

**PARTICULAR SPECIFICATION CWD32**  
**CONVENTIONAL CONCRETE FOR DAMS**



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## PARTICULAR SPECIFICATION CWD32

### CONVENTIONAL CONCRETE FOR DAMS

#### CWD32.1 SCOPE

This specification comprises the requirements for concrete work (plain and reinforced) for dam construction. It covers the supply and standards of materials, the plant and formwork required, the quality, manufacture, cooling and curing of concrete, the tolerances in workmanship, tests and acceptance criteria.

#### CWD32.2 INTERPRETATIONS

##### CWD32.2.1 Supporting Specifications and Standards

This specification is supported by the specifications and standards referred to or contained elsewhere in this document.

##### CWD32.2.2 Definitions and Abbreviations

For the purpose of this specification the definitions and abbreviations given elsewhere in this document and the following definitions and abbreviations shall apply:

###### CWD32.2.2.1 General

Adverse weather. Cold weather, or weather in which

the ambient temperature is above 25°C, and

the relative humidity is low, or

high concrete temperatures, or

the wind velocity is high,

or weather in which any combination of these three conditions occurs, and which tends to impair the quality of fresh or hardened concrete or otherwise causes concrete to have abnormal properties. To assist in determining such conditions, Adverse Weather shall be deemed to be when the Evaporation Rate as calculated as shown in Appendix A exceeds 1.0 kg/m<sup>2</sup>/h.

Built-in parts. Built-in parts shall be deemed to refer to all reception frames and guide frames and similar parts of the hydraulic steelwork cast within second stage concrete after erection.

Cementitious Materials. Includes cement and Portland cement extenders

Cold weather. Weather conditions in which the ambient temperature is 5°C or less.

Concrete cover. The thickness of concrete between the face of the concrete and the outside of the nearest reinforcing steel.

Cool weather. Weather conditions in which the ambient temperature is higher than 5°C but not higher than 15°C.

Embedded parts. Embedded parts shall be deemed to refer to all anchor plates or carrier channels or similar parts of the hydraulic steelwork cast in with the primary concrete.

Fixture. An item such as a bolt, anchorage, bearing or similar component that is cast or grouted into concrete and would include built-in parts and embedded parts.

Formwork. Temporary works required to support and shape the concrete for a structure.

Hot weather. Weather conditions in which the temperature is higher than 32°C.

Normal weather. Weather conditions in which the ambient temperature is higher than 15°C but not higher than 32°C.

#### CWD32.2.2.2 Quality

Approved laboratory. A laboratory suitably equipped and staffed for purposes of concrete testing and as such approved by the Engineer.

Concrete class. A concrete class refers to strength concrete and is designated by the grade of concrete followed by the maximum nominal size of aggregate used in millimetres.

Consistency. The consistency relates to the wetness or dryness of the mix. The consistency of low-workability concrete is measured with the Vebe consistometer, whilst with normal workability concrete it is measured by the slump cone.

Grade of concrete. An identifying number for the concrete which is numerically equal to the specified 150 mm cube strength at 28 days measured in megapascals (MPa).

Prescribed mix concrete. Concrete for which the Engineer has prescribed the mix proportions.

Ready-mixed concrete. Concrete complying with the relevant requirements of the specification delivered on Site in a plastic state.

Strength concrete. Concrete designed primarily for strength.

Workability. The property of fresh concrete that determines the ease with which it can be placed and compacted without segregation of the constituent materials. The workability is measured by the compaction factor.

#### CWD32.2.2.3 Strength

Characteristic strength. The concrete strength stated in the Contract, which in all cases represents the strength below which not more than 5 % of valid 28-day compressive strength test results, obtained on 150 mm cubes of concrete of the same class, may fall. For mass concrete with a specified grade of 15 MPa or lower, the 5% failure rate may be increased to 10% at the discretion of the Engineer.

Specified strength. The characteristic strength specified on the Drawings.

Target strength. An average value of the strength of concrete that is higher than the specified strength to ensure that the specified strength is attained.

Valid test result. The average result obtained from the compression testing of three 150 mm test cubes of concrete in accordance with SANS 5863.

#### CWD32.2.2.4 Abbreviations

FA	Fly ash
GBS	Ground granulated blast furnace slag
PC	Portland Cement
W:C Ratio	Water: Cement ratio

**CWD32.2.3 Explanation of Terms****CWD32.2.3.1 Exposure Conditions****(a) Mild Conditions**

Conditions under which the concrete is protected from the weather and exposed only to air.

**(b) Moderate Conditions**

Conditions under which the concrete is

- (i) sheltered from severe rain and is not subject to freezing when wet; or
- (ii) buried in non-aggressive soil; or
- (iii) continuously under fresh water.

**(c) Severe Conditions**

Conditions under which the concrete is exposed or subject to any of the following :

- (i) driving rain;
- (ii) alternate wetting and drying;
- (iii) freezing when wet;
- (iv) fresh water (at the water line);
- (v) splashing or spraying with fresh water;
- (vi) corrosive fumes or heavy condensation of water;
- (vii) aggressive soil;
- (viii) salt laden air.

**(d) Very Severe Conditions**

Conditions under which the concrete is exposed to any of the following :

- (i) sea water (below or at the water line);
- (ii) sea water spray or windborne salts;
- (iii) water containing sulphates or chlorides;
- (iv) highly corrosive fumes.

**CWD32.2.3.2 Strength Concrete**

A strength concrete is referred to by the concrete class and designated by its specified grade in MPa and the maximum nominal size of coarse aggregate in mm used in its manufacture, e.g. Class 25/75 refers to a grade 25 mix made with 75 mm maximum size coarse aggregate.

**CWD32.2.3.3 Joints****(a) Designated Joints**

All joints shown on the Drawings.

**(b) Movement Joints**

These joints can be of the expansion or contraction type and allow the adjacent concrete sections to move relative to each other.



## (c) Construction Joints

A joint between concrete sections which requires a firm bond. Construction joints shall be located only where shown on the Drawings or approved by the Engineer. Where the Contractor proposes construction joints other than those shown on the Drawings these proposals shall be submitted to the Engineer for his approval at least 28 days prior to the concrete pour. If approved, such joints shall become designated joints.

## (d) Unforeseen Joints

This type of joint arises during a halt in a concreting operation as a result of plant failure, inclement weather or other unforeseen circumstances. This creates a construction joint.

**CWD32.3 MATERIALS****CWD32.3.1 Approval of Materials**

The Contractor shall supply to the Engineer eight weeks prior to the commencement of concreting, adequate samples of aggregates, cementitious materials, additives and water, for his approval. In addition, the Contractor shall supply full details of source, delivery and storage arrangements together with a full set of relevant test results/certificates from an approved laboratory that the water and aggregates comply with the requirements of this specification.

**CWD32.3.2 Cementitious Materials****CWD32.3.2.1 Applicable Specifications**

The cementitious materials to be used in the Works shall comply with the requirements of the following specifications, as appropriate :

- BS 1370 Specification for low heat portland cement
- SANS 50197 Part 1: Composition, specifications and conformity criteria for common cements.
- SANS 1491 (Part I) Portland cement extenders. Part I : Ground granulated blast furnace slag
- SANS 1491 (Part II) Portland cement extenders. Part II : Fly ash

All cementitious materials shall bear the official mark of the appropriate standards authority.

For the purpose of reducing the alkali-silica reaction, the equivalent available sodium oxide content of the MGBS or FA shall not exceed 1,5 %.

Cements other than CEM I 42,5 N shall only be used with the prior approval of the Engineer after the Contractor has submitted full details explaining the reasons for using this type of cement and what measures he intends to take to minimise the effects of the increased heat of hydration and the slower rate of gain of long-term strength.

**CWD32.3.2.2 Storage of Cementitious Materials**

Separate facilities shall be provided for each type and origin of cementitious materials. Cementitious materials may be delivered in bulk or in multi-walled paper bags. The Contractor shall supply to the Engineer on a daily basis, copies of the delivery notes which shall include details of supplier, date of manufacture and factory of manufacture. Storage facilities shall provide adequate protection against moisture and other factors which can cause deterioration of the materials. The design of silos shall ensure that no dead-spots can form. Storage sheds for material supplied in bags shall ensure that the bags will not be in contact with the ground or the outside walls. At no time shall the stacks exceed 12 bags in height.

The Contractor shall ensure that the oldest material is used first and any material older than 10 weeks or which has become contaminated shall be immediately removed from Site. The Contractor shall provide sufficient storage capacity to cater for 2 weeks peak production of concrete.

**CWD32.3.3 Water**

Water shall be clean and free from detrimental concentrations of acids, alkalis, salts, sugar, organic matter and other chemical substances and petroleum products. The Contractor shall provide adequate storage

tanks on Site to ensure no interruption of the concreting operations and these tanks shall be so constructed that no contamination of the water can occur.

#### CWD32.3.4 Aggregates

##### CWD32.3.4.1 General

The Contractor shall construct storage facilities that :

- (a) provide adequate capacity to ensure no interruption to the construction,
- (b) provide separate storage areas for different types and sizes of material,
- (c) ensure there is no intermixing or contamination by deleterious matter,
- (d) ensure there is no segregation,
- (e) ensure that the aggregates are shaded from direct sunlight during periods of adverse weather, and
- (f) restrict the height of stockpiles to less than 3 m in order to prevent breaking down of particles.

##### CWD32.3.4.2 Coarse Aggregates (Stone)

The coarse aggregates shall meet the requirements of stone for concrete in SANS 1083, except the grading which shall meet the requirements of Table CWD32.1 and shall not have any property, which in the opinion of the Engineer, could adversely affect the concrete.

Table CWD32.1 : Coarse Aggregate Grading

SIEVE SIZE (MM)	MASS (%) PASSING			TEST METHOD
	SIZE CLASS			
	53,0 - 37,5	37,5 - 19,0	19,0 - 4,75	
75	100			SANS 201
53	85-100	100		
37,5	0-15	85-100	100	
28,5	0-5	20-45	100	
19	0	0-10	90-100	
9,5		0-5	30-55	
4,75			0-5	SANS 201
Dust content, material that passes a 75 micron sieve, (mass %, max)			2	

The coarse aggregate shall be separated and separately stockpiled in 53,0 mm, 37,5 mm, 28,5 mm, 19,0 mm and 9,5 mm nominal sizes of stone or sizes as directed by the Engineer.

The stone shall be tested for the following properties:

**Table CWD32. 2 : Coarse Aggregate Properties**

PROPERTY	VALUE	TEST METHOD
10 % FACT value of less than 13,2 mm and more than 9,5 mm fraction (dry), kN (min)	110	SANS 5842
Flakiness index (% max)	35	SANS 5847
Shape (voids content, % max)	48	SANS 5845
Soundness and durability (loss in mass, % max) (sodium and magnesium sulphate method)	8	ASTM C88
Abrasion resistance (% max)	48	SANS 5846
Content of material of low density (each size fraction, % max)	2	SANS 5837
Water absorption (% max)	1	SANS 5843

The aggregate shall meet the requirements of a structure where shrinkage is important.

#### CWD32.3.4.3 Fine Aggregate (Sand)

The fine aggregate shall meet the requirements of sand for concrete in SANS 1083, except the grading which shall meet the requirements of Table CWD32.3 and shall have no property which, in the opinion of the Engineer, could adversely affect the concrete.

**Table CWD32.3 : Fine Aggregate Grading**

SIEVE SIZE	MASS (%) PASSING		TEST METHOD
	LOWER LIMIT	UPPER LIMIT	
6,7 mm	100	98	SANS 201
4,75 mm	100	95	
2,36 mm	95	80	
1,18 mm	90	60	
0,600 mm	70	40	
0,200 mm	35	15	
0,150 mm	10	5	
0,075 mm	5	0	

The sand may be of either class specified in Table 1 of SANS 1083 or may be a blend of both classes. The Fineness Modulus shall be between 2,0 and 3,2 and if necessary shall be achieved by the blending of at most two types of sand. Different types and classes of sand shall be separately stockpiled. The Contractor shall submit for approval the Fineness Modulus that he proposes to adopt for the sand and after approval the actual value of the Fineness Modulus shall not differ from the approved value by more than 0,2.

The sand shall be tested for the following properties:

**Table CWD32. 4 : Fine Aggregate Properties**

PROPERTY	VALUE	TEST METHOD
Methylene absorption value (max)	0,7	SANS 6243
Clay content material < 5 micron (mass, % max)	2,0	SANS 6243
Chloride content, expressed as Cl (mass, % max)	0,03	SANS 202
Organic impurities	< 3	SANS 5832
Presence of sugar	0	SANS 5833
Non-soluble deleterious material including material of low density in each size fraction (% max)	2	SANS 5837
Water absorption	1,0	SANS 5843

The aggregate shall meet the requirements of a structure where shrinkage is important.

#### CWD32.3.4.4 Use of Plums

The use of plums will not be permitted.

**CWD32.3.5 Admixtures**

Admixtures shall not be used in any concrete mix without the prior approval of the Engineer and shall be subject to the conditions specified by the Engineer. If admixtures are used, they shall conform to ASTM C494. Any request from the Contractor for such approval shall include the following information :

- (a) The trade name of the admixture, its source and the manufacturer's recommended method of use.
- (b) Typical dosage rates and the effects of underdosage and overdosage.
- (c) Details of the admixture's composition and in particular the chloride content.
- (d) The Contractor's proposed method of use and control.

**CWD32.3.6 Reinforcement**

The reinforcing bars shall comply with the requirements of SANS 920 and shall bear the official mark of the SABS. The different types of reinforcement given in Clause 3.1 of SANS 920 are shown on the Drawings with the following designations :

- R : hot-rolled mild steel bars of plain round cross-section,
- Z : hot-rolled mild steel deformed bars, cold-worked to increase yield stress,
- Y : hot-rolled high yield stress steel deformed bars.

Welded steel fabric shall comply with the requirements of SANS 1024.

All reinforcing steel shall be stored on Site in such a manner as to avoid distortion and shall be protected from aggressive environments and contamination from foreign matter. Bars shall be clearly marked either individually or in bundles with their code numbers immediately after cutting and/or bending, and before fixing commences.

**CWD32.4 PLANT****CWD32.4.1 Batching Plant****CWD32.4.1.1 General**

The Contractor shall ensure that, irrespective of the equipment used, batching of new material cannot proceed until the weighing hoppers have been completely emptied of the previous batch and the scales are completely in balance. When concrete production is initiated, the batching and mixing plant will have been adequately tested and calibrated to ensure complete compliance with the related specifications. Material not complying with this specification shall be rejected and any placed concrete shall be removed, as directed by the Engineer.

**CWD32.4.1.2 Materials Feed**

Aggregates shall be fed to the batch plant bins by an approved method. Hoppers shall have indicators and a light bar visual to the operator indicating level of aggregates. Where reclaim conveyors are used, there shall be at least two feeders per conveyor. The feeders shall be capable of adjustable feed rates controllable by the plant operator and by the plant's electronic control system.

**CWD32.4.1.3 Bins and Silos**

Separate bins or compartments shall be provided for each size of aggregate. The bins shall have steep side slopes, large gate openings, and be capable of handling the aggregate in a damp condition without choking. The bins shall be so arranged as to avoid the possibility of cross contamination of aggregate sizes.

If so specified in the Project Specification, facilities for the introduction of chilled air for the cooling of aggregates in the batch plant storage bins must be applied.

**CWD32.4.1.4 Weigh Batchers**

Aggregates shall be weighed in separate weigh batchers with individual scales and cements and pozzolans shall each be weighed on a separate scale in a separate weigh batcher. Water may be measured by weight or by volume. If measured by weight, it shall not be weighed cumulatively with another ingredient. Admixtures may be batched by weight or by volume. The weigh batchers shall be arranged so as to permit the convenient addition, or removal of material.

The batching and mixing plant shall have a realisable reserve capacity of at least 30 % of the required maximum placement rate.

**CWD32.4.1.5 Water Batchers & Dispenser**

A suitable water measuring device shall be provided which will be capable of measuring the mixing water within the specified requirements for each batch. The mechanism for delivering water to the mixers shall be free from leakage when the valves are closed. The filling and discharge valves for the water batcher shall be interlocked so that the discharge valve cannot be opened before the filling valve is fully closed. When a water meter is used, a suitable strainer shall be provided ahead of the metering device. Water delivery pipes shall be free of leaks downstream of the measuring device.

The dispenser shall be interlocked with the electronic plant control and shall warn the operator and shut down the plant if insufficient liquid is available.

**CWD32.4.1.6 Moisture Control**

The plant shall allow the simple adjustment of the materials batch weights to compensate for variations in the aggregate moisture content, as determined by manual measurement, or by moisture content probes.

**CWD32.4.1.7 Admixture Dispensers**

A separate batcher or dispenser shall be provided for each admixture. Volumetric dispensers shall be used only for liquid admixture and each plant shall be equipped with the necessary calibrated devices that will permit convenient checking of the accuracy of the dispensed volume of the particular admixture. The batching or dispensing devices shall be capable of repetitively controlling the batching of the admixtures to the accuracy specified. Piping for liquid admixtures shall be free from leaks and properly valved to prevent backflow or siphoning. The dispensing system shall include a device or devices which shall either detect and indicate the presence or absence of flow of the admixture, or provide a convenient means of visually observing the admixture in the process of being batched or discharged. Each system shall be capable of ready adjustment to permit variations of the quantity of admixture to be batched. Each dispenser shall be interlocked with the batching and discharge operations so that each admixture is added separately to the batch in solution in a separate portion of the mixing water, or of the fine aggregate, in a manner that ensures uniform distribution of the admixtures throughout the batch during the required mixing period.

The nozzles of admixture dispensers shall be maintained in a clean and fully operational condition at all times.

**CWD32.4.1.8 Scales**

Adequate facilities shall be provided for the accurate measurement and control of each of the materials entering each batch of concrete. Standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device must be provided. Tests shall be made in the presence of the Engineer prior to the start up of concrete placing and at least monthly thereafter. Each weighing unit shall include a visible springless dial which shall indicate the scale load at all stages of the weighing operation. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials and indicators. The minimum acceptable scale measurement accuracy shall be 0.5% in respect of water and cementitious materials and 1% in respect of aggregates.

**CWD32.4.1.9 Cement, Pozzolan and Aggregate Feed**

Cement, pozzolan and aggregates shall be uniformly fed into the mixer by belt, auger, vane feeder or other acceptable method. The feed bins shall be equipped with a low level indicator that both warns the operator and can shut the plant down in case of insufficient material availability to ensure adequate materials for batching.

**CWD32.4.1.10**

O

Operation and Accuracy

The measuring operation of each material shall start when actuated by one or more starting mechanisms and stop automatically when the designated weight or volume of each material has been reached. They shall be interlocked in such a manner that the discharge device cannot be actuated until the indicated quantity of material is within the applicable tolerance. The plant shall be arranged so as to facilitate the inspection of all operations at all times.

The control system shall be capable of changing mix designs instantaneously, producing at least 16 different mix designs, producing any of the mix designs at a variable production rate and tracking the mix change either to a hopper or a conveyer system. The control panel shall display the designed formula values and the instantaneous percentage values, or actual measured masses, for each ingredient and shall record the values at a preset time interval, or on demand, with a multiple copy printer/recorder.

The plant control shall be automatic and shall not require manual intervention to adjust the material flow. The plant shall further possess the capability of full manual operation for a single concrete at a time, at limited production and for short periods, in the event of loss of electronic control. The electronic control system shall incorporate modular replaceable components to reduce down time in the event of a control system malfunction. An inventory shall be maintained of such replaceable components.

The moisture content of the fine aggregate shall be monitored using a device that takes measurements immediately prior to dispensing into the mix plant weigh out system.

Delivery of materials from the batching equipment shall be within the limits of accuracy given in Table CWD32.5.

**Table CWD32.5 : Limits of Accuracy for Batching Equipment**

MATERIAL	PERMISSIBLE VARIATION (%)
Cement	+2
Pozzolan	+2
Water	+2
Aggregate smaller than 37 mm	+3
Aggregate larger than 37 mm	+3
Admixtures	+3

## CWD32.4.1.11

R

recorders

An accurate recorder or recorders shall be provided for the aggregates and cementitious materials. The recorder shall note formula changes and shall print total quantities of each ingredient and total weights produced on demand. The weights or volumes of water and admixtures shall also be recorded. The recorders shall conform to the following requirements:

- (a) The recorders shall produce a graphical record on a single visible screen and a digital record on a hard drive of the weight or volume of each material in the batchers at the conclusion of the batching cycle. A printed record shall be produced prior to delivery of the materials to the mixer. After the batchers have been discharged, the recorder shall reflect the return to empty condition.
- (b) Graphical recording units shall be completely housed in lockable cabinets.
- (c) The printed records shall be so marked that each batch may be permanently identified and so that variation in batch weights of each type of batch can be readily observed.
- (d) The printed record shall indicate the time of day at intervals of not more than 15 minutes.
- (e) The printed records shall become the property of the Engineer.
- (f) The recorders and readout screens shall be placed in a position convenient for observation by the concrete plant operator and the Engineer.
- (g) The recorded weights or volumes, when compared to the weights or volumes actually batched, shall be within the limits of accuracy specified in Table CWD32.6.

Table CWD32.6 : Limits of Accuracy for Recording Equipment

MATERIAL	PERMISSIBLE VARIATION (%)
Cement & Pozzolan	+2
Water	+2
Aggregate	+2

## CWD32.4.1.12

B

Batch Counter

The plant or the mixers shall include a device for automatically counting the total number of batches of concrete mixed.

## CWD32.4.1.13

P

Protection

The weighing, indicating, recording and control equipment shall be sufficiently protected against exposure to dust, moisture and vibration to eliminate interference with the proper operation of the equipment.

## CWD32.4.2 Mixing Plant

CWD32.4.2.1 General

The Contractor shall ensure that the type and capacity of the mixing plant is such that the rate of output of concrete is suitable for the rate of concrete placement. Each mixing machine shall be capable of producing a uniform distribution of the ingredients throughout the batch. Worn or bent blades shall be replaced and inner surfaces of the mixer shall be kept clean and free of hardened concrete. Blades worn by more than 15 % of their depth shall be replaced. The mixers shall not be charged in excess of the capacity recommended by the manufacturer and the drum, or mixing blade speed designated by the manufacturer shall not be exceeded.

Mixers shall be batch type. Continuous mixers shall not be allowed. Only twin horizontal shaft mixers capable of thorough mixing of the constituent materials, split drum, or other approved types of mixer shall be used. The mixing period shall be sufficiently long to ensure the complete and thorough mixing of materials. It shall remain the Contractor's responsibility to prove the adequacy of the mixing time proposed. The plant shall be equipped with at least two interchangeable mixers, each of adequate reserve capacity for at least 30 % production above the required maximum concrete placement rate.

The Engineer reserves the right to order that the mixing time be set to some period which, in his opinion, is required to achieve thorough mixing. The mixing time shall be increased when such increase is necessary to secure the required uniformity and consistency of the concrete. Excessive over-mixing requiring additions of water will not be permitted.

When the Contractor proposes to reduce the mixing time, three uniformity tests at the proposed (reduced) mixing time will be made under the supervision of the Engineer. These tests will determine whether the reduced mixing time will produce concrete that meets the requirements of this specification. Suitable facilities shall be provided for obtaining representative samples of concrete for uniformity tests. All necessary platforms, tools, and equipment for obtaining samples shall be furnished.

In order to allow the consideration of a reduced mixing time, the Contractor must prove that, when tested for each of the following, each of three samples taken from the mix produced reflects variations within the ranges given in Table CWD32.7, when compared to a mix produced according to the approved mixing time:

Table CWD32.7 : Ranges of Variations in Mixing Times

TEST	ALLOWABLE VARIATION COMPARED TO ORIGINAL MIXING TIME
Water content of mortar, percent by weight	85 – 115
Coarse aggregate content of concrete, percent by weight	90 – 110
Unit weight of air-free mortar	96 – 104
Cement content of dried mortar, percent by weight	80 – 120

Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

#### CWD32.4.3 Vibrators

Except for thin sections where vibrating shutters may be employed, the Contractor shall use suitably sized internal vibrators on the Works. The Contractor shall provide one standby vibrator for every three or less vibrators necessary for the rate of placing. Internal vibrators shall operate at a frequency of between 100 cycles per second and 200 cycles per second.

#### CWD32.4.4 Formwork

##### CWD32.4.4.1 Design

The formwork shall be so designed and constructed that the concrete can be properly placed and compacted to the required shapes, finishes, positions, levels and dimensions as shown on the Drawings and subject to the tolerances given in Clause CWD32.6. The formwork and joints shall be capable of resisting the dead load, including the pressure exerted by the wet concrete, wind forces and all other superimposed loads and forces. The Contractor shall submit for the Engineer's approval, full details of the type and design of formwork proposed by him. This shall include details of all measures to ensure the safety of personnel working in and around the area affected by the concreting operation.

##### CWD32.4.4.2 Finish

The quality of the formwork shall be such that the finished surface shown on the Drawings is consistently produced.

##### CWD32.4.4.3 Ties

The type and design of any embedded tie employed in the Works shall be such that it can be installed with at least 50 mm clearance to any finished concrete surface or reinforcement. Ties shall be installed to a regular pattern and shall not mar the surface finishes. The Contractor shall submit details of all proposed ties to the Engineer for approval.

#### CWD32.4.5 Cooling Equipment

The Contractor shall provide cooling equipment previously approved by the Engineer. The capacity of the equipment shall be such that the programmed production rate of the concrete can be maintained during any concreting operation. Sufficient standby equipment shall be available to ensure that concreting will not be interrupted. Where liquified nitrogen or other coolant is used the supplies on Site shall be sufficient for 2 weeks peak production of concrete.

##### CWD32.4.5.1 Temperature Reading Equipment

The Contractor shall supply the following equipment :

- (a) A digital type immersion thermometer to measure placing temperatures on the dam wall. It shall have a penetration probe length of approximately 700 mm and a temperature range from zero to 50°C (to an accuracy of 0,5°C).
- (b) A minimum and maximum thermometer to measure the ambient temperature at the sites of both the mixing plant and of placing concrete. It shall have a temperature range of minus 10°C to plus 60°C (to an accuracy of 0,5°C) and record the minimum temperature during the night and the maximum temperature during the following day.



- (c) A sling hygrometer comprising a thermometer bulb permanently wetted as well as a normal thermometer.

Permanent temperature probes may be cast into various portions of the concrete works and this is covered by Particular Specification CWD35.

## **CWD32.5 CONSTRUCTION**

### **CWD32.5.1 Reinforcement**

#### **CWD32.5.1.1 Cutting**

No flame cutting of high yield steel bars shall be permitted without prior authorisation from the Engineer.

#### **CWD32.5.1.2 Bending**

Reinforcing bars shall be bent to the dimensions shown on the Drawings and in accordance with SANS 282. Subject to the approval of the Engineer and provided that the bars do not depend for their strength on cold working, bars of diameter 32 mm or more may be bent hot. They shall be heated slowly to a temperature not exceeding 840°C (cherry red heat) and after bending be allowed to cool slowly in air. Hot bars shall not be quenched in water. Except as provided for above, all bars shall be bent cold and this shall be carried out slowly with a steady, even pressure without jerking or impact. Already bent reinforcing bars shall not be rebent at the same spot.

#### **CWD32.5.1.3 Fixing**

The Contractor shall ensure that, at the time of placing concrete, all steel is free from loose or powdery rust, scale, oil and other coatings that may reduce the bond between steel and concrete, affect the durability of the concrete or initiate corrosion in the reinforcement. If any material other than water is used for lubricating the formwork, every precaution shall be taken to avoid contamination of the reinforcement. Reinforcement shall be positioned as shown on the Drawings and maintained in those positions with the permissible deviation to Degree of Accuracy II as specified in Clause CWD32.6, unless otherwise shown on the Drawings or ordered by the Engineer. The reinforcement shall be secured by tying at intersections with annealed wire of nominal diameter 1,6 mm or 1,25 mm or by the use of acceptable clips. Reinforcement shall be supported in its correct position by means of hangers or saddles and aligned by chairs and spacers. Welding of reinforcement will not be permitted.

#### **CWD32.5.1.4 Cover**

The reinforcement shall be fixed to ensure the minimum concrete cover as specified on the Drawings is maintained between the outside of any bar or stirrup and the face of the concrete. The permissible deviation shall be to Degree of Accuracy II as specified in Clause CWD32.6, unless otherwise shown in the Drawings or ordered by the Engineer. Any cover or spacer blocks used to maintain the concrete cover shall be as small as possible and be of an approved material and design.

### **CWD32.5.2 Formwork**

#### **CWD32.5.2.1 Classification of Finishes**

In addition to complying with the tolerances specified in Clause CWD32.6 of this specification, the class of surface finish on formed concrete surfaces as shown on the Drawings shall also comply with the following requirements :

##### **(a) Class F1**

After repair work has been carried out to any surface defects in accordance with Clause CWD32.5.5.18, no further treatment is required to the as-stripped surface. The finish of the concrete surface will not be more accurate than Degree of Accuracy I as defined in Clause CWD32.6.

Formwork may be either of timber or steel provided it does not leak mortar during concreting.

## (b) Class F2

Imperfections such as small fins, bulges, irregularities, surface honeycombing and slight surface discolourations shall be made good and repaired in accordance with Clause CWD32.5.5.18. The finish of the concrete surface shall be accurate to Degree of Accuracy II as defined in Clause CWD32.6. All abrupt irregularities shall be removed by grinding on a bevel of 1:10 height to length ratio.

Formwork may be either of plywood or steel. The formwork shall be fixed rigidly to ensure no visual depressions or marks are formed on the concrete surface and such that the concrete surface will have a uniform texture without any stains.

Except where another class of surface finish is shown on the Drawings, Class F2 surface finish shall apply.

## (c) Class F3

This classification relates to surface finishes exposed to public view where appearance is of special importance. All projections shall be removed, irregularities repaired and the surface rubbed and polished to obtain a smooth finish of uniform texture, appearance and colour over the whole surface, according to the process described in Clause CWD32.5.5.18. The finish of the concrete surface shall be to a Degree of Accuracy III as specified in Clause CWD32.6. All abrupt irregularities shall be removed by grinding on a bevel of 1:20 height to length ratio.

Formwork shall only be approved plywood or tongue-and-groove boards, except in certain cases such as for precast units where permission may be granted to use steel formwork provided that sufficient vibration is used. All internal joints between formwork panels shall be sealed by means of adhesive sealing tapes as approved by the Engineer in order to prevent the leakage of any mortar or moisture from the joints.

After treatment of the surface curing of the surface shall be ensured as specified in Clause CWD32.5.5.18.

## (d) Class F4

This classification relates to special hydraulic surfaces where indicated on the Drawings. The finish of the concrete surface shall be to Degree of Accuracy IV as specified in Clause CWD32.6.

Formwork used shall have an absorptive lining, so that the concrete subjected to the flow of water is given a dense surface having a high degree of resistance to abrasion, free from voids, air holes and other defects. All internal joints between formwork panels shall be sealed by means of adhesive sealing tapes as approved by the Engineer in order to prevent the leakage of any mortar or moisture from the joints.

The finish shall be of such a standard that no surface treatment is required after removal of formwork, except for the removal of abrupt irregularities as described for Class F3 surface finish and the specified curing.

CWD32.5.2.2 Preparation of Formwork

All formwork shall be securely erected to achieve the specified degree of accuracy required of the finished concrete. The joints shall be suitably treated to ensure that there is no loss of mortar from the newly placed concrete. Prior to placing concrete, all foreign matter shall be carefully removed from within the section to be cast. Surfaces of forms that are to be in contact with fresh concrete shall be treated with a coat of non-staining mineral oil or other approved material to ensure easy release and prevent adhesion of the formwork during stripping.

CWD32.5.2.3 Re-use of Formwork

All formwork which the Contractor proposes to re-use shall be reconditioned and surfaces that are to be in contact with concrete shall be thoroughly cleaned.

CWD32.5.2.4 Temporary openings

Where necessary for the proper placing of the concrete, temporary openings for cleaning, inspection or placing purposes shall be provided. The method of closure shall be compatible with the required class of finish and the tolerances specified in Clause CWD32.6.

**CWD32.5.2.5 Removal of Formwork**

Formwork shall not be removed before the concrete has attained sufficient strength to ensure that it will not be damaged when the formwork is removed and to support its own weight and any loads that may be imposed on it. Formwork shall be removed carefully so that shock and damage to the concrete is avoided. The formwork shall remain in place, after completion of the concrete placing, for the minimum period given in Table CWD32.8, unless the Contractor proves to the satisfaction of the Engineer that a shorter period will meet the requirements given earlier in this paragraph.

The formwork removal times for members with on Site blends of MGBS or FA shall be determined by the Engineer based on the results of the trial mixes.

The provisions of this clause do not relieve the Contractor of his responsibility to make good any damage to the concrete arising from the removal of formwork or its supports.

**Table CWD32.8 : Removal of formwork - minimum time in days**

TYPE OF STRUCTURAL MEMBER OR FORMWORK	TYPE OF CEMENT			
	CEM I AND CEM II		CEM III	
	WEATHER			
	HOT OR NORMAL	COLD	HOT OR NORMAL	COLD
(a) Beam sides, walls, unloaded columns and sides of mass concrete sections	1,0	1,5	2	4
(b) Slabs with props left underneath	4	7	6	10
(c) Beam soffits with props left underneath	7	12	10	17
(d) Slab props including cantilevers	10	17	10	17
(e) Beam props, including cantilevers	14	21	14	21

NOTE : 1 day = 24 hours

**CWD32.5.3 Pipes, Conduits and Other Embedded Items**

No pipes, conduits or other embedded items, other than those shown on the Drawings, shall be permanently embedded in the concrete without the prior approval of the Engineer.

The Contractor shall ensure that any item to be cast into the concrete is securely fixed into position prior to beginning the concreting operation and in this regard the Contractor shall refer to requirements stated in the relevant specification. The special requirements for cooling of pipework during concreting and curing are stated in the relevant specification. The Contractor shall submit to the Engineer for his approval, details of the methods proposed for fixture and protection during concreting. Any item to be cast into a concrete section shall be clean of all foreign matter which will reduce the bond or contaminate the concrete during placing. The Contractor shall ensure that any open ends are protected against the ingress of concrete into the pipe, conduit or other item being cast in.

**CWD32.5.4 Holes and Chases**

No holes or chases, other than those shown on the Drawings or approved by the Engineer, shall be cut or otherwise formed in the concrete. The methods proposed by the Contractor for forming or cutting holes and chases shall be approved by the Engineer.

**CWD32.5.5 Concrete****CWD32.5.5.1 Strength Concrete**

The Contractor shall be responsible for the design of strength concrete which shall meet the requirements specified in Table CWD32.11 (at end of this Specification). If any material constituent changes during the construction, all new mixes shall be submitted to the Engineer for approval.

**CWD32.5.5.2 Trial Mixes**

The Contractor shall carry out a series of trial mixes using the constituent materials approved for use in the Works, for the approval of the Engineer, to determine the proportions of the constituent materials required to achieve maximum concrete density and durability, based on the minimum requirements of Table CWD32.11. If, during the course of the Contract, the concrete-making properties of the constituent materials have altered

or, the concrete mix, in the opinion of the Engineer, is failing to meet the requirements of the Specification or showing signs of excessive segregation or bleeding, the Contractor shall as part of his obligations in terms of the Contract carry out a further series of trial mixes to determine the revised mix proportions. The requirements for testing of the various aspects of the trial mixes are given in Clause CWD32.7. In addition to the properties listed in Table CWD32.11 the Contractor's report on the trial mixes shall give full details of the constituent materials used in the trial mixes and also the results of 7-day compressive strength tests conducted on 150mm concrete cubes as well as the concrete cube densities.

#### CWD32.5.5.3 Workability

The workability shall be measured in terms of the compacting factors and tests shall be carried out in accordance with SANS 5882. The compacting factors shall not be less than those given in Table CWD32.11 for the appropriate concrete class designation. The concrete shall be of such workability that it can be readily compacted into the corners of the formwork and around reinforcement without segregation of the materials or excessive bleeding of the free water at the surface.

#### CWD32.5.5.4 Chloride Content

The maximum permissible amount of chloride ion present in the concrete is given in Table CWD32.9 expressed as a percentage by mass of the cementitious material content.

Table CWD32.9 : Maximum chloride content (Percentage by mass of cementitious material)

TYPE OF CONCRETE			
MASS CONCRETE	REINFORCED AND POST-TENSIONED CONCRETE	PRETENSIONED CONCRETE	
		WIRES WITH DIAMETER OVER 5 mm	WIRES WITH DIAMETER OF 5 mm AND LESS
0,30	0,30	0,08	0,05

#### CWD32.5.5.5 Batching

All constituents of the mix shall be batched in the proportions determined by the trial mixes or as otherwise directed. Provision shall be made for determining the moisture content of the aggregates and adjusting the mass of aggregates and the quantity of mixing water accordingly throughout any particular concreting operation.

At the end of every week a concreting materials reconciliation statement shall be prepared by the Contractor of the cement and of each aggregate fraction that is in storage at the end of the week and that has been delivered and batched during that week as well as of each class of concrete cast during that week, and immediately be delivered to the Engineer.

#### CWD32.5.5.6 Mixing

The mixing of materials for concrete shall be conducted by an experienced operator. The sequence of charging the mixing plant shall be approved prior to commencing the concreting operations and this sequence shall be maintained unless otherwise approved by the Engineer. The minimum mixing periods shall be as approved by the Engineer, but shall not be less than those recommended by the manufacturer. The maximum mixing periods, measured from the time when all the constituent materials are in the drum or pan to the commencement of discharge, shall not exceed 10 minutes and 6 minutes per batch for drum-type and pan-type mixers respectively. On commencing work with a clean mixer, the first batch shall contain only 50 % of the normal quantity of coarse aggregate so as to compensate for the finer materials which adhere to the mixer. This batch shall be mixed for at least a minute longer than the normal time.

The quantity of the mixed material per batch shall not exceed the manufacturer's rated capacity of the mixer. No ingredients shall be added while the mixer is stationary and excessive over-mixing requiring the addition of water to preserve the required concrete consistency shall not be permitted. Any batch of concrete which cannot be discharged within the specified maximum mixing time shall not be used in the Works.

The discharge shall be arranged so that there is no segregation of the materials in the mix. The mixer shall be completely emptied before it is recharged. If the mixer has been out of use for longer than 30 minutes, it shall be thoroughly cleaned. Particular attention shall be given to removing any build-up of material in and around the mixer.

CWD32.5.5.7 Transportation

The Contractor shall submit full details to the Engineer for his approval, of his proposals for transporting fresh concrete from the mixer to the placing points. These proposals shall ensure that there is no segregation, loss of ingredients or contamination by foreign matter. In addition, the transporting system shall ensure that the mix is of the correct temperature and workability at the place and time of placing.

CWD32.5.5.8 Placing

No concrete shall be placed when the temperature is at or below 2°C or when indications are that the temperature will drop below 2°C within the next 5 hours. This decision rests solely with the Engineer. During cold weather, when the temperature remains below 2°C for extended periods, the concrete shall be protected by means of tarpaulins, straw covering or similar means, to the approval of the Engineer, for at least 5 days after placing.

The Contractor shall give the Engineer at least 24 hours notice in writing of his intention to place concrete in a particular section of the Works. This notice shall include the proposed time of commencement and the total volume of concrete to be placed. Concreting shall only be placed in any part of the structure after the forms, staging, reinforcing steel, concrete surfaces, water stops, embedded parts, bearing assemblies and/or cable sleeves, mandrels and anchors, as well as preparations for casting have been inspected and approved in writing by the Engineer.

Concrete or rock surfaces to receive concrete shall be prepared as specified in Clause CWD32.5.5.16.

The concrete shall be placed and consolidated within 30 minutes of being discharged from the mixer unless otherwise approved by the Engineer and approved agitators are used and at no stage shall it be re-tempered by the addition of water or any other material.

The forms to be filled shall be clean internally. All surfaces of an absorbent nature that are to come in contact with the concrete shall be dampened with water. There shall be no free water on the surfaces against which concrete is to be placed.

Immediately before concreting, any pools of water shall be blown from the concrete or rock surfaces. Thereafter a 20 mm thick mortar conforming to the requirements specified for foundation surfaces (Clause CWD32.5.5.16) shall be applied just before starting to place the fresh concrete, taking care also not to let the mortar become dry or start to set. The concrete shall be placed immediately on the fresh mortar. If in the opinion of the Engineer the local presence of persistent seepage may weaken the mortar as a bedding layer, a 19 mm concrete shall be used in lieu of the mortar as a bedding layer with the same grade as that of the concrete.

Wherever possible, the concrete shall be deposited vertically into its final position to avoid segregation and displacement of reinforcement and other embedded items. Deposited concrete shall not be so worked as to cause it to flow laterally. The Contractor shall provide all necessary chutes and baffles to avoid segregation. Concrete shall not be allowed to fall freely through a height of more than 1.5 m. Where a chute is used to convey the concrete, its slope shall be such as will not cause segregation and suitable spouts or baffles shall be used at the end of the chute or wherever the concrete drops vertically.

Concrete shall be placed in layers not exceeding 400 mm in thickness for mass concrete and 300 mm for reinforced concrete and approximately parallel to the horizontal and/or inclined construction joint planes. The minimum layer thickness shall be approved by the Engineer for the type of construction and class of concrete being used. These layers shall be deposited across the full width from one face to the opposite face until the full height of the lift is reached. Each layer shall be deposited on the previous layer before the latter has taken its initial set and in such a manner as to keep the exposed area of fresh concrete to a minimum. A new layer may be started before the previous layer has been completed. When closed circuits are being concreted, work shall commence at one or more points in the circuit and proceed in opposite directions at the same time so that on completion of the circuit the junction or junctions are formed with freshly placed concrete.

If it is required that more than one class of concrete be used in a particular lift, the mix shall be changed at the appropriate surface without interruption of the concreting of the layer or lift as a whole. The contact surface shall at all times fall outside the zone of higher strength concrete shown on the Drawings.

Concrete shall not be placed during rain sufficiently heavy or prolonged to wash mortar from coarse aggregate on the exposed sloping faces of fresh concrete nor in cold weather.

Concrete shall be placed as a continuous operation without interruption in lifts of generally constant height for each separate structure. The lift heights shall be as shown on the Drawings or approved by the Engineer, which approval shall be obtained prior to commencing concreting in any particular portion of the Works. In mass concrete construction the lift height shall usually be between 1 200 mm and 2 400 mm, although lower heights of lift shall be used when casting fresh concrete on top of rock, on top of a cold joint or on top of concrete that is more than 14 days old. Concrete placed in other sections of the Works shall generally be placed in lifts not exceeding 2 400 mm but the Engineer may authorise or instruct different heights to be used according to the section of concrete being placed, the type of formwork being used and whether cooling of the concrete is done or not. This is not applicable when filling large potholes or depressions in the foundations.

The Contractor shall obtain the Engineer's prior approval for time intervals between lifts before commencing with the concrete work on any portion of the Works. The time interval between two consecutive lifts of concrete in the same block of mass concrete shall not be less than 24 hours for each 600 mm of height of lift, although the Engineer may authorise a reduced interval of time depending on the geometric proportions and temperatures of the lifts being cast. The maximum time interval to be allowed between consecutive lifts shall vary between 24 hours and 72 hours for each 600 mm of height of lift for thin and mass concrete sections respectively, after which a construction joint shall be treated as a cold joint, i.e. as if the concrete were more than 14 days old.

The time interval between adjacent concrete lifts at the same elevation, but separated by contraction joints shall vary depending on the location and the distance between contraction joints. Intermediate sections shall generally not be cast within 14 days of the adjacent sections being cast, but as this is governed by the distance between contraction joints and the requirement that the adjacent concrete sections should have passed their peak temperatures and to minimise the width of contraction joints the Contractor shall obtain the prior approval of the Engineer as to the time intervals to be allowed between the casting of adjacent sections of concrete separated by contraction joints.

The placing of concrete by pumping in any section of the Works together with any changes in mix proportions shall be subject to the approval of the Engineer.

#### CWD32.5.5.9 Placing Concrete Underwater

Placing of concrete underwater will be permitted only under exceptional circumstances when it is, in the opinion of the Engineer, not practicable to dewater before placing. No concrete shall be placed in flowing water. The methods and equipment for placing concrete under water together with any changes in the mix proportions shall be subject to the approval of the Engineer. During and after concreting underwater, pumping or dewatering operations in the immediate vicinity shall be suspended should there be, in the opinion of the Engineer, any danger that such operations will interfere with the freshly placed concrete before it has gained adequate strength.

#### CWD32.5.5.10

##### Concrete Cooling

The Contractor shall submit to the Engineer for his approval, full details of all methods proposed by him for minimising the rise in the temperature of newly placed concrete due to the generated heat of hydration. During adverse weather or when directed by the Engineer, the Contractor shall implement the approved measures and he shall take regular temperature readings of the placed concrete at intervals determined by the Engineer.

The temperature of concrete, at the point of final placement, that is placed to the maximum permitted normal lift heights in sections where the minimum section dimension exceeds 2 000 mm or in such thinner sections as may be shown on the Drawings or ordered by the Engineer, shall not exceed the lesser of the following temperatures

$$T = 40 - 0,1 \times T_{\max} - 0,1 \times B$$

or

$$T = 18 + 0,67 \times T_{\min} - 0,06 \times B$$

where

$T$  = maximum permitted placing temperature in °C.

$T_{\max}$  = maximum expected average day temperature in °C of the surface of the concrete during the first 7 days after placement of the particular concrete.

$T_{\min}$  = minimum expected temperature in °C of the surface of the concrete during the first 14 days after placement of the particular concrete.

$B$  = total equivalent cementitious content in kg/m<sup>3</sup> of concrete where the equivalent cementitious contents of the various binders are accepted to be as follows:

Cement	-	1,0kg/kg
GBS	-	0,65kg/kg
FA	-	0,40kg/kg

In addition to the foregoing criteria, the temperature of concrete, at the point of final placement, that is placed in lifts of reduced thickness in the proximity of rock foundations, cold concrete construction joints or concrete that is otherwise more than 14 days old and also where the minimum horizontal section dimension exceeds 2 000 mm or in such thinner sections as may be shown on the Drawings or ordered by the Engineer, shall not exceed the following :

$$T = 15,5 + 1,4 \times T_{\text{ave}} - 0,6 \times T_{\max} - 0,08 \times B$$

where

$T$  = maximum permitted placing temperature in °C.

$T_{\text{ave}}$  = average surface temperature of the underlying rock or concrete during the preceding 2 days.

$T_{\max}$  = maximum expected average day temperature in °C of the surface of the concrete during the first 7 days after placement of the particular concrete.

$B$  = total equivalent cementitious content in kg/m<sup>3</sup> of concrete as defined hereinbefore.

In order to comply with the aforementioned temperature requirements the Contractor shall take some or all of the following precautions as may be approved by the Engineer :

- (a) Precool the mixing water or replace this with ice.
- (b) Shade aggregate stockpiles.
- (c) Precool the aggregates.
- (d) Cool the freshly mixed concrete with liquified nitrogen gas.

Should the Contractor elect to use ice in the mixing water or to replace the latter with ice entirely, the mixing times shall be extended as approved by the Engineer to ensure complete melting and dispersion before mixing is completed. All measures adopted by the Contractor shall be subject to the prior approval of the Engineer.

During a particular concreting operation or within a particular concrete lift the temperatures of the ingredients used in the concrete mixes shall only be changed to the extent necessary to maintain a constant placing temperature. Regular temperature readings of the freshly placed concrete and of the wet-bulb air temperature shall be made by the Contractor at intervals to be approved by the Engineer and copies of the records of these temperature readings shall be delivered to the Engineer on a form to be approved by the Engineer.

All surfaces against which fresh concrete is to be placed, irrespective of temperature, shall be kept damp in order to prevent excessive absorption of water from the fresh concrete.

ompaction

The concrete shall be fully compacted using mechanical immersion vibrators, during and immediately after placing. They shall be inserted vertically and penetrate through into the upper portion of the underlying layer of concrete which shall still be sufficiently plastic to permit inter-knitting. The necessary period of vibration shall be carefully determined by trials performed in the presence of the Engineer for each class of concrete. Vibration shall continue until the concrete has ceased to settle, a thin layer of mortar has appeared on the surface and air bubbles have ceased to appear. The concrete shall be thoroughly worked against the formwork and around reinforcement and other embedded items. Over-vibration resulting in segregation, surface laitance, leakage or any combination of these effects shall not be permitted.

Particular care shall be taken to ensure adequate compaction against formwork which creates an exposed concrete surface.

## CWD32.5.5.12

P

rotective Measures

During periods when the ambient temperature could reach 30°C or more, the Contractor shall erect suitable shading for all metal surfaces other than reinforcing steel which come into contact with the concrete or its constituent materials.

When necessary, the Contractor shall erect windbreaks to prevent the initial rapid drying out of the concrete prior to commencing curing procedures.

## CWD32.5.5.13

J

oints

The Contractor shall place concrete continuously between construction or movement joints (designated joints) as shown on the Drawings or otherwise agreed with the Engineer.

If an emergency occurs and an interruption is unavoidable, the Contractor shall have readily available suitable prefabricated shuttering as stop-ends to form an emergency construction joint. The concrete already placed shall be properly finished up to the stop-end as directed by the Engineer.

## CWD32.5.5.14

U

nformed Concrete Surfaces

Exposed surfaces of concrete not finished against forms shall be brought up to a plane, uniform surface with suitable screed boards. The required surface finish is indicated on the Drawings with the following classifications :

## (a) Class U1

After completion of the placing and compaction of concrete as specified in Clauses CWD32.5.5.8 and CWD32.5.5.11, the top surface shall be screeded and tamped on the surface with the screeding board to ensure that the surface concrete is adequately compacted. The surface shall be left slightly rough at completion.

The finish shall be used as a first step for all other unformed concrete surfaces.

The finish of the concrete surface shall be accurate to Degree of Accuracy I as defined in Clause CWD32.6.

## (b) Class U2

After the concrete has been screeded and has set sufficiently, it shall be floated with a wooden float to produce a non-skid surface free from screed marks and uniform in appearance and texture. Floating may be performed by the use of hand or power driven equipment.

Joints and edges shall be tooled and entrance slabs and steps reeded as required.

The finish of the concrete surface shall be accurate to Degree of Accuracy II as defined in Clause CWD32.6.



## (c) Class U3

After being screeded, the surface shall be lightly wood-floated. It shall be left undisturbed until it has stiffened markedly to prevent an excess of fine materials from being drawn to the surface. At this stage any bleed water and laitance shall be removed from the surface which shall then be steel-floated. Adequate pressure shall be applied to compact the surface to the highest degree possible to flatten the sandy texture of the floated surface and produce a clean uniform surface free from blemishes and trowel marks.

On no account shall neat cement be applied to the surface during trowelling. Where this finish is required for special hydraulic surfaces extreme care shall be taken to avoid an excess of fine materials or moisture on the surface.

The finish of the concrete surface shall be accurate to Degree of Accuracy III as defined in **Clause CWD32.6**.

Irrespective of the specified degree of accuracy the Contractor shall ensure that no depressions that can collect standing water exist on the finished surface.

## (d) Class U4

The requirements are similar to a U3 finish but the surface shall be accurate to a Degree of Accuracy IV, as defined in **Clause CWD32.6**.

## (e) Class U5 – Brushed Finish

The concrete surface shall firstly be prepared as a U2 finish and then lightly brushed with a stiff broom to produce a textured finish. The broom used, once approved, shall be kept for this finish only and not used for any other purpose.

## (f) Special Surface Finishes

The floor surface finish of the operating and control rooms shall have a special steel float finish, prepared as a U3 finish, and be treated with a non-metallic surface hardener as specified, applied in accordance with the manufacturer's instructions.

## CWD32.5.5.15

Curing and Protection of Concrete

As soon as any portion of the concrete being cast has taken on its final set it shall be protected against loss of moisture and short-term surface temperature changes by adequate curing, which curing shall be performed without interruption for a minimum period of 14 days after casting on exposed surfaces or on surfaces where the formwork is removed before the end of the said curing period. Curing shall be accomplished by one or more of the following standard methods of curing as approved by the Engineer for each type of structure, unless otherwise indicated on the Drawings or in these specifications :

- Continuously spraying or sprinkling of water.
- Ponding of water on exposed surfaces.
- Covering with moisture retaining materials, such as sand or cotton or jute mats which are kept continuously wet.

Covering the concrete with waterproof plastic sheets firmly held and sealed at the edges so as to prevent the escape of moisture shall be employed for concrete receiving a U3 or other special finish, until such time as, in the opinion of the Engineer, the concrete has hardened sufficiently for other methods of curing to be applied without damaging the surface. The materials used to cover the concrete shall generally be such as to ensure adequate heat dissipation.

Liquid curing compounds, applied by spraying only, shall be used only with the prior approval of the Engineer and where other methods are impractical.

Whatever method of curing is adopted, the concrete shall not be stained, marked, contaminated or damaged.

Curing will not be required in galleries or chambers if airtight bulkheads are provided, which in the opinion of the Engineer adequately protect the concrete from loss of moisture. The Contractor shall however ensure that sufficient moisture is present within the area to maintain a high relative humidity. Where absorptive formwork or formwork which, in the opinion of the Engineer, will allow the loss of moisture from the surface of the formed concrete is used these forms shall be kept continuously wet.

After casting, all freshly placed concrete shall be protected from direct exposure to the sun for a period of at least 72 hours or the minimum specified time interval between lifts, whichever is the longer. Adequate protection shall be provided during the critical period between casting and commencing curing.

When at any stage during the curing period the air or water temperature is expected to drop below the minimum expected temperature adopted for establishing the concrete placing temperature in terms of Clause CWD32.5.5.10 the Contractor shall immediately inform the Engineer who shall determine what measures are to be taken to protect the concrete.

When at any stage during the curing period the air or water temperature drops below 10°C the curing period shall be extended at least by the same length of time as that for which the air or water temperature dropped to below 10°C.

The Contractor shall protect all concrete against injury or damage.

#### CWD32.5.5.16

P

##### reparation of Concrete and Rock Surfaces

The following paragraphs specify the requirements for preparing construction joints in concrete and rock surfaces to ensure a firm bond with the newly placed concrete. The specified preparation of concrete surfaces shall be carried out up to 20 mm from the edges of the concrete surface to prevent damage to the concrete edges, also taking particular care to ensure that the surfaces are thoroughly cleaned in the vicinity of reinforcing, waterstops, steel pipework and other embedded components. When chipping is used, care must be taken not to induce cracking in the remaining aggregate.

(a) Concrete less than 24 hours old

The surface shall be prepared using an air-water jet to remove all laitance and to expose clean, sound coarse aggregate. Care shall be taken not to undercut the edges of larger aggregate. The air pressure used in the jet shall be 700 kPa plus or minus 5 kPa and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. On completion, the surface shall be washed to remove all loose particles. The surface shall again be washed just prior to placing the succeeding lift.

(b) Concrete more than 24 hours but less than 3 days old

Cleaning shall be carried out using a high pressure water jet with a pressure of not less than 20 MPa. Only the surface laitance shall be removed to expose clean, sound coarse aggregate and no undercutting of the larger aggregate particles shall be permitted. All loose debris shall be washed from the surface which shall be repeated just prior to placing the next lift.

(c) Concrete more than 3 days old but less than 14 days old

Sandblasting, scraping or chipping shall be carried out until all accumulated laitance, coatings, stains, debris and other foreign matter have been removed. The surface of the concrete shall then be washed to remove all loose material and this shall be repeated just prior to placing the next lift.

(d) Rock surfaces and concrete more than 14 days old

Whenever fresh concrete must be cast upon a rock foundation or must be bonded to underlying concrete at a cold construction joint or to underlying concrete that is more than 14 days old the approval of the Engineer shall first be obtained. Unless otherwise approved by the Engineer the heights of the lifts shall be reduced temporarily as shown on the Drawings. The normal height of lift can usually be reverted to after concrete has been cast to a height equal to at least one normal lift above the old concrete or the highest point of the rock foundation. The Contractor shall prepare for the approval of the Engineer a programme of proposed time intervals between lifts to be adopted for the lifts of reduced height and the subsequent lifts of normal height. The placing temperatures for the concrete in the various lifts shall be as specified in the relevant clauses of this specification.

The surfaces of concrete construction joints shall be prepared as specified in the foregoing paragraph (c).

Excavated rock surfaces accepted and approved in terms of Particular Specification CWD20, shall be prepared by raking out all unsuitable material in any crevices or seams and then cleaned with air/water jets. Features with an average width of less than 25 mm shall be filled with cement grout having a water : cement ratio of not more than 0.55. Seams and crevices between 25 mm and 75 mm wide shall be filled with cement mortar rodded into position with steel bars. The mortar shall

comprise sand and cement in the same proportions as used for a grade 25 MPa concrete. Wider features shall be filled with Class 25/19 or Class 25/38 concrete, as appropriate.

The surfaces of contraction joints shall be cleaned thoroughly of accretions of concrete or other foreign matter by scraping, or other means satisfactory to the Engineer before any fresh concrete is placed against such a joint. Where positive separation of the concrete faces is required, bitumen painting or other approved bond breaker or approved filler materials are to be incorporated where shown on the Drawings or ordered by the Engineer.

The washing operations specified above shall be continued until all cloudiness in the wash water is removed.

Particular care shall be taken in removing water and debris from the surface of a construction joint to ensure there is no damage or staining of exposed concrete faces and there is no pollution of natural watercourses.

The rock or construction joint surface shall be kept continuously wet for a period of 24 hours prior to placing concrete. All free water shall be removed from the surface before placement of additional concrete. Immediately prior to placing the new concrete, the joint or rock surface shall be covered with a 20 mm layer of mortar. The mortar shall comprise sand and cement in the same proportions as used for the concrete and shall be of a consistency such that it is sufficiently plastic to be easily placed. Concrete shall be placed immediately upon the fresh mortar. If in the opinion of the Engineer the local presence of persistent seepage water may weaken the composition of the mortar, a 19 mm concrete shall be used in lieu of the mortar as a bedding layer with the same grade as that of the concrete. Any mortar which becomes dry or which starts to set before being covered with concrete shall be removed, the area cleaned and fresh mortar placed.

#### CWD32.5.5.17

##### reparation of Concrete Surfaces to Receive Second Stage Concrete

P

The surfaces of concrete to receive second stage concrete shall be prepared by means of scraping, chipping, sandblasting, washing or other means until clean sound aggregates are exposed over the entire surface. This surface preparation shall be carried out prior to the installation of built-in parts as required for the hydraulic steelwork. Lift joints in second stage concrete shall be prepared as specified in Clause CWD32.5.5.16.

Prior to placing second stage concrete, all surfaces of the recesses in contact with the second stage concrete as well as the lift joints in second stage concrete shall be treated with wet-to-dry concrete epoxy adhesive in accordance with the manufacturer's specification. The epoxy adhesive to be used shall be subject to the Engineer's prior approval.

#### CWD32.5.5.18

##### remedial Treatment of Surface Defects

R

##### (a) General

Immediately after the formwork has been removed, the Contractor shall examine the concrete surfaces and report any defects to the Engineer. All repairs of such defects shall be performed by skilled workmen only, using methods approved by the Engineer. Under no circumstances shall any repairs be undertaken without the prior authorisation of the Engineer.

After examination of the quality and strength of any defective work, the Engineer may either authorise remedial treatment or order the demolition and reconstruction of the whole of the defective work. All remedial treatment and demolition and reconstruction shall be for the Contractor account.

Remedial treatment of whatever nature shall be carried out immediately after removal of the formwork.

##### (b) Surface Blemishes

Any minor surface blemishes shall be repaired to the satisfaction of the Engineer immediately after removal of the formwork. Remedial measures may include the following:

- (i) Holes in concrete of such size as will accept concrete, shall be filled with the same class of concrete as the damaged concrete. Larger size aggregates shall be screened out of the concrete used for filling of holes.
- (ii) Holes left by formwork supports (tie holes) shall be thoroughly cleaned out to remove all loose material and the sides shall be roughened, if necessary, to ensure a satisfactory bond. They shall then be filled with dry pack mortar. Where a F4 surface finish has been specified, an

epoxy mortar to be approved by the Engineer shall be used. The use of commercial repair mortars shall only be used with the prior approval of the Engineer.

- (iii) Small areas that show honeycombing or other defects such as isolated holes formed by air and water bubbles, shall be filled with mortar having a water : cement and cement : sand ratio equal to that of the concrete being repaired.
- (iv) Abrupt and gradual irregularities may be rubbed down with carborundum and water after the concrete has been fully cured.
- (v) Small defects and minor honeycombing shall be chipped out perpendicular to the face of the concrete to a depth of at least 25 mm and filled with a commercial repair mortar, such as Sika Rep or equal, applied according to the manufacturer's instructions.

All filling shall be bonded tightly to the surfaces of the hole and shall be sound and free from shrinkage cracks and hollow areas after the fillings have been cured and dried.

If a concrete finish does not comply with the specified requirements, then such a surface shall be rubbed and polished as described below until it does comply.

(c) Larger Defects

For the repair of larger and more extensive defects, special methods and techniques such as the pneumatic application of mortar, pressure grouting, epoxy adhesive products or other methods of repair shall be used as agreed and approved by the Engineer. Other methods may include:

- (i) Removing the whole pour and re-concreting.
- (ii) Cutting out to a depth of 25 mm with a diamond saw to give a regular edge to the repair. Further chipping to form a hole with dovetail shape to sound concrete, or to a depth of 75 mm behind the reinforcing steel shall be carried out. Stainless steel mesh reinforcing shall be sprung into the dovetail. The void shall be refilled with a repair mortar, such as Sika Rep or equal, applied according to the manufacturer's instructions.

If a concrete finish does not comply with the specified requirements, then such a surface shall be rubbed and polished as described below until it does comply.

Particular care shall be exercised to ensure that the colour of the repair work shall match the colour of the surrounding concrete. No cement washing or plastering shall be carried out except on the written approval of the Engineer.

(d) Rubbing and Polishing of Formed Surfaces

Before commencement of rubbing and polishing, all other repair work shall be completed. The surface shall be soaked with water for at least one hour. Initially the surface shall be rubbed with a medium coarse carborundum stone by using small quantities of mortar on the surface in the proportion as specified above. Polishing shall continue until all shutter marks, protrusions and other marks are removed and a uniform surface is obtained. The paste resulting from the polishing shall be left on the surface. Final polishing shall be done with a fine carborundum stone and water. This polishing shall be continued until a smooth, uniform texture and uniform colour are obtained on the whole surface.

Thereafter the surface shall be washed with water and a brush to remove all excess paste and powder.

(e) Preparation for Remedial Work

The Contractor shall thoroughly clean any hole or defective area that is to be filled and where the surface has been damaged the Contractor shall break out any loose, broken or cracked concrete or aggregate.

Where the remedial work is to be carried out using dry-pack mortar, the concrete surrounding the hole shall be thoroughly soaked after which the surface shall be dried so as to leave a small amount of free water on the surface. The surface shall then be dusted lightly with cement by means of a small dry brush until the whole surface that will come into contact with the dry-pack mortar has been covered and darkened by the absorption of the free water by the cement. Any dry cement in the hole shall be removed.

## (f) Curing of repaired surfaces

Curing of repaired surfaces shall be carried out for the durations and in the manners prescribed by Clause CWD32.5.5.15 of this specification or in such a manner and for such periods as the Engineer may direct from time to time.

## (g) Protection of surfaces

The Contractor shall ensure that all surfaces (apart from F1 and U1) are protected against rust marks, spilling of concrete, stains and all other damages.

## (h) Dry-pack Mortar

Dry-pack mortar for filling holes and repairing surfaces shall be made from one part by weight of cement and three parts aggregate passing a 1 mm sieve. The colour of the mortar shall match that of the surrounding concrete. The mortar shall be mixed with only sufficient water to make the materials stick together when being moulded in the hands.

The dry-pack material shall be placed and packed in layers having a thickness not greater than 15 mm. The compaction shall be carried out by use of a hardwood block and hammer and shall extend over the full area of the layer, particular care being taken to compact the dry-pack against the sides of the hole. After compaction of the surface of each layer shall be scratched before further loose material is added. Holes shall not be over filled and the surface shall be finished by laying a hardwood block against the dry-pack fill and striking the block several times. Steel finishing tools shall not be used and water shall not be added to facilitate finishing.

## CWD32.5.5.19

o-fines concrete

N

No-fines concrete shall comprise approved cement or cementitious material and 19 mm aggregate. The concrete shall have a water : cement ratio of not more than 0,45 and an aggregate : cement ratio of between 10 and 5 as approved by the Engineer. The actual aggregate : cement ratio shall be determined by the Contractor from trial mixes. The mix shall be so designed that cement and water do not settle out or block the openings in the drain pipes while ensuring sufficient paste to fully coat the aggregate particles and provide the minimum strength with a freely draining concrete. The strength shall be determined from cubes manufactured, cured and tested in accordance with SANS 5863. The minimum strength at 14 days shall be 4,5 MPa.

The construction of no-fines concrete shall commence at the lowest point of the foundations. Construction joints shall coincide with the designated joints in any overlying slab. Shuttered construction joints shall be cut back to a porous surface should the struck surface texture not be porous enough in the opinion of the Engineer.

The coarse aggregate for no-fines concrete shall be mixed with sufficient water to be properly wetted before the cement and the remaining water are added. The concrete shall be placed within 20 minutes of being mixed. The methods utilised for transport and placing shall minimise any segregation of the mix.

No-fines concrete shall be compacted by rodding and screeding to fill all spaces but no tamping, ramming or vibration shall be used which may cause clogging of the openings in pipes embedded in the concrete. The Contractor shall ensure that any underlying filters do not become clogged with cement paste and the top of the concrete surface is entirely porous.

No-fines concrete shall be cured by continuous wetting or spraying for a period of 10 days.

The Contractor shall protect the no-fines concrete layers from becoming damaged or clogged prior to construction of the overlying layers. Any damaged or clogged drains shall be reinstated or replaced by the Contractor at his own cost.

## CWD32.5.5.20

low Concrete

E

Flow concrete is a self-compacting concrete which has a slump of at least 250 mm and which is self-levelling under horizontal gravity flow without the occurrence of any segregation. The mixture shall be designed to prevent bleeding of the concrete. The purpose of using flow concrete is to ensure that the concrete will fill the diversion opening right up to the roof soffit after placing of the concrete to roof level, while at the same time being well compacted. It is also used to close off the compensation water pipe.

The use of an appropriate superplasticiser reduces the cement content and water demand of the mix relative to that of a conventional mix with an equivalent 28-day strength. Consequently, both drying and heat induced shrinkage and cracking is minimised.

For this reason, only a superplasticiser requiring a low water : cement ratio and a low water content in order to produce concrete with a maximum permissible 28-day strength of 20 MPa will be acceptable.

Flow shall be measured in accordance with BS 1881 : Part 105. Concrete is regarded as flowing when the diameter of spread, measured on a flow table exceeds 510 mm.

The flow concrete must be designed in such manner that it can be pumped to the point of placement without segregation and/or blockages of the pumping line.

## CWD32.5.5.21

G

routing

Concrete surfaces in pockets, under bedplates or any other voids in which grouting is required shall first be prepared by scabbling, steel brushing and washing with water to remove all dirt or loose material. The mortar grout shall consist of an approved mixture of cement, sand, water, and admixture, and shall be so rammed into the pockets under each base or bedplate (as applicable) that all voids and pockets are completely filled around the bolt or between the top of the concrete and underside of the metalwork. The exposed surfaces shall be wood-floated to a neat finish at the level indicated on the Drawings or ordered by the Engineer.

## CWD32.5.5.22

R

records

The Contractor shall maintain a detailed daily record of all concreting operations on Site and shall submit copies to the Engineer the following morning. These records shall include :

- (a) Location of section concreted.
- (b) Date of placing.
- (c) Start and completion time of concreting.
- (d) Rainfall, relative humidity and wet and dry bulb air temperature readings. The humidity and temperature shall be the maximum and minimum readings for the day in question.
- (e) The type, number, size, time, location and identification of all samples taken.
- (f) The type and results of field testing on samples taken.

## CWD32.6 TOLERANCES

## CWD32.6.1 Basis of Measurement

CWD32.6.1.1 General

The Contractor shall construct each of the various parts of the Works within the limits of the applicable permissible deviations set out in Table CWD32.10. The required Degree of Accuracy is specified on the Drawings or in this specification, failing which, Degree of Accuracy II shall apply.

The permissible deviations apply to linear dimensions, position, verticality, level, squareness and bow.

CWD32.6.1.2 Method of Measurement of Deviations

Certain deviations will be measured as set out below :

- (a) Any deviation from flatness of a plane surface will be measured as the maximum deviation of the surface from any straight line of length 3 m joining two points on the surface. The deviation will be determined by means of a straight edge, the ends of which are supported on identical blocks of suitable thickness placed over each of the points.

- (b) Any abrupt change in a continuous surface, including a local depression or peak in a floor or wall and any abrupt change caused by a joint in formwork, will be measured as specified in (a) above.
- (c) Out-of-squareness of a corner or an opening or an element such as a column will be measured by taking the longer of two adjacent sides as the base line and determining any departure from the perpendicular of the side at either end of the base line.
- (d) Deviations on all other dimensions will be measured on the basis as shown in Figure CWD01-1 at the end of Particular Specification CWD01.

## **CWD32.7 TESTS**

### **CWD32.7.1 Facilities and Test Certificates**

#### **CWD32.7.1.1 General**

All Site testing carried out by the Contractor shall be performed in an approved suitably equipped and staffed laboratory by competent and sufficiently experienced laboratory staff in accordance with the quality control procedures approved in terms of Particular Specification P01. Off-site testing shall be carried out by a recognised testing Institution, an approved laboratory or a firm approved by the Engineer.

#### **CWD32.7.1.2 Test Certificates**

All cementitious materials and reinforcement deliveries not carrying the mark of the standards institution shall be accompanied by test certificates from the appropriate standards institution confirming compliance with the relevant specifications. In the case of cementitious materials the deliveries shall be accompanied by a certificate from the manufacturer stating the date of manufacture. In the case of steel that is subjected to consignment inspection by the SABS it shall be accompanied by a certificate issued by the SABS confirming compliance with the relevant specifications.

Table CWD32.10 : Permissible deviations (mm)

		DEGREE OF ACCURACY			
		I	II	III	IV
(1)	Reinforcement				
	(a) Spacing between two adjacent bars	+/-25	+/-20	+/-15	
	(b) Longitudinal location of band's and ends of bars	+/-40	+/-30	+/-20	
	(c) Cover to reinforcement	-0 +20	-0 +20	-0 +10	
(2)	Formwork				
	Formwork shall be so constructed as to ensure that the position of the finished work will be as specified, subject to the relevant permissible deviations given below.				
(3)	General mass and reinforced concrete				
	(a) Position on plan of any edge or surface measured from the reference line	+/-20	+/-15	+/-5	
	(b) Linear (other than cross-section) dimensions	+/-30	+/-20	+/-10	
	(c) Cross-section dimensions	-10 +20	-5 +15	0 +5	
	(d) Level (deviation from designed level with reference to the nearest transferred datum (TD) of the upper or lower surface, as may be specified, of any slab or other element or component)	-20 +10	-15 +5	-10 +0	
	(e) Verticality, per metre of height	5	5	2	
	subject to a maximum over the full height of	30	25	15	
	(f) Out-of-squareness of a corner or an opening or an element such as a column (see Clause CWD32.6.1.(c)) for short side of length				
	i) Up to and including 0,5m	+/-10	+/-5	+/-3	
	ii) over 0,5m up to and including 2m	+/-20	+/-15	+/-10	
	iii) over 2m up to and including 4m	+/-25	+/-20	+/-15	
	(g) Exposed concrete surface:				
	i) Flatness of plane surface	10	5	3	
	ii) Abrupt changes in a continuous surface	10	3	2	
	(h) Exposed concrete surface to be plastered:				
	i) Flatness of plane surface	15	10	5	
	ii) Abrupt changes in a continuous surface	10	5	3	
(4)	Special mass, reinforced and second stage concrete (i.e. special hydraulic surfaces, spillway crest, piers, precast members and concreting around built-in parts)				
	(a) Position on plan of any edge or surface or any point on a curved surface from the reference line	*	*	*	+/-5
	(b) Linear (other than cross-section) dimensions	*	*	*	+/-5
	(c) Cross-section dimensions	*	*	*	+/-5
	(d) Level (deviation from designated level of any element or any point on a curved surface)	*	*	*	+/-5
	(e) Verticality, per metre of height	*	*	*	+/-3
	subject to a maximum over the full height of	*	*	*	+/-6
	(f) Exposed concrete surfaces:				
	i) Flatness of plane surface				3
	ii) Deviation from specified curved profile				3
	iii) Abrupt changes in a continuous plane or curved profile				0
	(g) Upstream primary concrete (from which bellmouth protrude) face parallel with upstream face of the bellmouth		+0 -25		
(5)	Embedded parts for hydraulic steelwork				
	(a) The centreline of an embedded part from its designated position	*	+/-10	*	
	(b) The top of an embedded part from its designated level	*	+/-10	*	
	(c) Verticality, per metre of height	*	5	*	
	subject to a maximum over the full height of	*	25	*	
	(d) Bellmouth upstream intake face (measured relative to dam reference line)		+0 -25		
	Note : Refer Drg No. CWD7201				
	(e) For installation of guides and sealing frames around bellmouths refer installation procedure as per installation drawing (Drg No. CWD7201)				
(6)	Waterstops				
	(a) Position measured from reference line or concrete edge or surface	+/-20	+/-10	+/-5	
	(b) Linear distance from any reinforcement or embedded steel item	*	+/-10	*	
	(c) Position of centreline of waterstop from contraction/expansion/construction joint surface	*	+/-5	*	
(7)	Location of holding-down bolts				
	(a) The centre line of a holding-down bolt from its designated location in plan	*	+/-3	*	
	(b) The top of the bolt from its designated elevation	*	-3 +5	*	
(8)	Edges for gratings and covers				
	(a) Position from its designated location in plan	*	+/-5	*	
	(b) Level (deviation from designated level)	*	+/-5	*	



	DEGREE OF ACCURACY			
	I	II	III	IV
(8) Pipework				
(a) Position from its designated location in plan	*	+/-5	*	
(b) Level (deviation from designated level)	*	+/-5	*	
(c) Verticality, per metre of height	*	3	*	
subject to a maximum over the full height of the assembled stack	*	25	*	
(d) Axial direction		+0 -10		
(e) angular deflection				
≤ 1500 NB		≤ 2°		
> 1500 NB		≤ 1°		
(f) Misalignment of joining pipe ends		+/-3		

\* Tolerances not stated

## CWD32.7.2 Testing

### CWD32.7.2.1 General

All testing described in this specification shall be carried out by the Contractor in accordance with the methods referred to in this specification and to confirm compliance with all the specified requirements. Copies of the results of all tests carried out by the Contractor shall be submitted to the Engineer immediately after the testing.

The Engineer may take such samples, prepare such specimens and conduct such tests as and when he requires for quality monitoring.

### CWD32.7.2.2 Tests on Constituent Materials

#### (a) Registers and Reporting

A register of samples shall be kept by the Laboratory Manager clearly indicating the sample no., location, material description and name of sampler for concrete and aggregates.

A daily register shall be kept in which the following information is entered in respect of the concrete cubes made that day.

- (i) Mix proportions
- (ii) Class of concrete
- (iii) Workability
- (iv) Where sampled
- (v) Where placed (e.g. block no., reduced, level, chainage, etc.)
- (vi) Weather conditions at day of placing (e.g. cloudy sky, windy, hot or cool, temperature, etc.)

A weekly materials report shall be prepared which shall include all relevant information on materials and placed concrete. This report shall be submitted to the Engineer no later than 15:00 on the Monday immediately following the reporting period.

#### (b) Cementitious Materials

No tests on the cementitious materials need be conducted on Site, but all cementitious materials shall have been certified by the SABS.

#### (c) Coarse Aggregates

Coarse aggregates shall be tested daily by the Contractor as part of his quality and process control to ensure compliance with the requirements of Clause CWD32.3.4. Sampling and testing shall be carried out in accordance with SANS 195 and 1083 respectively.

The Contractor shall also provide such facilities as may be required by the Engineer for procuring representative samples for quality monitoring tests.

No coarse aggregates will be approved for use in the Works until satisfactory 28-day compression tests have been made by the Contractor on concrete cubes using the aggregates.

Samples for testing shall be taken from the aggregate stockpiles in accordance with and in lot sizes as specified in SANS 1083 unless otherwise approved by the Engineer.

The percentage of free moisture present shall be checked hourly at the batching plant whenever concreting is in progress.

The appropriate tests listed in Appendix A shall be carried out on the coarse aggregates.

(d) Fine Aggregates

Fine aggregates shall be tested daily by the Contractor as part of his quality and process control to ensure compliance with the requirements of Clause CWD32.3.4. Sampling and testing shall be carried out in accordance with SANS 195 and 1083 respectively.

The Contractor shall also provide such facilities as may be required by the Engineer for procuring representative samples for quality monitoring tests.

Samples for testing shall be taken from aggregate stockpiles in accordance with and in lot sizes as specified in SANS 1083 unless otherwise approved by the Engineer.

During concreting operations the fine aggregate used at the batching plant shall be sampled and tested at least hourly for moisture content in order to maintain a constant water : cement ratio in the concrete mixes.

The appropriate tests listed in Appendix A shall be carried out on the fine aggregates.

(e) Water

Water shall be tested on a monthly basis by an approved laboratory to ensure compliance with the requirements of Clause CWD32.3.3.

#### CWD32.7.2.3 Reinforcement

No tests on the reinforcement need be conducted on Site. Unless steel is delivered directly from the manufacturer the steel shall be subject to consignment inspection by the SABS at the plant, factory or steel yard.

#### CWD32.7.2.4 Concrete

The Contractor shall as part of his quality and process control carry out tests on the concrete at regular intervals to ensure compliance with this specification. The frequency at which the tests listed below are carried out by the Contractor during a concreting shift shall be agreed between the Contractor and Engineer, except for the frequency of compression strength tests which shall be carried out as described hereinafter.

The frequency of sampling and testing shall be as follows:

(a) Initial Concrete (at start of production)

(i) For testing of 28 day strength

3 x 150 mm cubes from one mix for every 50 m<sup>3</sup> concrete placed with a maximum of 12 cubes per day.

(ii) For testing of 7 day strength

3 x 150 mm cubes from the same mix from which the 28 day strength cubes are taken for every 50 m<sup>3</sup> concrete placed.

(b) Production Concrete (defined as concrete placed when the batching plant is in full operation)

(i) For testing of 28 day strength

120 x 150 mm cubes from 40 different mixes at 3 cubes per mix plus 3 x 300 mm cubes (for unreinforced structural concrete only) taken at 1 cube from every 10<sup>th</sup> mix.

## (ii) For testing of 7 day strength

3 x 150 mm from each mix which is sample for 28 days strengths.

The cubes at the start of production stage shall be taken within the shortest possible period.

## (c) First three months after start of production

## (i) For testing 28 day strength

6 x 150 mm cubes from 6 different mixes per day taken at near equal time intervals over that day plus 1 x 300 mm cube (unreinforced structural concrete only) every second day.

## (d) Quality control for remainder of concrete placing programme

## (i) For testing 28 day strength

3 x 150 mm cubes per day taken from 3 different mixes at near equal intervals for a given day plus 1 x 300 mm cube (unreinforced structural concrete only) every week.

The above procedures shall be repeated for each class of concrete.

All samples taken, test specimens prepared and tests conducted by the Contractor may be witnessed by the Engineer if so desired and vice versa.

Sampling of freshly-mixed concrete shall be carried out in accordance with SANS 5861 at the nearest practicable point prior to final placement. Where the test method requires a maximum nominal size of aggregate of 38 mm, the sample shall be wet-screened to remove all particles larger than 38 mm in size together with the adhering cement paste and fine aggregate. The appropriate tests listed in Appendix E shall be carried out on the freshly mixed and hardened concrete.

Test cubes shall be cured in a thermostatically controlled curing tank in accordance with SANS 5861-3.

Whereas the criteria for concrete strength in the specification are based on 150 mm cubes compression tested at the age of 28 days only, additional cubes shall be made each time as specified hereinbefore for early-strength testing by the Contractor. Correlation between early-strength test results and expected strength at 28 days shall be based on sufficient evidence obtained through continuous testing at the different ages.

Early-strength test results (i.e. less than 28 days) shall not be used for assessment of strength in terms of Clause CWD32.7.3.

**CWD32.7.3 Acceptance Criteria for Strength Concrete****CWD32.7.3.1 General**

Any particular class of concrete shall be deemed to have failed to meet the requirements of this specification if:

- (a) The strength does not satisfy the criteria of Clause CWD32.7.3.2.
- (b) The water : cement ratio is higher than the approved ratio.
- (c) The total mass of cementitious materials is below the approved mass or exceeds the approved mass by more than 4 % by mass of cementitious materials.
- (d) The mass of extenders used to replace cement departs by more than 2 % by mass of extender from the approved mass.
- (e) The compaction factor is less than the specified value.
- (f) The placing temperature of the concrete is above the required placing temperature.
- (g) Curing has not been performed in terms of the specified requirements.

- (h) The concrete has not been compacted to the specified requirements or bleeding, segregation or honeycombing has occurred.

Under such circumstances, the Engineer shall determine the extent of the affected section of the Works and the Contractor shall immediately and before proceeding with further concreting operations submit to the Engineer for approval of detailed proposals for ensuring that future concrete will comply with the specifications and also for rectifying the defects, which shall include extended curing or replacement or strengthening of concrete.

If in his opinion it is deemed necessary the Engineer shall instruct the Contractor or shall himself conduct all or any of the examinations set out in Clause CWD32.7.3.3 before approval is given for the proposed methods of rectifying the particular defects.

#### CWD32.7.3.2 Strength Criteria

The concrete shall be deemed not to satisfy the requirements of this specification if for any class of concrete :

- (a) The average of any three consecutive valid test results does not exceed the specified strength by at least 2,0 MPa.
- (b) Any single valid test result is more than 2,0 MPa or 3,0 MPa below the specified strength for concrete grades below 20 MPa and 20 MPa and above respectively.

#### CWD32.7.3.3 Procedure for Examination of Concrete Failing to Meet Requirements

If an evaluation of the concrete and the test results indicates that the concrete has failed to meet the requirements of the specification, the Engineer may adopt the procedures in the order given below.

- (a) Assess the stress level in the structure concerned in relation to the test results obtained.
- (b) Non-destructive testing, subject to similar concrete of proven acceptable quality being available in comparable members in the same construction as a reference.
- (c) The drilling, preparation and testing of concrete cores in accordance with SANS 5865.
- (d) Full-scale load tests under terms and conditions agreed upon between the Engineer and the Contractor.

#### CWD32.7.3.4 Replacement or Strengthening of Concrete

Where the methods of examination of Clause CWD32.7.3.3 are either impractical or inappropriate, or if a portion of the Works fails to pass the tests, or if in the opinion of the Engineer the concrete does not comply with the specified requirements and cannot be adequately improved by extended curing the Contractor shall either replace or strengthen the affected portions of the Works.

The Contractor shall carry out such approved remedial works, and where ordered, under the instruction and direction of the Engineer. The extent of the replacement or strengthening works shall include each section that failed or contains concrete that has failed and any other section, irrespective of strength, whose functional purpose is affected by the section or concrete specified above.

The cost of any replacement or strengthening referred to in this clause as well as any other remedial measures that may be ordered to restore the durability of the concrete to that achievable by concrete of the quality required in terms of this specification shall not be deemed to be additional work or a variation in terms of the Contract.

**CWD32.8 MEASUREMENT AND PAYMENT****CWD32.8.1 Basic Principles****CWD32.8.1.1 Formwork**

The unit rate shall cover the cost of all parts of formwork in contact with the concrete, including forming fillets or splays up to 25 mm x 25 mm, and the necessary bearers, struts, safety platforms and other supports plus the labour and plant necessary to erect and strike such formwork.

- (a) Formwork, other than formwork covered by Clause CWD32.8.1.1(b) will be measured as the net area of the face of the concrete to be supported during the deposition of concrete. No deduction will be made for fillets and splays of size up to 50 mm x 50 mm or for openings of diameter up to 0,7 m or of an area up to 0,5 m<sup>2</sup>.
- (b) Formwork in continuous lengths of narrow widths and of fillers or splays over 25 mm x 25 mm will be measured by length, the width or range of widths being stated in the Schedule.
- (c) Separate items will be scheduled for each class of finish required on the formed concrete.
- (d) Separate items will be scheduled for each inclination of formwork on the following basis :
 

Description	Angle of inclination from vertical
Horizontal	Exceeding 85° and not exceeding 95°
Sloping	Exceeding 10° and not exceeding 85°
Battered	Not exceeding 10°
Vertical	0°
- (e) Separate items will be scheduled for each inclination of each type of structural element, such as walls and beams, for different prop heights for beams and slabs and for formwork to curved (single and double curvature), curved in plan only, arched, domical, specially moulded and other types of work.
- (f) Separate items will be scheduled for depths of openings, measured perpendicular to the surface, required in the formed concrete, as follows :
 

not exceeding 0,5 m	
exceeding	0,5 m but not exceeding 1,0 m
exceeding	1,0 m but not exceeding 1,5 m
exceeding	1,5 m but not exceeding 2,0 m
exceeding	2,0 m
- (g) Separate items will be scheduled for voids formed in the concrete as follows
 

large voids :	exceeding 0,1 m <sup>2</sup> and not exceeding 0,5 m <sup>2</sup> or exceeding 0,35 m diameter and not exceeding 0,7 m diameter
small voids :	not exceeding 0,1 m <sup>2</sup> or not exceeding 0,35 m diameter
- (h) Where a special finish is required and scheduled, payment will become due when the finish has been achieved as specified.

**CWD32.8.1.2 Reinforcement**

Steel for normal reinforced concrete will be measured net by mass of all bars, including supporting steel detailed on the reinforcing schedules. The mass will be computed from the nominal bar size and the nominal mass per unit length. No allowance will be made for cutting, waste, spacer devices (materials other than steel bars) or binding wire. The unit rates shall cover the cost of supply, cutting, bending and the provision of all spacer devices as well as the cost of tests in terms of SANS 920.

Steel reinforcement for precast concrete units will not be measured unless so scheduled (see Clause 0).

Welded mesh will be measured by area as shown on the drawings, no allowance being made for cutting, waste, caps or deductions for end cover. The areas measured will be those of the concrete floor or slab reinforced by means of mesh. In the case of continuous units partly reinforced by mesh, the area will be computed from the outside dimensions of the area covered by mesh regardless of whether additional reinforcing steel is present in the same area.

Steel off-cuts resulting from the cutting and bending of reinforcement in accordance with the bending schedule shall be deemed to be the property of the Contractor.

Separate items will be scheduled for :

- (a) each size and type of steel bars
- (b) type and mass per square metre of welded mesh
- (c) each steel section where rails and other steel sections are used.

### CWD32.8.1.3 Concrete

Concrete will be measured net to the dimensions shown on the drawings or to the dimensions cast, whichever are the smaller. Structural elements that are undersized will be measured for payment only if they are acceptable to the Engineer.

No allowance will be made for concrete required to make up overbreak in excavation unless expressly ordered by the Engineer to replace unsuitable material.

Subfoundation carpets and blinding layers will be measured to the plan size of the concrete structure resting on the carpet. Where concrete is scheduled by volume it will be measured on the nominal thickness indicated on the Drawings.

Separate items will be scheduled for each class of concrete and for each unit of the Works or each element of a structure where these could materially influence the pricing of the work and where the cost of depositing concrete is affected by its position in the Works or by the conditions of placing such as :

- slabs that are sloping, conical or horizontal and those of different thicknesses
- concrete deposited under water
- small quantities each less than 0,5 m<sup>3</sup> of formed concrete.

The unit rates shall cover the cost of the design of the mix, the provision of materials, batching, mixing, testing, joint and surface preparation, transport, placing, compacting, the forming of stop-ends and unforeseen joints, striking off or levelling as applicable, curing and repairing as necessary.

Floor slabs where placed on sub-foundation carpets or directly on the prepared ground surface will be measured to the net thickness dimensioned on the Drawings. Concrete in a column supporting a reinforced concrete beam or slab structure will be measured between the top surface of the foundation, beam or slab on which the foot of the column is standing and the underside of the beam or slab supported by the column.

No deduction or addition will be made for nosings, bolt holes, chamfers or splays of size up to 50 mm x 50 mm, grooves or chases not exceeding 0,015 m<sup>3</sup> each in volume, or holding-down bolts, rails, steel sections and reinforcement cast in concrete.

### CWD32.8.2 Scheduled Formwork Items

#### CWD32.8.2.1 Class F1

Unit: m<sup>2</sup>

The surfaces to be so formed will be identified in the schedule.

#### CWD32.8.2.2 Class F2

Unit: m<sup>2</sup>

The surfaces to be so formed will be identified in the schedule.

The surfaces to be so formed will be identified in the schedule.

CWD32.8.2.4 Class F4Unit: m<sup>2</sup>

The surface to be so formed will be identified in the schedule.

CWD32.8.2.5 Narrow Widths (up to ...mm wide)

Unit: m

The range of widths if up to 300 mm, or width and depth in the case of grooves or chases, will be stated.

CWD32.8.2.6 Box Out Holes/Form Voids. Items will be scheduled as set out below :

- (a) Small, circular, of diameter up to and including 0,35 m

	Over and	up to and including
1)		0,5 m deep
2)	0,5 m	1,0 m deep
3)	1,0 m	1,5 m deep
4)	1,5 m	2,0 m deep
5)	2,0 m deep	

Unit: No

Unit: No

Unit: No

Unit: No

Unit: No

- (b) Small, other than circular, of area up to and including 0,1 m<sup>2</sup>

Unit : No

Depths as in (a) above.

- (c) Large, circular, of diameter over 0,35 m up to and including 0,7 m

Unit: No

Depths as in (a) above.

- (d) Large, other than circular, of area over 0,1 m<sup>2</sup> and up and including to 0,5 m<sup>2</sup>

Unit: No

Depths as in (a) above.

CWD32.8.3 Scheduled Reinforcement ItemsCWD32.8.3.1 Steel Bars

Unit: t

The type of steel (mild, high-tensile, or other) will be stated.

CWD32.8.3.2 High-Tensile Welded MeshUnit: m<sup>2</sup>

The type reference will be stated.

CWD32.8.3.3 Rails or other Steel Sections used as Reinforcement

Unit: t

CWD32.8.4 Scheduled Concrete ItemsCWD32.8.4.1 Blinding Layer

Either of the following will be stated :

Minimum thickness and class

Unit: m<sup>2</sup>

Class

Unit: m<sup>3</sup>CWD32.8.4.2 Strength ConcreteUnit: m<sup>3</sup>

The class and positions or elements in the Works will be stated.

CWD32.8.4.3 Secondary ConcreteUnit: m<sup>3</sup>

The class and positions or elements in the Works will be stated.

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CWD32.8.4.4 No-fines Concrete

CWD32.38

Unit: m

CWD32.8.4.5 Flow Concrete

Unit: m<sup>3</sup>

The class and position or elements in the Works will be stated.

CWD32.8.4.6 Unformed Surface Finishes

Unit: m<sup>2</sup>

Items will be scheduled for each class or type of finish, i.e. :

- (a) Class U1 finish
- (b) Class U2 finish
- (c) Class U3 finish
- (d) Class U4 finish
- (e) Class U5 finish

CWD32.8.4.7 Aggregate (where measured separately)

Unit: m<sup>3</sup>

The rate shall cover the cost of supplying and using the aggregate in the manner specified.

CWD32.8.4.8 Cement (where measured separately)

Unit: t

The rate shall cover the cost of supplying and using the cement in the manner specified.

CWD32.8.5 Joints

CWD32.8.5.1 Joints

Unit: m

Separate items will be scheduled for different types and sizes of joints and involving different types, sizes, and qualities of waterstops, soft board, sealers.

The unit rate shall cover the cost of all materials and labour for the construction of each joint as specified in Particular Specification CWD34 or shown on the Drawings, including the cost of formwork, preparation of surfaces, protection, jointing, intersection pieces, testing and making good.



**CWD32.8.6 Special Surface Preparation**Unit : m<sup>3</sup>

When the Engineer introduces an additional horizontal construction joint, not specified as such on the Drawings, due to a Site Instruction or a revised construction drawing issued to the Contractor, or due to interrupted pouring of concrete as directed by the Engineer, the surface preparation of such a concrete surface as per Clause CWD32.5.5.16 shall be paid for under this payment item. The surface preparation of the diversion culvert to receive flow concrete shall also be paid for under this item.

**CWD32.8.7 Manufacture (or Supply) and Erect Precast Elements****CWD32.8.7.1 Manufacture (or Supply) and Erect Precast Elements**Unit : No. or m<sup>3</sup>

Separate items will be scheduled for :

- (a) Different qualities of concrete;
- (b) different types and sizes of units;
- (c) small units not exceeding 0,5 m<sup>3</sup> of formed concrete;
- (d) different positions of units for erection purposes.

Except where separate items are scheduled for specific operations or materials, the rates shall cover the cost of supply of all materials, plant and labour for the concrete and reinforcement in the elements including the cost of moulds for forming the element, special finishes, curing, transport, handling to Site, erecting or building in or fixing, and grouting.

**CWD32.8.8 Grouting**

- (a) Under bases (or beds)

Unit: m<sup>3</sup>

Grouting under structural steel column bases or members or under pumps, motors, or other machinery will be measured by the volume of grout (before the edges are trimmed at 45° from the bottom edges of bedplates) necessary to fill the voids and pockets between the underside of the metalwork and the top of the concrete. No deduction will be made for bolts, packers, baseplate shear keys protruding into the grout space.

- (b) HD bolts or similar. (see Clause CWD32.8.9)

Unit: m<sup>3</sup>

Separate items will be scheduled for HD bolts or pockets, as applicable, of different diameters, lengths, and types, and for miscellaneous metal work of different types. The quantity will be measured by the volume of grout necessary to fill the voids in the concrete. No deduction will be made for bolts and packers protruding into the grout space.

The rates for (a) and (b) above shall cover the cost of scabbing, cleaning, and preparing the concrete surfaces, providing an approved grout, placing and ramming it solidly into all voids and pockets, and mitring the outside edges to a true wood-floated surface. Formwork, if any, will be measured separately in terms of Clause CWD32.8.2.

**CWD32.8.9 HD Bolts and Miscellaneous Metal Work****CWD32.8.9.1 HD Bolts and Miscellaneous Metal Work**

Unit: No or t

Whether to be supplied by the Contractor or by others will be stated. Separate items will be scheduled as specified in Clause CWD32.8.8 (b).

The rate shall cover the cost of supplying and delivering or taking delivery (as applicable), fixing or casting into concrete, and all cleaning, preparation, and finishing.

**CWD32.8.10 Cooling of Concrete****Cooling of Concrete**Unit : m<sup>3</sup>.°C

Volumes will be the actual volume in m<sup>3</sup> of the concrete that was placed at a temperature below the wet-bulb air temperature at the instant of placing. The temperature differences applied will be computed in °C as the

difference between the maximum allowable placing temperature for the concrete in a particular pour and the average wet-bulb air temperature for that volume of concrete that was placed at a temperature below the wet-bulb air temperature at the instant of placing.

Table CWD32.11 : Requirements for strength concrete

CONCRETE CLASS DESIGNATION	GRADE (MPa)	MSA <sup>(1)</sup> (mm)	MAXIMUM W:C RATIO <sup>(2)</sup>	MINIMUM COMPACTING FACTOR <sup>(3)</sup>	SLUMP <sup>(4)</sup> (mm)	MINIMUM CEMENTITIOUS MATERIALS CONTENTS (kg/m <sup>3</sup> concrete)	MASS REPLACEMENT OF OPC WITH EXTENDERS (Percent of mass of cement replaced)			
							MGBS		FA	
							Maximum	Minimum	Maximum	Minimum
40/19	40	19	0.45	0.90	60 - 80	380	50	30	30	30
40/38	40	38	0.45	0.90	60 - 80	350	50	30	30	30
30/19	30	19	0.50	0.90	50 - 80	380	50	30	30	30
30/38	30	38	0.50	0.85	60 - 80	320	50	30	30	30
25/19	25	19	0.50	0.90	50 - 80	340	50	30	30	30
25/38	25	38	0.50	0.85	60 - 80	300	50	30	30	30
20/19	20	19	0.55	0.90	50 - 80	320	50	30	30	30
20/38	20	38	0.55	0.85	40 - 80	280	50	30	50	30
20/53	20	53	0.55	0.80	40 - 60	280	50	30	50	30
15/38	15	38	0.55	0.85	40 - 70	280	70	50	50	30
15/53	15	75	0.55	0.80	30 - 70	270	70	50	50	30

NOTES :

(1) The MSA is the maximum nominal size of coarse aggregate that may be present in the concrete mix of the particular concrete designation. The concrete mix of particular concrete designation shall contain aggregate of the MSA size designation in the proportion approved by the Engineer generally to yield the maximum dry rodded density of the combined aggregates without the concrete mix showing any tendency to segregate or bleed.

The coarse and fine aggregates shall be so proportioned as to give, in the opinion of the Engineer, a smooth curve of cumulative mass passing against grain size for the combined coarse and fine aggregates in the mix, subject to the other relevant requirements specified for the determination of the concrete mix proportions. Gap or skip graded mixes shall not be used.

(2) The maximum water:cement ratio and/or minimum cementitious materials content may not necessarily be consistent with the specified strength or other specified properties. The mixes shall be proportioned to ensure that neither the specified concrete strength nor the specified minimum cementitious materials content nor the specified compacting factor are below the specified values.

(3) The compacting factor shall be the compacting factor, when using the small apparatus, of the fresh concrete when sampled after discharge at the point of final placement

(4) Fresh concrete when sampled after discharge at the point of final placement.

## APPENDIX A

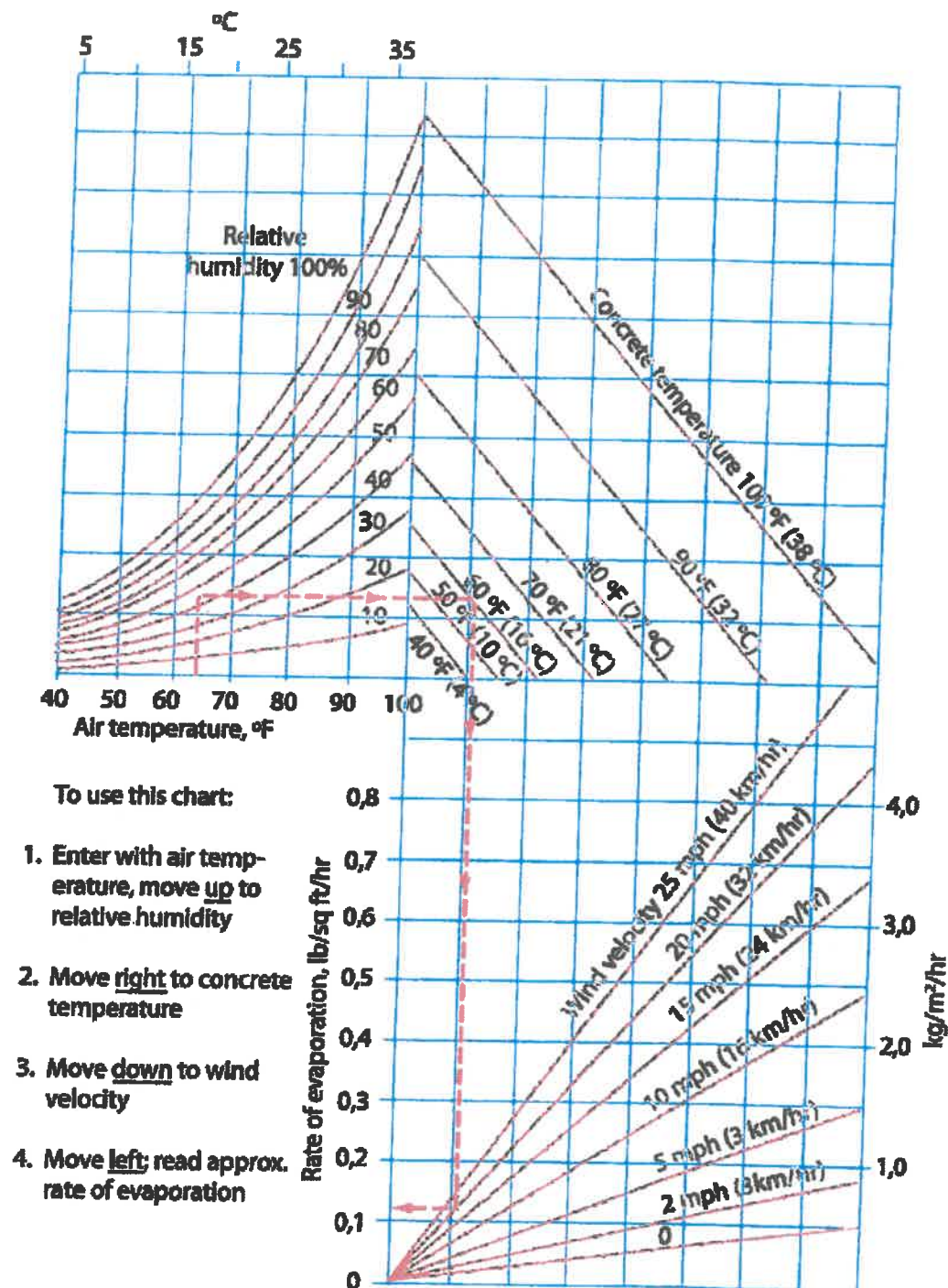


Figure 1: Effect of concrete and air temperatures, relative humidity, and wind velocity on the rate of evaporation of surface moisture from concrete. This chart provides a graphic method of estimating the loss of surface moisture for various weather conditions. To use, follow the four steps outlined above. If the rate of evaporation approaches 0.2 lb per sq ft per hr (1.0 kg/m<sup>2</sup>/hr), precautions against plastic shrinkage cracking are necessary. These precautions are to be approved by the Engineer. Chart obtained from "Curing of Concrete," Concrete Information Sheet IS 55.02T, Portland Cement Association, Chicago, 1966.

## SUMMARY OF APPLICABLE STANDARDS

## APPENDIX B

	Title
SANS 201	Sieve analysis, fines content and dust content of aggregates
SANS 202	Chloride content of aggregates
SANS 5832	Organic impurities in fine aggregates
SANS 5833	Detection of sugar in fine aggregates
SANS 5834	Soluble deleterious impurities in fine aggregates (limit test)
SANS 5841	Aggregate crushing value of coarse aggregates
SANS 5842	FACT value of coarse aggregates
SANS 5847	Flakiness index of coarse aggregate
SANS 6243	Deleterious clay content of fines in aggregates
SANS 5838	Sand equivalent value of fine aggregates
SANS 5843	Water absorption of aggregates
SANS 5845	Bulk densities and voids content of aggregates
SANS 197	Preparation of test samples of aggregates
SANS 5844	Particle and relative densities of aggregates
SANS 5846	Los Angeles abrasion resistance of coarse aggregate
SANS 195	Sampling of aggregates
SANS 6241	Particle size distribution of material of diameter smaller than 75 micron in fine aggregate (hydrometer method)
SANS 5861-1	Mixing fresh concrete in the laboratory
SANS 5861-2	Sampling of freshly mixed concrete
SANS 5861-3	Making and curing of test specimens
SANS 5862-1	Consistence of freshly mixed concrete – Slump Test
SANS 5862-3	Consistence of freshly mixed concrete – Vebe Test
SANS 5862-4	Consistence of freshly mixed concrete – Compacting factor
SANS 5863	Compressive strength of hardened concrete
SANS 5865	The drilling, preparation and testing for compressive strength of cores taken from hardened concrete
SANS 6250	Density of compacted freshly mixed concrete
SANS 6251	Density of hardened concrete
SANS 8252	Air content of freshly mixed concrete – pressure method
SANS 5860	Dimensions, tolerances and uses of cast test specimens
SANS 1083	Aggregates from natural sources – concrete aggregates
SANS 1090	Aggregates from natural sources – fine aggregates for plaster and mortar



**water affairs**

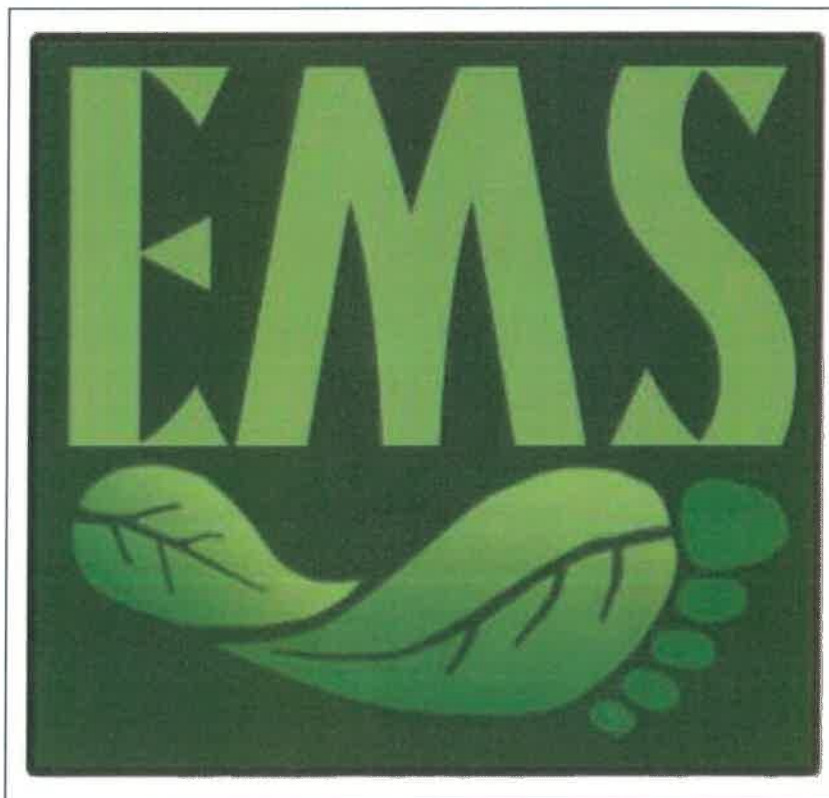
Department:  
Water Affairs  
REPUBLIC OF SOUTH AFRICA

Chief Directorate: Construction Management

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**OLIFANTS-DOORN RIVER WATER RESOURCES DEVELOPMENT PROJECT**

# **RAISING OF CLANWILLIAM DAM BASELINE ENVIRONMENTAL MANAGEMENT PLAN**





## Baseline Environmental Management Plan

### ACKNOWLEDGEMENT

*Front page logo designed by:* Sue Thompson





## Baseline Environmental Management Plan

### Acronyms and Abbreviations

APP:	Approved Professional Person
CER:	Contractors Environmental Representative
DEA:	Department of Environmental Affairs
DMR:	Department of Mineral Resources
DWA:	Department of Water Affairs
EIA:	Environmental Impact Assessment
EIR:	Environmental Impact Report
EMP:	Environmental Management Plan
ESM&R:	Environmental Site Management and Rehabilitation
IEM:	Integrated Environmental Manager under the employ of DWA or employed as an outside Consultant to DWA
NEMA:	National Environmental Management Act (Act No 107 of 1998)
RoD	Record of Decision
RID	Record of Implementation Decision
MPRDA:	Minerals and Petroleum Resources Development Act (No 28 of 2002)
I&AP	Interested And Affected Party
DEADP:	Provincial Department of Environmental Affairs and Development Planning
ODRWRDP:	Olifants-Doorn River Water Resources Development Project
ORGWS:	Olifants River Government Water Scheme
IA:	Implementing Agent
PM:	Project Manager

### Definitions

<u>Approved Professional Person</u>	A person registered in terms of the Engineering Profession of South Africa Act, 1990 (Act No. 114 of 1990) and approved by the Minister of Water Affairs after consultation with the Engineering Council of South Africa (established by section 2 of that Act). The National Water Act ensures that only appropriately qualified people (approved professional persons (APP)) are allowed to design and inspect dams that pose a safety risk. This means
<u>Audit (EMP Audit)</u>	A systematic, documented and objective evaluation of the environmental performance of a project by obtaining and analysing evidence to determine whether the implementation of the EMP conforms to its requirements (Swaziland Environmental Authority, 1999).
<u>Authority</u>	National, regional or local authority that has a decision-making role or interest in the development.
<u>Catchment</u>	All the land area from mountaintop to seashore, which is drained by a single river and its tributaries.
<u>Compensation</u>	Trade-offs between different parties affected by the proposed development to the mutual satisfaction of all concerned parties.



<u>Contractor</u>	Individual and/or company responsible for the construction activities, the related activities and the implementation of the project.
<u>Contractors Environmental Representative (CER)</u>	Person on the site representing the Contractor who is knowledgeable in environmental issues and is responsible for the implementation of the findings of the environmental plan.
<u>Corrective (or Remedial) Action</u>	Reactive response required to address an environmental problem that is in conflict with the requirements of the Environmental Management Plan (EMP). The need for corrective action may be determined through monitoring, audits or management review.
<u>Cumulative Impact</u>	An action that in itself is not significant but is significant when added to the impact of other activities in the area.
<u>De-Bushing</u>	Clearing of the site of bush and undergrowth vegetation, but not including the removal of tree stumps.
<u>Environment</u>	<p>According to National Environmental Management Act (Act No 107 of 1998) (NEMA), the environment is the surroundings within which humans exist, being made up of:</p> <ul style="list-style-type: none"> <li>• the land, water and atmosphere of the earth;</li> <li>• micro-organisms, plant and animal life;</li> <li>• any plant or combination of i) and ii) and the interrelationships among and between them; and</li> <li>• the physical, chemical, aesthetic and cultural properties and conditions of the above that influence human health and well-being.</li> </ul> <p>However, for the purposes of this document the environment includes both the bio-physical as well as the social and economic aspects of the area.</p>
<u>Environmental Aspect</u>	Those components of the company's activities, products and services that is likely to interact with the environment.
<u>Environmental Awareness Training Course</u>	A presentation given to the Contractor and its Sub-contractors to raise environmental awareness and ensure that all staff, Contractor(s) and Sub-contractor(s) is familiar with or made aware of the contents of the Record of Decision (RoD) and the EMP.
<u>Environmental Impact</u>	Change in an environment resulting from the effect of an activity on the environment, whether positive or negative. Impacts may be the direct consequence of an individual's or organisation's activities or may be indirectly caused by them (DEA, 1998).
<u>Environmental Impact Assessment (EIA)</u>	The process of examining the environmental effects of a development in terms of the Environment Conservation Act (No 73 of 1989), the Environment Impact Assessment (EIA) Regulations of September 1997 (as amended) and EIA Regulations Guideline Document of April 1998.

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It is the process of assessing and incorporating potentially significant environmental impacts into the planning, design, approval and implementation of a project.

A detailed plan of action prepared to ensure that recommendations for enhancing positive impacts and/or limiting or preventing negative environmental impacts are implemented during the life-cycle of a project.

Environmental Management Programme Report (EMPR)

The report required to be prepared for all mining activities pursuant to the Minerals and Petroleum Resources Development Act (No 28 of 2002) (MPRDA).

Environmental Objective

Overall environmental goal as stated in the EMP.

Environmental Performance Certificate

The certificate issued by the Integrated Environmental Manager (IEM) at the end of a Contract confirming that all environmental specifications applicable to the Contractor have been met.

Environmental Policy

Statement of intent and principles in relation to overall environmental performance, providing a framework for the setting of objectives and targets.

Environmental Risk

The probability of a prescribed undesirable effect. Risks result from the existence of a hazard and uncertainty about its expression (Suter, 1993).

Environmental Specification

Instructions and guidance for specific construction activities designed to help prevent, reduce and/or control the potential environmental implications of these activities.

Environmental Target

Detailed requirement against which performance may be assessed, quantified where practicable, arising from an environmental objective and that needs to be met in order to achieve the associated objective. A target against which performance can be assessed.

Floodline

Lines on a map or drawing depicting water levels likely to be reached by a flood having a specified recurrence interval, such as a 1:100 year flood (A one-in-hundred-year flood is a flood event that has a 1% probability of occurring in any given year)

Floodplain

A flat expanse of land bordering a river channel, formed through sediment deposition and other alluvial processes, and often characterized by frequent flooding as a result of bank overspill from the river channel.

Groundwater

Subsurface water in the zone in which permeable rocks, and often the overlying soil, are saturated under pressure equal to or greater than atmospheric.

Heritage Resource

Any place or object of cultural significance including buildings, structures, landscapes, graves and geological, archaeological and paleontological

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sites.

**Interested And Affected Party (I&AP)**

Individuals or groups concerned with, or affected by, an activity and its consequences. These include the authorities, local communities, investors, work force, customers and consumers, environmental interest groups and the general public (DEA, 1998).

**Landscape**

Land modified for human use and occupation, embracing both the natural (wilderness) environment and the urban.

**Landscape Architecture**

The science, art and technique of planning and design of integrated man-made and natural elements and spaces to improve the quality of life.

**Mitigation**

Measures designed to avoid, reduce or remedy adverse impacts (DEA, 1998).

**Monitoring**

The repetitive and continued observation, measurement and evaluation of environmental criteria to follow changes over a period of time and to assess the efficiency of control measures (DEA, 1998).

**Natural Vegetation**

All existing vegetation species, indigenous or otherwise, of trees, shrubs, groundcover, grasses and all other plants found growing on the site.

**Overburden**

The soil overlying desirable material extracted during borrowing or quarrying.

**Pollution**

The residue of human activity which adversely affects the next user or environmental resource.

Any change in the environment caused by substances, radioactive or other waves, or noise, odours, dust or heat, emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or well-being or on the composition, resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future.

**Preventative Action**

A predetermined action to address potential problems before they develop into situations which would be contrary to the requirements of the EMP. Preventative action is most often determined from the results of monitoring and audits during management review.

**Progressive Reinstatement**

Reinstatement of disturbed areas to topsoil profile on an on-going basis immediately after selected construction activities (e.g. backfilling of a trench) are completed. This allows for passive rehabilitation (i.e. natural recolonisation by vegetation) to commence.

**Project Appraisal**

The collection and evaluation of detailed information concerning a proposed, usually to assess risk associated with it.

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<u>Project Manager</u>	Department of Water Affairs representative charged with coordinating and managing the various stages of a project.
<u>Protected Plants</u>	Plant species officially listed on the Protected Plants List (each province has one), and which may not be removed or transported without a permit to do so from the relevant provincial authority.
<u>Record Of Decision (RoD)</u>	The written statement from the relevant environmental authority in terms of the Environment Conservation Act (No 73 of 1989), with or without conditions, that records its approval of a planned activity and the implementation thereof and the mitigating measures required to prevent or reduce the effects of environmental impacts during the life of a contract.
<u>Red Data Species</u>	Plant and animal species officially listed in the Red Data Lists as being rare, endangered or threatened.
<u>Rehabilitation</u>	Rehabilitation is defined as the return of a disturbed area to a state, which approximates the state (where possible), which it was before disruption. Rehabilitation for the purposes of this specification is aimed at post-reinstatement revegetation of a disturbed area and the assurance of a stable land surface.  Revegetation should aim to accelerate the natural succession processes so that the plant community develops in the desired way, i.e. promote rapid vegetation establishment.
<u>Riparian Vegetation</u>	Vegetation occurring on the banks of a river or a stream (i.e. vegetation fringing a water body).
<u>Runoff</u>	The total water yield from a catchment including surface and subsurface flow.
<u>Significant Impact</u>	An impact that has crossed the threshold of significance.
<u>Site Specific Investigation</u>	An assessment or evaluation of the impact of the proposed development on the immediate environment.
<u>Subsoil</u>	The soil horizons between the topsoil horizon and the underlying parent rock.
<u>Topsoil</u>	This is defined as the A horizon of the soil profile. Topsoil is the upper layer of soil from which plants obtain their nutrients for growth. It is often darker in colour, due to the organic fraction, but regardless of the fertility appearance, structure, agriculture potential, this profile constitutes the topsoil.
<u>Transplanting</u>	The removal of plant material and replanting the same plants in another designated position.
<u>Veld</u>	Unimproved areas of natural vegetation.

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<u>Wastewater</u>	Means water contaminated by the activities.
<u>Watercourse</u>	A geomorphological feature characterized by the presence of a stream-flow channel, a floodplain and a transitional upland fringe seasonally or permanently conveying surface water.
<u>Waterlogged</u>	Soil or land saturated with water long enough for anaerobic conditions to develop.
<u>Weeds And Invader Plants</u>	Weeds and invader plants are defined as undesirable plant growth that shall include, but not be limited to all declared category 1, 2 and 3 listed invader species as set out in the Conservation of Agricultural Resources Act (No 43 of 1983) regulations. Other vegetation deemed to be invasive should be those plant species that show the potential to occupy in number, any area within the defined construction area.
<u>Wetland</u>	A seasonally, temporarily or permanently wet area, often exhibiting a specific vegetation community, for example, sedges, rushes, reeds, hydrophilic grasses, ground-covers and trees.



# Baseline Environmental Management Plan

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## Baseline Environmental Management Plan

In the absence of a Department of Water Affairs DWA issued Environmental Management Plan (EMP), this baseline EMP will be used.

This baseline EMP was compiled referring to the following sources:

- Department of Water Affairs: Integrated Environmental Management Series: Environmental Best Practice Specifications: Construction: For Construction Sites, Infrastructure Upgrades and Maintenance Works. 3rd Edition. February 2005
- Guidelines for Standardised Environmental Management Plans for Department of Water Affairs and Forestry Projects. May 2002
- Olifants-Doorn River Water Resources Development Project (ODRWRDP): Raising Of Clanwilliam Dam: Volume 2.1: Project Specification. Department of Water Affairs. April 2013.
- Record of Decision: Strengthening and Raising of the Clanwilliam Dam and Associated Re-Alignment of Certain Secondary Roads, Clanwilliam. Western Cape Department of Environmental Affairs and Development Planning. May 2009
- Record of Implementation Decision regarding the Raising of Clanwilliam Dam. Department of Water Affairs, Directorate: Options Analysis. April 2013.
- DWA Report: WSA17/E10/00/0907: Proposed Raising of Clanwilliam Dam and Associated Realignment of Affected Roads Final Environmental Impact Report, Dated: 28 September 2007
- Final Environmental Impact Report (EIR) for the Raising of Clanwilliam Dam

## 1 INTRODUCTION

### 1.1 Purpose of Baseline Environmental Management Plan

The purpose of this baseline EMP is to:

- outline the requirements in terms of the environmental management commitment required from the DWA during the raising of Clanwilliam Dam, thus during the pre-construction and construction phases of the project;
- ensure compliance to all relevant environmental and relevant legislation and regulatory requirements during all the phases; and

### 1.2 Environmental Authorisation

In January 2004 the Clanwilliam Dam Raising Association was appointed by the DWA Directorate: Options Analysis to undertake a feasibility study for the raising of Clanwilliam Dam. Deliverables from the feasibility study included an Environmental Scoping Report and a comprehensive EIA with associated public participation and consultation. The EIA concluded with the issuing of an approved Record of Decision (RoD) (attached as **Annexure A**) on 12 May 2009 by the Western Cape Provincial Department of Environmental Affairs and Development Planning (DEADP). An appeal process followed where after the original ROD was upheld by DEADP in an appeal decision letter dated 22 February 2010 (attached as **Annexure B**). As per the appeal process the expiry date of the RoD: Section J was amended to read as follows: *'This authorisation shall lapse if the activity does not commence within five (5) years of the date of issue of this appeal decision letter'*.

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### 1.3 Scope of this Document

This baseline EMP covers environmental activities associated with the civil components of the project and which are considered pertinent to proper environmental management and control in terms of relevant legislation.

Thus this document will outline:

- The description of the proposed project, namely the raising of Clanwilliam Dam.
- The activities to be undertaken.
- The potential environmental impacts identified.
- The mitigation measures.
- The reporting and organisational relationships and responsibilities.
- Overarching environmental principles and legal requirements.
- Baseline EMP.
- Monitoring and reporting requirements for the duration of the contract.

## 2 DESCRIPTION OF THE PROJECT

### 2.1 Background

The Olifants River Government Water Scheme (ORGWS) supplies raw water from the Clanwilliam Dam to farmers, municipalities, mines and industries in the Olifants River valley between the dam and the estuary.

Clanwilliam Dam is located on the Olifants River about two kilometres south west of the town of Clanwilliam, Western Cape.

Construction on the original Clanwilliam Dam was completed in 1935 and had a capacity of 69,9 million m<sup>3</sup>. The dam was a mass gravity concrete structure with a centrally situated 117,5 m long ogee spillway section.

During 1962 to 1966 the Clanwilliam Dam was raised. The work included:

- the lengthening of the overspill crest;
- the remodelling and raising of the crest by the addition of 3,05 m mass concrete to the top of the existing crest;
- the installation of 13 crest gates, each 7,77 m wide by 3,05 m high, to provide for increasing irrigation water demand;
- the raising of the non-overspill flanks by 4,88 m by means of mass concrete;
- the construction of a bridge superstructure across the dam to provide access for the operating of the gates; and
- for stability, the dam was tied to its foundation by means of post-tensioned cables positioned along the centreline of the dam, spaced from 1,52 m in the middle section to 3,05 m on the flanks.

The current dam wall has the following dimensions:

- height = 43 m;
- total length = 255 m; and
- capacity = 128 million m<sup>3</sup>, with a live storage capacity of 122 million m<sup>3</sup>.

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The Clanwilliam Dam wall suffered chemical attack over the years. Dam safety investigations found that the stability of the dam and especially the anchors does not meet safety standards. As a result extensive remedial works are required to maintain the integrity of the structure. The remedial works required therefore provided an opportunity that the storage capacity of the dam can be increased simultaneously through a raising of the full supply level (FSL) of the dam.

During 2006, the Sub-Directorate: Dam Safety Surveillance did a feasibility design for the possible raising of the dam. Various options regarding the details and height of the raising were investigated. The preferred dam raising option was determined and consists of:

- a mass concrete gravity rising by 13 m on the downstream side of the dam without crest gates; and
- the improvement of the inlet and outlet structures to provide for multilevel inlets.

## 2.2 Project Components

For the raising of Clanwilliam Dam, the following activities will be undertaken:

- Clearing, establishment and operation of a site camp with offices, storerooms and workshops, overnight accommodation for security and emergency staff, power lines and facilities for power generation, ablutions, wash bays, emergency health facilities, abstraction of water, supply of potable water, facilities for waste water management, and facilities for the storage of explosives.
- The raising of the dam wall by 13 m, which includes inter alia:
  - Excavations in and around the structure
  - Pressure grouting part of the footprint of the foundation excavations
  - Consolidation grouting through dental concrete
  - Tunnelling underneath the existing left bank NOC
  - Demolishing and removing of certain existing structures
- Construction of cofferdams and/or river diversions.
- Construction of an intake tower.
- Constructing a stilling basin.
- Construction of various temporary and permanent access roads, low level river crossings and haul roads.
- Construction and operation of batching plants.
- Construction and operation of a crusher.
- Construction and operation of a steel-bending yard
- Construction and operation of a small-scale water treatment and small-scale sewage treatment plant.
- Construction and operation of small-scale waste collection and disposal facility.
- Facilities for the bulk storage and dispensing of fuel (eg diesel and petrol) for construction vehicles.
- Stockpiling of construction materials for the construction of the dam, including the batching plants.
- Storage and handling of hazardous substances including diesel, engine oils and other listed substances.
- Establishment and operation of quarries, borrow pits and spoil sites.
- Excavation of borrow areas from which construction materials will be sourced.

- Construction of a standby generator house, access control structures and other minor brick structures.
- Construction of a boat launching slipway.
- Installation of a safety boom upstream of the spillway section.
- Construction of a seismic station.
- Construction of a river flow gauging weir immediately downstream of the dam.
- Construction of a river flow gauging weir in the Doorn River.
- Construction of a river flow gauging weir just downstream of Bulshoek Weir.

## 2.3 Potential Bio-Physical and Social Environmental Impacts

The EIA comprises among others the Final Environmental Impact Report (EIR) for the Raising of Clanwilliam Dam. As per the final EIR (attached as **Annexure C**), included in *DWA Report: WSA17/E10/00/0907: Proposed Raising of Clanwilliam Dam and Associated Realignment of Affected Roads Final Environmental Impact Report, Dated: 28 September 2007*, the following potential bio-physical and social environmental impacts relating to the construction phase of the raising of Clanwilliam Dam were identified:

- Disturbance of flora
- Disturbance of fauna
- Sedimentation and erosion
- Deterioration of water quality
- Traffic impacts
- Interruption of water releases
- Storage and utilisation of hazardous substances on site
- Risk of fire
- Creation of employment opportunities
- Influx of workers to the area (health and safety risks)
- Influx of job seekers
- Creation of business opportunities for local businesses
- Disturbance to sense of place, visual aesthetics
- Windblown dust
- Litter/ waste pollution
- Noise pollution
- Light pollution
- Impact of sourcing construction material

These impacts were assessed and the following impacts were highlighted as being of highest significance during the construction phase of the raising of Clanwilliam Dam:

- Deterioration of water quality
- Sedimentation and erosion
- Impact on aquatic ecology
- Storage and utilisation of hazardous substances
- Noise pollution

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The creation of employment opportunities was identified as a significant positive impact of the construction phase.

## 2.4 Mitigation Measures

Mitigation measures to mitigate the potential bio-physical and social environmental impacts relating to the construction phase of the Clanwilliam Dam raising, as listed under section 2.3, were suggested in:

- *DWA Report: WSA17/E10/00/0907: Proposed Raising of Clanwilliam Dam and Associated Realignment of Affected Roads Final Environmental Impact Report, Dated: 28 September 2007;*
- *Record of Decision: Strengthening and Raising of the Clanwilliam Dam and Associated Re-Alignment of Certain Secondary Roads, Clanwilliam. Western Cape Department of Environmental Affairs and Development Planning. May 2009; and*
- *Record of Implementation Decision regarding the Raising of Clanwilliam Dam. Department of Water Affairs, Directorate: Options Analysis. April 2013.*

These mitigation measurements are summarised in Table 1 together with the impacts and those responsible for implementation of the thereof.

Table 1: Summary of impacts identified, mitigation measures and responsibility

<i>Potential Impacts Identified in the EIR</i>	<i>Reason for Possible Impact</i>	<i>Mitigation Measures</i>	<i>Responsibility</i>
Disturbance of flora	<ul style="list-style-type: none"> <li>Invasion of alien vegetation</li> <li>Negative impact on riparian vegetation</li> </ul>	<ul style="list-style-type: none"> <li>Restore appropriate vegetation in all disturbed areas</li> <li>Remove bulbs, succulents and other suitable plants from areas to be disturbed</li> <li>Establish a plant nursery</li> </ul>	CD: CM
Disturbance of fauna	<ul style="list-style-type: none"> <li>Fauna would relocate during construction</li> </ul>	<ul style="list-style-type: none"> <li>The trapping, shooting or killing of animals are prohibited</li> </ul>	CD: CM
Sedimentation and erosion	<ul style="list-style-type: none"> <li>Increased soil erosion in vicinity of construction site</li> <li>Elevated turbidity levels in the river</li> </ul>	<ul style="list-style-type: none"> <li>Minimise the extent of disturbed areas</li> <li>Undertake appropriate diversion of the river</li> <li>Utilise silt traps, settling ponds and berms to trap silt</li> </ul>	CD: CM
Deterioration of water quality	<ul style="list-style-type: none"> <li>Elevated turbidity levels in the river</li> <li>Change in pH level of water</li> </ul>	<ul style="list-style-type: none"> <li>Undertake appropriate diversion of the river</li> <li>Utilise silt traps, settling ponds and berms to trap silt</li> <li>Construction of sedimentation ponds</li> </ul>	CD: CM
Traffic impacts	<ul style="list-style-type: none"> <li>Negative impact on traffic flow</li> <li>Increase risk of vehicle accidents</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that all regulations relating to traffic management are observed</li> <li>Construction of a temporary underpass under the N7</li> </ul>	DWA / CD: CM
Interruption of water releases	<ul style="list-style-type: none"> <li>Negative impact on Olifants River and its estuary</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that predetermined ecological flow releases are implemented</li> <li>Provide sufficient notice to water users regarding interruptions in water releases</li> </ul>	DWA / CD: CM
Storage and utilisation of hazardous substances on site	<ul style="list-style-type: none"> <li>Spillage could have an impact on the aquatic ecosystem as well as for irrigation farmers utilising the river water downstream</li> </ul>	<ul style="list-style-type: none"> <li>Ensure correct storage methods for hazardous compounds</li> <li>Compile emergency procedures to be followed in the event of a spillage</li> </ul>	CD: CM

<i>Potential Impacts Identified in the EIR</i>	<i>Reason for Possible Impact</i>	<i>Mitigation Measures</i>	<i>Responsibility</i>
Risk of fire	<ul style="list-style-type: none"> <li>Increased risk of fire</li> <li>Fire could have serious safety, economic and ecological implications</li> </ul>	<ul style="list-style-type: none"> <li>Compile emergency procedures to deal with fires</li> </ul>	CD: CM
Creation of employment opportunities	<ul style="list-style-type: none"> <li>Construction activities will result in employment</li> <li>Injection of income to the local economy</li> </ul>	<ul style="list-style-type: none"> <li>Establish employment offices in Clanwilliam, Citrusdal and Vredendal</li> <li>Establish business forums</li> </ul>	DWA / CD: CM
Influx of workers to the area (health and safety risks)	<ul style="list-style-type: none"> <li>Social impacts on host community: <ul style="list-style-type: none"> <li>Transmission of sexually transmitted diseases, including HIV/AIDS;</li> <li>Increase in prostitution;</li> <li>Increase in alcohol and drug related incidents;</li> <li>Increase in crime; and</li> <li>Creation of tension and conflict in the community</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Set up a liaison committee with the local community and local landowners to address conflicts that may arise</li> <li>Deal with internal and external complaints speedily and in an open and transparent manner</li> </ul>	DWA / CD: CM
Influx of job seekers	<ul style="list-style-type: none"> <li>Increased tension and conflict over available jobs and resources within the local community</li> </ul>	<ul style="list-style-type: none"> <li>Establish employment offices in Clanwilliam, Citrusdal and Vredendal</li> </ul>	DWA / CD: CM
Creation of business opportunities for local businesses	<ul style="list-style-type: none"> <li>Injection of income to the local economy</li> </ul>	<ul style="list-style-type: none"> <li>Establish business forums</li> </ul>	DWA / CD: CM
Disturbance to sense of place, visual aesthetics	<ul style="list-style-type: none"> <li>Disturbances caused by construction activities are likely to change the environment and people's experience of it, particularly for permanent residents.</li> <li>Disturbance are likely to impact on tourism</li> </ul>	<ul style="list-style-type: none"> <li>Screening of the construction area</li> </ul>	CD: CM
Windblown dust	<ul style="list-style-type: none"> <li>Increased production of windblown dust</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of appropriate dust suppression measures</li> </ul>	CD: CM

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<i>Potential Impacts Identified in the EIR</i>	<i>Reason for Possible Impact</i>	<i>Mitigation Measures</i>	<i>Responsibility</i>
Litter/ waste pollution	<ul style="list-style-type: none"> <li>Impact on biophysical environment in the vicinity of the dam and aesthetics of the area</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of appropriate measures to mitigate litter/waste pollution</li> </ul>	CD: CM
Noise pollution	<ul style="list-style-type: none"> <li>Increase in noise pollution due to construction activities</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that all regulations relating to noise generation are observed</li> </ul>	CD: CM
Light pollution	<ul style="list-style-type: none"> <li>Increase in light pollution due to construction activities (installation of large floodlights)</li> </ul>	<ul style="list-style-type: none"> <li>Lighting installed on site should not interfere with road safety or cause disturbance to the surrounding community</li> </ul>	CD: CM
Impact of sourcing construction material	<ul style="list-style-type: none"> <li>Destruction and disturbance of indigenous vegetation</li> <li>Extension of the quarry would have long-term visual impact</li> </ul>	<ul style="list-style-type: none"> <li>Removal, damage or disturbance of vegetation should be limited.</li> <li>Screening of the construction area</li> </ul>	CD: CM

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### 3 ENVIRONMENTAL MANAGEMENT PLAN ROLES AND RESPONSIBILITIES

To ensure the efficient and effective implementation of the EMP and the effective monitoring thereof the various role-players roles, responsibilities and accountability are as follows (Source: *Guidelines for Standardised Environmental Management Plans for Department of Water Affairs and Forestry Projects, dated May 2002*):

#### 3.1 Employer - Department of Water Affairs

The Employer for the raising of Clanwilliam Dam is DWA. Therefore, DWA remains ultimately responsible for ensuring that the raising of Clanwilliam Dam is implemented according to the requirements of this baseline EMP.

The DWA is thus:

- responsible for ensuring that sufficient resources (time, financial, human, equipment, etc) are available to efficiently perform its tasks in terms of the baseline EMP; and
- liable for restoring the environment in the event of environmental non-compliance or negligence leading to damage to the environment.

##### 3.1.1 Project Manager

DWA must appoint a Project Manager (PM), whether it is the Approved Professional Person (APP) or any other suitably qualified person, to represent the Department and who must ensure that the scope of work of the project includes environmental supervision.

All decisions regarding environmental procedures and protocol must be approved by the PM, who also has the authority to stop any construction activity in contravention of the document.

The Integrated Environmental Manager (IEM) must give direct feedback to the PM regarding all environmental matters.

DWA is responsible for the maintenance, updating and reviewing of the EMP.

##### 3.1.2 Implementing Agent

The raising of Clanwilliam Dam is an in-house DWA activity, thus the Implementing Agent (IA) is DWA itself, under the guidance of the Chief Directorate: Engineering Services, Directorate: Integrated Environmental Engineering.

The IA is responsible for the implementation of the EMP, however, the liability associated with non-compliance rests with DWA. Hence, the Department must ensure that environmental compliance is clearly defined for the contractor. A permanent IEM should be employed by DWA for the duration of the project. The IEM should be well versed in environmental studies. The contractor is answerable to the PM and/or IA, via the IEM for non-compliance with the requirements stated in the EMP.

##### 3.1.3 Integrated Environmental Manager

DWA must appoint an IEM which will be responsible for overseeing all environmental aspects relating to the development during the raising of Clanwilliam Dam.

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The IEM will liaise between the PM, IA and the contractor, DWA Chief Directorate: Construction Management (CD: CM) on all environmental concerns. DWA is responsible for the maintenance, updating and reviewing of the EMP. All modifications to the EMP must be communicated to the relevant parties through the IEM.

The IEM will compile a monitoring and auditing plan to ensure that the environmental management measures are implemented and are effective. The aim of such plan is to develop a cost effective environmental performance monitoring procedure. The IEM is also responsible for monitoring the performance of the Contractor's Environmental Representative (CER), issuing of site instructions to the contractor for non-listed activities and assisting in the resolution of conflicts.

In addition, the IEM is responsible for:

- Liaison with relevant authorities:
  - the IEM will be responsible for liaising with DEA. The IEM must submit monthly environmental audit reports to the authorities. These audit reports must contain information on the construction team's compliance with the EMP.
  - Such audit report must include a description of the general state of the site, with specific reference to sensitive areas and areas of non-compliance. The IEM is to suggest corrective actions measures to eliminate the occurrence of the non-compliance incidents.
- Undertaking routine monitoring and appointing competent persons/institutions to be responsible for specialist monitoring, if necessary.
- On a daily basis, via the PM and IA, monitor specifications on site and project compliance with the conditions of the ROD, environmental legislation and recommendations of the EMP.
- Monitoring and verifying compliance with the EMP and RoD, and keeping a register of compliance/non-compliance.
- Identifying and assessing previously unforeseen, actual or potential impacts of the project on the environment.
- Ensure the maintenance of the on-site public complaints register.
- Ensure that a monthly environmental performance audit is undertaken, verifying the monitoring reports submitted by the PM, IA and CER and maintain a register of these audits.
- Conducting site inspections during the defects liability period, and bringing any environmental concerns to the attention of the Employer.
- Recommending to the PM and IA that the Contractor suspend any or all works on site if the third parties who carry out all or part of the Contractor's obligations fail to comply with the environmental specifications.
- Advising on the rectification of any pollution, contamination or damage to the project site, rights of way and adjacent land.
- Attending site meetings (scheduled and ad hoc).
- Maintaining a filing system meeting the Project's Quality Management Plan.
- Ensuring that a copy of the RoD and latest version of the EMP are available on site at all times.
- Ensuring that the PM and IA are made aware of all applicable DEA approved changes to the EMP.

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### 3.2 Contractor - Department of Water Affairs Chief Directorate: Construction Management

The raising of Clanwilliam Dam will be done in-house by the DWA CD: CM. The CD: CM are bound to the conditions of the generic and baseline EMP and are responsible to ensure that such conditions are adhered to. The CD: CM management team, supervisors, foreman, and his appointed advisor (Contractor's Environmental Representative) must familiarise themselves with the requirements of the baseline EMP before entering the site and must request clarification on any aspect of these documents, should they be unclear. They must further be knowledgeable in environmental matters so that they can accurately and efficiently carry out the requirements of the baseline EMP.

The DWA CD: CM must ensure that sufficient budget for complying with all the conditions in the baseline EMP is available.

The DWA must comply with all orders, whether written or verbal, given by the IEM.

The Contractor shall:

- Be responsible for the implementation of the applicable environmental specifications in accordance with the requirements and provisions of the baseline EMP.
- Ensure that all third parties who carry out all or part of the Contractor's obligations comply with the requirements and provisions of the baseline EMP.
- Report any non-compliance to the PM and/or IA within 12 hours of the event occurring.
- Report any non-compliance event that constitutes an emergency immediately and in line with the protocol applicable to that particular emergency event.
- Ensure that all employees and sub-contractors attend environmental awareness training courses and are familiar with or are made aware of the contents of the RoD.
- The Contractor is liable for any and all remedial work required in terms of the baseline EMP, resulting from his environmental negligence, mismanagement and/or non-compliance.
- Arranging the presentation of the environmental awareness training course to all staff, Contractors and Sub-contractors and monitoring the undertaking by the Contractor(s) of environmental awareness training for all new personnel on-site.

#### 3.2.1 Contractor's Environmental Representative

The DWA CD: CM should appoint CER, who is responsible for the on-site implementation of the EMP. The CER can be the site agent, site engineer, a dedicated environmental officer or an independent consultant. The CD: CM must ensure that the CER is suitably qualified to perform the necessary tasks and is appointed at a level such that she/he can interact effectively with other site contractors, labourers, the environmental advisor and the public.

The CER is responsible for managing the day-to-day on-site implementation of the baseline EMP, and for the compilation of regular (usually weekly) Monitoring Reports. In addition, the CER must act as liaison and advisor on all environmental and related issues, seek advice from the IEM or PM and/or IA when necessary

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and ensure that any complaints received from the public are duly recorded and forwarded to the PM and/or IA.

As such the CER must:

- know the background of the project, and monitor the implementation of the EMP;
- ensure continuous auditing of the project for adherence to the document, identification of problem areas and provision of action plans to avoid costly stoppages and/or further environmental damage;
- ensure transparent and open communication for reporting significant environmental incidents to the relevant authorities and the IEM. Inform the IEM of the incident within 24 hours of the occurrence and maintain a photographic record where necessary;
- ensure that all complaints and concerns from the public and other Interested and Affected Parties (I&APs) be brought to the immediate attention of the IEM for further action;
- establish a liaison, co-ordination and reporting framework involving I&AP's;
- conduct regular site audits during the construction phase and subsequent phases.
- submit compliance reports to the environmental advisor at the stipulated frequency; and
- ensure that the development site is cleared and rehabilitation by the contractor according to the specifications as set out in this document.

## 4 ENVIRONMENTAL PRINCIPLES AND LEGAL REQUIREMENTS

### 4.1 Environmental Principles

The following principles should be considered during the pre-construction and construction phase activities.

- The environment is considered to be composed of both biophysical and social components.
- Construction is a disruptive activity and all due consideration must be given to the environment, including the social environment, during the execution of a project to minimise the impact on affected parties.
- Minimisation of areas disturbed by construction activities should minimise many of the construction related environmental impacts of the project and reduce rehabilitation requirements and costs.
- As minimum requirement, all relevant standards relating to international, national, provincial and local legislation, as applicable, shall be adhered to. This includes requirements relating to waste emissions (e.g. hazardous, airborne, liquid and solid), waste disposal practices, noise regulations, road traffic ordinances, etc.
- Every effort should be made to minimise, reclaim and/or recycle "waste" material.

### 4.2 Compliance with Legislation and Regulations

In terms of the Conditions of Contract for the Raising of Clanwilliam Dam, the Contractor is required to comply with all relevant legislation and regulations.

### 4.3 Required Environmental Permits, Licences and Authorisations

The following are required prior to the commencing of the raising of Clanwilliam Dam:

Table 2: Environmental Permits, Licences and Authorisations required prior to start of project

Activity	Required Environmental Permits, Licences and Authorisations	Applicable Legislation
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<i>Activity</i>	<i>Required Environmental Permits, Licences and Authorisations</i>	<i>Applicable Legislation</i>
Blasting	Blasting permits are required from the Department Mineral Resources	<ul style="list-style-type: none"> <li>Explosives Act (Act No 26 of 1956)</li> </ul>
Waste disposal	All wastes (general and hazardous) generated during the construction may only be disposed of at appropriately licensed sites.	<ul style="list-style-type: none"> <li>Environment Conservation Act (Act No 73 of 1989) Section 19, 19A, 20 and 24A</li> <li>Relevant provincial legislation</li> </ul>
Storage of hazardous substances	Storage and handling of hazardous substances	<ul style="list-style-type: none"> <li>Hazardous Substances Act</li> <li>Occupational Health and Safety Act and relevant Regulations</li> <li>SANS and international standards</li> </ul>
Health and safety of work teams	Health and safety plan required. A risk assessment must be undertaken by an appropriately qualified person(s) and the Contractor shall ensure that all employees under his or her control are informed, instructed and trained by a competent person regarding any hazard and the related work procedures before any work commences, and thereafter at such times as may be determined in the risk assessment	<ul style="list-style-type: none"> <li>Occupational Health and Safety Act (Act No 85 of 1993) Construction Regulations (2003)</li> </ul>

## 5 BASELINE ENVIRONMENTAL MANAGEMENT PLAN

This baseline EMP sets out specific actions to be undertaken in an attempt to minimise environment impacts associated with the raising of Clanwilliam Dam. It also provides a clear description of the role-players that will be responsible for the implementation of the prescribed mitigation measures.

The implementation of the baseline EMP needs to be responsive to new and changing circumstances. This could be realised through rapid short-term responses to problems or incidents, as well as regular planned review and revision of the baseline EMP at key stages in the project. The baseline EMP report is a dynamic 'living' document that will need to be updated regularly throughout the duration of the project life-cycle.

### 5.1 Pre-Construction Requirements

The Pre-Construction Phase refers to the period following final project planning and the tender phase, leading up to, but not including, the establishment on site by the appointed contractor.

#### 5.1.1 General

Some pre-construction activities are the responsibility of the Employer, via the PM or IA.

The Employer shall ensure that:

- an item for environmental issues will be provided for on the Construction Site Meeting Agenda;
- professional conduct is maintained at all times, addressing all role-players with respect and refrain from foul language and abuse;
- any disputes and complaints by stakeholders or the public are immediately be brought to the attention of the IEM for further action;

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- all persons employed by the Contractor or his sub-contractors abide by the requirements of the EMP as it applies to the Works;
- any employee of the Contractor or his sub-contractors found to be in breach of any of the EMP may be ordered to leave the site forthwith. The order may be given orally or in writing. Confirmation of an oral order will be given as soon as practicable but lack of confirmation in writing shall not be a cause for the offender to remain on site; and
- the Contractor is informed via Monitoring and Auditing Reports as well as by means of direct instruction as to what corrective actions are required in terms of Environmental Compliance, if required.

#### 5.1.2 Environmental Site Management and Rehabilitation Plan

Prior to the construction and rehabilitation phases of the raising of Clanwilliam Dam, the CD: CM shall draw up and submit for approval (to the PM and IA) an Environmental Site Management and Rehabilitation (ESM&R) Plan. The ESM&R Plan shall show the final positions and extent of all permanent and temporary site structures and infrastructure, including:

- Buildings and structures.
- Contractors' camp and laydown areas.
- Site offices.
- Site laboratories.
- Batching plants.
- Crusher plants.
- Sand washing plants.
- Roads and access routes.
- Gates and fences.
- Essential services (permanent and temporary water, electricity and sewage).
- Rubble and waste rock storage and disposal sites.
- Solid waste storage and disposal sites.
- Site toilets and ablutions.
- Hazardous waste storage and disposal sites.
- Firebreaks.
- Borrow areas.
- Excavations and trenches.
- Cut and fill areas.
- Sand extraction points.
- Topsoil stockpiles.
- Spoil areas.
- Settlement ponds.
- Construction materials stores.
- Vehicle and equipment stores.
- Workshops.
- Wash bays.
- Fuel stores.
- Hazardous substance stores.

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- Features and plants to be conserved.

The Contractor shall ensure that:

- limitations of the environment such as the seasonality of water bodies are taken into consideration in the construction programme prepared in terms of the Conditions of Contract; and
- the rehabilitation will be executed immediately upon the completion of the different phases of the civil works.

### 5.1.3 Water Management Plan

The Contractor shall further draw up and submit for approval (to the PM and IA) a Water Management (WM) Plan. This plan must show the positions, extent and specifications of all temporary and permanent water management structures and infrastructure, including:

- Taps, pipelines and irrigation systems.
- Underground drains.
- Grass drains.
- French drains.
- Trench and berm systems.
- Deflection berm systems.
- Bunds and sumps.
- Settlement ponds.
- Water discharge points (including energy dissipation specifications).
- Water testing points.
- Sewage water management systems.
- Grey water management systems.

The Contractor shall update the ESM&R and WM Plans throughout the construction period. Changes to either plan must be approved by the IEM, via the PM and/or IA.

### 5.1.4 Environmental Awareness and Environmental Awareness Training

Proper environmental awareness is a requirement for all the Contractor's employees. This will not only ensures the safety of the personnel, but also helps to protect the integrity of the environment during the raising of Clanwilliam Dam.

The Contractor shall ensure that the relevant Environmental Awareness Training Courses are presented before the commencement of construction, as well as during the project as and when new staff or sub-contractors are brought on site.

The awareness training courses shall be in English, Afrikaans and Xhosa and shall be compulsory for all employees, in order to ensure that employees:

- Acquire a basic understanding of the environment and the environmental features pertaining to the Work Site and environs.
- Are familiar with the environmental requirements as per the Civil Project Specification: Volume 2.1 as they apply to the Works.

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- Are made aware of any site-specific environmental matters, which are deemed to be necessary by the IEM, PM and/or IA.

It may also be necessary to present the EMP to employees, highlighting specific requirements and sensitivities.

#### 5.1.5 Appointments

The Contractor shall ensure that a Safety Officer (compulsory) and CER (compulsory) are appointed before the commencement of construction.

#### 5.1.6 Other Requirements

##### 5.1.6.1 Access/Haul Roads

The Contractor shall compile a site layout drawing/s detailing all access/haul roads that are required to be used during the construction phase of the proposed project. The access roads shall be capable of accommodating the type of vehicles and/or mechanical plant using the routes. Any changes to the routes during the construction period shall be submitted in drawing format to the PM and/or IA for approval, prior to the implementation thereof.

When determining the location and extent of access/haul roads, cognisance must be taken of sensitive and no-go areas. As far as reasonably possible, use must be made of existing roads in the area and temporary haul/access roads should be established within the boundaries of the demarcated works area. Any clearing for access or haul roads necessary outside the demarcated works area, shall only be undertaken after approval from the PM and/or IA.

##### 5.1.6.2 General Disturbance and Nuisance to Surrounding Areas

Dust control management practices and procedures will be implemented by implementing one or more of the following methods, depending on site specific circumstances:

- A maximum speed of 40 km/h for passenger and light commercial vehicles and 30 km/h for heavy vehicles and equipment must be strictly enforced to minimise dust generation.
- In areas where dust is expected to be problematic, reduce this maximum speed to 30 km/h.
- Apply watering or alternative chemical stabilisation as an additional means of controlling dust.
- Ensure appropriate mitigation measures are implemented to ensure noise levels are within their lawfully acceptable levels.
- Ensure that any lighting installed on the site for activities does not interfere with road safety or cause a reasonably avoidable disturbance to the surrounding community or other users of the area.

This can include:

- reducing the height from which floodlights are fixed;
- identifying zones of high and low lighting requirements with the focus of the lights being inward, rather than outward;
- avoid up-lighting of structures but rather direct the light downwards and focussed on the object to be illuminated;
- avoid directing the light towards the direction from where it would be most visible

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### 5.1.6.3 *Liaison with Surrounding Community*

The Contractor may not handle any complaint from the surrounding community with regard to environmental aspects, compensation or disturbance to economic activities or animals, but must immediately inform the PM and/or IA who will in turn involve the IEM for further action.

## 5.2 **Construction/Implementation Requirements**

The Construction Phase refers to the period of the project during which the actual Works are carried out, deemed to include site establishment and Site Works.

### 5.2.1 **Site Establishment**

When establishing the site, the environmental objective is to minimise:

- the footprint of disturbance; and
- the extent of soil erosion, loss of vegetation and the potential for pollution of soils and water resources.

#### 5.2.1.1 *Demarcation of the Site*

- The Contractor's right to access any portion of the Site is governed by the terms and conditions of the Conditions of Contract.
- Identify and demarcate the extent of the site and associated Works Areas as indicated on the ESM&R Plan using danger tape with steel droppers or other methods approved by the IEM, in consultation with the PM and/or IA.
- Minimise the extent of the Works Site footprint as much as is possible.
- In sensitive environments, or where unauthorised access into no-go areas may take place, then a perimeter fence (if practical) must be erected around the works area.
- Maintain the demarcation line, and ensure that no personnel or construction materials move outside the designated site.
- Maintain site demarcations in position until the cessation of construction works.
- In sensitive environments such as pristine or valuable vegetation and sensitive social environments, this working servitude may be reduced.
- Do not use the site for any other purpose other than for the proper carrying out of the Works under the Contract.
- Do not establish any Site Works besides those specified and allowed for in the project specification, unless specifically agreed upon by the PM and/or IA, in consultation with the IEM.
- Do not establish any activities or operations that, in the opinion of the IEM are likely to adversely affect the aesthetic quality of the environment.
- In the event that such activities and operations are deemed to be necessary, actions to reduce the adverse effects must be taken. Actions will be specified by the IEM, via the PM and/or IA.
- Do not paint or mark any natural feature. Marking for surveying and other purposes must be done using pegs, beacons or rope and droppers.

#### 5.2.1.2 *Protection of Vegetation and Natural Features*

- All plants and natural features to be protected during construction must be identified in the demarcated construction area prior to the Contractor commencing with land clearing. Any permits or licences required for the removal or pruning of protected tree species as per the Government

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Gazette Notice 1012 of 27 August 2004 and the National Forests Act (Act No 84 of 1998) must be obtained by the PM and/or IA.

- The Contractor may clear only the vegetation within the construction area, unless specifically marked, and must take special care not to disturb plants outside the construction area during this process.
- Any plants or trees of value, close to the construction area that will remain, shall be marked clearly and must not be disturbed, defaced, destroyed or removed for the duration of the Contractor's presence on site, unless otherwise specified by the PM and/or IA.
- Maintain plant demarcations in position until the cessation of construction works.
- Do not disturb, deface, destroy or remove plants or natural features outside of the construction area, whether fenced or not, for the duration of the Contractor's presence on site, unless otherwise specified by the PM and/or IA.
- The Contractor will be held liable for the replacement of any plant or feature under the protection of these specifications that is removed or damaged by the Contractor's negligence or mismanagement.
- No open fires are permitted under trees.
- No material storage or laydown is permitted under trees.
- No vegetative matter may be removed for firewood.

#### *5.2.1.3 Protection of Fauna*

- No wild animal may under any circumstance be handled, removed or be interfered with.
- No wild animal may be feed on site.
- No wild animal, except for pests, may under any circumstance be hunted, snared, captured, injured or killed.
- The Contractor must regularly undertake checks of the surrounding natural vegetation, in fences and along game paths to ensure no traps have been set. Remove and dispose of any snares or traps found on or adjacent to the site.
- Ensure that the Work Site is kept clean, tidy and free of rubbish that would attract animal pests.
- Ensure that bins and waste storage facilities are scavenger-proof.
- The Contractor must report problem animals to the PM and/or IA who will facilitate any removal by the relevant organisation or authority via the IEM.
- Ensure that domesticated animals belonging to the local community are kept away and are safe from any unprotected Works.
- Do not make use of any pesticides, unless approved by the IEM.

#### *5.2.1.4 Protection of Archaeological Finding*

- The Contractor shall ensure that should any archaeological finding be made during the construction excavations, the Contractor shall inform the IEM, PM and/or IA immediately in order to reach agreement regarding proper procedures to minimise damage and or effect salvage operations of the findings.
- Where the IEM, PM and/or IA require the finding/s area/s to be marked for protection, this shall be done using danger tape and steel droppers.
- Maintain demarcations in position until the cessation of construction works, or as instructed by IEM, PM and/or IA.

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- Do not disturb deface, destroy or remove protected findings, whether fenced or not, for the duration of the Contractor's presence on site, unless otherwise specified by the IEM, PM and/or IA.
- If by chance any archaeological finds, graves or skeletal material are unearthed, halt Works in that area immediately and inform the IEM, PM and/or IA for further action.
- Do not resume Works in the area in question without permission from the IEM, PM and/or IA.

#### 5.2.1.5 Topsoil Conservation

- The stripping and stockpiling of topsoil is covered by the Technical Specifications.
- In the absence of a recognisable topsoil layer, strip the uppermost 300 mm of soil.
- Co-ordinate Works to limit unnecessarily prolonged exposure of stripped areas and stockpiles.
- Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction/earthworks in that area.
- Strip and stockpile herbaceous vegetation, overlying grass and other fine organic matter along with the topsoil.
- Do not strip topsoil when it is wet.
- Do not mix topsoil obtained from different sites, unless the IEM gives permission.

#### 5.2.1.6 De-bushing and De-stumping

- Obtain permission from the IEM, PM and/or IA to proceed with de-bushing.
- Only de-bush areas specified on the ESM&R Plan.

### 5.2.2 Site Infrastructure

#### 5.2.2.1 Buildings and Structures

- Locate all buildings and structures, including offices, workshops, stores, site laboratories as well as the weather station within predetermined zones as per the ESM&R Plan.
- No accommodation will be permitted on site.
- The Contractor shall not provide single quarters labour accommodation.
- Secure the areas around buildings and structures using 1,8 m high fence. In areas where security or theft is a problem, the fence height may be increased to 2,4 m and topped with razor wire. These fences are to remain in position until the cessation of Works.
- Maintain essential services in a functional state. These may not be overloaded. Defects and inadequacies must be rectified immediately.

#### 5.2.2.2 Contractors Camp and Lay-Down Areas

- Locate all storage areas and material laydown sites within predetermined zones as per the ESM&R Plan.
- Additional areas required by the Contractor for laydown and storage must be approved by PM and/or IA, in the form of an amended ESM&R Plan indicating the extent and anticipated utilisation of the storage and laydown area.
- Keep the camp and all its storage and laydown areas secure and neat at all times and employ appropriate access control measures during construction.
- Clearly indicate which activities are to take place within which areas of the site using demarcation and/or signage.

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- Position security lighting so that it does not pose a nuisance to residential properties or tourist facilities or a danger to road users.
- Locate all other structures (including site offices, site laboratories, substations, workshops, wash bays, stores, substations etc.) as indicated on the ESM&R Plan.

#### 5.2.2.3 *Batching Plants*

- Position batching plants on the basis of convenient location to the Work Sites as well as environmental limitations/opportunities
- Do not locate batching plants or associated settlement ponds within the 1:100 year floodline, or within a horizontal distance of 100 m (whichever is greater) of a watercourse or drainage line.
- Protect the batching plant on the up-slope side by an earth berm or sandbag system to deflect clean surface runoff away from the plant.
- Contain the batching plant on the down-slope side by a trench and earth berm or sandbag system to control contaminated runoff and construction water emanating from within the plant.
- Collect all construction water and contaminated runoff emanating from within the batching plant (and associated wash bays) and contain within a sedimentation dam for later disposal in the appropriate manner.
- Clean out all sedimentation dams on a regular basis, and disposed of sludge in the appropriate manner.
- Ensure that appropriate measures are in place to prevent the overflow of sedimentation dams during heavy rains and storm conditions. A method statement to this effect shall be provided by the Contractor for approval by the PM and/or IA.
- Scrape waste concrete and cement sludge off the side of the batching plant on a regular basis, and dispose of in the appropriate manner.

#### 5.2.2.4 *Crusher Plants*

- Position crusher plants on the basis of convenient location to the Work Sites as well as environmental limitations/opportunities.
- Utilise the minimum area required for the storage of different stone sizes.
- Do not locate crusher plants or associated settlement ponds within the 1:100 year floodline, or within a horizontal distance of 100 m (whichever is greater) of a watercourse, drainage line or identified wetland.
- Do not locate crusher plants or associated settlement ponds within any riparian vegetation zone.
- Protect the crusher plant on the up-slope side by an earth berm or sandbag system to deflect clean surface runoff away from the plant.
- Contain the crusher plant on the down-slope side by a trench and earth berm or sandbag system to control contaminated runoff and construction water emanating from within the plant.
- Collect all construction water and contaminated runoff emanating from within the crusher plant and contain within a closed settlement pond system.
- Filtered water from the settlement pond may be liberated into the environment in an appropriate manner.
- Clean out settlement pond on a regular basis, and disposed of sludge in the appropriate manner.

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- Ensure that appropriate measures are in place to prevent the overflow of settlement ponds during heavy rains and storm conditions. A method statement to this effect shall be provided by the Contractor for approval by the PM and/or IA.

#### **5.2.2.5 Sand Washing Plants**

- Position sand washing plants on the basis of convenient location to the Work Sites as well as environmental limitations/opportunities.
- Do not locate sand washing plants or associated settlement ponds within the 1:20 year floodline, or within a horizontal distance of 50 m (whichever is greater) of a watercourse, drainage line or identified wetland unless specified additional sediment retention methods are implemented such as silt curtains.
- Do not locate sand washing plants or associated settlement ponds within any riparian vegetation zone.
- Protect the sand washing plant on the up-slope side by an earth berm or sandbag system to deflect clean surface runoff away from the plant.
- Contain the sand washing plant on the down-slope side by a trench and earth berm or sandbag system to control contaminated runoff and construction water emanating from within the plant.
- Collect all construction water and contaminated runoff emanating from within the sand washing plant and contain within a closed settlement pond system.
- Filtered water from the settlement pond may be liberated into the environment in an appropriate manner. Clean out settlement pond on a regular basis, and disposed of sludge in the appropriate manner.
- Ensure that appropriate measures are in place to prevent the overflow of settlement ponds during heavy rains and storm conditions. A method statement to this effect shall be provided by the Contractor for approval by the PM and/or IA.

#### **5.2.2.6 Nursery and Plant Rescue**

- Locate on-site nurseries as indicated on the ESM&R Plan.
- Where necessary, fence in the nursery area using a 1,2m high fence. In areas where security or theft is a problem, the fence height may be increased to 1,8m or even 2,4m and topped with razor wire. Provide a double gate for vehicle access and deliveries.
- Fully service the nursery with water. Where necessary, equip the nursery with its own designated water tank for irrigation purposes (two 10000 litre plastic reservoirs on tanks stands will suffice for a nursery measuring approximately 100m x 100m in extent).
- Install pipelines, taps and hose lines as required. For long term nurseries, consider installing a semi-automated system.
- Where necessary, service the nursery with electricity, sanitation and a small office.
- The IEM will identify indigenous flora or any rare or endangered flora that shall be preserved.
- The Contractor shall demarcate such and undertake all necessary measures to ensure the protection of such flora, including re-planting and any special care required.

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- All harvested seeds and seedlings, as well as plants removed for transplanting which are not immediately re-planted, are the responsibility of the Contractor and must be kept under approved nursery conditions.
- Plants removed for transplanting and re-planting must be healthy, full in shape, well rooted, free of insects, pests and diseases.
- All specified species lifted from open ground must be delivered and / or retained in containers or bags as specified.
- For plants in containers held in the nursery, use 2 parts of supplier approved topsoil to 1 part of approved compost.
- Ensure that the nursery is properly equipped with the necessary implements, containers, fertilizers and other equipment necessary to function efficiently.
- The use of herbicides is prohibited unless approved by the IEM.

#### 5.2.2.7 Roads and Access

- Develop all permanent and temporary roads and access routes as indicated on the ESM&R Plan.
- Slight deviations of alignment are permitted, so as to avoid significant vegetation specimens and communities, natural features and sites of cultural and historical significance identified by the IEM. These deviations must be approved by the PM and/or IA.
- Make use of existing roads and tracks where feasible, rather than creating new routes.
- Ensure that adequate vehicle turning areas are allowed for. Position these in disturbed areas as far as possible.
- Where construction will obstruct existing access, be sure to allow for alternative temporary access routes.
- In general, construction routes should not be wider than 3 m in sensitive areas, with passing bays where two-way traffic is required.
- Any additional routes and turning areas required by the Contractor must be approved by the PM and/or IA in consultation with the IEM, in the form of an amended ESM&R Plan indicating the position and extent of the proposed route/area.
- Plan access routes to avoid significant vegetation specimens and communities, natural features and sites of cultural and historical significance or wetlands.
- Routes should not traverse slopes with gradients in excess of 8%. Where this is unavoidable, stabilise the road surface, if not gravel, using methods approved by the PM and/or IA.
- Avoid routes through drainage lines and riparian zones wherever possible. Where access through drainage lines and riparian zones is unavoidable, only one road is permitted, constructed perpendicular to the drainage line. Avoid roads that follow drainage lines within the floodplain.
- Enforce speed limits at all times on site roads.
- Allow for safe pedestrian crossing where necessary.
- Ensure that only authorised roads and access routes are used.
- Vehicles may not leave the designated roads and tracks and turnaround points will be limited to specific sites.

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- Where this is avoidable, maintain all access routes and roads adequately in order to minimise erosion and undue surface damage. Repair rutting and potholing and maintain stormwater control mechanisms.
- Runoff from roads must be managed to avoid erosion and pollution problems.
- Regularly remove topsoil (and other material) accumulated in side drains of roadways to keep these open and functional.
- Clear up any gravel or cement spillage on roads.
- Clean and make good any damage to public or private roads caused by the Contractor during the construction phase.
- No off-road driving is permitted, unless authorised by the PM and/or IA through the IEM.
- Do not permit vehicular or pedestrian access into natural areas beyond the necessary work site.
- Prior to the construction of temporary site roads the Contractor shall submit a Method Statement for approval by the PM and/or IA. A photographic record of the proposed route shall be also be prepared by the Contractor prior to the construction of the access roads, and submitted with the Method Statement.

#### 5.2.2.8 Gates and Fences

- Protect and maintain existing private property, fences and gates.
- Respect the open or closed status of gates for the duration of the construction period.
- Prevent unnecessary vehicular and personnel access into adjacent undisturbed areas.
- Small sensitive areas may be fenced where necessary, as the work site progresses.
- Additional fencing may be specified by the by the PM and/or IA, on advice from the IEM to counter problems arising on site. The Contractor must erect such fencing and/or gates when and where required by the by the PM and/or IA, and re-erect and maintain temporary fencing and or gates as necessary.
- Fences must be aligned to avoid significant vegetation specimens and communities, natural features, sites of cultural and historical significance and animal movement corridors as advised by the by the PM and/or IA, via the IEM. All alterations must be approved by the by the PM and/or IA.
- Limit clearing for fencing to the removal of trees and shrubs within 1 m of the fence line. No removal of the grass cover or topsoil is to occur within this width.
- Retain temporary fencing and/or gates in position until replaced by permanent fencing or until the by the PM and/or IA directs their earlier removal.
- If temporary fencing and or gates are removed temporarily for the execution of any part of the Works then these must be reinstated as soon as practicable by the Contractor.

### 5.2.3 Site Management

#### 5.2.3.1 Rubble and Waste Rock

- Store inert building rubble and waste rock as indicated on the ESM&R Plan.
- Subject to approval by the PM and/or IA, in consultation with the IEM, certain borrow pits and/or quarries may be utilised for the disposal of waste rock and inert building rubble.
- If no on-site disposal opportunities exist, then rubble and waste rock must be disposed of at the nearest registered solid waste disposal facility.

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#### 5.2.3.2 Solid Waste

- Collect all domestic waste in adequate numbers of litter bins located as required on the Work Site and within the Contractors camp.
- Where feasible, collect waste paper, glass and metal waste separately and arrange for collection by recycling contractors.
- For linear works, provide litter bins at regular positions, with spacing not exceeding 100 m throughout the Work Site.
- Litter bins must be equipped with a closing mechanism to prevent their contents from blowing out.
- Ensure that personnel make use of the litter bins provided. Keep all Work Sites and the Contractors camp tidy and litter free at all times.
- Empty litter bins weekly (or as required before they reach capacity).
- Where necessary, dedicate a storage area on site for the collection of construction waste.
- Remove stored domestic waste to the nearest registered solid waste disposal facility.
- Ensure that solid waste is transported so as to avoid waste spills en-route.
- Where solid waste disposal is to take place on site, ensure that only non-toxic materials, which have no risk of polluting the groundwater, are buried in designated approved areas at acceptable depths below ground level.
- No solid waste disposal site may be located below the full supply level of the prospective dam.
- No solid waste may be burned on site.

#### 5.2.3.3 Liquid Waste

- Provide portable chemical toilets at all Work Sites, unless a proper septic tank is installed as per the conditions of the RoD or project specifications.
- Ensure that adequate numbers of conveniently located site toilets are available on all Work Sites at all times in quantities related to the number of users (this shall not exceed 1 toilet per 20 users).
- Do not locate any site toilet, sanitary convenience, septic tank or French drain within the 1:100 year floodline, or within a horizontal distance of 100 m (whichever is greater) of a stream or identified wetland.
- Maintain and clean site toilets regularly as is required to keep them in good, functional working order and in an acceptable state of hygiene. Sewage from chemical toilets may not be dumped into the environment – the sewage is to be removed to a proper waste water treatment facility.
- Combine drinking water facilities with hand washing facilities near site toilets.

#### 5.2.3.4 Hazardous Waste

- Store hazardous waste as indicated on the ESM&R Plan.
- Ensure compliance with all national, regional and local legislation with regard to the disposal of hydrocarbons, chemicals, solvents and any other harmful and hazardous substances and materials.
- Drip trays must be used where dispensing mechanisms or stored receptacles may leak. Collect any hazardous waste in receptacles located on a drip tray on site pending disposal.
- Retain waste oils and batteries for recycling by the supplier wherever possible.
- Water and oil should be separated in an oil trap. Oils collected in this manner should be retained in a safe holding tank and removed from site by a specialist oil recycling company for disposal at approved waste disposal sites for toxic/hazardous materials. Oil collected by a mobile servicing unit

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should be stored in the service unit's sludge tank and discharged into the safe holding tank for collection by the specialist oil recycling company.

- Regularly dispose of all hazardous waste not earmarked for reuse, recycling or resale (such as oil contaminated with chlorinated hydrocarbons, electrical cleaning solvent, certain chemicals and fluorescent tubes) at a registered hazardous waste disposal site.
- Contain chemical spills, and arrange for clean-up/control by the supplier, or by professional pollution control personnel.
- All used filter materials should be stored in a secure bin for disposal off site. Hazardous waste shall not be stored or stockpiled in any area other than that designated on the construction-site layout.
- Maintenance and servicing bays shall have a concrete floor and be fitted with sumps and collection tanks for wastewater that is contaminated with diesel, petrol and oil. This wastewater shall be removed to a registered disposal site.
- Regularly dispose of all hazardous waste not earmarked for reuse, recycling or resale (such as oil contaminated with chlorinated hydrocarbons, bitumen, tar, electrical cleaning solvent, certain chemicals and fluorescent tubes) at a registered, approved hazardous waste disposal site.

#### **5.2.3.5 Pollution Control**

- Do not locate any reservoir, dam or depot for any substance, which causes or is likely to cause pollution, within the 1:100 year floodline, or within a horizontal distance of 100 m (whichever is greater) of a watercourse, drainage line or identified wetland.
- Do not dump waste of any nature, or any foreign material into any drainage line or wetland.
- Do not allow the use of any drainage line or wetland for swimming, bathing, or the cleaning of clothing, tools or equipment.
- Prevent the discharge of water containing polluting matter or visible suspended materials directly into drainage lines or wetlands.
- Deflect any unpolluted water/runoff away from any dirty area (including plants, maintenance areas, workshops and contractors' yards).
- Otherwise clean, but silt laden water may be discharged overland, provided no erosion is resultant from this discharge.
- Where necessary, turbid water pumped from excavations within rivers must be passed through a sand filter or settling pond before being released back into the river. Discharge of this water must be in a controlled manner, and no erosion may result.
- Design, construct, maintain and operate any settlement pond that forms part of a dirty water system to have a minimum freeboard of 0.8 m above full supply level.
- The installation of a septic tank requires approval from the local authority. Septic tanks may only be installed where soil conditions are suitable.
- Ensure that no stormwater is allowed to enter any drainage installation for the reception, conveyance, storage and/or treatment of sewage.
- Ensure that water passing through vehicle wash bays and workshops pass through oil baffles/oil traps/oils separators before passing into conservancy tanks.
- Treat all oil sludge collected in the said traps, including sump liners, as hazardous waste.
- Take special care during rainy periods to prevent the contents of sumps and drip trays from overflowing.

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- Before any water is permitted to enter natural drainage lines, the quality of the water must comply with the standards contained within the General Authorisations of the Department of Water Affairs
- Water may only be discharged into a stormwater or sewer system with the permission of the local authority.
- Immediately clean any accidental oil or fuel spills or leakages.
- Do not hose oil or fuel spills into a storm water drain or sewer, or into the surrounding natural environment.
- Clean small oil or fuel spills with an approved absorbent material, such as 'Drizit' or 'Spill-sorb'.
- Contain oil or fuel spills in water using an approved oil absorbent fibre.
- Treat soil contaminated by oil or fuel using one of the following approved methods, as per instruction of the PM and/or IA or the IEM:
  - Remove the soil to the depth of the contamination and dispose of at a registered Hazardous Waste Disposal Site.
  - Remove the soil to the depth of the contamination, and regenerate using approved bio-remediation methods.
  - Report major oil or fuel spills to the provincial Department of Water Affairs , as well as to the relevant Local Authority.
- Carefully control all on-site operations that involve the use of cement and concrete (this applies to areas other than the batching plant).
- Limit cement and concrete mixing to single sites where possible.
- Dispose of all visible remains of excess cement and concrete after the completion of tasks.
- Dispose of in the approved manner (solid waste concrete may be treated as inert construction rubble, but wet cement and liquid slurry, as well as cement powder must be treated as hazardous waste.
- Contain water and slurry from cement and concrete mixing operations as well as from batching area wash bays. Direct such waste water into a settlement pond or sludge dam for later disposal.
- Do not allow the washing of trucks delivering concrete anywhere but within designated wash bays equipped with runoff containment. Direct such waste water into a settlement pond or settlement pond for later disposal.
- Where possible, make use of timber products treated off-site.
- Underlay areas where on-site application of timber treatment products is to take place with a PVC sheet to prevent the contamination of the soil.

#### 5.2.3.6 *Implements and Equipment*

- Make use of mobile plant and equipment, which is appropriate to the task (i.e. for construction, rehabilitation and maintenance) in order to minimise the impact on and extent of damage to the environment.
- Should the IEM at any time determine that the method, mobile plant or equipment utilised by the Contractor is unsuitable for the task at hand, or unnecessarily detrimental to the environment, then he may specify the use of a suitable alternative.

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#### 5.2.3.7 *Blasting*

- The specifications included under this section do not exempt the Contractor from complying with all the Regulations as included in the Explosives Act (Act No. 15 of 2003). The contractor is further referred to this Act and all its regulations.
- Plan the type, duration and timing of blasting procedures with due cognisance to:
  - blasting vibrations and the proximity of the existing dam structure; and
  - other land uses and structures in the vicinity.
- Inform local landowners and communities ahead of any blasting event.
- When blasting is to be carried out within 500m of any building, railway, public thoroughfare, powerline, telephone line, pipeline, sports field or any place where people congregate, then these must be inspected and their condition photographically recorded prior to blasting. The provisions and requirements of the relevant authorities must be complied with. These include:
  - The South African Roads Agency concerning national roads;
  - Eskom concerning powerlines;
  - Telkom concerning telecommunications lines;
  - Water boards and local authorities, concerning the protection of water mains, gas mains, sewers and sewerage mains and electric cables;
  - Any other authorities who have jurisdiction in the area.
- Favour the use of nitrate-free explosives wherever possible (i.e. methods including as drilling and black powder, expanding mortar or old fashioned plugs and feathers).
- Make use of noise mufflers and / or soft explosives during blasting.
- When blasting, take measures to limit flyrock.
- Give audible warning of a pending blast at least 3 minutes in advance of a blast.
- Collect and remove all flyrock (of diameter 150mm and larger) which falls beyond the cleared working area, together with the rock spill.

#### 5.2.3.8 *Air quality*

- Manage dust resultant from the Works and fugitive dust in an efficient and environmentally sensitive manner.
- Dust must be controlled through the regular watering of the work areas. Ensure that a dust control system (i.e. sprinkler or vacuum) is installed and maintained in an operating condition at the crusher plant.
- Dust from the construction site must not disturb economic or social activities in the vicinity of the construction site.
- In areas where dust is expected to be problematic, particularly nearby residential areas, enforce a maximum speed of 40 km/h for passenger and light commercial vehicles and 30 km/h for heavy vehicles and equipment.
- Apply watering as an additional means of controlling dust.

#### 5.2.3.9 *Noise Control*

- Ensure that employees and staff conduct themselves in an acceptable manner while on site, both during work hours and after hours.
- No loud music is permitted on site.

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- Notify adjacent landowners of after-hours construction work and of any other activity that could cause a nuisance.
- Any disputes and community complaints by stakeholders or the public with regard to noise generation must immediately be brought to the attention of the IEM for further action.
- Where complaints cannot be addressed to the satisfaction of all parties, then the Contractor will, upon instruction by the PM and/or IA, via the IEM, provide an independent and registered Noise Monitor to undertake a survey of the noise output levels. Recommendations to reduce noise to legislated levels must be implemented. This may include the construction of noise barriers, earth berms or sound attenuation walls as required.

#### **5.2.3.10 Fire Control**

- Take adequate precautions to ensure that fires are not started as a result of Works on site the Contractor will be held liable for any damage to property adjoining the Site as a result of any fire caused by one of his employees.
- Establish and maintain fire breaks around the Work Sites as and when specified by the ECO and as required by applicable legislation and the local authority.
- In areas highly susceptible to fire (plantations), night time security guards must be employed.
- A minimum requirement for construction in a high fire risk area is a water truck or cart, with a minimum capacity of 5 000 litres, equipped with pump and hose (minimum length 30 m), which must be permanently on site.
- Ensure that the Work Site, the contractor's camp and all living quarters are equipped with adequate fire fighting equipment. This includes at least rubber beaters when working in veld areas, and at least one fire extinguisher of the appropriate type irrespective of the site.
- Take immediate steps to extinguish any fire, which may break out on the construction site.
- No open fires are permitted anywhere on site.
- Restrict contained fires for heating and cooking (i.e. in a fire drum) to designated areas on site. Prevent employees from creating fires randomly outside designated areas.
- Do not store any fuel or chemicals under trees.
- Do not store gas and liquid fuel in the same storage area.
- Do not permit any smoking within 3 m of any fuel or chemical storage area, or refuelling area.

#### **5.2.3.11 Health and Safety**

- The Contractor shall implement a Health and Safety Policy in line with various statutory regulations
- The specifications included under this section do not exempt the Contractor from complying with all the Regulations as included in the Occupational Health and Safety Act (Act 85 Of 1993). The contractor is further referred to this Act and all its regulations.
- The safety of all construction and operational personnel, as well as any member of the public on the site is the responsibility of the Contractor.
- Control access onto and off the site by means of a register system. This includes visitors.
- Ensure that first aid / emergency facilities / procedures are in place.
- Ensure that all personnel are trained in basic site safety procedures.
- Keep a register with contact numbers of all people employed and one relative for each.
- Keep a list of all relevant emergency numbers in an easily accessible location on site.

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- Keep a record of all incidents, accidents and illnesses on site and make the information available at meetings.
- Ensure that proper footwear is worn by employees at all times.
- Ensure that employees are issued with and make use of the necessary safety equipment when working in dusty, noisy and / or dangerous situations. Such equipment may include, but is not necessarily limited to hardhats, goggles, masks, earplugs, gloves, safety footwear and safety ropes as required.
- Ensure that adequate drinking water, wash water and sanitary facilities are available at all times and on all work sites.
- Where necessary, provide a designated place for food storage, preparation and consumption on site. This should be a shaded area.
- Ensure that personnel are transported legally, and in a safe and responsible manner.
- Ensure that all vehicle and machine operators are qualified and licensed to operate their vehicles / machines.

#### 5.2.4 Borrow Areas

##### 5.2.4.1 Borrow Pits and Rock Quarries

- All work must be done in accordance with the Employer issued EMPR, issued through the PM, IA or IEM, as authorised by the Department of Minerals and Energy (DMR).
- Do not commence with opencast mining, prospecting or quarrying activities before the necessary DMR approvals are in place
- Any additional borrow areas and quarries required by the Contractor must be approved by the PM and/or IA, in consultation with IEM, in the form of an amended ESM&R Plan, and may only be opened once approved by DMR in terms of the requirements of the Minerals and Petroleum Resources Development Act (Act No 28 of 2002).
- Avoid stripping material to bedrock (if relevant). This limits rehabilitation potential for these areas.
- Minimise the flow of any surface water or floodwater into borrow areas. Where necessary protect borrow areas by an earth berm or sandbag system to deflect clean surface runoff away from the excavations.
- Allow for the natural free drainage of borrow areas. All borrow areas must be drained unless otherwise specified.
- Ensure that truck loads are covered with tarpaulins when sand is being transported on public roads.
- Control the type of material imported to ensure that soil contamination, in terms of weeds and alien invasive plants, does not occur.
- Bury coarse material incapable of supporting vegetation beneath the finer material.
- Backfill inert rubble (e.g. brick, rock, dry waste concrete and other building rubble that will not liberate toxic residues into the soil or ground water over time, once buried) in layers of not more than 1 m, level and compact. Proceed in this manner until the level of backfilling has been reached and then cover the site with a layer of fine overburden at least 500 mm thick, followed by a layer of topsoil at least 200 mm thick
- No residue or substance which causes or is likely to cause pollution of a water resource may be placed in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation.

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#### 5.2.4.2 Sand Mining

- Only screening activities are permitted within the riverbed. No unnecessary stockpiling of material should take place in the riverbed.
- Locate all support activities outside of the riparian vegetation zone.
- Test the quality of the water both up and downstream of the activity. The downstream turbidity reading should not exceed the upstream reading by more than 10%.
- Limit access to single routes and access points at all times. Access through riparian vegetation to sand borrow areas must be constructed perpendicular to the drainage line.

#### 5.2.5 Earthworks

##### 5.2.5.1 Excavations and Trenches

- Undertake excavations carefully, incorporating appropriate drainage.
- For significant trees as indicated by the IEM, trenching must 3 m away from the stem.
- Excavate and backfill trenches on a progressive basis as covered in Specifications.
- During construction through a drainage line, the majority of the flow must be allowed to pass down the stream (i.e. no damming must be allowed to take place). In-stream diversions should be used rather than the construction of new channels.

##### 5.2.5.2 Cut and Fill

- The PM and/or IA may identify cut and fill areas that need protection and will specify a solution in terms of the most appropriate approved method and technology.
- In general, no slopes steeper than 1(V):3(H) will be allowed. Steeper slopes must be stabilised using the most appropriate approved method and technology as specified by the IEM.
- Finish blasted areas and cut and fill slopes as roughened surfaces, which emulate the natural surroundings.
- Ensure that no concrete rubble is present within the top 1,5 m of any embankment.

##### 5.2.5.3 Shaping and Trimming

- Shape areas to correct contours to within a tolerance of 300 mm. This tolerance applies to areas where the final contours are shown on the drawings.
- Trim areas already shaped to within an acceptable tolerance, with all undulations following a smooth curve. This tolerance applies to areas where the final contours are shown on the drawings.
- Dispose of excess material in the agreed manner.
- Plan shaping and trimming operations to allow for topsoil application: final trimmed levels must make provision for the specified depth of reapplied topsoil.
- Where machine operations are not practicable, trimming must be carried out using hand tools.

#### 5.2.6 Stockpiles, Storage and Handling

##### 5.2.6.1 Topsoil

- Topsoil is to be handled twice only – once to strip and stockpile, and once to replace and level.
- Position topsoil stockpiles as indicated on the ESM&R Plan.

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- Any additional topsoil stockpile areas required by the Contractor must be approved by the PM and/or IA in consultation with the IEM, in the form of an amended ESM&R Plan indicating the position and extent of thereof.
- Position topsoil stockpiles on the higher side of a disturbed area, and above a 1:50 year floodline wherever possible.
- Ensure that all topsoil is stored in such a way and in such a place that it will not cause the damming up of water, erosion gullies, or wash away itself.
- In linear developments, stockpile topsoil in windrows parallel to the excavation.
- In riverine areas, stockpile topsoil above the riverine zone.
- Do not stockpile topsoil in drainage lines.
- Do not stockpile topsoil in heaps exceeding 2 m in height.
- Protect topsoil stockpiles from erosion.
- Remove exotic/invasive plants and broad leaf weeds that emerge on topsoil stockpiles.
- If topsoil is to be stockpiled for extended periods, especially during the wet season, then the IEM may recommend one of the following measures:
  - The re-vegetation of the stockpiles with indigenous grasses.
  - The covering of the stockpiles with a protective material such as hessian mats.
- Ensure that topsoil is at no time buried, mixed with spoil (excavated subsoil), rubble or building material, or subjected to compaction or contamination by vehicles or machinery. This will render the topsoil unsuitable for use during rehabilitation.
- The Contractor will be held liable for the replacement of any topsoil rendered unsuitable for use during rehabilitation, for reasons due to his negligence or mismanagement on site.

#### 5.2.6.2 Spoil

- Position spoil (excavated subsoil) as indicated on the ESM&R Plan.
- No spoiling shall take place outside of the designated construction area.
- Any additional spoil storage area required by the Contractor must be approved by the PM and/or IA in consultation with the IEM, in the form of an amended ESM&R Plan prior to initiating the activity. The following information is required for approval:
  - The location, description of and access to proposed sites.
  - The quantity of material to be stored as spoil.
  - The type of material to be stored as spoil (i.e. blast rock, excavated rock, subsoil etc.).
  - The proposed method of storing spoil.
  - A proposal for the reinstatement and rehabilitation plan, including the final profile.
- In linear projects, spoil must be positioned in windrows parallel to the excavation.
- Position spoil on the higher side of a disturbed area, and above a 1:20 year floodline wherever possible.
- Ensure that all spoil is stored in such a way and in such a place that it will not cause the damming up of water, erosion gullies, or wash away itself.
- Store spoil in low heaps, not exceeding 2 m in height.
- Do not store spoil in drainage lines.
- Properly rehabilitate any permanent spoil dumps as soon as work in that area is complete.
- In general, no slopes steeper than 1(V):3(H) will be allowed.

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- Bury the coarser material beneath the finer material, and overlay all permanent spoil heaps with a layer of topsoil at least 200 mm thick.

#### 5.2.6.3 *Vehicles and Equipment*

- Vehicles used during construction must have the minimum impact on the environment or other road users.
- Regularly check vehicles, machinery and equipment operating on site to ensure that none have leaks or cause spills of oil, diesel, grease or hydraulic fluid.
- No vehicles, machinery or equipment with leaks or causing spills may be allowed to operate on the construction site. These must be sent to the maintenance yard or workshop for repair, or must be removed from site.
- Ensure that the maintenance of all vehicles and equipment, including oil and lubricant changes, takes place only within properly equipped, bunded maintenance areas or workshops as indicated on the ESM&R Plan.
- Only emergency and essential repairs of vehicles and equipment, except for non-movable equipment such as dozers, creter-cranes, etc, may take place on site.
- Underlay light-duty vehicle wash bays and workshops with an impermeable PVC lining or thin concrete slab which drains into a conservancy tank.
- Underlay heavy duty maintenance areas and workshops with a concrete slab, enclosed within a bund, which drains into a conservancy tank.
- Provide drip pans for generators, or any machinery that will be in position for longer than one day.
- Drip trays are to be watertight, and must be emptied regularly. The contents of drip trays are to be treated as hazardous waste.
- Where oil and fuel spills are expected, parking is to be on an impervious surface with adequate pollution control mechanisms in place.

#### 5.2.6.4 *Fuel*

- Position long term fuel stores as indicated on the ESM&R Plan.
- Do not locate any fuel depot within the 1:100 year floodline, or within a horizontal distance of 100m (whichever is greater) of a watercourse, drainage line or identified wetland.
- Store fuel at long term depots within a bunded area, underlain by a concrete slab, sloped toward a sump for spillage removal. The bund must be able to accommodate at least 110% of total storage capacity of the containers.
- Store fuel at temporary depots within a bunded area, or alternatively in an area underlain by heavy duty PVC sheeting and covered with 100mm of sand. This is to include an area adjacent to the tanks upon which vehicles must park during refuelling.
- Provide impervious paving adjacent to fuel tanks, upon which vehicles must park during refuelling. This will help to accommodate fuel spills during refuelling.
- The only permitted method of fuel transfer is by means of a pump / controlled valve / tap / hose / funnel.
- Treat spills within the bund and the contents of the sump as hazardous waste.

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#### 5.2.6.5 Hazardous Substances

- Ensure compliance with all national, regional and local legislation with regard to the storage, transport and use of hydrocarbons, chemicals, solvents, explosives and any other harmful and hazardous substances and materials.
- Position hazardous substance stores as indicated on the ESM&R Plan, in areas not threatening human life or the environment.
- Keep a record of all hazardous substances stored on site for submission to the IEM.
- Ensure that explosives are stored in a dedicated Explosives Store, located at least 150m from any Work Site or surface infrastructure.
- Store all hazardous substances in secure, safe and weatherproof facilities, underlain by a bunded concrete slab to protect against soil and water pollution.
- Clean any accidental spills immediately, treating the spilled material and use cleaning products as per hazardous waste.
- Provide for controlled loading / unloading areas, underlain by an impervious paving or PVC sheet to protect against soil and water pollution.
- Ensure that personnel handling hazardous substances have been educated in terms of the correct handling, use and disposal thereof.
- Empty containers in which hazardous substances were kept are to be treated as hazardous waste.

#### 5.2.7 Erosion Control

##### 5.2.7.1 Surface Water Use and Management

- Do not drain, fill or alter in any way, any drainage line, including the riverbanks unless this forms part of the construction Works, or upon specific instruction by the PM and/or IA.
- Monitor water use and ensure that areas of waste are identified and minimised (i.e. water used for surface wetting, for batching, at the crusher plant, for potable supply etc.).
- Repair identified leaks and address issues of water wastage as soon as these are identified.
- Where possible, recycle water on the construction site.
- Avoid over-wetting, saturation and unnecessary runoff during dust control activities and irrigation.
- Locate any point of overland discharge at least 50m away from any river, stream or drainage way.
- Ensure that overland discharge occurs over areas that have a minimum cover of 90% grass at a minimum height of 150mm. This applies to areas downslope of the discharge point as well.
- Where possible, undertake river diversions outside of the rainy season.
- Environmental (Reserve) releases (i.e. for sustained downstream ecological requirements and basic human needs) releases must catered for throughout the raising of Clanwilliam Dam.

##### 5.2.7.2 Erosion Control and Protection

- Line overflow and scour channels with stone pitching along their length and at their points of discharge to prevent soil erosion. The point of discharge must be at a point where there is natural grass cover.
- Ensure that channels do not discharge straight down the contours. These must be aligned at such an angle to the contours that they have the least possible gradient.
- Locate any point of overland discharge at least 50 m away from any river, stream or drainage way.

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- Identify all areas susceptible to erosion so that they can be protected from undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas.
- Retain natural trees, shrubbery and grass species wherever possible.
- Do not permit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the Work Area.
- Utilise only light equipment for access and deliveries into areas of unstable soils, in areas where erosion is evident, and at stream and river embankments.
- Limit vehicular access into rocky outcrops and ridges.
- Institute adequate sedimentation control measures at river crossings and when excavation or disturbance within riverbanks, or the riverbed takes place.
- Address erosion donga crossings as river crossings, applying soil erosion control and bank stabilisation procedures as specified by the IEM.
- Do not allow erosion to develop on a large scale before effecting repairs. When in doubt, seek advice from the IEM, via the PM and/or IA.
- Repair all erosion damage as soon as possible and in any case not later than six months before the termination of the Defects Notification Period to allow for sufficient rehabilitation growth.
- In general, slopes steeper than 1(V):3(H) or slopes where the soils are by nature dispersive or erodible, must be stabilised. The PM and/or IA, in consultation with the IEM, will specify a solution in terms of the most appropriate approved method and technology. One or more of the following methods may be required:
  - Topsoil covered with a geotextile, plus a specified grass seed mixture.
  - Gravel armouring cover specified by the PM and/or IA.
  - Silt fencing designed by the PM and/or IA.
  - Earth or rock-pack cut-off berms
  - Benches (sand bags), gabions or similar.
  - Stormwater berms.
- Where the river diversion has a higher energy flux than the natural channel or a smaller cross-section which would lead to erosion in excess of the natural river course, protect the slopes using one or more of the following methods or similar may be used, as specified by the PM and/or IA, in consultation with the IEM:
  - Sandbags.
  - Reno mattresses.
  - Plastic liners and/or coarse rock (undersize rip-rap).
- During the course of construction, the IEM may identify additional slopes in need of stabilisation and through the PM and/or IA will specify actions in terms of the most appropriate practical approved method and technology.

#### 5.2.8 Control of Alien Plants

- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge.
- Follow manufacturer's instruction when using PM and/or IA approved chemical methods, especially in terms of quantities, time of application etc.
- Ensure that only properly trained people handle and make use of chemicals.

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- Dispose of the eradicated plant material at an approved solid waste disposal site. If no toxic sprays or persistent poisons were used during eradication, then the wood may be sold or donated.
  - Rehabilitate all identified areas as soon as practically possible, utilising specified methods and species

## 6 AMENDMENTS

Amendments to this baseline EMP will be required as the project proceeds. Any proposed amendments to the EMP will be confirmed with the Employer, thus DWA, prior to being issued as a formal amendment. Copies of amendments will be forwarded to the DEA by the Employer via the PM, IA or IEM.

**C2.3.2**

## **OHSA 1993 SAFETY SPECIFICATION**

**PARTICULAR SPECIFICATION CWD01 HS  
HEALTH AND SAFETY**

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## 1. SCOPE

This specification covers the health and safety requirements to be met by the Contractor to ensure a continued safe and healthy environment for all workers, employees and subcontractors under his control and for all other persons entering the site of works.

This specification shall be read with the Occupational Health and Safety Act (Act No 85 and amendment Act No 181) 1993, and the corresponding Construction Regulations 2003, and all other safety codes and specifications referred to in the said Construction Regulations.

This safety specification and the Contractor's own Safety Plan as well as the Construction Regulations 2003, shall be displayed on site or made available for inspection by all workers, employees, inspectors and any other persons entering the site of works.

Monitoring of compliance on site shall be to the requirements of the Occupational Health and Safety Act and Regulations as well as the contents of the Health and Safety Plan(s) (H&S Plan(s)) of the Principal Contractor and Contractors.

## 2. APPLICATIONS AND INTERPRETATION

This document is to be read in conjunction with the following:

- Occupational Health and Safety Act (Act 85 of 1993);
- All regulations published in terms of the Occupational Health and Safety Act;
- Construction Regulations (2003);
- SABS (SANS) codes referred to by the Occupational Health and Safety Act;
- Contract documents; and
- Basic Conditions of Employment Act (Act 75 of 1997).

## 3. DEFINITIONS

For the purpose of this contract the following shall apply:

- (a) **"Employer"** where used in the contract documents and in this specification, means the Employer as defined in the General Conditions of Contract and it shall have the exact same meaning as **"client"** as defined in the Construction Regulations 2003. **"Employer"** and **"client"** are therefore interchangeable and shall be read in the context of the relevant document.

- (b) **"Contractor"**, wherever used in the contract documents and in this specification, shall have the same meaning as **"Contractor"** as defined in the General Conditions of Contract.

In this specification the terms **"principal contractor"** and **"contractor"** are replaced with **"Contractor"** and **"subcontractor"** respectively.

- (c) **"Mandatory"**, wherever used in the contract, includes an agent, a contractor or a subcontractor for work, but without derogating from his status in his own right as an employer or user.

For the purpose of this contract the **"Contractor"** will, in terms of the agreement contemplated in section 37(2) of the Occupational Health and Safety Act (OHSA) 1993,

be the mandatory, responsible to comply with all provisions of OHSA 1993 and the Construction Regulations (CR) 2003.

- (d) **"Engineer"** where used in this specification, means the engineer as defined in the General Conditions of Contract (GCC). In terms of the Construction Regulations the Engineer may act as agent on behalf of the Employer (the client as defined in the Construction Regulations).
- (e) **Health and Safety Plan** means a document plan, which addresses hazards, identified and includes safe work procedures to mitigate, reduce or control the hazards identified.
- (f) **Health and Safety Specification** means a documented specification of all health and safety requirements pertaining to the associated works on a construction site, so as to ensure the health and safety of persons.
- (g) **Risk Assessment** means a program to determine any risk associated with any hazard at a construction site, in order to identify the steps to be taken to remove, reduce or control such hazard.

Also refer to definitions given in the **Occupational Health and Safety Act (Act 85 of 1993)** and the **Construction Regulations (2003)**.

#### 4. TENDERS

The Contractor shall submit the following with his tender:

- (a) A documented Health and Safety Plan as stipulated in Regulation 5 of the Construction Regulations. The safety Plan must be based on the Construction Regulation 2003 and will be subject to approval by the Employer;
- (b) A declaration to the effect that he has the competence and necessary resources to carry out the work safely in compliance with the Construction Regulations 2003;
- (c) A declaration to the effect that he made provision in his tender for the cost of the health and safety measure envisaged in the Construction Regulations.
- (d) Failure to submit the foregoing with his tender, will lead to the conclusion that the Contractor will not be able to carry out the work under the contract safely in accordance with the Construction Regulations.

#### 5. NOTIFICATION OF COMMENCEMENT OF CONSTRUCTION WORK

After award of the contract, but before commencement of construction work, the Contractor shall, in terms of Regulation 3 of the Construction Regulations (2003), notify the Provincial director of the Department of Labour in writing if the following work is involved:

- (a) Construction work that will exceed 30 days of 300 person-days;
- (b) Working at a height greater than 3,0 m above ground or landings.

The notification must be done in the form of the pro forma included as Annexure A in the Construction Regulations (2003)

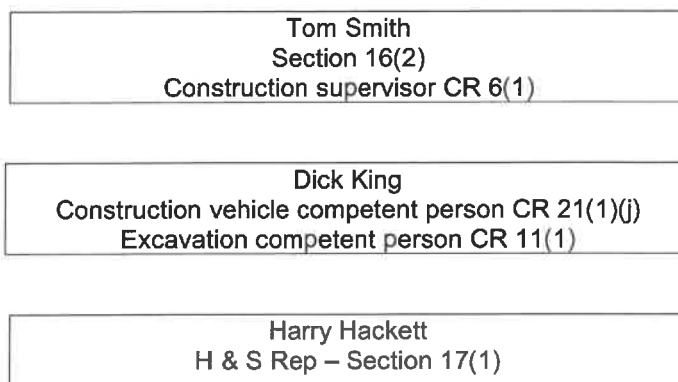
A copy of the notification form must be kept on site, available for inspection by inspectors, Employer, Engineer, employees and persons on site.

## 6. LEGAL DOCUMENTATION / APPOINTMENTS

The following documents must be provided in the Health and Safety Plan:

- Health and Safety Policy;
- Letter of good standing with the Compensation Commissioner, Federated Employers of similar insurer; and
- Health and Safety Organogram (or table, outlining the Health and Safety Team, as well as the appointment(s) they have under the Act and Regulations (reference to specific section/regulation applicable to appointment).

Example of Safety Organogram:



- The competency of each member of Health and Safety Team must be provided and should include knowledge, training, experience & qualifications specific to the work or task being performed.

Signed copies of legal appointments must be provided in the Health and Safety Plan.

The following information must be provided in the Health and Safety Plan:

- Indicate the estimated number of employees to be working on site.
- Indicate the expected number of contractors to be appointed by the Principal Contractor.

## 7. RISK ASSESSMENT

Before commencement of any construction work during the construction period, the Contractor shall have a risk assessment performed and recorded in writing by a competent person. (Refer Regulation 7 of the Construction Regulations 2003).

The risk assessment shall identify and evaluate the risks and hazards that may be expected during the execution of the work under the contract, and it shall include a documented plan of safe work procedures to mitigate, reduce or control the risks and hazards identified.

The risk assessment shall be available on site for inspection by inspectors, Employer, Engineer, sub-contractors, employees, trade unions and health and safety committee members, and must be monitored and reviewed periodically by the Contractor.

Risk assessments of all required activities shall form an integral part of the Health and Safety plan.

All risk assessments shall be conducted in terms of an acceptable methodology, prior to commencement of work, according to the provisions of Regulation 7 of the Construction Regulations (2003) and should cover at least the following:

- Movement of construction vehicles;
- All work near overhead power lines and underground cables;
- Locating underground cables/ existing services;
- Hand excavation of trenches;
- Mechanical excavation of trenches;
- All work carried out inside trenches, including compacting, pipe laying, backfilling etc.;
- Temporary stockpiling and removal of excavated material;
- Transporting material;
- Cutting into existing sewage line;
- All work carried out from scaffolding;
- Exposure to raw sewerage;
- All work carried out on live electrical installations;
- Welding in confined spaces;
- Working at heights;
- Roof work;
- Cladding;
- Formwork / Support work;
- Demolition work;
- Working with hand tools;
- Working with portable electrical tools;
- Asphalting; AND
- All health hazards that can be present during any of the above activities and should include individual dusts, gases, fumes, vapours, noise, extreme temperatures, illumination, vibration and ergonomic hazards due to any of the above activities.

The above list is by no means exhaustive and should not be limited to these activities but must cover all activities that forms part of the said construction work. Each activity must be split down to individual tasks and all associated hazards identified and listed in the risk assessment. This ensures that critical tasks and subsequent critical hazards are not missed.

The risk assessment to be included in the Health and Safety Plan must clearly indicate:

- The methodology used to do the risk assessments;
- Frequency, likelihood and consequence;
- Breakdown of processes and activities covered; and
- High risks anticipated.

All risk assessments are to be conducted by a competent person as appointed under paragraph 6 of this document. The plan must include a declaration in this regard or the risk assessment must contain the signature(s) of these appointed persons.



## 8. APPOINTMENT OF EMPLOYEES AND SUBCONTRACTORS

### Health and Safety plan

The Contractor shall appoint his employees and any sub-contractors to be employed on the contract, in writing, and he shall provide them with a copy of his documented Health and Safety Plan, or relevant sections thereof. The Contractor shall ensure that all subcontractors and employees are committed to the implementation of his Safety Plan. To this end the Employer, or the Engineer or Agent on his behalf, will, in terms of Regulations 4(1)(d) and 5(3)(c), carry out audits on a regular basis to ensure that the Contractor as well as any sub-contractors in his employ, do implement the Contractor's Safety Plan as well as the Employer's Safety Specifications in accordance with the Construction Regulations.

### Health and safety induction training

The Contractor shall ensure that all employees under his control, including sub-contractors and their employees, undergo a health and safety induction training course by a competent person before commencement of construction work. No visitor or other person shall be allowed or permitted to enter the site of the works unless such person has undergone health and safety training pertaining to hazards prevalent on site. The Employer or the Engineer on his behalf will carry out audits from time to time to ensure compliance by the Contractor.

The Contractor shall ensure that every employee on site shall at all times be in possession of proof of the health and safety induction training issued by a competent person prior to commencement of construction work.

## 9. APPOINTMENT OF SAFETY PERSONNEL

### Construction Supervisor

The Contractor shall appoint a full-time **Construction Supervisor** with the duty of supervising the performance of the construction work. (*Refer Regulation 6(1)*). He may also have to appoint one or more competent employees to assist the construction supervisor where justified by the scope and complexity of the works.

### Constructions Safety Officer

Taking into consideration the size of the project and the hazards or dangers that can be expected, the Contractor shall appoint in writing a full-time or part-time **Construction Safety Officer** if so decided by the Inspector of the Department of Labour. The Safety Officer shall have the necessary competence and resources to perform his duties diligently. (*Refer Regulation 6(2)*). Provision will be made in the schedule of quantities to cover the cost of a dedicated construction safety officer appointed after award of the contract if so ordered by the Engineer.

### Health and safety representatives

In terms of **Section 17 and 18 of the Act (OHSA 1993)** the Contractor, being the employer in terms of the Act for the execution of the contract, shall appoint a **health and safety representative** whenever he has more than 20 employees in his employment on the site of the works. The health and safety representative must be selected from employees who are employed in a full-time capacity at a specific workplace.

The number of health and safety representatives for a workplace shall be a least one for every 100 employees.

The function of the health and safety representative(s) will be to review the effectiveness of health and safety measures, to identify potential hazards and major incidents, to examine causes of incidents (in collaboration with his employer, the Contractor), to investigate complaints by employees relating to health and safety at work, to make representations to the employer (Contractor) or inspector on general matters affecting the health and safety of employees, to inspect the workplace, plant, machinery etc. on a regular base, to participate in consultations with inspectors and to attend meetings on the health and safety committee.

### **Health and safety committee**

In terms of **Sections 17 and 18 of the Act (OHSA 1993)** the Contractor (as employer), shall establish one or more **health and safety committee(s)** where there are two or more health and safety representatives at a workplace. The persons selected by the Contractor to serve on the committee shall be designated in writing.

The function of the health and safety committee shall be to hold meetings at regular intervals, but at least once every three months, to review the health and safety measures on the contract, to discuss incidents related to health and safety with the Contractor and the inspector, and to make recommendations regarding health and safety to the Contractor and to keep record of recommendations and reports made by the committee.

### **Competent persons**

In accordance with the Construction Regulations the Contractor has to appoint in writing **competent persons** responsible for supervising construction work.

A competent person may be appointed for more than one part of the construction work with the understanding that the person must be suitably qualified and able to supervise at the same time the construction work on all the work situations for which he has been appointed.

The appointment of competent persons to supervise parts of the construction work does not relieve the Contractor from any of his responsibilities to comply with **all** requirements of the Construction regulations.

## **10. RECORDS AND REGISTERS**

In accordance with the Construction Regulations (2003) the Contractor is bound to keep records and registers related to health and safety on site for periodic inspection by inspectors, the Engineer, the Employer, trade union officials and sub-contractors and employees. The following records and registers must be kept on site and shall be available for inspection at all times.

- (a) A copy of the OHSA 1993 Construction Regulation 2003;
- (b) A copy of the Client's Health and Safety Specification;
- (c) A copy of the Contractor's Health and Safety Plan (Regulation 4);
- (d) A copy of the Notification of Construction Work (Regulation 3);
- (e) A health and safety file in terms of Regulation 5(7) with inputs by the Construction Safety Officer (Regulation 6(7));
- (f) A copy of the risk assessment described in Regulation 7;
- (g) A full protection plan and the corresponding records of evaluation and training of employees working from elevated positions as described in Regulation 8;
- (h) A register for recording of findings by the competent person appointed to inspect construction vehicles and mobile plant (Regulation 21(1)(j)).

## 11. CONTRACTOR'S RESPONSIBILITIES

For this contract the Contractor will be the mandatory of the Employer (Client), as defined in the Act (OHS 1993), which means that the Contractor, as employer in his own right in respect of the contract, will be responsible for all the duties and obligations of an employer as set out in the Act (OHS 1993) and the Construction Regulations (2003).

Before commencement of work under the contract, the Contractor shall enter into an agreement with the Employer (Client) to confirm his status as mandatory (employer) for the contract under consideration.

The Contractor's duties and responsibilities are clearly set out in the Construction Regulations (2003), and are not repeated in detail but some important aspects are highlighted hereafter, without relieving the Contractor of any of his duties and responsibilities in terms of the Construction Regulations. Safety reminders in the form of a checklist of some of the more important aspects of safety as related to personnel on site, must be displayed at a prominent position at the site (see Annexure 1: Safety on the site of Works).

### *(a) Contractor's position in relation to the Employer (Client) (Regulation 4)*

Section 4 of the Regulations by implication requires that the Contractor shall at all times liaise closely with the Employer, or the Engineer on behalf of the Employer, to ensure that all requirements of the Act and the Regulations are met and complied with.

### *(b) The Principal Contractor and Contractor (Regulation 5)*

The Contractor for the contract under consideration is the equivalent of "Principal Contractor" as defined in Regulation 2(b) of the Construction Regulations, and he shall comply with all the provisions of Regulation 5.

Any subcontractors employed by the Contractor must be appointed in writing, setting out the terms of the appointment in respect of health and safety. An independent subcontractor shall however provide and demonstrate to the Contractor a suitable, acceptable and sufficiently documented health and safety plan before commencement of the subcontract. In the absence of such a health and safety plan the subcontractor shall undertake in writing that he will comply with the Contractor's safety plan, the health and safety specifications of the Employer and the Construction Regulations 2003.

### *(c) Supervision of construction work (Regulation 6)*

The Contractor shall appoint the safety and other personnel and employees as required in terms of Regulation 6 and as set out in paragraph 7 above. Appointment of those personnel and employees does not relieve the Contractor from any of the obligations under Regulation 6.

### *(d) Risk assessment (Regulation 7)*

The Contractor shall have the risk assessment made as set out in paragraph 7 above before commencement of the work, and it must be available on site for inspection at all times. The Contractor shall consult with the health and safety committee or health and safety representative(s) etc. on a regular basis to ensure that all employees, including subcontractors under his control, are informed and trained by a competent person regarding health hazards and related work procedures.

No subcontractor, employee or visitor shall be allowed to enter the site of works without prior health and safety induction training, all as specified in Regulation 7.

*(e) Fall protection (Regulation 8)*

Fall protection, if applicable to this contract shall comply in all respects with Regulation 8 of the Construction Regulations.

*(f) Scaffolding (Regulation 14)*

The Contractor shall ensure that all the provisions of Regulation 14 of the Construction Regulations are complied with. *(Note: Reference in the Regulations to "Section 44 of the Act" should read "Section 43 of the Act")*

*(g) Construction vehicles and mobile plant (Regulation 21)*

The Contractor shall ensure that all construction vehicles and plant are in good working condition and safe for use, and that they are used in accordance with their design and intended use. Workers or operators who have received appropriate training, all in accordance with all the requirements of Regulation 21, shall only operate the vehicles and plant.

All vehicles and plant must be inspected on a daily basis, prior to use, by a competent person and the findings must be recorded in a register to be kept on site.

*(h) Water environments (Regulation 24)*

Where construction work is done over or in close proximity to water, the provisions of Regulation 24 shall apply.

*(i) Housekeeping on Construction sites (Regulation 25)*

Housekeeping on all construction sites shall be in accordance with the provisions of the environment Regulations for workplaces (Government Notice R2281 of 16 October 1987) and all the provisions of Regulation 25 of the Construction Regulations.

*(j) Stacking and storage on construction sites (Regulation 26)*

The provisions for the stacking of articles contained in the General Safety Regulations (Government Notice R1031 of 30 May 1986) as well as all the provisions of Regulation 26 of the Construction Regulations shall apply.

*(k) Fire precautions on construction sites (Regulation 27)*

The provisions of the environment Regulations for Workplaces (Government Notice R2281 of 16 October 1987) shall apply.

In addition the necessary precautions shall be taken to prevent the incidence of fires, to provide adequate and sufficient fire protection equipment, sirens, escape routes etc. all in accordance with Regulation 27 of the Construction Regulations.

*(l) Construction welfare facilities (Regulation 28)*

The Contractor shall comply with the constructions site provisions as in the Facilities Regulations (Government Notice R1593 of 12 August 1988) and the provisions of Regulation 28 of the Construction Regulations.

*(m) Non-compliance with the Construction Regulations (2003)*

The foregoing is a summary of parts of the Construction Regulations applicable to all construction projects.

The Contractor, as employer for the execution of the contract, shall ensure that all provisions of the Construction Regulations applicable to the contract under consideration are complied with to the letter.

Should the Contractor fail to comply with the provisions of the Regulation 3 to 28 as listed in Regulation 30, he will be guilty of an offence and will be liable, upon conviction, to the fines of imprisonment as set out in Regulation 30.

**THE CONTRACTOR IS ADVISED IN HIS OWN INTEREST TO MAKE A CAREFUL STUDY OF THE ACT AND THE CONSTRUCTION REGULATIONS, AS IGNORANCE OF THE ACT AND THE REGULATIONS WILL NOT BE ACCEPTED IN ANY PROCEEDINGS RELATED TO NON-CONFORMANCE TO THE ACT AND THE REGULATIONS.**

## **12. TRAINING**

Each Health and Safety Plan shall indicate the following regarding training:

- Name and contents of the following training courses which have to be conducted:
  - Induction Training;
  - Training regarding hazards identified and any corrective measures in place;
  - Training regarding all applicable regulations; and
  - Specific training regarding applicable competencies.
- Attendance registers must be kept as proof of training provided.
- Method of informing visitors and other persons entering the site of hazards prevalent site.
- Method providing personal protective equipment to visitors and non-employees.
- An example of ID training card for each employee (if used).
- Methodology to be used in the issuing and communicating of written instructions/safe work procedures.

## **13. GENERAL REQUIREMENTS**

### ***Personal Protective Equipment***

The procedures for issuing and control over PPE shall be indicated in the Health and Safety Plan, as well as the enforcement for the wearing thereof.

### ***Hired Plant***

The responsibility for the safe condition and use of all hired plant shall be that of the contractor.

### ***Transport of Employees***

Transport of employees shall be carried out in terms of the National Road Ordinances. The Health and Safety Plan shall detail the arrangements and methods of the transportation of workers.

**Signs**

The Principal Contractor shall indicate in his Health and Safety Plan the arrangements regarding the posting of danger signs.

**Certificates of fitness**

The Principal Contractor shall include in his H&S Plan copies of all employees that require medical fitness certificates under the following regulations where applicable:

- Construction Regulations (2003) Regulation 21 – Construction vehicles and Mobile plant operators.

**Site Visitors Register**

A site visitor's register is to keep on site and steps are to be taken to ensure that all visitors sign the visitor's register before entering the site. A sign should also be provided directing all visitors to report to the site officer.

**14. MEASUREMENT AND PAYMENT****(a) Principles**

It is a condition of this contract that Contractors, who submit tenders for this contract, shall make provision in their tenders for the cost of all health and safety measures during the construction process. Special reference is made to the following:

**i. Safety personnel**

All safety personnel and competent persons referred to in clauses 9 will normally be members of the Contractor's personnel, and no additional payment will be made for the appointment of such safety personnel.

However provision will be made in the schedule of quantities for payment under the contract for a Construction supervisor in terms of Clause 7.1 and for a dedicated Construction Safety Officer in terms of Clause 7.2 on the instruction of the Inspector of the Department of Labour.

**ii. Records and Registers**

Provision will be made in the schedule of quantities for payment to the Contractor for the keeping of health and safety-related records and registers as described in Clause 8.

**(b) Scheduled items**

Payment will be done under :

CWD01SC 5.4.1 Health and Safety and Environment

Unit : Sum

The sum shall cover all the Contractor's time-related costs related to complying with Health and Safety standards and the Environmental Requirements including the appointment of dedicated Construction Supervisor and Health and Safety Officer and up keeping of records and registers.

Payments for these items do not absolve the Contractor from his responsibilities and liabilities in terms of Regulation 30 of the Construction Regulations 2003

## ANNEXURE 1: SAFETY ON THE SITE OF WORKS

The basic day-to-day requirements for safety on the site of works are listed below. Compliance with these aspects does not relieve the Contractor of any of his obligations and responsibilities detailed in Regulations 4 to 28 referred to paragraph 9 of the Safety Specification.

### 1. Fall protection

- (a) All unprotected openings in floors, slabs, hatchways and stairways must be adequately guarded, fenced or barricaded or similar means must be used to safeguard any person from falling through such openings;
- (b) Notices must be placed conspicuously at all openings where the possibility exists that a person might fall through such openings;
- (c) Where roof work is being performed on a construction site, the contractor shall ensure that:
  - (1) No employees are permitted to work on roofs during inclement weather conditions or if weather conditions are a hazard to the health and safety of the employees;
  - (2) Prominent warning notices are to be placed where all covers to openings are not of sufficient strength to withstand any imposed loads and where fragile material exists; and
  - (3) There is suitable and sufficient guard-rails or barriers and toe-boards or other similar means of protection to prevent, so far as is reasonably practicable, the fall of any person, material or equipment.

### 2. Cranes

The Contractor shall ensure that where tower cranes are used, that:

- (a) The tower crane operators are competent to carry out the work safely; and
- (b) The tower crane operators are physically and psychologically fit to work in such an environment by being in possession of a medical certificate of fitness.

### 3. Construction vehicles and mobile plant

- (a) The contractor shall ensure that all construction vehicles and mobile plant; are operated by workers who:
  - (1) Have received appropriate training and been certified competent and been authorized to operate such machinery; and
  - (2) Are physically and psychologically fit to operate such construction vehicles and mobile plant by being in possession of a medical certificate of fitness.
- (b) The Contractor shall furthermore ensure that:
  - (1) No person rides or be required or allowed to ride on any construction vehicle or mobile plant otherwise than in a safe place provided thereon for that purpose;
  - (2) Vehicles used to transport employees have seats firmly secured and adequate for the number of employees to be carried; and
  - (3) When workers are working on or adjacent to public roads, reflective indicators are provided and worn by the workers.

### 4. Use and temporary storage of flammable liquids on construction sites

- (a) The Contractor shall ensure that:
  - Where flammable liquids are being used, applied or stored at the workplace concerned, it is done in a manner that would not cause fire or explosive hazards, and that the workplace is effectively ventilated. Where the workplace cannot effectively be ventilated:

- (a) Every employee involved must be provided with a respirator, mask or breathing apparatus of a type approved by the chief inspector, and
  - (ii) Steps must be taken to ensure that every such employee, while using or applying flammable liquids, uses the apparatus supplied to him or her.
- (b) No person smokes in any place in which flammable liquid is used or stored, and the contractor shall affix a suitable and conspicuous notice at all entrances to any such areas prohibiting smoking;
- (c) An adequate amount of efficient fire-fighting equipment is installed in suitable locations around the flammable liquids store with the recognized symbolic signs.

## **5. Fire precautions on construction sites**

The contractor shall ensure that smoking is prohibited and notices in this regard are prominently displayed in all places containing combustible or flammable materials.

## **6. Construction welfare facilities**

- (a) The contractor shall, depending on the number of workers and the duration of the work, provide at or within reasonable access of every construction site, the following clean and maintained facilities:
  - (1) At least one shower facility for every 15 workers;
  - (2) At least one sanitary facility for every 30 workers;
  - (3) Changing facilities for each sex; and
  - (4) Sheltered eating areas.
- (b) The Contractor shall also ensure that:
  - (1) No horseplay between employees or aggressive or threatening behaviour by anybody is allowed on site;
  - (2) Workers shall wear appropriate protective clothing for particular tasks, including protective eyewear, gloves, boots, ear protection, masks, etc. Workers shall not be allowed to wear loose clothes or footwear.
  - (3) Workers executing tasks in manholes for sewer and storm water systems shall be made aware of the existence of hazardous gasses in closed areas, and shall be issued with masks as necessary. Only specialists shall be allowed to work in gas-filled chambers;
  - (4) Blasting must be done by specialists in accordance with the Explosive Act;
  - (5) Workers shall not be allowed to make open fires on any part of the site, unless in designated areas approved by the health and safety manager;
  - (6) No vehicle or equipment shall be operated on site if it produces noise above 90 decibels, measured at a distance of 10m from the unit;
  - (7) Adequate signage shall be used on site to indicate:
    - Non-smoking areas on the site;
    - Safety exits / emergency exits from buildings under construction;
    - Stairs (temporary and permanent works);
    - Toilets;
    - Fire fighting equipment;
    - Fire assembly points;
    - Fire escapes;
    - Overhead works;
    - Areas where members of the public are not allowed; and
    - First aid facilities.
  - (8) Visitors to the site shall only be allowed to enter the site by pre-determined procedures, including safety induction training. Records of visitors shall be kept in the health and safety files.