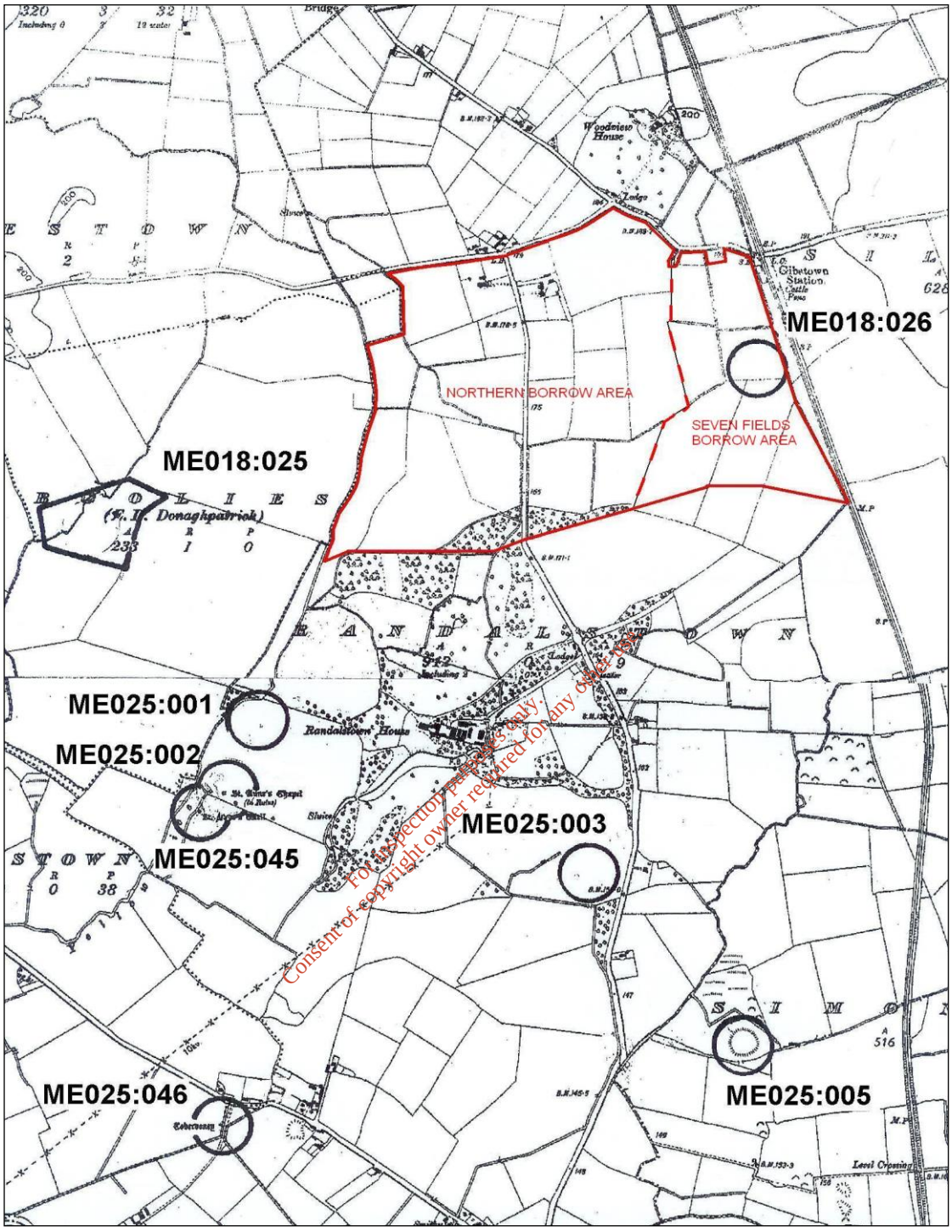


Fig. 12.1.1 Location of development on extract from sheets 18 and 25 of *Record of Monuments and Places: County Meath.*

EPA Export 06-01-2017:02:02:16

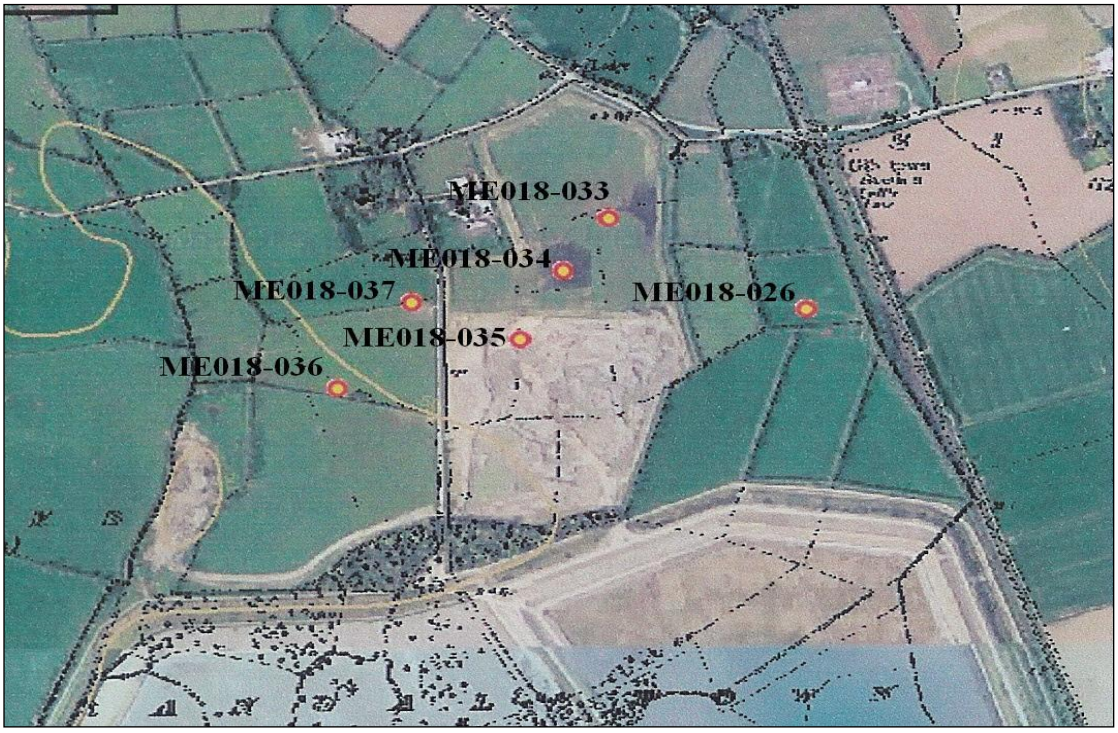


Figure 12.1.2 Recorded Monuments in the proposed borrow pit areas as indicated on DEHLG website

For inspection purposes only.
Consent of copyright owner required for any other use.

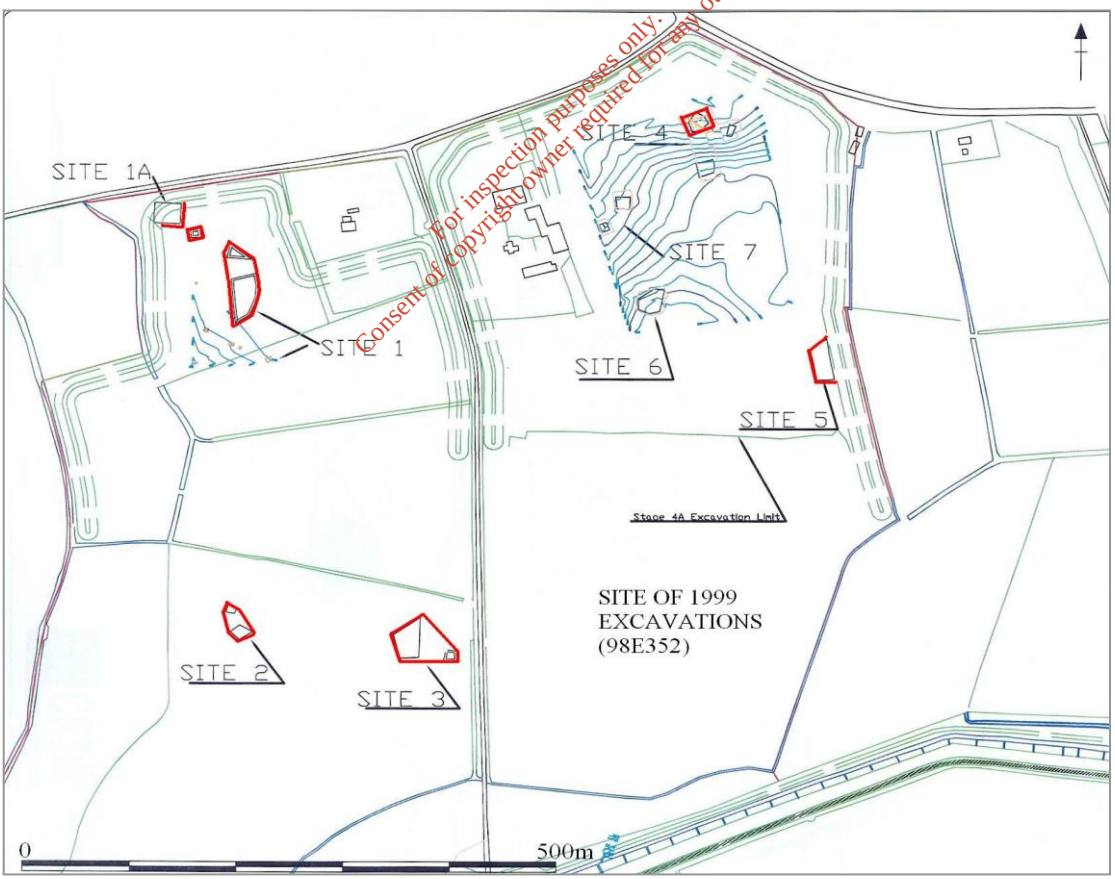


Figure 12.1.3 Northern Borrow Area with unexcavated sites Nos. 1, 2, 3, 4 and 5 indicated in red.

EPA Export 06-01-2017:02:02:16

12.2.5 Field Survey

Field surveys were carried out in the application areas.

The Northern Borrow Area was inspected on 29th April 2009. It originally comprises c.52 hectares situated to the east and west of the old 'Randalstown road' running north-south from the R163 to Rathaldron and no longer a through road since the construction of Stage 3 of the tailings facility in 1986. It consisted of generally flat farmland divided into twelve fields.

The Northern Borrow Area was extensively quarried in 1999 and 2004 for the construction of Stage 4A and 4B tailings facility extensions. Two houses at the northern end of the Northern Borrow Area, with the gardens and yards attached, were excluded from the development; a single storey house over basement, to the east of the road and ancillary farm buildings and a two-storey early-19th century on the west side of the road is roofless and derelict.

The entire borrow area was stripped of topsoil in 1999 and 2003, apart from a narrow strip of ground underneath the ESB power lines that run NE-SW across the borrow area. The greater part of the borrow area has been excavated to a depth of *c.* 2-3m into subsoil. The road and its boundary hedges at the centre of the Northern Borrow Area remain intact. One field at the south-west side of the borrow area, bordering the Yellow River, has been used as a stockpile area and a line of mature trees remains along its eastern boundary. There are some fir trees remaining near the road at the centre of the borrow area.

Consent of copyright owner required for any other use. For inspection purposes only.

Of the seven archaeological sites uncovered during monitoring of topsoil-stripping in 2003, two (Sites 6, 7) were fully excavated and are no longer extant, two were partially excavated (Sites 1, 4) and three (Sites 2, 3 and 5) were left *in situ*. The remaining archaeological sites are now on unexcavated 'islands' within the borrow area, each surrounded by a buffer zone *c.* 10-15m wide. Individual archaeological features, e.g. pits, deposits etc, are covered with plastic sheets or terram, held in place by a loose covering of topsoil. The unexcavated areas in the Northern Borrow Area are indicated on Fig. 12.1.3.

The Seven Field Borrow Area, comprising the extension to the east, was inspected on 10th October 2008. It originally comprises c.18 hectares. Its general topography is of flat to undulating farmland set out in large rectilinear pasture fields. The seven fields comprising the borrow area are numbered 1-7 on Figure 12.1.4. The field boundaries consist of traditional ditches and banks planted with hawthorn and ash with some sycamore trees. A stream runs from north to south down the centre, turning south-west to form the boundary between fields 3 and 5. Map evidence indicates that this stream formerly ran due west through the existing Northern Borrow Area and has been diverted south.

The only change in the field pattern between the O.S. 1st edition survey of 1836 is the removal of an east-west field boundary in Field 1 which probably enclosed a

EPA Export 06-01-2017:02:02:16

small field attached to the cottage shown on the map. The southern ends of Fields 5, 6 and 7 have been truncated by the construction of first phase of the tailings facility and the boundary along the south is a modern hawthorn hedge. The boundary on the eastern side of the development, i.e. the east side of Fields 2, 4, 6 and 7, is an unusually massive earthen bank, *c.* 4m wide and 2m high with a dry ditch on both sides (Fig. 12.1.6). The large dimensions may be due to the fact that the bank is not only the boundary between the townlands of Randalstown and Silloge, but is also the boundary between the parishes of Donaghpatrick and Kilberry and between the baronies of Upper Kells and Morgallion. This bank will not be affected by the development.

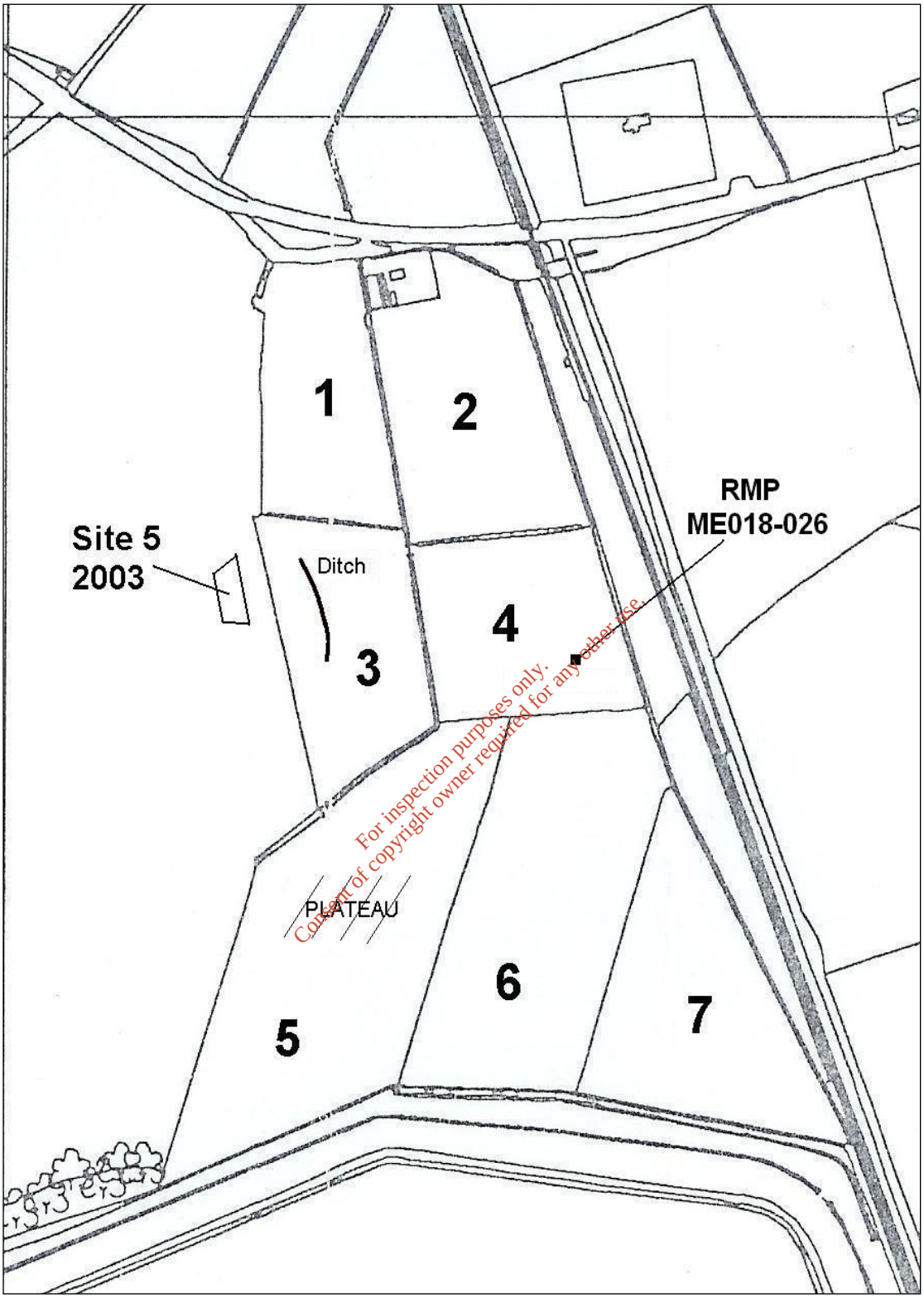
No previously-unrecorded upstanding archaeological features were noted during the field survey, but several areas of archaeological potential were identified;

There is slightly higher ground adjacent to the location of 'Site 5', an archaeological site of probable prehistoric date uncovered in 2003 during topsoil-stripping in the Northern Borrow Area for Stage 4B of the tailings facility extension. This site remains unexcavated at the eastern boundary of the borrow area. An aerial photograph in the archives of the National Monuments Section, DEHLG, which shows Recorded Monument ME018:026 in Field 4, also shows a curving ditch running north-south around the base of the higher ground in Field 3 (Fig. 12.1.5).

The ditch is situated an estimated 34-40m from the western boundary of the field. This is possibly the ditch of an enclosure associated with the archaeological features found at Site 5 and therefore the north-west part of Field 3 should be considered an area of high archaeological potential

For inspection purposes only.
Consent of copyright owner required for any other use.

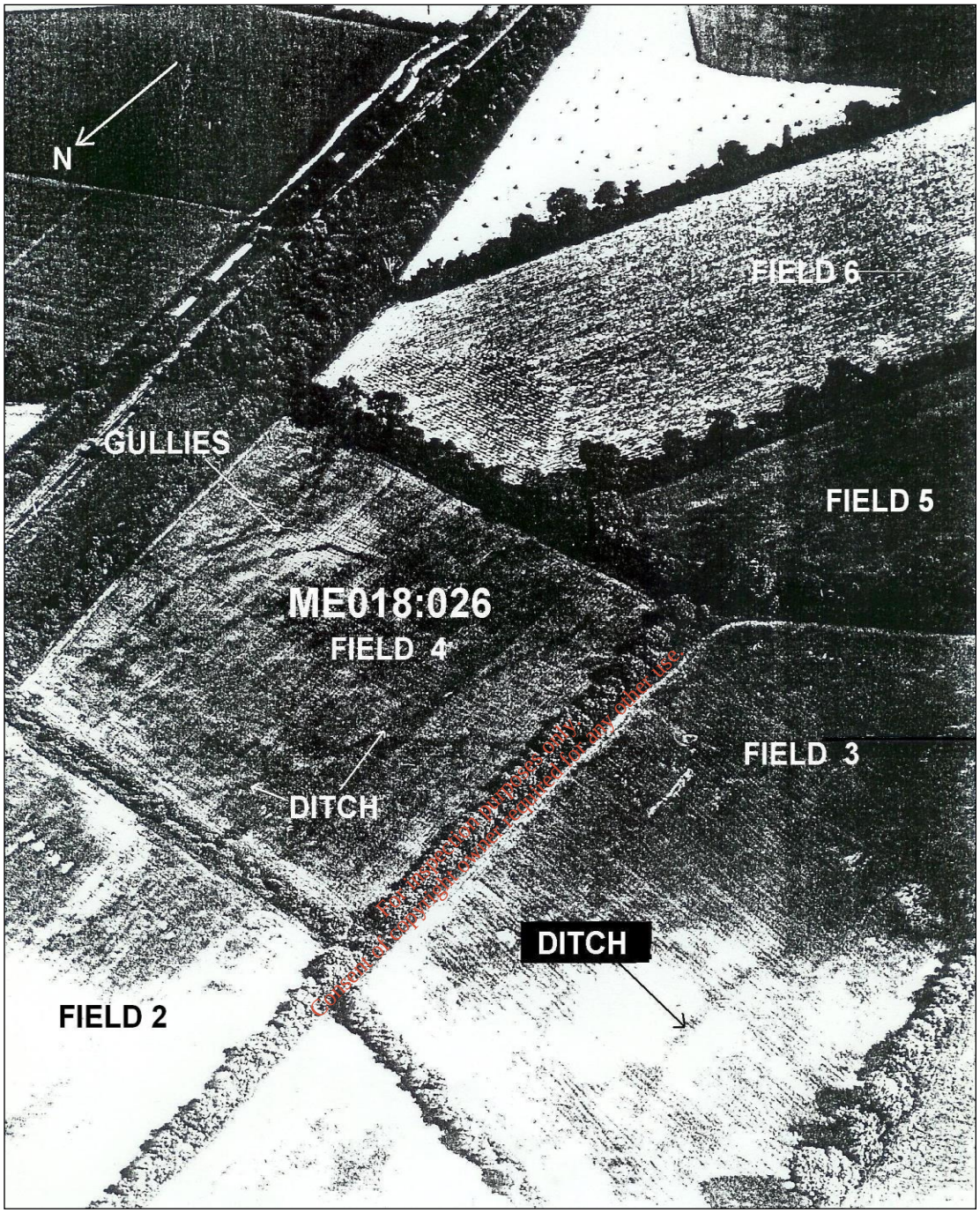
EPA Export 06-01-2017:02:02:16



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 12.1.4 Proposed Seven Fields Borrow Area with fields numbered 1-7, location of Recorded Monument ME018:026 and ditch revealed on aerial photograph.

EPA Export 06-01-2017:02:02:16



For personal use only
Copyright and other rights content may be retained for any other use.

Figure 12.1.5 Aerial photograph showing Recorded Monument ME018:026 in Field 4 and curving line of ditch in Field 3 (Cambridge University photograph in DEHLG archives).

EPA Export 06-01-2017:02:02:16

Figure 12.1.6 Field bank forming townland, parish and barony boundary as seen at eastern boundary.

For inspection purposes only.
Consent of copyright owner required for any other use.

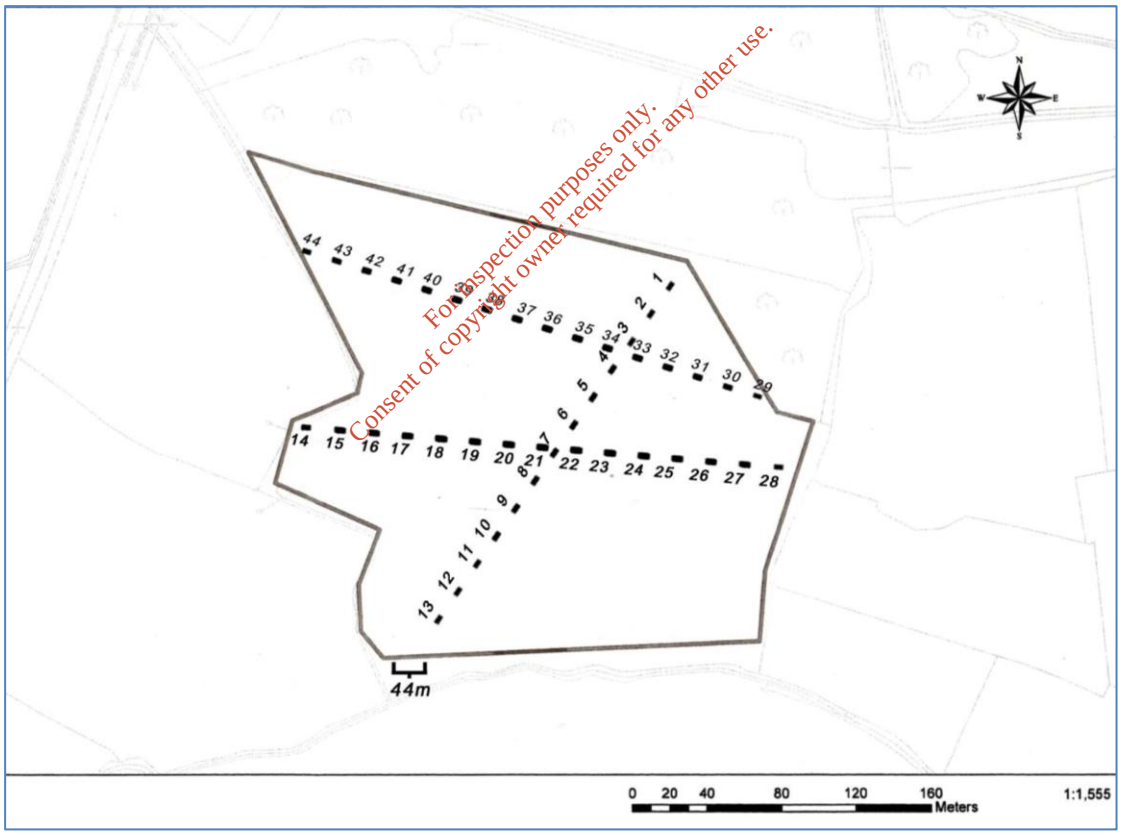
EPA Export 06-01-2017:02:02:16

12.2.5.3 Land South of TSF (proposed ICW site)

A Survey of a field south of the TSF (proposed ICW site) in the townland of Simonstown was carried out on 2nd February 2013. The field is N of local road, L.3409, that runs NW from Navan to Teltown and Oristown. The N portion of the field is planted with deciduous trees and the S part is wet low-lying ground close to a stream.

Three lines of test holes/trenches were cut in the field by machine with toothed bucket just less than a metre wide. All the trenches were taken down to at least 300mm below the surface of the boulder clay. Forty-Four trenches were excavated by machine with a toothed bucket just less than one metre wide and on average were taken down 700mm below the ground surface, that is c.400mm below the base of the overburden The trenches averaged 2.20m in length (refer to Figure 12.1.7 and Plates 12.1.1 – 12.1.4 below).

Nothing of archaeological interest was noted either small finds or features.



For inspection purposes only.
Consent of copyright owner required for any other use.

Figure 12.1.7 Aerial Outline of field (Top facing East, left facing north).

EPA Export 06-01-2017:02:02:16

Plate 12.1.1. General view of field looking E to S.

For inspection purposes only.
Consent of copyright owner required for any other use.

Plate 12.1.2. Row No.1 looking SW

EPA Export 06-01-2017:02:02:16

Plate 12.1.3.
Row No.2 looking W

Plate 12.1.4

Row No.3 looking W

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

12.2.6 Potential Impact of the Proposed Development

Both the Northern Borrow Pit area and the Seven Fields Borrow area have been archaeologically resolved by monitoring, followed by excavation.

Archaeological work commenced in the Northern Borrow Pit area in 1995 when K. Campbell identified a number of possible archaeological sites through survey. Sites in Randalstown were then test excavated (Excavations 1995 No.234, p.73). In 1999 D. Murphy excavated four areas which he claimed were Fulachta Fiadh (Bronze Age Cooking places). The evidence for these features which he claimed had been levelled, were spreads of burnt stone and dark soil (Excavations 1999 No.708, p.243-4). However later analysis of this material (Southern Scientific Services Ltd Report 4/10/2011) showed that it was not charcoal and the so-called burnt stone but naturally occurring red sandstone. The samples were taken from Sweetman's excavations in 2011 Randalstown (Report with BTML, and Archive in Dept of Arts Heritage and the Gaeltacht, licence No.10E75, "Report on Archaeological Assessment, Test Trenching at Randalstown" 1/3/2010). Test trenching also took place in the Seven Fields Borrow area in June 2010 under the same licence. Similar natural features were also found here.

In 1996 K. Campbell tested a crop-mark in the Seven Fields (field No.4) where he found drains and ditches (Excavations 1996 No. 313, p.88). These were later confirmed to be modern drainage systems (See Sweetman's report 28-29th June 2010 under licence No.10E75 entry No. 2010:534 www.excavations.ie). This report is in BTML archive.

For inspection purposes only.
Consent of copyright owner required for any other use.

In 2003 Kieran Campbell archaeologically monitored work in the c.100 acre Northern Borrow Pit area. The top soil stripping was in relation to stage 4B of the Tailings Pond extension. This archaeological work concerned the remaining portion of the Northern Borrow Pit. During the archaeological process seven sites were marked-off for archaeological resolution. Each of the seven sites contained so-called archaeological features. For instance in site No.1 there were 38 so-called archaeological features. A considerable quantity of these archaeological features had their material analysed later on and they turned out to be of natural origin (see report by Sweetman and Southern Scientific services 2011, mentioned above). The conclusion of Campbell was that the sites mirrored archaeological remains found by O'Drisceoil in 1998 in Simonstown. Much of the material found in 1998 in Simonstown also proved to be natural rather than so-called Fulachta Fiadh.

None of the seven sites were fully resolved until 2011 when Sweetman excavated sites 1 to 5 (See report dated July-August 2011 Licence No. 10E 75 in the Dept of Arts Heritage and the Gaeltacht and BTML archive) in the Northern Borrow Pit. Little of archaeological interest was found and the so-called *Fulachta Fiadh* sites were naturally occurring features as stated above. Any archaeology found was of a low grade nature and was removed under licence (10E75). However Site No.5

EPA Export 06-01-2017:02:02:16

did produce twelve features some of which had archaeological content. No Fulachta Fiadh were found on any of these sites.
Sites 6 and 7 had previously been archaeologically resolved in 1999 by D. Murphy (see P.6).

By 2011 all the archaeological remains and so-called Fulachta Fiadh sites had been excavated and removed from the Randalstown landscape, except for bank material which had been built up along the E border of the Northern Borrow area. The removal of this material was monitored in 2012 by Sweetman (Report August-September 2012 in Dept of Arts Heritage and the Gaeltacht and BTML archive). The area beside the site No.5 produced some low grade archaeology. The clay storage banks were totally removed.

It can be safely stated that all archaeological remains from the Northern Borrow Pit has been resolved and completely removed. However there remains a few small mounds on which there are electricity poles. It is unlikely that these small areas contain anything of archaeological interest.

In March 2010 following a geophysical Survey of the Seven Fields, Randalstown, test-trenching took place on anomalies indicated. Forty-two trenches were excavated in the areas of the anomalies and were heavily concentrated in fields 3, 4 and 5. The anomalies features for the most part turned out to be naturally occurring and included an old stream bed. Other features were frequently occurring field drains. Nothing of archaeological interest was noted. At the insistence of the Dept of Arts, Heritage and the Gaeltacht further testing of some of these anomalies took place (Report June 28-29th, 2010) but nothing of archaeological interest was found and the anomalies proved to be natural features.

Consent of copyright owner required for any other use.
For inspection purposes only.

In June/July 2011 the Seven Field Borrow area was completely stripped of its overburden. This was archaeologically monitored. Nothing of archaeological interest was noted. Numerous field drains and natural spreads of sandstone and dark grey soil were noted. When the above mentioned monitoring of the Seven Fields concluded, the entire Borrow Pit area had been archaeologically resolved.
However between the tailings pond and the Borrow areas there are trees and a ditch running E-W which has not been archaeologically tested.

At the N end of the site of the Northern Borrow Pit area, almost central, is the remains of Blake's House to the W of the Randalstown House site. This area is excluded from the proposed Stage 6 extension. Blake's House is not a listed building and when recently inspected was ruinous and badly overgrown with trees scrub etc. The front portion had steps leading up over a half basement to a hall of a two storey building over a basement. It is an early 19th century building with a later extension to the rear giving it a T-shape. It is of no particular interest. There will be no impact from the proposed development to Blake's House or the site of Randalstown house which now contains site offices etc.

EPA Export 06-01-2017:02:02:16

12.2.7 Remedial and Mitigation Measures

The entire Northern Borrow Pit area intended for the expansion of the Tailings Pond has been archaeologically resolved except for a few mounds which have electricity poles on them.

Immediately S of the Northern and Seven Fields Borrow Areas there is a line of trees running E-W close to the N dam wall of the Tailings Pond. There are also access roads here. These areas will be levelled during the construction of the Stage 6 extension and should be archaeologically monitored albeit that is not likely that there are archaeological remains there. Following the removal of the electricity poles on the small mounds in the Northern Borrow Pit area, there should be archaeological monitoring of the mounds. This would involve stripping of the overburden under archaeological supervision.

In order to mitigate the affect on the archaeological material, the following recommendations are made:

- A programme of pre-development archaeological test trenching, taking into account the results of the geophysical survey, should be carried out to assess the nature and extent of the material found. This would enable any archaeological sites uncovered to be avoided or to be archaeologically resolved in advance of the development.
- Archaeological monitoring of groundworks, in particular of topsoil-stripping, should take place during the course of the development.
- No further work should take place which would affect the existing archaeological sites in the Northern Borrow Area or their buffer zones.

Consent of copyright owner required for any other use. For inspection purposes only.

In all phases of the development, should any archaeological material be uncovered, works should cease in that area and the National Monuments Section, DEHLG, should be informed. Time should be allowed for a suitably qualified archaeologist to inspect the material and assess its significance. Adequate provision should be made for any resulting archaeological excavation or recording required and for related post-excavation work.

BTML should be prepared to be advised by the Heritage and Planning Division of the Department of the Environment, Heritage and Local Government with regard to any necessary mitigating action.

Under the National Monuments (Amendment) Act 1994 the owner of a monument or place which is listed in the *Record of Monuments and Places* is required to give two months notice to the National Monuments and Historic Properties Section, DEHLG, of any work proposed at such monuments or places.

EPA Export 06-01-2017:02:02:16

12.2.8 Conclusions

Between 1995 and 2011 archaeological monitoring and test excavations have taken place at Randalstown in the Northern Borrow Pit area and The Seven Fields Borrow area. Fairly low grade archaeological remains were found in the Northern Borrow Pit area, but nothing in the Seven Fields. Much of the so-called archaeological remains of *Fulachta Fiadh* turned out to be natural occurring features in the undisturbed clay.

The proposed Stage 6 development site has been totally archaeologically resolved except for a line of trees and access ways between the north end of the Tailings Pond and the Borrow areas and small mounds of clay supporting the electricity poles in the Northern Borrow Pit area. These limited areas should be archaeologically monitored albeit that the chance of finding archaeological remains is small. There is therefore no reason why on archaeological grounds this proposed development should not take place.

Bibliography

For inspection purposes only.
Consent of copyright owner required for any other use.

Bence-Jones, M. 1978 *Burke's Guide to Country Houses: Volume 1 Ireland*. London.
Bradley, J. 1988-9 'The Medieval Towns of County Meath'. *Ríocht na Midhe*, **8**, 2, 30-49.
Bradley, J. and King, H. 1987 *Urban Archaeology Survey: County Meath*. Office of Public Works, Dublin.
Cahill, M. 1987-8 'Nevinstown' in C. Manning and D. Hurl (eds) 'Excavations Bulletin 1980-84', 76. *Journal of Irish Archaeology* **IV**, 65-79.
Campbell, K. 1986 'Randalstown' in C. Cotter (ed) *Excavations* 1985, 32. Dublin.
Campbell, K. 1987 'Randalstown' in C. Cotter (ed) *Excavations 1986,* 31-2. Dublin.
Campbell, K. 1996 *Archaeological Assessment of cropmark Site at Randalstown, Co. Meath.* Unpublished report submitted to DEHLG and NMI.
Campbell, K. 1997 'Randalstown' in I. Bennett (ed) *Excavations 1996.* Dublin.
Campbell, K. 2006 'Randalstown' in I. Bennett (ed) *Excavations 2003*, 384-5. Bray.
Casey, C. and Rowan, A. 1993 *The Buildings of Ireland: North Leinster*. London.
Cogan, A. 1862 The Diocese of Meath Ancient and Modern. Dublin.
Ellison, C. 1983 *The Waters of the Boyne and Blackwater*. Dublin.
Everard, R. 1993 The Family of Everard, Part V: Everard of Randalstown, Co. Meath. *The Irish Genealogist*, XIII, no. 4, 575-601.
Kelly, E.P. 1976 'Randalstown' and 'Simonstown' in T.G. Delaney (ed) *Excavations 1975-76*, 17-8, 36. Belfast.
Kelly, E.P. 2002 'Antiquities from Irish Holy Wells and their wider context'. *Archaeology Ireland* **16**, 2, 24-8.
King, H. 1984 'Late Medieval Crosses in County Meath *c.* 1470-1635'. *Proceedings of the Royal Irish Academy*, **84C**, 2, 79-115.
Moore, M.J. 1987 *Archaeological Inventory of County Meath*. Stationery Office, Dublin.

EPA Export 06-01-2017:02:02:16

Murphy, D. 2000 'Randalstown' in I. Bennett (ed) *Excavations* 1999, 243-4. Bray.
Murray, C. 2008 *Excavations at Tara Mines, Randalstown, Co. Meath*. Unpublished report submitted to DEHLG and NMI.
Ó Drisceoil,C. 2000 'Simonstown' in I. Bennett (ed) *Excavations 1998*,166-7. Bray
Simmington, R.C. 1940 *The Civil Survey AD 1654-1656 County of Meath*. Dublin.

References

Campbell, K. 1996, Randalstown. In I. Bennett (ed), *Excavations 1996: Summary Accounts of Archaeological*
Excavations in Ireland, 88, Bray, Wordwell.
Campbell, K. 2003, Randalstown. In I. Bennett (ed), *Excavations 2003: Summary Accounts of Archaeological*
Excavations in Ireland, 384-5, Bray, Wordwell.
Murphy, D. 1999, Randalstown. In I. Bennett (ed), *Excavations 1999: Summary Accounts of Archaeological*
Excavations in Ireland, 243-4, Bray, Wordwell.
Murray, C. 2004, Randalstown. In I. Bennett (ed), *Excavations 2004: Summary Accounts of Archaeological*
Excavations in Ireland, 334-6, Bray, Wordwell.
O'Driscoil, D. 1998, Simonstown. In I. Bennett (ed), *Excavations 1998: Summary Accounts of ArchaeologicalExcavations in Ireland,* 166-7, Bray, Wordwell.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

Part B Soil, Vegetation and Land Use

12.3.1 Introduction

This section of the EIS assesses the potential impacts on soil, vegetation and land use of the proposed Stage 6 lateral extension to the existing tailings storage facility (TSF) and the construction of an Integrated Constructed Wetlands (ICW) system.

The land use implications of the proposed Stage 6 extension differ materially from the previous Stage 5 extension in that there will be no new soil or land-take from the agricultural landscape. This is because the footprint will occupy the disturbed areas known previously as the *Northern Borrow Area* and the *Seven Field Borrow Area*. The TSF extension will be constructed using fill materials sourced in-situ from development of the basin area of the facility and the remainder imported from third party, licenced suppliers.

The ICW will be constructed over an area of c. 12 ha and will be located on the applicant's property south of the existing TSF. This area is currently in agricultural use (pasture) and will be taken out of production. The function of the wetland is to provide a passive treatment system to treat water runoff in the post closure phase of the TSF lifecycle. The main earthworks involved in the development of the ICW is leveling, excavation and placement of soils for the enclosing embankments around each of the 5 ponds within the wetland.

For inspection purposes only.
Consent of copyright owner required for any other use.

Scoping undertaken, and comments made, during consultation meetings identified the following potential impacts:

During construction:

- Potential impacts on adjacent (agricultural) land during placement of the imported construction materials.
- Potential impacts on adjacent (agricultural) land during construction of the ICW.

During operation:

- Potential impacts arising from dust emissions from deposited tailings.

Post closure:

- Potential impacts on adjacent (agricultural) land arising from the long-term environmental management of the TSF.
- Potential long-term suitability of the restored TSF for an agricultural end-use.

EPA Export 06-01-2017:02:02:16

12.3.2 The Existing Environment

12.3.2.1 Sources of Information

Existing soil and vegetation conditions and land-use have been described using information gained from a programme of fieldwork supported by desk study research and aerial photography:

- Desk study review of publicly available information (including 1:126,760 map of County Meath & aerial photographs).
- Site reconnaissance and soil quality survey undertaken by Dr James Collins, UCD, in 2008 and by Professor Michael Johnson in 2015.
- Environmental monitoring data (soil and vegetation) collected by Boliden Tara Mines Limited in 1987, 1992, 1997, 2004 and 2009.
- Survey of trace metal concentrations in surface and sub-surface soils and herbage undertaken by Knight Piésold in 1995.

12.3.2.2 Land Use

The predominant land-use in and around the existing TSF is agricultural pasture and arable, and is of an intensive nature. The topography is flat to slightly undulating. Small patches of woodland and scrub exist immediately to the north and south of the tailings facility.

Consent of copyright owner required for any other use. For inspection purposes only.

The land included within the footprint of the proposed Stage 6 extension to the TSF is located in the catchment of the *Yellow River* and its left-hand tributary, *Blakes Stream*. Its altitude is at approximately 51 to 53.5m AOD; but the area has been extensively altered in recent years having served as the Borrow areas for the construction of Stage 5. Some original hedgerows remain as does watercourse habitat but the considerable disturbance in the recent past has yielded a predominant 'mound and hollow' topography interspersed with pockets of land where re-grading and restoration to agriculture has taken place. *Blakes Stream* forms the southern boundary of the area and joins the Yellow River at the South West corner.

The land included within the footprint of the proposed ICW is located south of the TSF with the *Doug Stream* to its Southern Boundary and Simonstown Stream to the west. The River Blackwater located 1.5km from proposed site.

The North section of the site comprises an area of c. 2 ha of modified woodland (WD2 consisting of mixed broadleaved / conifer woodland) while the Southern section comprises a single field, c 10 ha of grassland habitat (GA1 – Improved agricultural grassland) with hedgerow to the north, west and east boundaries of the field. Hedgerow comprised primarily hawthorn, Ash & Beech.

EPA Export 06-01-2017:02:02:16

12.3.2.3 Trace Metal Concentrations in Soils

Every five to seven years a soil and herbage survey is carried out in the vicinity of the TSF. Surveys of lead, zinc and cadmium concentrations in soil samples recovered from the top 10 cm of the soil profile were undertaken by Boliden Tara Mines Limited in 1987, 1992, 1997, 2004 and 2009. The results are presented in Table 12.3.1.

Table 12.3.1 Summary of Trace Metal Concentrations in Soils

Survey Results*					
Parameter	**1987 (n=152)**	**1992 (n=297)**	**1997 (n=315)**	**2004 (n=134)**	**2009 (n=163)**
Zinc	86 (7-191)	85 (29-541)	90 (44-260)	104 (68-333)	80 (40-156)
Lead	33 (24-92)	32 (17-138)	33 (12-416)	36 (21-60)	52 (38-92)
Cadmium	0.6 (0.3-1.9)	0.8 (0.3-2.7)	0.6 (0.4-2.0)	0.8 (0.4-1.6)	0.9 (0.4-1.9)

*All data expressed as median (range) in mg/kg dry weight.
Survey results obtained from Boliden Tara Mines Limited database

For inspection purposes only.
Consent of copyright owner required for any other use.

Knight Piesold undertook an additional survey in 1995 (in connection with the EIA for the Stage 4 raise). The survey was based on 50 sampling points located within 500m of the TSF. The results are presented in Table 12.3.2.

The recorded trace metal concentrations of soils around the TSF are generally in accordance with typical soil values (refer to Figure 12.3.1 for sampling locations). The concentrations of cadmium, zinc, and lead, recorded at a few locations marginally exceed the maximum concentrations quoted for typical Irish soils (*Parle & Fleming, Trace Elements - Co. Meath, 1983*), but are within a normal range quoted for a wider spectrum of soils (*Bowen, H.J.M., Environ. Chemistry of the Elements*, 1979). The spatial distributions of the samples with elevated lead, zinc and/or cadmium concentrations (Figure 12.3.2) do not show any systematic pattern.

In addition to the soil recovered from a depth of 0-10 cm, samples were also taken during the 1995 survey at depths of 10-20 cm and 20-30 cm, at 10 points located in areas of pasture (i.e. where the profile is not disturbed by periodic ploughing). The analysis of samples at various depths within a soil profile gives an indication of whether the burden of trace metals derives from airborne deposition (in which case recorded concentrations would tend to be greatest near to the soil surface), or are derived from natural geochemical influences. In the latter case the tendency would be for there to be no correlation between metal concentration and depth or, in some cases, an increasing metal concentration deeper down the profile.

EPA Export 06-01-2017:02:02:16

Table 12.3.2 Trace Metal Concentrations in Soils

Parameter	KP Survey Results*	Typical levels found in Irish Soils [1&2]	Typical range of Soil Concentrations[3]
Zinc	84 (58-169)	10 - 200	1 - 900
Lead	31 (25-56)	2 - 200	2 - 300
Cadmium	0.7 (0.3-1.6)	0.1 - 1.0	0.01 - 2.0
pH	5.3 (4.4-7.4)		
Antimony	3 (<1-6)	-	0.2 - 10
Arsenic	7 (3-13)	1 - 50	0.1 - 40
Boron	37 (21-51)	2 - 100	-
Cobalt	8 (4-11)	1 - 25	0.5 - 65
Copper	13 (8-30)	2 - 100	2 - 250
Chromium	24 (19-31)	5 - 250	5 - 1500
Manganese	694 (221-1757)	20 - 3000	20 - 10000
Mercury	0.5 (<0.1-1.8)	0.03 - 0.8	0.01 - 0.5
Molybdenum	1 (<1-3)	0.2 - 5	0.1 - 40
Nickel	26 (18-44)	0.5 - 100	2 - 750
Selenium	0.3 (0.1-1.3)	0.2 - 1.0	0.1 - 5
Thallium	<0.5	-	0.1 - 0.8
Vanadium	28 (4-50)	20 - 200	3 - 500

Consent of copyright owner required for any other use. For inspection purposes only.

*All data expressed as median (range) in mg/kg dry weight.
Survey results obtained from samples collected from 0-10 cm depth
Source : Parle P.J. & Fleming G.A., Trace Elements Co. Meath (1983) in Finch et. al., (1983) Soils of Co. Meath
Source : Conroy M (undated), Soils of Co. Laois
Source : Bowen H.J.M., Environmental Chemistry of the Elements (1979) in Alloway B. J. (Ed). Heavy Metals in Soils. (1990)

EPA Export 06-01-2017:02:02:16

The results of the depth profile survey (Table 12.3.3) suggest that the elevated metal concentrations around the TSF are not due to airborne deposition. There are no specified standards defining "acceptable" levels for soil metal concentrations in Ireland. However, of the elevated metal concentrations detected, none exceed the strictest of the threshold values originally adopted by the U.K Department of the Environment for domestic gardens (ICRCL, Guidance Note 59/83 on the Assessment and Redevelopment of Contaminated Land, 1987), and, therefore, are not considered to present a hazard.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

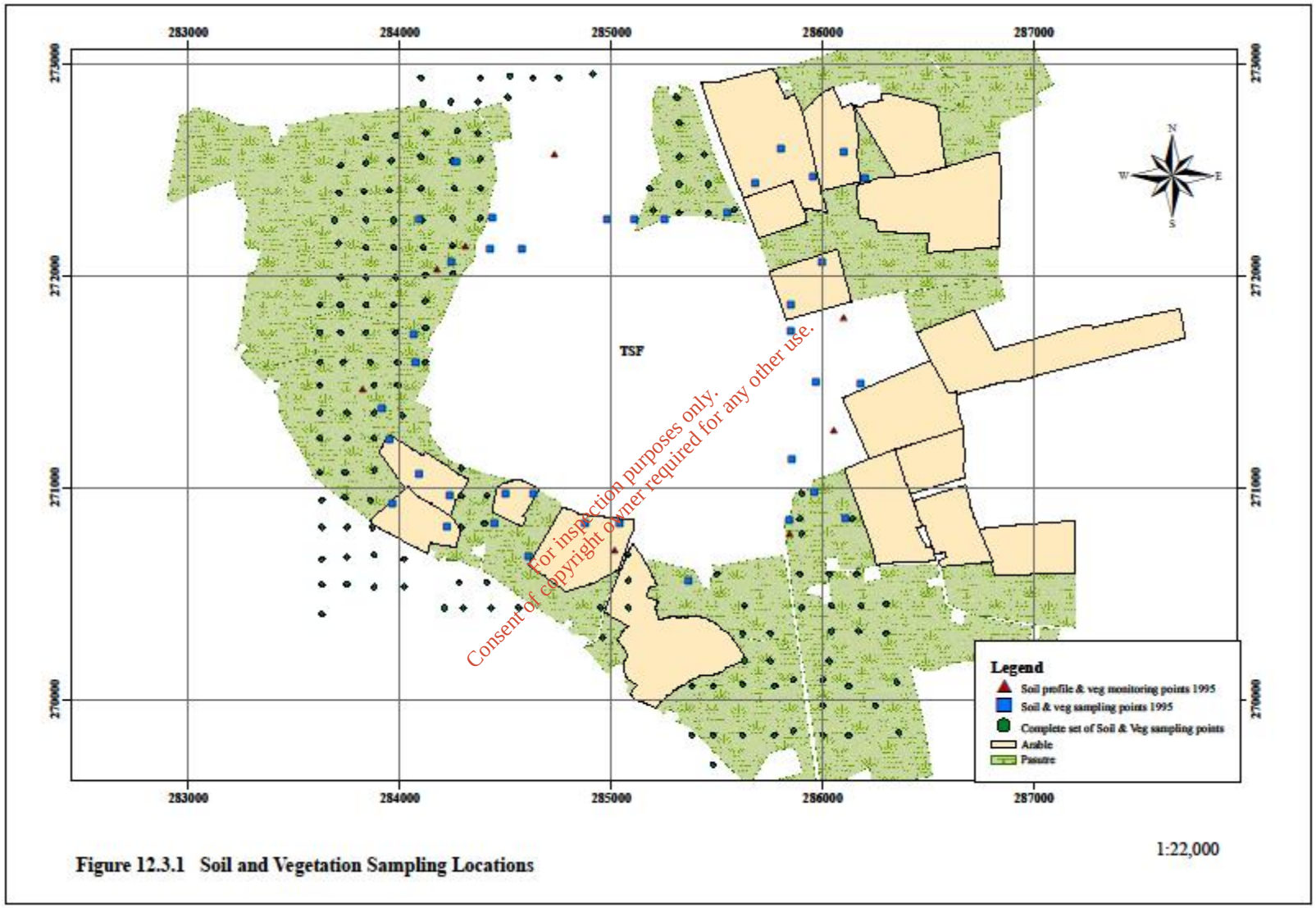


Figure 12.3.1 Soil and Vegetation Sampling Locations

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

Table 12.3.3 Soil Metal Concentrations Recorded at Depth

Survey Results at recorded depths *			
Parameter	**0-10cm**	**10-20cm**	**20-30cm**
Zinc	80 (72-97)	80 (62-101)	80 (54-86)
Lead	30 (25-37)	30 (23-37)	30 (24-32)
Cadmium	0.7 (0.3-1.2)	0.6 (0.5-1.0)	0.6 (0.4-1.0)
Arsenic	8 (3 – 10)	6 (3-10)	7 (2 – 11)
Copper	12 (11-15)	13 (9-16)	14 (7-18)
Manganese	558 (301-941)	660 (366-979)	676 (388-1009)
Mercury	0.5 (0.1-0.9)	0.4 (0.1-1.3)	1.0 (0.1-1.6)

*All data expressed as median (range) in mg/kg dry weight.
Survey results obtained from soil samples collected at various profile depths (Knight Piesold 1995).

12.3.2.4 Trace Metal Concentrations in Vegetation

A vegetation survey has been carried out in the vicinity of the TSF every five to seven years utilising the same sampling points as for the periodic soil surveys. Trace metal data for composite samples of vegetation cover are summarised in Table 12.3.4. These shows a remarkable consistency in levels of cadmium, zinc and lead over a period of nearly 25 years, with neither the mean values nor the occasional outlier datapoints approaching those that are considered to be anomalous for Irish conditions or hazardous to grazing animals (ICRCL, Guidance Note 70/90 on the *Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing*, 1990).

For inspection purposes only.
Consent of copyright owner required for any other use.

Table 12.3.4 Summary of Foliar Trace Metal Concentrations

Survey Results*					
Parameter	**1987 (n=152)**	**1992 (n=297)**	**1997 (n=315)**	**2004 (n=134)**	**2009 (n=153)**
Zinc	34.2 (19.9-57.7)	27.5 (12-57)	31.1 (9-109)	25.1 (15-52)	26.7 (13-99)
Lead	2.1 (0.3-5.5)	1.4 (1.0-6.5)	2.3 (0.1-17)	0.88 (0.16-3)	2.1(0.1-15.7)
Cadmium	0.2 (0.1-0.7)	0.2 (0.06 - 0.5)	0.2 (0.1 – 0.65)	0.07 (0.01-0.6)	0.14 (0.05-1.3)

*All data expressed as median (range) in mg/kg dry weight of unwashed samples.
Survey results obtained from Boliden Tara Mines Limited database.

In October 1995 samples of foliar herbage were collected from 45 sites located within areas of pasture (see Figure 12.3.1 and Table 12.3.5). This was in order to

EPA Export 06-01-2017:02:02:16

conduct a trace metals survey with a broader range of analyses than is sampled routinely by BTML on pasture vegetation. The concentrations of trace metals in herbage are known to vary seasonally (Mitchell & Reith, *The Lead Content of Pasture and Herbage*, J. Sci. Food. Agric., Vol. 17, 1966) with the highest values appearing in autumn and winter. In addition, the degree of contamination of samples with soil particles will have a profound influence on the apparent metal content. Comparison with data recorded from other sites must therefore be undertaken with care. However, the recorded concentrations from the samples collected are broadly consistent with data obtained from other locations. As with all previous surveys, metal levels were below those considered likely to give rise to adverse effects in grazing animals. (ICRCL, Guidance Note 70/90).

Table 12.3.5 Foliar Metal Concentrations

Parameter	Survey Results *	Concentrations recorded in Irish herbage [1]	Typical range of Concentrations [2]	Max conc. acceptable in herbage for stock grazing [3]
Zinc	71 (44-120)	20 - 60	1 – 400	220
Lead	11 (4-45)	1 - 10	0.2 - 20	50
Cadmium	0.5 (0.2-2.2)	0.1 – 0.3	0.1 – 2.4	2
Arsenic	<0.1 (<0.1–1.0)	0.05 – 0.3	0.02 - 7	25
Copper	14 (7-20)	4-15	5-20	-
Mercury	0.03 (<0.02-0.05)	0.01 – 0.05	0.005 – 0.17	-
Nickel	3 (1-10)	0.5 – 2.0	0.02 - 5	-

*All data expressed as median (range) in mg/kg dry weight of unwashed samples.
Survey results obtained from herbage samples collected by Knight Piesold, 1995

For inspection purposes only.
Consent of copyright owner required for any other use.

[1] An Foras Taluntais (1988)
[2] Bowen, H.J.M (1979). Environmental Chemistry of the Elements. In Alloway (B.J.) (Ed.) (1990). Heavy Metals in Soils
[3] ICRCL. Guidance Note 70/90 on the *Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing* (1990).

EPA Export 06-01-2017:02:02:16

12.3.3 Impacts During Construction

During the construction phase, the potential impacts include:

- Impacts associated with the importation of construction material from external sources.
- Impacts associated with the generation of dust during construction activity.
- Impacts associated with the construction of the wetlands.

12.3.3.1 Impacts arising from Material Importation

Impact Prediction

During the construction phase aggregates and topsoil will be imported and stockpiled around the perimeter of the proposed Stage 6 extension to the TSF. There will be no impacts on adjacent lands.

Significance of Predicted Impacts

The land quality of the footprint of the Stage 6 location is of no consequence as it comprises a much disturbed former 'borrow-pit' (for Stage 5) of markedly lower quality land than most of the surrounding area. During construction, some minor modifications of the local drainage network may be necessary in order to facilitate the workings of the area but these will have no impact on the drainage network of adjacent lands.

For inspection purposes only.
Consent of copyright owner required for any other use.

Mitigation Measures

Since there is no requirement for a new 'borrow area', there will be no further disturbance to nearby agricultural land and thus no requirement for mitigation measures. When placement of the construction fill material is complete, appropriate drainage will be installed and the margins restored to a diverse, vegetated landscape.

12.3.3.2 Impacts Arising from Construction Activity

Impact Prediction

All construction activity involving the placement of fill materials has the potential to generate dust. The quantities of dust generated are dependent upon the nature of the fill materials used, the precise nature of the operations involved and the prevailing weather conditions.

The principal construction fill materials (A1 Structural Fill, A2 Structural Fill and A1 Blanket Fill) are, by virtue of their moisture content and particle size, not prone to

EPA Export 06-01-2017:02:02:16

dusting. Filter sand will be transported to the site, as and when required, thus minimising the need for stockpiling and double handling.
During the construction phase vegetation and topsoil will be stripped from the Stage 6 and ICW footprint areas and used to construct temporary screening berms around the perimeter. While working these areas the drainage systems will need to be deepened (c. 10 h within the ICW footprint will be lost for grazing). There will be no impacts on adjacent lands.

Significance of Predicted Impacts

The general construction work is not considered to have the potential to generate significant quantities of dust and any resultant impact will be temporary and insignificant (refer to *Air* Section of EIS).

Mitigation Measures

Although the prediction is for there to be no significant source of dust during construction, temporary mitigation measures will be available in the form of a mobile bowser supported by a fixed, but flexible, sprinkler system that can be deployed and moved at short notice.

Residual impacts

The combined proposed mitigation measures will eliminate dusting from the tailings surface prior to and during construction. The residual impact arising from the dust generated during construction activity, therefore, will be insignificant.

For inspection purposes only.
Consent of copyright owner required for any other use.

12.3.4 Impacts During Operation

During the operation of the tailings facility, there will be no direct disturbance of land outside the existing tailings facility boundary.

Impact Prediction

Potential impacts will be confined to those associated with the emission of airborne particulates (dust) from the limited exposed surface areas of tailings, as was experienced in May 2008. The impact of these emissions on surrounding soils, vegetation and land-use will be insignificant.

Mitigation Measures

The following mitigation measures will be in place:

- The use of extensive and flexible sprinkler system on exposed areas of tailings as required within the operational part of the Tailings Facility

EPA Export 06-01-2017:02:02:16

- The rapid establishment of a temporary vegetation cover on the surface of non-operational parts of the Tailings Facility.
- The conrolled dewatering of the tailings to ensure that a minimum area of tailings beaches is exposed
- A CCTV system that allows continuous 24-hour manned surveillance from the Mill Central Control Room.
- Availability of a trained mine rescue team on a 24-hour call-out basis.

12.3.4 Decommissioning and Post Closure

Potential impacts will again be confined to those associated with the emission of airborne particulates (dust) from the exposed areas of tailings prior to capping. These emissions will be insignificant.

The potential long-term suitability of the restored Tailings Facility for agriculture has been evaluated. It is intended that the post-closure land-use for the tailings facility will not include "commercial" agriculture, although the use of limited grazing as a grassland management technique is feasible and has a proven value (CRAMP, 2014).

For inspection purposes only.
Consent of copyright owner required for any other use.

12.3.6 Environmental Monitoring

Environmental monitoring of soils, vegetation and land-use in the vicinity of the TSF will focus on three aspects:

- Periodic monitoring of the concentration of zinc, lead and cadmium concentrations in soils and vegetation around the TSF (continuation of the existing monitoring programme).
- Monitoring of the final restoration of the tailings surface (CRAMP, 2014).

12.3.7 Unexpected Circumstances

Various factors may change the precise extent and location of temporary workings. For instance, extreme weather conditions may introduce alterations to the proposed construction schedule. However, these circumstances will not change the significance of predicted impacts, the proposed mitigation measures or the restoration proposals.

EPA Export 06-01-2017:02:02:16

Part C Animal Health Study

12.4.1 Introduction

This section of the EIS involve an assessment of animal health and performance and levels of heavy metals in soil, herbage and animals on farms adjacent to the Randalstown Tailings Storage Facility (TSF).

The most recent study is the fourth to be commissioned by Boliden Tara Mines Limited (BTML), previous studies having been carried out in 1995, 2000 and 2007.

In each case, the purpose of the study was to monitor the environmental impact of the tailings ponds at Randalstown, specifically to confirm that the operation of the facility has:

i) had no demonstrable effect on the health or productivity of livestock on the adjacent farms

ii) not resulted in the accumulation of heavy metals in the soil, herbage or livestock of the farms, or that any such accumulation is insufficient to be of veterinary or public health significance.

For inspection purposes only.
Consent of copyright owner required for any other use.

In addition, the current study provided a basis to assess the potential impact from the proposed Stage 6 extension to the TSF on the adjoining farms.

As far as possible, the study followed the same design as previous investigations and consists of two parts. The first part comprises an assessment of the animal health and performance on adjacent farms while the second investigates whether there was any increase lead, zinc and cadmium levels in soil, herbage or animals which could be attributed to their proximity to the TSF.

An additional component of the current study was a comparison of the chemical composition of the upper and lower portions of the soil cores from the study farms for any indication of wind borne deposition of dust from the tailings pond.

The data collected were compared both to reference values reported in Irish and International literature and to the levels found in the previous studies for any evidence of accumulation of heavy metals in the soil, plants or animals on the study farms.

EPA Export 06-01-2017:02:02:16

12.4.2 Study Design

12.4.2.1 Study Farms

The earliest studies in 1995 and 2000 looked at livestock enterprises on six farms (Farms 1 to 6) directly contiguous to the tailing pond. By 2007, two of these farms (Farms 3 and 5) were not active and were replaced by two new farms in the vicinity of the pond (Farms 7 and 8). For the current study, five of the original farms were again included, Farms 1, 2, 4, 5 and 6 together with Farm 8. A summary of the study farms is given below together with details of the samples that were taken.

Animals were blood sampled in late July/early August 2015 while soil and herbage samples were collected between July and August 2015. Where possible, soil and herbage samples were taken from the same fields as had been used in the previous studies. While blood and herbage sampling in the previous studies took place somewhat earlier in the year, between May and July, such differences are unlikely to be of significance.
All sample locations are shown in Figure 12.4.1 below and sample type and numbers are listed in Table 12.4.1 below.

For inspection purposes only.
Consent of copyright owner required for any other use.

Farm 1 (PK)
Enterprise : Sheep and Cattle
Samples : Blood samples were taken from 5 cattle. Two sets of soil and herbage samples were taken from fields contiguous to the TSF. The same fields have been used in all studies to date.

Farm 2 (JK)
Enterprise : Dairying
Samples : Two sets of soil and herbage samples, blood samples from 5 milking cows. The fields on this farm which were included in the first two studies were purchased by BTML and used in the Stage 5 extension to the TSF. For the current study, two fields to the North and adjacent to the new boundary of the tailings pond site were used.

Farm 3 (GC/EB)
Enterprise :
Samples : Two sets of soil samples only. No herbage or livestock samples were available as the farm is not being actively worked. The original owner of this farm retired prior to 2007 and as a result it was not included in that year's study. The fields used in the earlier studies, which are directly contiguous to the TSF, have since been sold and were again included in the current study.

Farm 4 (BB)
Enterprise : Suckler cows and sheep

EPA Export 06-01-2017:02:02:16

Samples : Two sets of soil and herbage samples, blood samples from 5 suckler cows and 5 ewes. Soil and herbage samples were taken from the same fields close to the tailings pond as were used in the previous studies.

Farm 5 (JD)
Enterprise : none
Samples : One set of soil and herbage samples, no bloods. The owner of this small suckler enterprise had again retired from farming prior to the 2007 study. However one set of soil and herbage samples from a field contiguous to the tailings pond was included in the present study.

Farm 6 (DB)
Enterprise : Dairy cows and sheep
Samples : Three sets of soil and herbage samples, bloods from 5 milking cows and 5 ewes. Soil and herbage samples were taken from 3 fields contiguous to the TSF as in all previous studies.

Farm 7 (TH)
Enterprise :
Samples : This farm was included as a replacement for Farm 5 in 2007 but was not included in the present study. It is approximately 500 metres from the TSF.

Farm 8 (TF)
Enterprise : Suckler cows
Samples : Two sets of soil and herbage samples, bloods from 5 suckler cows. This farm is along the boundary of the tailings pond and was included as a replacement in 2007. Two sets of soil and herbage samples were taken from fields closest to the TSF in the current study.

Farm 9 (PG)
Enterprise : None
Samples : One set of soil and herbage samples, no bloods.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 06-01-2017:02:02:16

Table 12.4.1. Samples taken for 2015 study

Farm	Code	Soil	Herbage	Blood (Sheep)	Blood (Cattle)
1	PK1	1	1		5
	PK2	1	1		
2	JK1	1	1		5
	JK2	1	1		
3	GC / EB1	1	0		
	GC / EB2	1	0		
4	BB1	1	1	5	5
	BB2	1	1		
5	JD2	1	1		
6	DB1	1	1	5	5
	DB2	1	1		
	DB3	1	1		
8	TF1	1	1		5
	TF2	1	1		
9	PG1	1	1		

A flock of Soay sheep has been kept at the tailings facility for a few years as part of the pasture management programme. Unlike the studies carried out in the 1990s when sheep were grazing on the revegetated tailings, the current flock live on the perimeter bembankments. As a convenience sample, blood samples from 10 of this flock were included in the current study.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

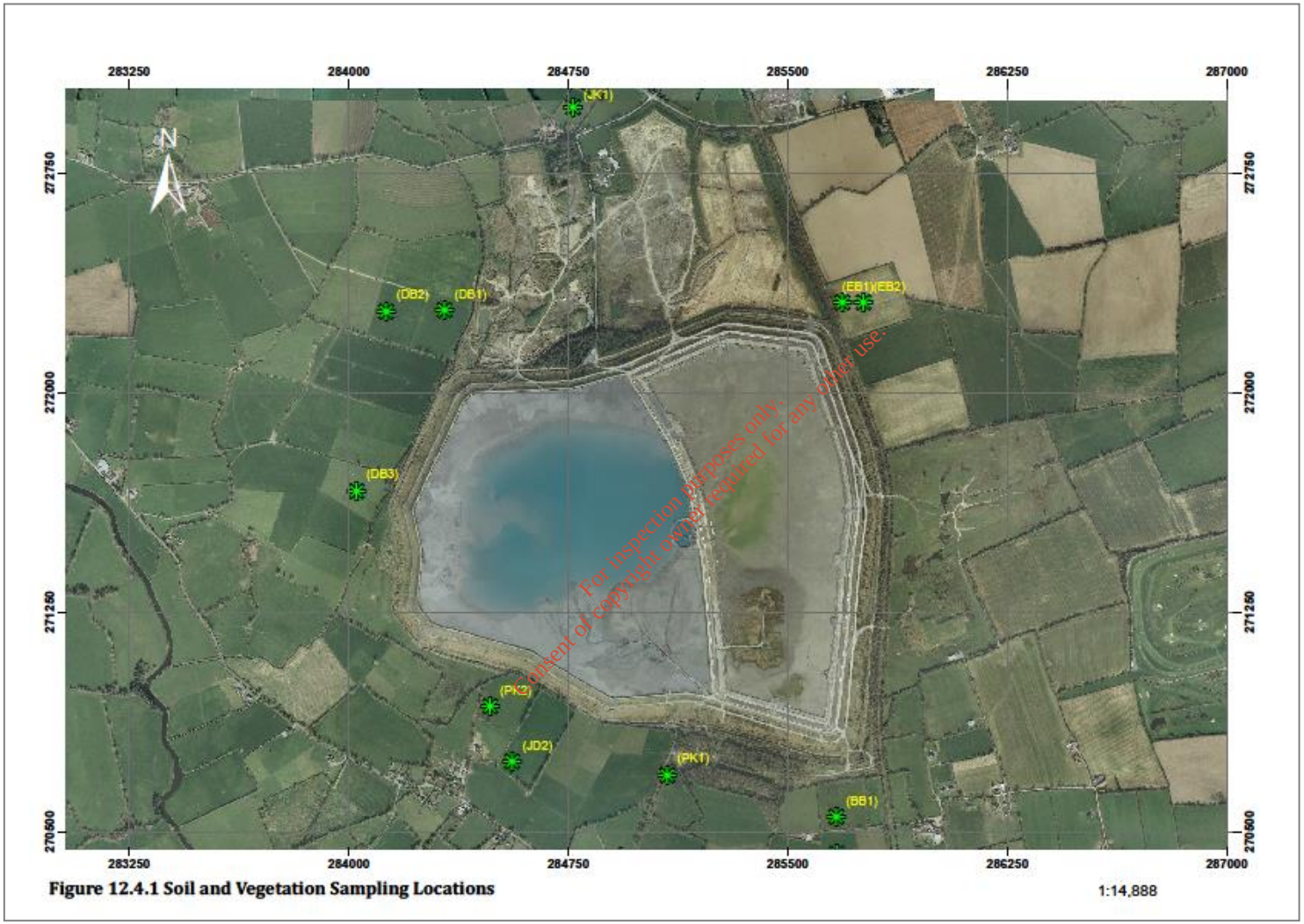


Figure 12.4.1 Soil and Vegetation Sampling Locations

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

12.4.2.2 Sample Analysis

In the earlier studies, analyses were carried out by Teagasc at their laboratories in Grange, Co. Meath and Johnstown Castle, Co. Wexford and by the Department of Agriculture Central Veterinary Laboratory at Backweston, Co Dublin. As these agencies no longer provide commercial analytical services, blood, soil and herbage samples in the current study were submitted to Oldcastle Laboratories, a private laboratory accredited for veterinary, agricultural and environmental analyses located in Oldcastle, Co. Meath. Oldcastle had also been used in 2007 to carry out some replicate analysis of herbage samples.

As far as possible, the same protocols were used as in the earlier studies.
A total of 15 soil samples taken from the study farms in 2015 were analyzed for soil fertility, major and trace elements and heavy metal concentrations. The following parameters were assessed:

Soil fertility – soil pH and lime requirement,
Major and trace elements – magnesium, copper, cobalt and manganese,
Heavy metals – lead, cadmium, and zinc.

In a refinement to the previous studies, the soil cores from each field were separated into upper and lower portions which were analyzed separately for a total of 47 chemical elements by mass spectroscopy.

A total of 13 herbage samples from 7 of the 8 study farms (no herbage was available from Farm 9 as the land was under tillage) were analyzed for the following constituents:
Major elements – calcium, phosphorus, magnesium, sodium, sulphur, potassium, iron and nitrogen,
Trace elements – copper, molybdenum, selenium and manganese,
Heavy metals – lead, cadmium and zinc.

Blood samples were taken from a total of 35 animals (10 sheep and 25 cattle) and analyzed for a range of major and trace elements, metabolites, enzymes and heavy metals. Three samples were taken from each animal, one clotted, and one each with lithium heparin and fluoride oxalate as anticoagulants. Blood samples were tested for the following parameters:

Major elements – calcium, phosphorus and magnesium,
Trace elements – copper, selenium,
Metabolites – Total protein, albumin, globulin and urea,
Enzymes - Glutamate dehydrogenase (GLDH), gamma glutamyl transferase (GGT) and aspartate aminotransferase (AST),
Heavy metals – lead and zinc (plasma).

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

12.4.2.3 Statistical Methodology

Each parameter in the present study was included in a database with the results from the previous studies in 1995, 2000 and 2007. Where an element was below the limit of detection an arbitrary value of half of that limit was assigned in order to perform statistical analyses. A linear regression model was used to test the hypothesis that there was no significant difference between the years for each parameter of interest. Where there was evidence of a difference, post-hoc pairwise comparisons were carried out to identify which year results differed and at what level of statistical significance.

Comparison of the chemical composition of the upper and lower profiles of the soil cores were carried out by pairwise statistical analysis for each of 47 elements. Observed anomalies consistent with the known composition of the mine tailings would be considered to be indicative of wind-borne deposition of tailings dust.

Results are reported by year, range and mean value, together with the relevant analysis of variance (ANOVA) statistics. For soil samples, the average value of the upper and lower profiles is reported.

For inspection purposes only.
Consent of copyright owner required for any other use.

12.4.3 Soil and Herbage Results

12.4.3.1 Soil and Herbage Heavy Metals

Lead

Soil lead levels on 15 samples from the study farms were in the range 18.4-36.7 mg/kg with a mean of 27.2 mg/kg. Soil lead levels in the present study were somewhat higher than those recorded in 1995 (range: 16.3-28.9 mg/kg, mean: 22.8 mg/kg), 2001 (range: 15.0 to 31.9 mg/kg, mean: 21.6 mg/kg) and 2007 (range: 20.2-27.0 mg/kg with a mean of 23.7 mg/kg. An analysis of variance model with soil lead as the dependent variable and year-laboratory as a categorical variable showed statistically differences in pairwise comparisons between the 2015 values and those recorded in each of the previous studies.. The field with the highest recorded value, TF2 on Farm 8, had soil lead values of 36.9 and 36.4 mg/kg in the upper and lower profiles respectively consistent with high natural geochemical levels rather than pollution from the tailings ponds.

EPA Export 06-01-2017:02:02:16

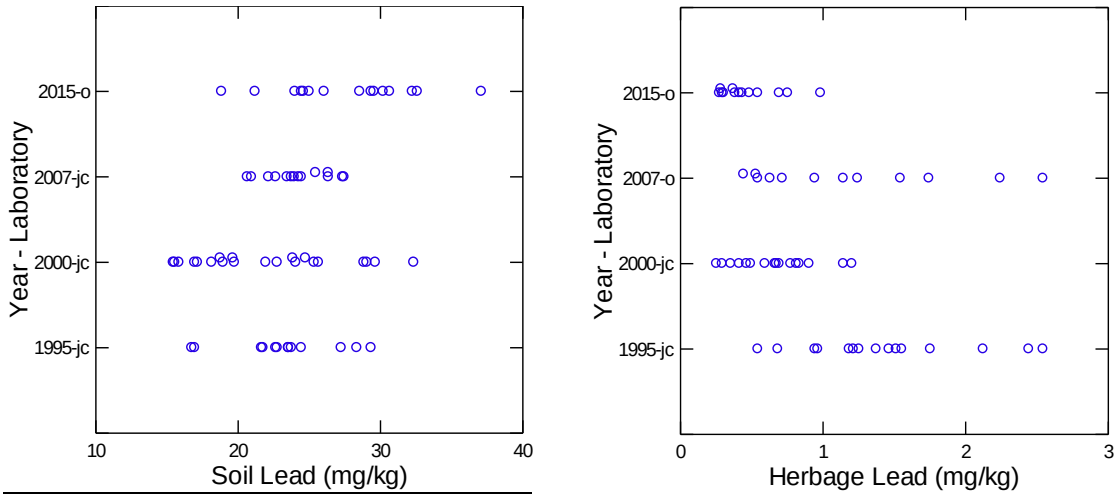


Figure 12.4.2. Soil and herbage lead by year and laboratory.

The observed levels in 2015 were within the reported range for Irish agricultural soils of 2.0 - 80 mg/kg (McGrath et al. 2001) or those quoted for uncontaminated soils of 5-50 mg/kg. In comparison, mean soil lead levels of 780 mg/kg were found in 213 agricultural soils at Silvermines, (DAFRD Report, 2000). The soil guideline value, recommended by the Expert Group for lead in Silvermines (EPA, 2002) above which active management is recommended is 1000 mg/kg.

Lead levels in 13 herbage samples from the study farms ranged from 0.23-0.94 mg/kg with a mean value of 0.43 mg/kg. Herbage lead levels in the 1995 study ranged from 0.50-2.50 mg/kg with a mean value of 1.34 mg/kg while those in 2000 were in the range 0.21-0.86 mg/kg with a mean of 0.54 mg/kg. In 2007, herbage lead ranged from 0.41-2.5 mg/kg with a mean value 1.12 mg/kg .

Herbage lead levels in 2000 and 2015 were significantly lower than those recorded in 1995 or 2007. While factors such as grass species, stage of growth or the level of soil contamination at the time of sampling may account for some of the observed differences, the year to year variation is unexpectedly high. This lack of consistency in what is one of the most important metrics in the study is disappointing.

Herbage lead levels in the present study were close to the reference values for herbage from uncontaminated agricultural sites quoted in the Silvermines report of 0.6 mg/kg and substantially below the levels at agricultural sites in Silvermines where a mean value of 8.5 mg/kg was reported (DAFRD Report, 2000). Previous analyses have shown the herbage on the revegetated tailings ponds at Randalstown to have a mean lead content of 14.6 mg/kg.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:16

Cadmium

Cadmium values in 15 soil samples from the study farms in 2015 ranged from 0.39-1.12 mg/kg with a mean of 0.74 mg/kg. These levels were not significantly different from those recorded in 1995 (range 0.44-1.34 mg/kg, mean 0.90mg/kg), 2000 (range 0.36-1.01 mg/kg, mean 0.70 mg/kg) or 2007 (range 0.67-1.09 mg/kg, mean 0.90 mg/kg).

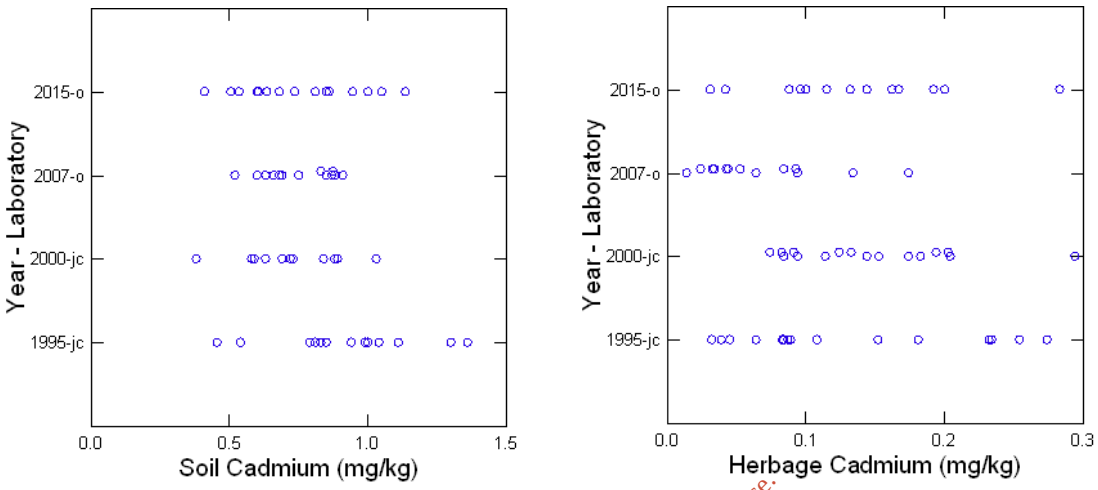


Figure 12.4.3. Soil and herbage cadmium by year and laboratory.

Consent of copyright owner required for any other use. For inspection purposes only.

In all studies, cadmium values tended towards the upper half of the normal range for Irish agricultural soils of 0.1-1.0 mg/kg. Co Meath is recognised as having some of the highest levels of soil cadmium in Ireland with values greater than 1.0 mg/kg frequently recorded (Spatial Distribution Map for Cadmium in Irish Soils, National Soils Database, 2007).

Oldcastle laboratory reported cadmium levels in 13 herbage samples to be in the range 0.03-0.28 mg/kg with a mean value of 0.13 mg/kg. Herbage cadmium levels in 2015 were similar to those recorded in 1995 (range 0.03-0.27 mg/kg, mean 0.13 mg/kg) and 2000 (range 0.07-0.29 mg/kg, mean 0.14 mg/kg) while the difference with 2007 values (range 0.01-0.17 mg/kg, mean 0.06 mg/kg) was of borderline statistical significance (P=0.051). Cadmium levels in all herbage samples in 2015 were within the normal range for Irish pastures of 0.01-0.30 mg/kg (McGrath et al. 2001).

Zinc

Soil total zinc levels on the study farms in 2015 were reported to be in the range 68.0-119.5 mg/kg with a mean value of 92.6 mg/kg. Previously recorded values were: 1995, range: 64.8-98.3 mg/kg, mean: 80.1 mg/kg; 2000, range: 77.3 to 121.0 mg/kg, mean: 94.3 mg/kg and 2007, range: 71.8-105.4 mg/kg, mean: 92.8 mg/kg. All values are within the normal range quoted for total zinc in Irish soils of 10-200 mg/kg and those for 2015 did not differ significantly from the results of the previous studies.

EPA Export 06-01-2017:02:02:16

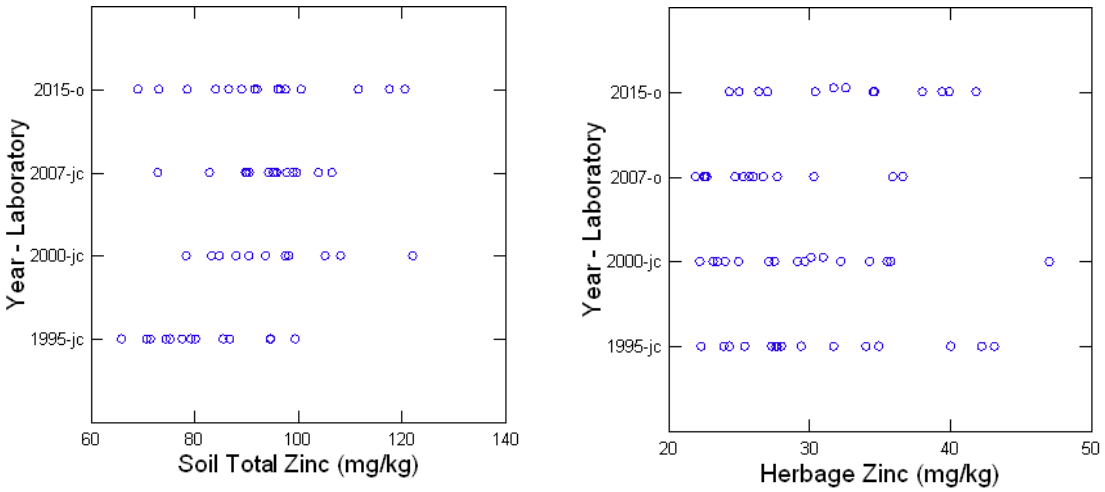


Figure 12.4.4. Soil total zinc and herbage zinc by year and laboratory.

Herbage zinc levels in 2015 were in the range 23.9-41.4 mg/kg with a mean of 32.3 mg/kg. These values are slightly higher than those reported in previous years: 1995 (range 21.9-42.7 mg/kg, mean 30.6 mg/kg), 2000 (range 21.8-44.6 mg/kg, mean 29.4 mg/kg) and 2007 (range 21.5-36.2 mg/kg, mean 26.4 mg/kg) but only in the case of 2007/2015 comparison was the difference statistically significant (P=0.018) Teagasc reference values for zinc in Irish pastures are between 27 and 55 mg/kg indicating that the results from the study farms have remained within the normal range since 1995.

For inspection purposes only.
Consent of copyright owner required for any other use.

12.4.3.2 Soil Fertility and Major Elements

Soil levels of phosphorus and potash, together with lime requirement are used to assess soil fertility. Lime requirement is also a reflection of soil pH which can have a major influence on the availability of heavy metals for uptake by plants.

Lime Requirements and Soil Phosphorus

Soil pH recorded in 2015 was in the range 5.2-6.2 with a mean of 5.8. These values did not differ significantly from the soil pH recorded in 1995, (range: 5.1–6.6, mean: 5.8) and 2007 (range: 5.3–7.3, mean: 5.9). Soil pH was not recorded in 2000. The optimal pH of soil is dependant on the crop but for grazing is considered to be 6.0-6.8 with lower pH favoring less productive grasses. The majority of soil samples had sub-optimal soil pH levels.

EPA Export 06-01-2017:02:02:16

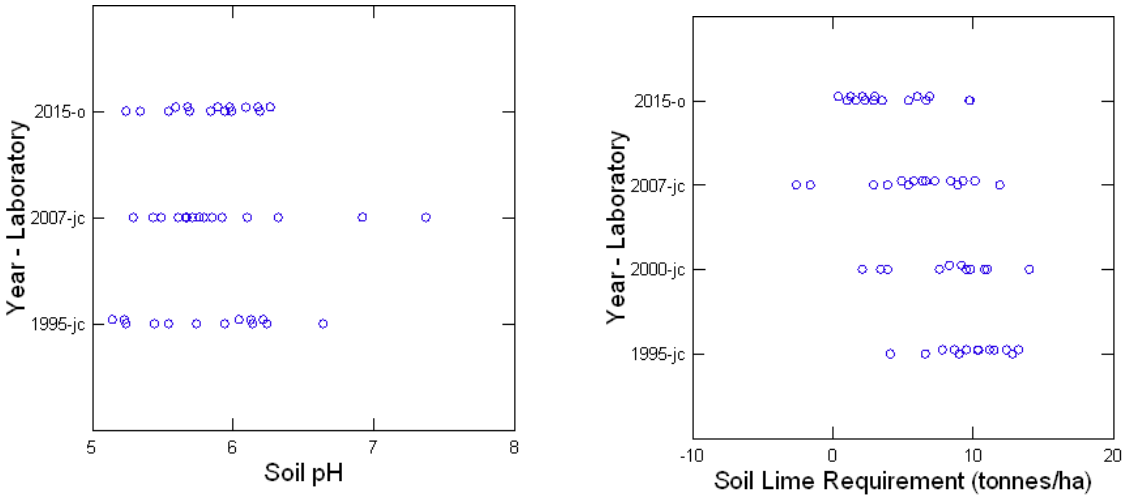


Figure 12.4.5. Soil pH & lime requirement (t/ha) by year and laboratory.

Soil pH values are more commonly expressed as Lime Requirement (LR). Lime requirement is the amount of lime needed to raise soil pH to 6.8 and is inversely related to soil acidity. LR on the 15 soil samples in 2015 ranged from 0 - 9.4 tonnes/ha with a mean value of 3.4 tonnes/ha. The lime requirement on the study farms has declined progressively from 1995 (range 3.7-12.4 tonnes/ha, mean 8.7 tonnes/ha), 2000 (range 1.7-13.6 tonnes/ha, mean 7.7 tonnes/ha) and 2007 (range -3.0-11.5 tonnes/ha, mean 5.0 tonnes/ha). The average pH of 29 samples of tailings taken during revegetation trails between 1991 and 1993 was 7.3 with a range of 6.8-7.9.

For inspection purposes only. Consent of copyright owner required for any other use.

The values recorded in 2015 were significantly lower than those in 1995 and 2000 ($P<0.001$ and $P=0.002$ respectively) while the difference between 2007 and 2015 was not statistically significant. The lime requirement is the only parameter showing a consistent and statistically significant change over the 20 year period these surveys have been carried out (Figure 12.4.6). This may be due to better pasture management by the farmers concerned.

EPA Export 06-01-2017:02:02:16

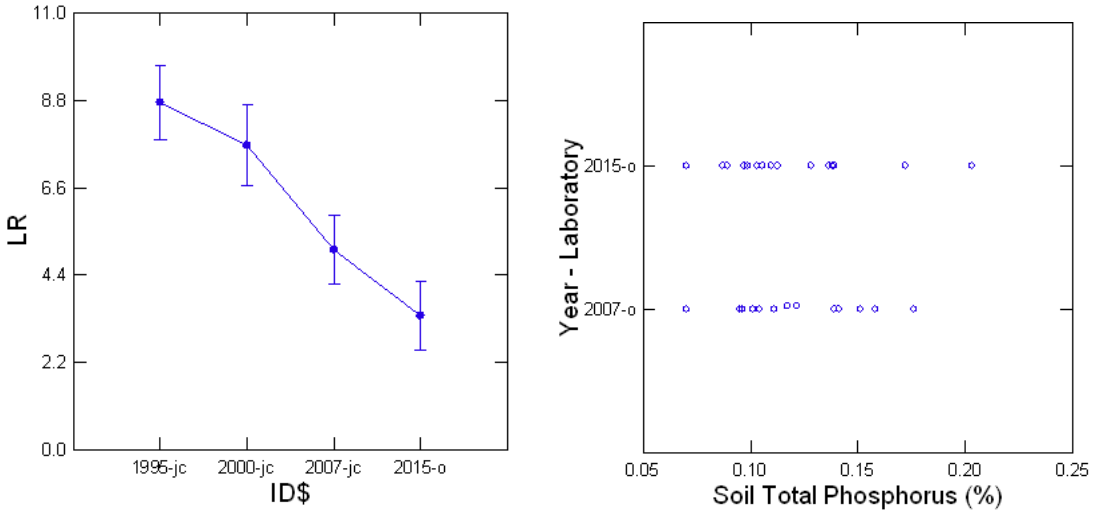


Figure 12.4.6. Lime requirement & total phosphorus by year & laboratory.

Soil test for available phosphorus, designed to help predict the soil's nutrient status, were used by Johnstown Castle in the earlier studies of 1995 and 2000. In contrast, total soil phosphorous was estimated by Oldcastle Laboratories in 2007 and 2015. Total P is a more suitable environmental indicator for use in nutrient management planning. As the two parameters are not comparable only total P levels are quoted. In 2015, total P content on the study farms ranged from 0.068-0.201% (680-2,010 mg/kg) with a mean value of 0.117% (1,170 mg/kg) compared to a range of 0.068-0.174% and mean of 0.119% recorded in 2007. The typical range for total P content of agricultural soils is estimated at between 0.020 to 0.20% (McGrath, 1994). There is no significant difference between observed total P levels in the two studies.

For inspection purposes only.
Consent of copyright owner required for any other use.

Soil Potassium and Magnesium

As with phosphorus, the previous studies measured extractable and/or exchangeable potassium (exchangeable K) as included in the Johnstown Castle soil testing package, to provide guidance on the need or otherwise for applications of K fertilizer. In contrast, total soil K reserves were estimated by Oldcastle Laboratories for the 2015 study. As a consequence, there is no baseline data with which to compare total soil potassium values recorded in the current study.

Total soil potassium content in 2015 ranged from 0.06-0.18% (600-1,800 mg/kg) with a mean value of 0.10% (1,000 mg/kg). The observed values are very low relative to those quoted in the Soil Geochemical Atlas of Ireland which reported the 25th and 75th percentiles for Irish mineral soils as 0.81 and 1.42% respectively. However the authors indicate that their values are unusually high due to the use of hydrofluoric acid (HF) in the digestion procedure for the samples which dissolved potassium from K-rich silicate minerals in the soil.

EPA Export 06-01-2017:02:02:17

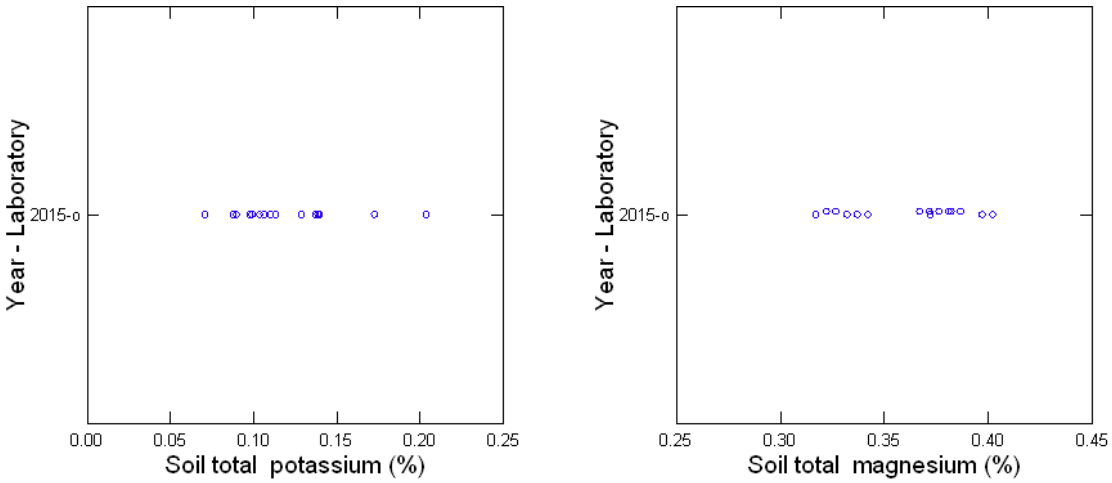


Figure 12.4.7 Soil total Potassium & Magnesium (%) by year & laboratory.

Total rather than available magnesium levels in soils were again recorded in 2015 in contrast to the previous studies. **Total Mg ranged from 0.315-0.400% (315-400 mg/kg) with a mean value of 0.356% (356 mg/kg).** The observed values are within the 25th and 75th percentiles for total Mg in Irish mineral soils of 0.25% and 0.47% (250 and 470 mg/kg) although levels of up to 0.6% (600 mg/kg) are reported in Co Meath and elsewhere in the North East attributable to the presence of basic volcanic material in the underlying geology (Soil Geochemical Atlas of Ireland, 2011).

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:17

12.4.3.3 Soil Trace Elements

Soil Total Copper

Total copper levels in the soils on the study farms in 2015 ranged from 13.7-26.95 mg/kg with a mean of 20.7 mg/kg. Comparative values in the previous studies were: 1995 (range 12.4-19.7 mg/kg, mean 15.2 mg/kg), 2000 (range 13.8-20.0 mg/kg, mean 17.0 mg/kg) and 2007 (range 12.7-22.2 mg/kg, mean 18.3 mg/kg).

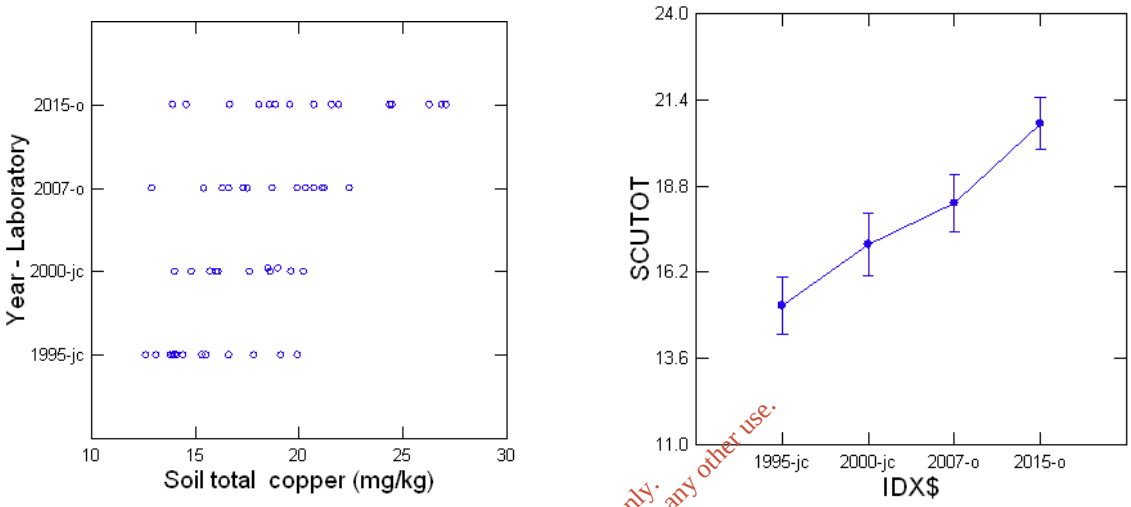


Figure 12.4.8. Soil total copper by year and laboratory.

Consent of copyright owner required for any other use. For inspection purposes only.

Although total copper values on the study farms fell consistently between the 25th and 75th percentiles for Irish mineral soils of 12.5 and 26.2 mg/kg, mean values have risen progressively between 1995 and 2015. While Cu is an essential element for all plants and animals, Cu and all its compounds can be toxic at high concentrations, particularly for sheep and young calves.

Soil Arsenic and Total Manganese

Arsenic occurs naturally in minerals and soil in small amounts and is often found in ores with Cu and Pb. It is an essential element for humans and animals, but only at very low levels with both the metal and its compounds being toxic. The arsenic content of the tailings recorded during revegetation trials in the 1990s was between 600-770 mg/kg. Soil As levels on the study farms in 2015 ranged from 5.20-10.15 mg/kg with a mean value of 7.25 mg/kg. Comparable values in the previous studies were 1995 (range 5.5-10.0 mg/kg, mean 7.9 mg/kg), 2000 (range 7.5-10.5 mg/kg, mean 8.0 mg/kg) and 2007 (range 5.7-10.4 mg/kg, mean 7.9 mg/kg). With the exception of 2000/2015 comparison, none of the differences was statistically significant ($P<0.05$). The 25th and 75th percentile for As in Irish mineral soils are 5.74 and 11.16 mg/kg respectively(Soil Geochemical Atlas of Ireland, 2011).

EPA Export 06-01-2017:02:02:17

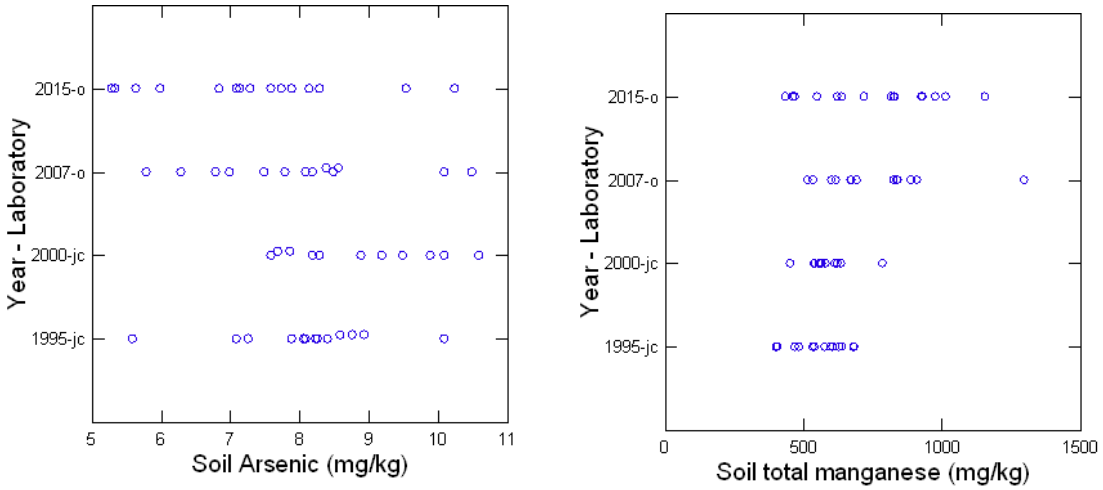


Figure 12.4.9. Soil arsenic and total manganese by year and laboratory.

Total manganese levels in the soils on the study farms in 2015 ranged from 414-1135 mg/kg with a mean of 737 mg/kg. These values are towards the upper end of the normal range for Irish soils. Comparative values in the previous studies were: 1995 (range 381-663 mg/kg, mean 537 mg/kg), 2000 (range 432-765 mg/kg, mean 566 mg/kg) and 2007 (range 495-1276 mg/kg, mean 741 mg/kg). While values reported by Johnstown Castle in 1995 and 2000 were significantly lower than those found by Oldcastle Laboratories in 2007 and 2015, differences between years within each laboratory were not statistically significant, indicating that sample preparation or testing methodology may have been the cause of the variability.

Consent of copyright owner required for any other use.
For inspection purposes only.

12.4.3.4 Herbage Major Elements

Herbage Calcium and Phosphorus

Herbage calcium levels in 2015 were in the range 0.35-0.87 percent with a mean of 0.55 percent. Calcium levels in herbage on the study farms in 1995 were: range: 0.44-1.00 percent, mean: 0.68 percent, 2000: range: 0.37-0.92 percent, mean: 0.58 percent and 2007: range: 0.40-0.87 percent, mean: 0.56 percent. The herbage calcium values reported in 1995 were significantly greater than those recorded in subsequent studies but those recorded in 2015 did not differ significantly from those in 2000 or 2007. Herbage Ca levels in all samples were within the normal range for Irish pastures of 0.20-1.70 percent (Fleming and Parle, 1982).

EPA Export 06-01-2017:02:02:17

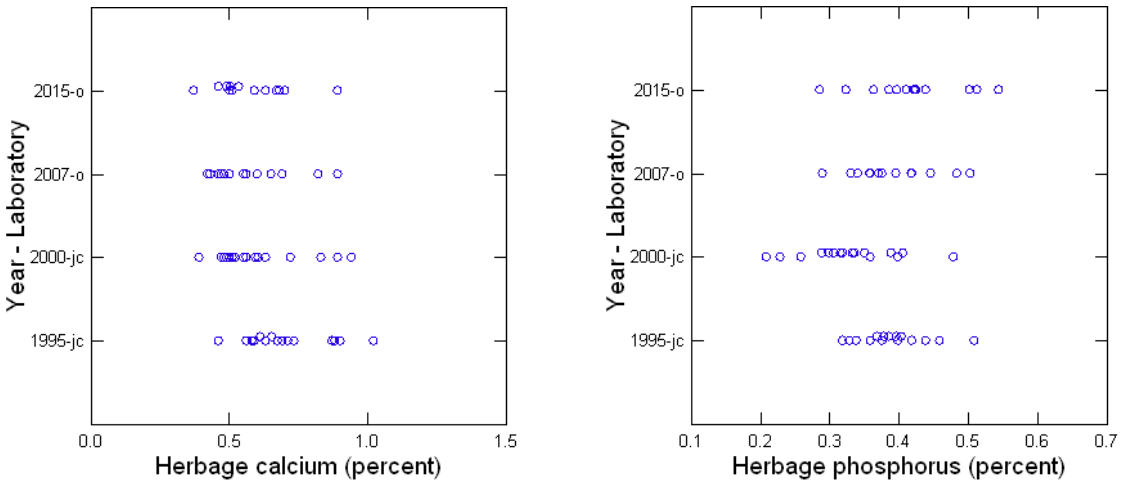


Figure 12.4.10. Herbage calcium and phosphorus levels by year.

Oldcastle reported herbage phosphorus in 2015 to be in the range 0.28-0.54 percent with a mean of 0.41 percent. Corresponding values in 1995 were range: 0.31-0.50 percent, mean: 0.38 percent, in 2000: range: 0.20-0.47 percent, mean: 0.31 percent and 2007: range 0.28-0.49 percent,mean: 0.38 percent. While the results for 2000 were significantly lower than in other years, differences in herbage P levels for the other studies were not statistically significant. Values for herbage P were at the upper end of the normal range for Irish pastures of 0.10-0.50 percent quoted by Fleming and Parle (1982).

Consent of copyright owner required for any other use. For inspection purposes only.

Herbage Magnesium and Sodium

Herbage magnesium levels reported in 2015 ranged from 0.12-0.21 percent with a mean of 0.16. Corresponding values in 1995 were: range 0.16-0.29 percent, mean 0.21 percent, 2000: range: 0.10-0.27 percent, mean: 0.17 percent and 2007: range: 0.11-0.21 percent, mean: 0.15 percent. Herbage Mg levels in 1995 were significantly higher than in the later studies (P<=0.01) but other differences were not statistically significant. The normal range for magnesium in Irish pasture is between 0.08 and 0.50 percent.

Herbage sodium levels in 2015 were in the range 0.04-0.31 percent with a mean of 0.16 percent. The corresponding values in previous studies were 1995: range: 0.11-0.35 percent, mean: 0.25 percent, 2000: range 0.06-0.47 percent, mean 0.24 percent and 2007: range: 0.04-0.31 percent, mean: 0.16 percent. Herbage Na levels in 2015 were significantly below those recorded in 1995 and 2000, (P=0.045 and 0.042 respectively), but did not differ significantly from 2007 values. Normal range for herbage sodium is 0.01-0.60 percent.

EPA Export 06-01-2017:02:02:17

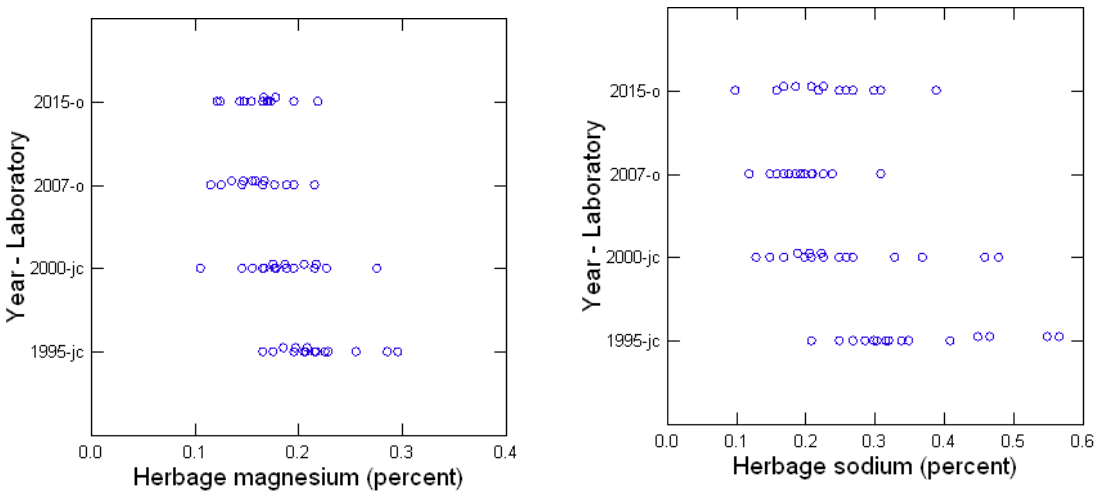


Figure 12.4.11. Herbage magnesium and sodium by year.

Herbage Potassium and Sulphur

Oldcastle reported herbage potash levels in the range 1.41-3.86 percent with a mean value of 2.66. 1.30-4.27 percent with a mean value of 2.72 percent while the corresponding values for Johnstown Castle were range: 0.43-4.13 percent, mean 2.41 percent. Herbage potassium values on the study farms in 1995 were range: 1.92-4.39 percent, mean: 2.91 percent, 2000: range 1.08-3.79 percent, mean 2.45 percent and 2007: range 1.30-4.27 percent, mean 2.72 percent. All values were within the normal range for potassium in Irish pastures quoted by Fleming and Parle of 0.8-4.0 percent and there was no statistical difference between any of the datasets.

For inspection purposes only.
Consent of copyright owner required for any other use.

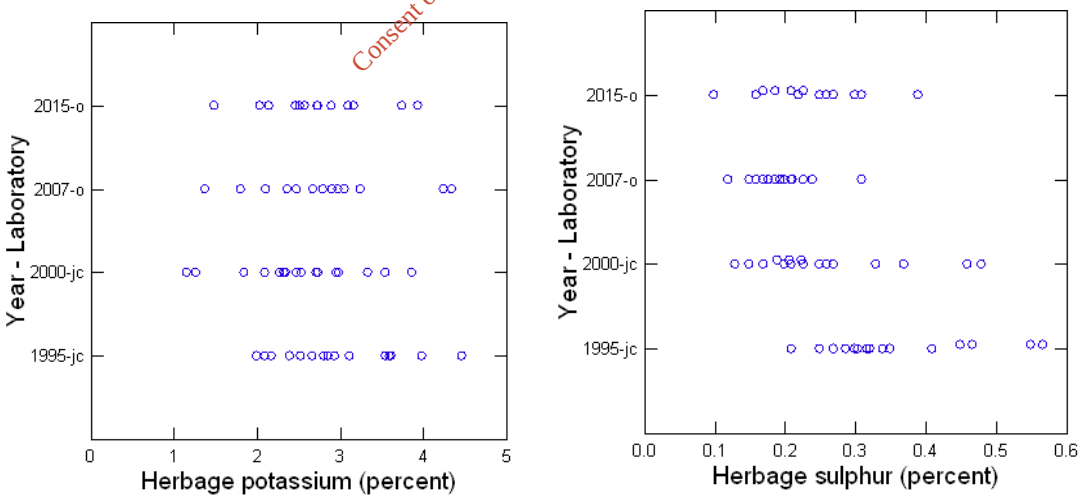


Figure 12.4.12 Herbage potassium and sulphur by year.

EPA Export 06-01-2017:02:02:17

Herbage sulphur in 2015 ranged from 0.09-0.38 percent with a mean value of 0.22 percent. Corresponding values in 1995 were range: 0.20-0.54 percent, mean: 0.34 percent), 2000 range: 0.12-0.47 percent, mean: 0.24 percent and 2007: range: 0.11-0.30 percent, mean: 0.18 percent. While herbage S values in 1995 were significantly higher than in all subsequent studies, ($P<0.01$ in each case), levels in 2015 did not differ significantly from those in either 2000 or 2005.

Fleming and Parle quote the normal range for sulphur in Irish pastures to be 0.15 to 0.35 percent. The minimum requirement for livestock is estimated at 0.16 percent while sulphur levels of less than 0.20 percent can adversely affect production and quality of grass. In 2015, 4 of 13 herbage samples from the study farms containing less than 0.20 percent sulphur.

12.4.3.5 Herbage Trace Elements

Herbage Copper and Molybdenum

Herbage copper levels on the study farms recorded by Oldcastle in 2015 ranged from 5.12–10.15 mg/kg with a mean of 7.78 mg/kg. The corresponding values reported in previous studies were 1995: range: 6.22-13.23 mg/kg, mean: 8.89 mg/kg, 2000: range: 4.15-12.80 mg/kg, mean: 7.82 mg/kg and 2007: range 4.70–8.70 mg/kg, mean 6.71 mg/kg. Observed herbage Cu values in 2015 did not differ significantly from those in earlier studies. As noted previously, there has been a progressive increase in soil total copper levels over the course of the four studies. In the absence of a corresponding increases in herbage Cu levels, the observed increase in soil Cu must be in a form which is unavailable for uptake by plants.

Consent of copyright owner required for any other use. For inspection purposes only.

Herbage molybdenum levels recorded by Oldcastle in 2015 were in the range 2.01-7.98 mg/kg, with a mean of 3.96 mg/kg). Herbage Mo in previous studies were 1995: range: 0.30-7.80 mg/kg, mean: 2.25 mg/kg, 2000: range: 0.34-6.43 mg/kg, mean: 2.19 mg/kg and 2007: range: 0.94-7.75 mg/kg, mean: 3.44 mg/kg.) There was evidence of a laboratory effect for herbage Mo with levels recorded by Oldcastle in 2007 and 2015 being significantly higher than those reported by Johnstown Castle in 1995 and 2000, confounding the interpretation of the data. However the increase in herbage Mo values in 2015 was not statistically significant relative to 2005 values.

EPA Export 06-01-2017:02:02:17

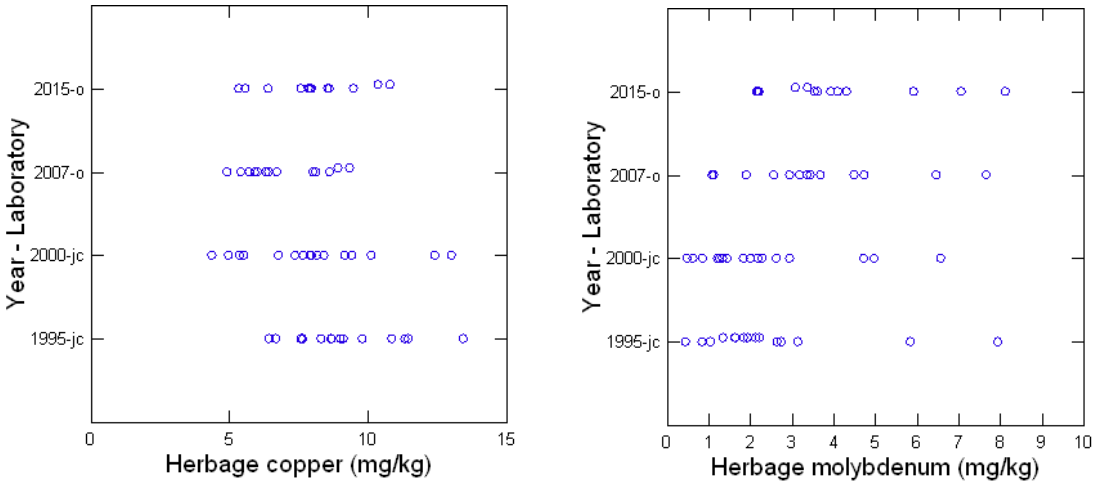


Figure 12.4.13. Herbage copper and molybdenum levels by year.

The normal range of copper in Irish pastures is 2-15 mg/kg while levels of less the 5 mg/kg are seriously deficient for both cattle and sheep. Molybdenum is both an antagonist to copper and itself a toxic element. Herbage levels greater than 4 mg/kg are considered undesirable while values of 10 mg/kg or greater are toxic. Fleming and Parle quote the normal range for molybdenum as 0.05-2.00 mg/kg. While a Cu:Mo ratio of at least 3:1 to 4:1 is considered necessary both to prevent copper deficiency and avoid molybdenum toxicity, the observed ratio in 7 of 13 herbage amples was less than 2:1, highlighting the risk of induced copper deficiency on some of the study farms.

For inspection purposes only.
Consent of copyright owner required for any other use.

12.4.3.5.2 Herbage Selenium and Manganese

Herbage selenium in 2015 was in the range 0.04-0.48 mg/kg with a mean value of 0.12 mg/kg. Corresponding values from previous studies were 1995: range 0.04-0.63 mg/kg, mean 0.13 mg/kg, 2000, range 0.04-0.14 mg/kg, mean 0.06 mg/kg, 2007: range 0.10-0.40 mg/kg, mean 0.18 mg/kg.

The normal range for Se in Irish pastures quoted by Fleming and Parle is 0.03-0.20 mg/kg. Despite the presence of several anomalously high outliers, reported values in 2015 did not differ significantly from those recorded in the previous studies.

EPA Export 06-01-2017:02:02:17

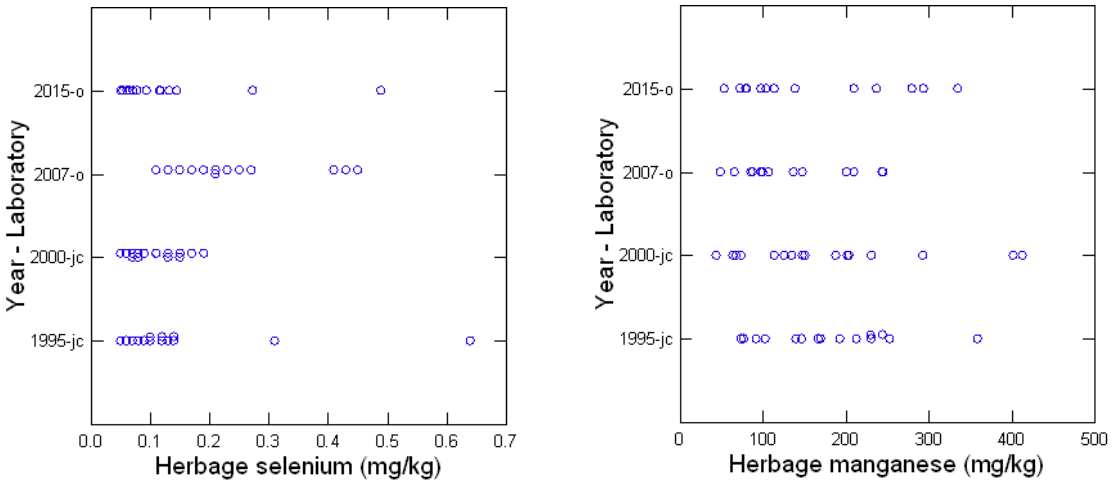


Figure 12.4.14. Herbage selenium and manganese levels by year.

Levels of **herbage manganese** recorded in 2015 were in the range 46-328 mg/kg with a mean of 154 mg/kg. There was no statistically significant year to year variation between these values and those recorded in the previous studies which were **1995: range 67-352 mg/kg, mean 172 mg/kg, 2000: range 37-406 mg/kg, mean: 172 mg/kg** and **2007: range 42-238 mg/kg, mean 130 mg/kg.**

Fleming and Parle quote 20-300 mg/kg as the range for manganese, indicating that the observed values for this element on the study farms are generally within the normal range.

For inspection purposes only.
Consent of copyright owner required for any other use.

12.4.3.6 Comparison of upper and lower soil profiles

Given the high background level of geo-chemical pollution in an area so close to the mine, it is unlikely that any deposition of dust from the tailings pond would be sufficient to cause a demonstrable increase in heavy metal concentration on the surrounding farmland. Comparison of the mineral composition of the upper and lower strata of the soil cores from each field for a wide spectrum of elements was therefore considered a more sensitive means of detecting any anomalies which could be attributed to dust blows from the tailings.

In order to identify any differences in composition which could be attributed to contamination from the tailings ponds, the soil cores from each of the 15 fields in the study were separated into upper and lower fractions which were analysed individually by ICP mass spectrometry.

Levels of 47 individual elements were included in the assay of which two, boron and tantalum, showed no variability with all samples being below the limits of detection of the test (1 ppm in both cases). For each of the other 45 elements, a simple linear regression model was used to compare the observed concentration in the upper layer of the soil cores with that of the lower layer.
While heavy metals such as lead, zinc and cadmium are of particular interest in assessing potential animal health implications, the ability to screen a wide

EPA Export 06-01-2017:02:02:17

spectrum of elements, some of which are selectively accumulated in the tailings, provided an additional tool for monitoring the environmental impact.

From a total of 15x45= 675 pairwise comparisons, 32 data points were deemed to be statistical outliers with Studentized Residuals > 2. More than half of these outliers, 19 in total, related to one field, PG1. In 15 of the 19 instances (elements: Al, As, Ba, Fe, Ga, La, Li, Nb, Sb, Sc, Sn, U, V, Y and Zr), the coefficient of the Studentized Residual was negative, indicating that the observed level of that particular element was less in the top portion of the soil cores than would be expected from the level recorded in the lower portion. No other field had more than two outliers.

Of these 15 elements, the average value in the tailings was known for 8 (Al. As, Ba, Fe, La, Sb, Sc and V). If the reduction in the level of these elements observed at the soil surface was due to wind-borne deposition of dust from the tailings pond then their concentration in the tailings should be lower than in the soil. However as Al, As, Fe and Sb are all relatively abundant in the tailings, deposition should have resulted in higher concentrations in the upper layer of the soil cores. For 3 of the 4 elements (Cd, Co and Mn) whose concentration in the upper part of the soil cores were greater than expected, this was consistent with higher levels in the tailings while in the other case, Cr, deposition of tailings should have caused a net reduction.

In the case of field PG1, it can therefore be concluded that the observed anomalies between the upper and lower portions of soil cores could not have been caused by deposition of dust from the tailings pond. For the other fields on the study farms, there was a high degree of correlation between the results for the upper and lower portions of the soil cores. The consistency of the results validates the accuracy and reliability of the testing methodology. In addition, it supports the contention that the fields adjacent to the tailings pond have not been subjected to any detectable dust borne pollution.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 06-01-2017:02:02:17

12.4.4 Animal Samples

Blood

In 2015, a total of 25 cows and heifers from 5 herds and 10 ewes from two flocks on study farms were blood sampled. In addition, 10 Soay sheep in the flock kept on site at Randalstown tailings facility were blood sampled. Results for these animals are reported separately as their nutrition and management would be substantially different from the flocks on the study farms.

Blood Major and Trace Elements

Table 12.4.2 shows the blood values for major and trace elements in cattle and sheep on the study farms in 1995, 2000, 2007 and 2015. For purposes of comparison, the values for sheep in 1995 exclude lambs as only ewes were blood sampled in subsequent years.

For the majority of parameters, results for both cattle and sheep are close to or within the normal ranges, the main exceptions being low copper levels in cattle and elevated blood selenium values in sheep, both on the study farms and the Soay sheep at the tailings pond.

Consent of copyright owner required for any other use.
For inspection purposes only.

Copper deficiency

The potential for molybdenum-induced copper deficiency was identified from the herbage analysis. In the event, suckler cows on one of the study farms recorded blood levels indicative of copper deficiency, ranging from 3.41-7.04 µmol/l (0.22-0.45 ppm) while copper levels in cattle on the other study farms as well as sheep on the study farms were deemed adequate. In cattle, copper deficiency is most common in young grazing animals.

Selenium excess

Blood selenium estimation was only included in the 2000 and 2015 studies as Teagasc Grange, which carried out the earlier blood analyses in 1995 and 2000, measured levels of the enzyme glutathione peroxidase (GPx) as a proxy for selenium status. Blood Se levels in cattle in 2015 were all within the normal range of 0.75-3.0 µmol/l (0.06-0.24 ppm) but the majority of sheep on the study farms and all 10 Soay ewes at the tailings pond exceeded the upper end of the normal range. While the observed levels are unlikely to be of any clinical significance, they are consistent with the known seleniferous nature of soils in this area of Co Meath.

Blood Metabolites and Enzymes

Levels of blood parameters which reflect protein status and blood enzymes are shown in table 12.4.3. The main anomalies were elevated globulin levels in

EPA Export 06-01-2017:02:02:17

sheep, similar to findings reported in previous studies in 2000 and 2007 and high AST readings in both cattle and sheep.

Elevated globulin levels

High serum globulin levels are indicative of a chronic inflammatory or infectious disease or condition. Globulin levels in all cattle on the study farms in 2015 were within the normal range.

Elevated AST

Aspartate aminotransferase (AST) is used as an indicator of liver damage. In the 2015 study, elevated blood levels of AST were detected in the suckler cows in one tudy farm and in ewes on 2 study farms as well as the Soay sheep at the tailings pond. The observed levels were consistent of hepatic damage with fascioliasis as the most likely cause. Fascioliasis is an endemic problem in much of the Irish midlands and routine dosing is required on many farms to prevent economic loss through clinical or sub-clinical disease, particularly in wet years.

Blood Heavy Metals

Blood levels of lead and plasma zinc in cattle and sheep on the study farms in 2015 were estimated by Oldcastle Laboratories and the results are shown in Table 12.4.2 above. Blood lead levels are displayed graphically in Figure 12.4.15 below. Where results are below the LOD, an arbitrary value of half of that limit was used.

For inspection purposes only.
Consent of copyright owner required for any other use.

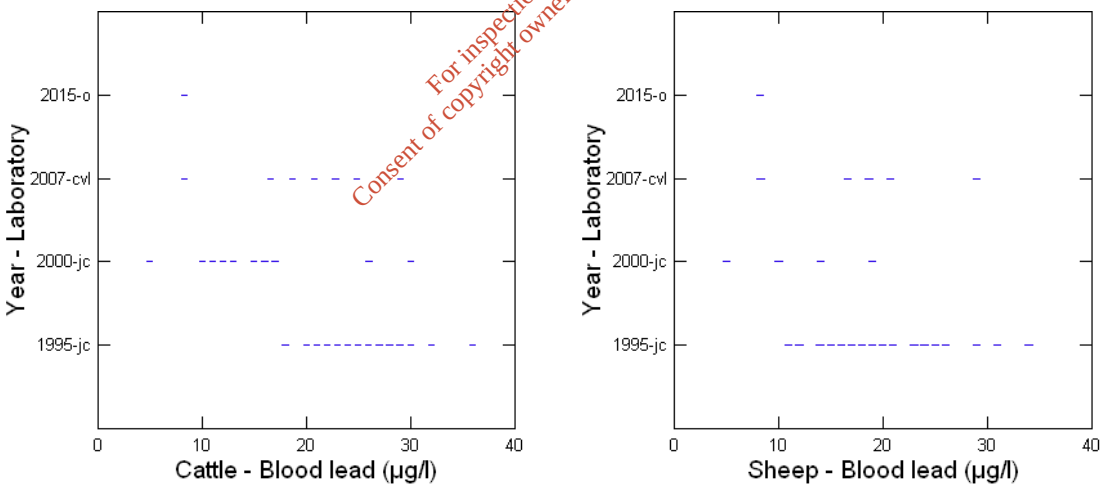


Figure 12.4.15. Blood lead levels in cattle and sheep (µg/l) by year and laboratory.

EPA Export 06-01-2017:02:02:17

Table 12.4.2. Blood major elements, trace elements and heavy metals in cattle and sheep by year.

Blood Parameter		1995			2000			2007			2015			Normal Range
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	
Calcium (mmol/l)	Cattle	2.22	2.73	2.48	2.37	2.76	2.61	1.98	2.83	2.49	2.20	2.78	2.50	2.1 – 3.1
	Sheep	2.40	2.96	2.65	2.48	2.90	2.62	1.91	3.03	2.64	2.23	2.84	2.55	
	Tara Sheep										2.58	3.24	2.91	
Phosphorus (mmol/l)	Cattle	0.43	1.92	1.27	1.03	2.57	1.85	1.65	1.74	1.70	1.94	3.24	2.53	1.80– 2.50
	Sheep	0.14	2.23	1.01	1.13	2.19	1.74	1.65	1.78	1.70	1.73	2.94	2.36	0.90 – 2.55
	Tara Sheep										0.85	3.42	2.40	
Magnesium (mmol/l)	Cattle	0.59	1.22	0.95	0.57	1.24	0.98	0.76	1.09	0.93	0.79	1.23	1.03	0.70 – 1.23
	Sheep	0.28	0.91	0.64	0.80	1.05	0.92	0.81	1.16	1.01	1.08	1.30	1.14	
	Tara Sheep										1.14	1.32	1.24	
Copper (µmol/l)	Cattle	9.42	14.13	12.11	9.42	18.06	13.00	5.20	25.40	14.79	**3.41**	15.20	10.18	11.0 – 25.6
	Sheep	5.50	16.49	11.11	9.42	18.06	13.66	9.70	26.80	16.70	10.20	16.30	13.01	9.4 – 19.0
	Tara Sheep										**8.19**	13.50	10.10	
Selenium (µmol/l)	Cattle							1.66	3.30	2.26	0.70	2.91	1.67	0.75 – 3.00
	Sheep							2.04	3.71	2.91	2.65	**4.32**	3.38	
	Tara Sheep										**3.42**	**4.33**	3.80	
Zinc (plasma) (µmol/l)	Cattle	11.33	18.12	13.99				14.20	26.80	21.88	10.50	18.70	14.32	5 - 25
	Sheep	9.06	18.12	13.46				11.90	29.20	20.50	9.22	14.70	11.94	
	Tara Sheep										7.12	12.20	10.01	
Lead (µmol/l)	Cattle	18.0	36.0	26.6	<10	30.0	10.9	<16.6	29.01	17.16	<16.6	<16.6	<16.6	10 – 200
	Sheep	12.0	29.0	18.0	<10	19.0	9.2	<16.6	29.01	11.99	<16.6	<16.6	<16.6	20 - 250
	Tara Sheep										<16.6	<16.6	<16.6	
Blood Parameter		1995			2000			2007			2015			Normal Range
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	
Blood Urea (mmol/l)	Cattle	4.16	7.98	6.00	2.80	10.30	5.84	3.91	8.31	6.01	2.20	2.78	2.50	2.0 – 6.6
	Sheep	7.63	12.06	9.30	5.90	15.20	11.28	6.20	13.58	9.34	2.23	2.84	2.55	

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:17

	Tara Sheep										2.58	3.24	2.91	2.7 – 6.6
Total Protein (g/l)	Cattle	68.3	82.4	72.0	64.5	100.5	83.1	64.2	85.1	75.58	63.8	83.4	72.3	53.0 – 75.0
	Sheep	57.7	76.3	69.4	78.0	96.8	86.8	58.9	88.1	75.46	74.4	89.5	80.8	
	Tara Sheep										70.1	84.3	75.3	66.0 – 75.0
Albumin (g/l)	Cattle	33.34	41.69	37.75	33.80	41.30	37.60	28.10	40.00	36.44	30.2	37.8	34.6	29.0 – 39.0
	Sheep	23.78	31.06	27.10	26.60	32.90	29.46	26.4	35.50	31.36	23.0	31.5	28.3	
	Tara Sheep										27.1	32.4	29.5	28.0 – 34.0
Globulin (g/l)	Cattle	29.04	45.14	34.25	26.40	66.00	45.51	28.70	50.90	39.14	28.1	49.2	37.7	31.0 –55.0
	Sheep	32.47	49.73	42.33	47.60	68.60	57.37	28.50	57.50	44.10	47.7	**59.1**	**52.4**	
	Tara Sheep										37.8	**57.2**	45.8	32.0 – 43.0
GGT (u/l)	Cattle	7.1	46.4	14.2	12.0	51.0	27.6	5.0	101.0	20.4	2.0	51.0	13.1	< 32
	Sheep	27.6	129.7	43.4	31.0	105.0	47.0	15.0	146.0	44.0	6.0	46.0	26.9	
	Tara Sheep										24.0	64.0	43.9	< 67
GLDH (u/l)	Cattle	7.3	39.4	17.7	7.8	77.3	24.9	4.0	63.0	20.9	6.0	218.0	26.3	
	Sheep	4.6	387.1	46.8	9.1	210.0	36.9	7.0	187.0	40.4	9.0	46.0	22.2	< 25
	Tara Sheep										6.0	50.0	16.4	
AST (u/l)	Cattle							74.0	172.0	103.0	80.0	452.0	135.4	
	Sheep							73.0	279.0	151.0	124.0	**177.0**	141.8	38 - 120
	Tara Sheep										136.0	**203.0**	**160.4**	

Table 12.4.3. Blood metabolites and enzymes in cattle and sheep by year.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:17

Blood lead

Blood lead levels in all cattle and sheep in 2015 were below the limit of detection of 16.6 µg/l (0.08 µmol/l). Levels recorded in 1995 for cattle ranged from 18.0 – 36.0 µg/l with a mean of 26.6 µg/l and for sheep: range 11.0 – 34.0 µg/l, mean 20.2 µg/l. Blood lead levels in 2000 were cattle (range: <10 – 30 µg/l , mean: 10.9 µg/l) and sheep (range <10 – 19 µg/l , mean 9.2 µg/l). Corresponding values for cattle in 2007 were cattle (range <16.6 – 29 µg/l, mean 17.2 µg/l) while for sheep10 of 14 blood samples had lead levels below the LOD with the others in the range 16.6 – 29.0 µg/l., with a mean for the group of 12.0 µg/l.

While some animals in previous years were below the LODs of 10 or 16.6 µg/l, this was the first study in which no animal had demonstrable levels of lead in their blood. Using the convention of setting samples with values below the limit of detection at half of that limit, 2015 blood lead values for both cattle and sheep were significantly less that those recorded in 1995 or 2007 ($P<0.01$ in each case) while 2000 and 2015 values did not differ significantly.

The normal range of blood lead quoted for cattle and sheep is extremely wide and overlaps with values found in cases of lead poisoning. Previous studies at Randalstown have indicated a breakpoint of 35.6 µg/l as being indicative of lead exposure in lambs. No blood lead levels recorded in cattle or sheep in any of the studies to date have been indicative of exposure above background levels.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:17

Plasma zinc

Blood zinc can be measured either in whole blood or plasma/serum. Of the total zinc in blood, 75-88 percent is in the red cells, 12-22 percent is in the plasma with the remainder in white blood cells and platelets. (Mertz,W., 1986). Both whole blood and/or plasma zinc have been used in previous studies. For the current study, Oldcastle Laboratory analyzed plasma zinc only. Corresponding plasma zinc values are available for 2007, assayed by Central Veterinary Laboratory and 1995 by Teagasc Grange. No plasma zinc data are available for 2000. **Details of the minimum, maximum and mean values for cattle and sheep in each study are given in Table 12.4.3** and shown graphically in Figure 12.4.16 below.

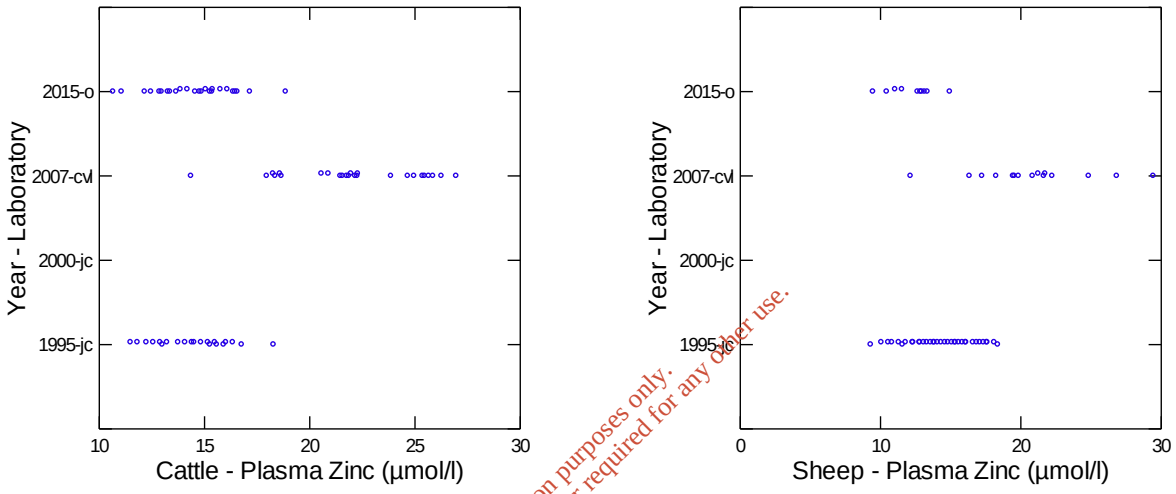


Figure 12.4.16. Plasma zinc levels in cattle and sheep (µg/l) by year and laboratory.

Consent of copyright owner required for any other use. For inspection purposes only.

While the 1995 and 2015 values do not differ significantly for either cattle or sheep, each differed significantly from the levels reported by the CVL in 2007 for both species. The inconsistency in so great that it is most likely the result of methodological differences between the laboratories. In any event, the plasma zinc levels recorded in both cattle and sheep in 2015 were within the normal range. Plasma zinc levels in the 10 Soay sheep at Randalstown in 2015 were significantly lower that those in the study farm sheep (P=0.028), probably as a result of poorer nutrition.

EPA Export 06-01-2017:02:02:17

12.4.5 Animal Fertility and Production

12.4.5.1 Heavy metal levels in milk and animal tissues

In monitoring the environmental impact of the tailings pond, it is important to ensure that there is no risk to consumers from heavy metals entering the food chain via milk or meat. To this end, previous studies included an analysis of heavy metal levels in liver and kidney samples from lambs reared on the study farms as well as milk samples from cows and ewes. While no such samples were taken in 2015, it is recommended that this should be done in the coming year as an addendum to the present study.

12.4.6 Summary

As far as possible, the design of this study replicated those carried out in 1995, 2000 and 2007. By collating the data from all four studies in a single database, it has been possible to review parameters of interest on the study farms over an extended time period. However it is inevitable that changes would occur over the intervening 20 years, one of which has been the loss of the analytical laboratory services at Teagasc, Johnstown Castle and Teagasc, Grange. It has proven extremely difficult, in some instances impossible, to find the same capacity in other commercial laboratories.
As a result, the range of tests available, particularly in relation to animals, is somewhat less than in the previous studies, and the need to compare results from different laboratories using different analytical methodologies has complicated the interpretation of the data. In contrast, advances in mass spectrometry have dramatically increased the range of elements which can be assayed at very low concentrations in soil and herbage. This capacity was used in the present study.

Consent of copyright owner required for any other use. For inspection purposes only.

Despite these limitations, the study succeeded in its main objectives of demonstrating that i) there have been no discernible adverse effects on the health or productivity of livestock on the study farms and ii) there is no evidence of increased levels of heavy metals in the soil, herbage or livestock as a result of their proximity to the tailings pond.

The absence of health effects was established through metabolic profiles and clinical examination of the livestock at the time of blood sampling. No clinical disease events consistent with acute or sub-acute toxicity from lead, zinc, cadmium, arsenic or mercury such as gastro-intestinal or central nervous system dysfunction, sudden death etc. was recorded. Chronic toxicity is characterized by non-specific signs such as anorexia, rumen stasis and impaired hepatic function resulting in decreased weight gain and milk production. These would result in abnormal metabolic profiles of the animals and reduced productivity, neither of which was evident on the study farms. The identification of both clinical diseases and metabolic anomalies arising from other causes on the study farms validated the efficacy of the methodology.

EPA Export 06-01-2017:02:02:17

The second objective of confirming that there has been no accumulation of heavy metal levels on the study farms was accomplished by analysis of soil herbage and blood samples. Observed levels were compared both to reference values and to the results from the previous studies in 1995 and 2000. In no case was there any increase in heavy metals which could be attributed to proximity to the tailings pond, indeed for a number of parameters, a decline in values relative to 1995 was observed.

Lastly, regarding the potential impact of the proposed extension to the tailings facility, there was no indication that it would have an adverse effect on the adjacent farms.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:17

References

Moneypoint Power Station, Environmental Impact Study and Consequences for Agriculture (1984), ed. Fleming,GA, An Foras Taluntais

Report of the Investigation into the Presence and Influence of Lead in the Silvermines area of County Tipperary (2000), ed. Murray, A, Department of Agriculture, Food and Rural Development, 2000

The Significance of Heavy Metals and Organic Micropollutants in Soils, (1999), McGrath,D and McCormack,RJ, End of Project report, Teagasc ISBN 84170 27 4

Baseline Survey in the Vicinity of Aughinish Island (1982), Fleming,Ga and Parle,PJ, An Foras Taluntais

Arsenic: Medical and Biological Effects of Environmental Pollutants, (1977), Committee on Medical and Biological Effects of Environmental Pollutants, National Research Council

Mineral Levels in Animal Health: Diagnostic Data, 2nd edition (1994), Puls,R, Sherpa International, Canada

Evaluation of Blood and Tissue Lead as Estimators of Exposure in Sheep, (1998), Crilly,J, Kinsella,AJ, Johnson

Expert Group on Lead in Silvermines, County Tipperary – Interim Report. Environmental Protection Agency, 2002, Johnstown Castle Estate, Wexford.

Organomicropollutants and trace element pollution of Irish soils. McGrath, D., (1994), Science of the Total Environment, Vol. 164, pp 125-133

Trace Elements in Human and Animal Nutrition, 5th edition (1986), Mertz, W, Academic Press

Soil Geochemical Atlas of Ireland, Fay,D. et al, (2011), Teagasc and the Environmental Protection Agency.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 06-01-2017:02:02:17