



**Workshop & Lectures on Dam Engineering**  
**TAILINGS STORAGE FACILITIES**  
**Technical Specifications & Construction**

P. J. Burgess – Senior Principal – Coffey Geotechnics

# **Tailings Dam in the Hierarchy of Dam Sites**

## **Hydro-Electric and Water Supply Dams**

Best Sites

Best Foundations

Best materials

Best Care in Construction

Grouted Foundations

Multiple Filters

Money No Object

Operated well below Maximum Operating Level

# Tailings Dam in the Hierarchy of Dam Sites

## Tailings Dams

Worst Sites

Worst Foundations

Worst Materials

Often Little Care in Construction

UngROUTED Foundations

Often No Filters

Cheap is Essential

Operated as close to dam crest as possible

# **Technical Specifications – General Clauses**

**1.1 REQUIREMENT**

**1.2 DESCRIPTION OF WORKS**

**1.3 DAM SAFETY MANAGEMENT**

**1.4 WINDROWS**

**1.5 HAUL ROAD WIDTH**

**1.6 DEFINITIONS**

**1.7 CONSTRUCTION DRAWINGS**

**1.8 WORK TO BE UNDERTAKEN BY PRINCIPAL**

**1.9 WATER SUPPLY**

**1.10 PROTECTION OF MONITORING INSTALLATIONS**

**1.11 MATERIALS TO BE FURNISHED BY CONTRACTOR**

**1.12 SURVEY**

**1.12.1 GENERAL**

**1.12.2 REQUIRED SURVEY LOCATIONS**

**1.12.3 USE OF DGPS SYSTEMS**

# **Technical Specifications – General Clauses**

## **1.13 MEASUREMENT OF WORK FOR PAYMENT**

## **1.14 STANDARDS**

## **1.15 MOBILISATION**

### **1.15.1 MOBILISATION**

### **1.15.2 MEASUREMENT AND PAYMENT**

## **1.16 DEMOBILISATION**

### **1.16.1 DEMOBILISATION**

### **1.16.2 MEASUREMENT AND PAYMENT**

## **1.17 COMMENCEMENT, EXECUTION AND COMPLETION OF WORKS**

### **1.17.1 COMMENCEMENT**

### **1.17.2 CONSTRUCTION DRAWINGS**

### **1.17.3 SITE WORKS**

## **1.18 HOLD POINTS**

# **Technical Specifications – General Clauses**

## **1.19 SOURCES OF CONSTRUCTION MATERIALS**

**1.19.1 GENERAL**

**1.19.2 ROCKFILL**

**1.19.3 RIP RAP**

**1.19.4 EARTH-ROCKFILL**

**1.19.5 EARTHFILL**

**1.19.6 ZONE 2B FILTER**

## **1.20 TEMPORARY STOCKPILES**

## **1.21 DRAINAGE**

**1.21.1 REQUIREMENT**

**1.21.2 REQUIREMENT TO MAINTAIN DRY FOUNDATION**

**1.21.3 REQUIREMENT TO CONTROL FOUNDATION SEEPAGE**

**1.21.4 EXCESS POREWATER PRESSURES**

**1.21.5 DISPOSAL OF PUMPED WATER**

**1.21.6 MEASUREMENT AND PAYMENT**

# **Technical Specifications – General Clauses**

## **2 CLEARING AND GRUBBING**

### **2.1 REQUIREMENT**

### **2.2 PROTECTION OF EXISTING PIEZOMETERS AND**

#### **OBSERVATION WELLS**

#### **2.2.1 SCOPE**

#### **2.2.2 PROTECTION OF EXISTING PIEZOMETERS AND OBSERVATION WELLS**

#### **2.2.3 EXTENSION OF EXISTING PIEZOMETERS AND OBSERVATION WELLS**

### **2.3 REMOVAL OF OBSTRUCTIONS**

#### **2.3.1 GENERAL**

#### **2.3.2 REMOVAL OF SOUTH WALL PIPE CULVERT AND WEIR**

#### **2.3.3 MEASUREMENT AND PAYMENT**

### **2.4 UNSUITABLE MATERIALS**

#### **2.4.1 CUTS AND TRENCHES**

#### **2.4.2 AREAS UPON WHICH FILLING IS TO BE PLACED**

#### **2.4.3 TREATMENT OF UNSUITABLE MATERIALS**

#### **2.4.4 DISPOSAL**

### **2.5 DISPOSAL OF MATERIALS**

### **2.6 SURVEY MARKS AND EQUIPMENT**

### **2.7 MEASUREMENT AND PAYMENT**

## **Technical Specifications – General Clauses**

- **1.19 SOURCES OF CONSTRUCTION MATERIALS**
- **1.19.1 GENERAL**
- **1.19.2 ROCKFILL**
- **1.19.3 RIP RAP**
- **1.19.4 EARTH-ROCKFILL**
- **1.19.5 EARTHFILL**
- **1.19.6 ZONE 2B FILTER**



# Technical Specifications – General Clauses

- 1.20 TEMPORARY STOCKPILES
- 1.21 DRAINAGE
  - 1.21.1 REQUIREMENT
  - 1.21.2 REQUIREMENT TO MAINTAIN DRY FOUNDATION
  - 1.21.3 REQUIREMENT TO CONTROL FOUNDATION SEEPAGE
  - 1.21.4 EXCESS POREWATER PRESSURES
  - 1.21.5 DISPOSAL OF PUMPED WATER
  - 1.21.6 MEASUREMENT AND PAYMENT
- 2 CLEARING AND GRUBBING
  - 2.1 REQUIREMENT
  - 2.2 PROTECTION OF EXISTING PIEZOMETERS AND OBSERVATION WELLS
    - 2.2.1 SCOPE
    - 2.2.2 PROTECTION OF EXISTING PIEZOMETERS AND OBSERVATION WELLS
    - 2.2.3 EXTENSION OF EXISTING PIEZOMETERS AND OBSERVATION WELLS
  - 2.3 REMOVAL OF OBSTRUCTIONS
    - 2.3.1 GENERAL
    - 2.3.2 REMOVAL OF SOUTH WALL PIPE CULVERT AND WEIR
    - 2.3.3 MEASUREMENT AND PAYMENT
  - 2.4 UNSUITABLE MATERIALS
    - 2.4.1 CUTS AND TRENCHES
    - 2.4.2 AREAS UPON WHICH FILLING IS TO BE PLACED
    - 2.4.3 TREATMENT OF UNSUITABLE MATERIALS
    - 2.4.4 DISPOSAL
  - 2.5 DISPOSAL OF MATERIALS
  - 2.6 SURVEY MARKS AND EQUIPMENT
- 2.7 MEASUREMENT AND PAYMENT

# Technical Specifications – Earthworks Clauses

- 3 EARTHWORKS
- 3.1 DAM EMBANKMENT CONSTRUCTION GENERAL
- 3.1.1 DEFINITION
- 3.1.2 SET OUT OF WORKS
- 3.1.3 REQUIRED FOUNDATIONS DEPTH
- 3.1.4 PRESERVATION OF FOUNDATIONS AND SURROUNDS
- 3.1.5 OVER EXCAVATION
- 3.1.6 SAFETY OF EXCAVATED SLOPES
- 3.1.7 DISPOSAL OF WASTE AND EXCESS MATERIAL
- 3.1.8 TOLERANCES
- 3.1.9 SURFACE PREPARATION - FOUNDATIONS
- 3.1.10 SUPERINTENDENT'S APPROVAL OF FOUNDATIONS
- 3.1.11 LAYER THICKNESS CONTROL
- 3.1.12 ZONE INTERFACES
- 3.1.13 SUPERINTENDENT'S PROGRESSIVE APPROVAL OF CONSTRUCTED WORK
- 3.1.14 CONTAMINATION OF MATERIAL
- 3.1.15 ACCESS RAMPS
- 3.1.16 MEASUREMENT AND PAYMENT

# Technical Specifications – Earthworks Clauses

- 3.2 ACCESS RAMPS TO DAM CREST
- 3.2.1 REQUIREMENT
- 3.2.2 MEASUREMENT AND PAYMENT
- 3.3 EXCAVATION FOR NEW FOUNDATIONS
- 3.3.1 REQUIREMENT
- 3.3.2 NOTIFICATION
- 3.3.3 STRIPPING OF TOPSOIL
- 3.3.4 NEW FOUNDATION REQUIREMENTS
- 3.3.5 USE OF MATERIALS FROM FOUNDATION EXCAVATIONS
- 3.3.6 PRESERVATION OF FOUNDATIONS AND SURROUNDS
- 3.3.7 DIFFERENTIAL HEIGHT BETWEEN ZONES
- 3.3.8 LONGITUDINAL PROFILE FOR PLACEMENT ABOVE RL 47.5M
- 3.3.9 CATCH DRAINS
- 3.3.10 OVER EXCAVATION
- 3.3.11 CLEARING OF LOOSENED MATERIALS
- 3.3.12 MEASUREMENT AND PAYMENT

# Technical Specifications – Earthworks Clauses

- 3.4 CONSTRUCTION OF PERIMETER ACCESS ROAD
- 3.4.1 REQUIREMENT
- 3.4.2 REMOVAL OF EXISTING ROAD PAVEMENT
- 3.4.3 MEASUREMENT AND PAYMENT
- 3.5 CONSTRUCTION OF EMBANKMENT ZONE 3A
- 3.5.1 REQUIREMENT
- 3.5.2 SOURCE OF ZONE 3A
- 3.5.3 PREPARATION AND SELECTION OF MATERIAL
- 3.5.4 REQUIRED PROPERTIES
- 3.5.5 PLACEMENT OF ZONE 3A MATERIAL – FOUNDATION FLOOR
- 3.5.6 PLACEMENT OF ZONE 3A MATERIAL – ADJACENT TO ZONE 2B FILTER.
- 3.5.7 PLACEMENT OF ZONE 3A MATERIAL - GENERAL
- 3.5.8 INTEGRATION WITH EXISTING STOCKPILES
- 3.5.9 INTEGRATION WITH EXISTING BATTERS
- 3.5.10 COMPACTION REQUIREMENTS
- 3.5.11 RATE OF COMPACTION TESTING
- 3.5.12 MEASUREMENT AND PAYMENT

# **Technical Specifications – Earthworks Clauses**

- **3.6 CONSTRUCTION OF ZONE 2B**
- **3.6.1 REQUIREMENT**
- **3.6.2 SOURCE OF ZONE 2B**
- **3.6.3 REQUIRED PROPERTIES**
- **3.6.4 SURFACE PREPARATION**
- **3.6.5 PLACEMENT OF ZONE 2B MATERIAL**
- **3.6.6 COMPACTION REQUIREMENTS**
- **3.6.7 COMPACTION TESTING**
- **3.6.8 MEASUREMENT AND PAYMENT**
- **3.7 PREPARATION OF EXISTING ZONES 1A, AND 1B FOR PLACEMENT**
- **3.7.1 REQUIREMENT**
- **3.7.2 REMOVAL OF PROTECTIVE COVER MATERIALS FROM ZONES 1A AND 1B**
- **3.7.3 MEASUREMENT AND PAYMENT**

# **Technical Specifications – Earthworks Clauses**

- **3.8 CONSTRUCTION OF ZONES 1A & 1B**
- **3.8.1 REQUIREMENT**
- **3.8.2 SOURCES OF EARTHFILL**
- **3.8.3 SUPERINTENDENT'S RESTRAINT**
- **3.8.4 MATERIAL PROPERTIES**
- **3.8.5 PLACEMENT OF ZONES 1A AND 1B MATERIAL**
- **3.8.6 MOISTURE CONTENT**
- **3.8.7 BLENDING OF MATERIALS**
- **3.8.8 CONTAMINATION**
- **3.8.9 COMPACTION REQUIREMENTS**
- **3.8.10 COMPACTION TESTING**
- **3.8.11 COMPACTION EQUIPMENT**
- **3.8.12 MEASUREMENT AND PAYMENT**

# Technical Specifications – Earthworks Clauses

- 3.9 CONSTRUCTION OF RIP RAP LAYER
  - 3.9.1 REQUIREMENT
  - 3.9.2 SOURCE OF RIP RAP
  - 3.9.3 PREPARATION AND SELECTION OF MATERIAL
  - 3.9.4 REQUIRED PROPERTIES – RIP RAP TYPE 1
  - 3.9.5 REQUIRED PROPERTIES – RIP RAP TYPE 2
  - 3.9.6 PLACEMENT OF RIP RAP MATERIAL
  - 3.9.7 FILTER BLANKET LAYER
  - 3.9.8 COMPACTION REQUIREMENTS
  - 3.9.9 COMPACTION TESTING
  - 3.9.10 MEASUREMENT AND PAYMENT
- 3.10 CONSTRUCTION OF THE TAILINGS PIPELINE RAMP
  - 3.10.1 REQUIREMENT
  - 3.10.2 OPERATION OF THE RAMP
  - 3.10.3 SOURCE OF MATERIAL FOR PIPELINE RAMP
  - 3.10.4 REQUIRED PROPERTIES – TAILINGS PIPELINE RAMP
  - 3.10.5 PLACEMENT OF RAMP MATERIAL
  - 3.10.6 MEASUREMENT AND PAYMENT
- 3.11 CREST ACCESS ROAD CONSTRUCTION
  - 3.11.1 REQUIREMENT
  - 3.11.2 REQUIREMENT
  - 3.11.3 MEASUREMENT AND PAYMENT

# **Risk Assessment in Construction**

# **Risk Assessment in Construction**



# Case History - Common Mistakes

- Blockage of Diversion Channel – (Cowarra Dam)
- Incomplete Liner – (Cowarra Dam)
- Inadequate compaction – untrained personnel (Bulawan)
- “Reverse Christmas Tree” (Penrith)
- Sliding of Rip Rap on Geotextile (Maryvale)
- In appropriate use of Bentomat (Tamworth)
- Underdrains not effective
- Change of Piezometer Numbers
- Overtopping of Crest by Tailings